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(54) GEOGRAPHICAL WEB BROWSER, METHODS, APPARATUS AND SYSTEMS

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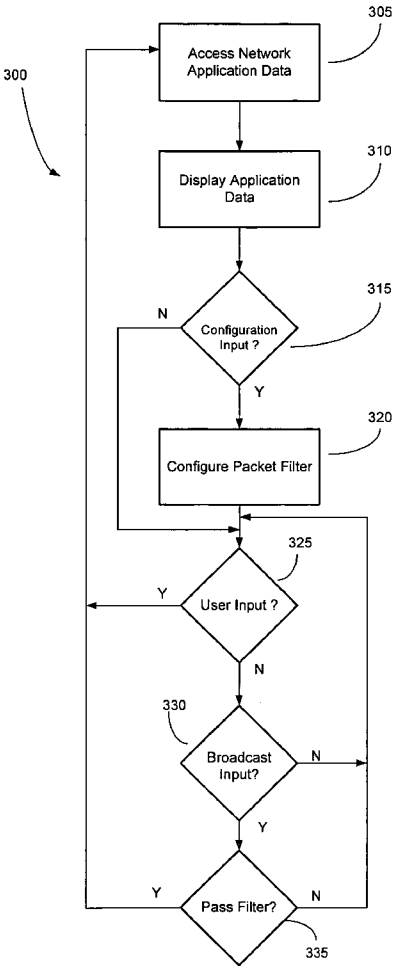
(57) **ABSTRACT**

A geographical web browser allows a user to navigate a network application such as the Word Wide Web by physically navigating in geographical coordinates and roaming through coverage areas of cellular base stations, wireless LANs, microcells, and other such broadcast domains. A mobile unit communicates with a network server via an air interface that supports wireless packet data. A network server uses a set of user preferences to filter a set of server-side information in accordance with a user's interest. A content-selective information filter performs a network server-side search to identify content that matches the user's preferences and automatically downloads the information to the mobile unit based on a geographic event.



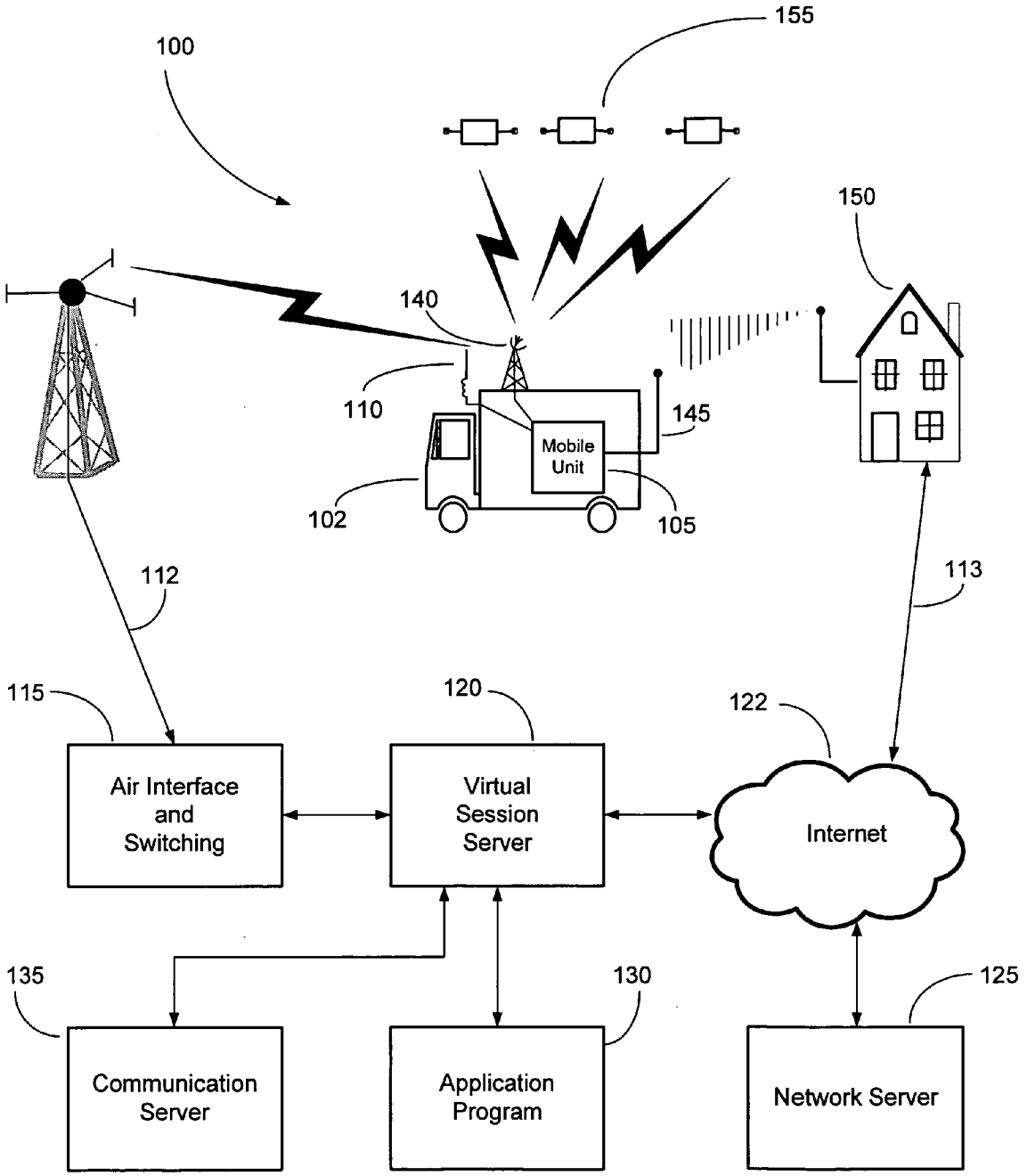

100
155
150
140
110
145
Mobile Unit
102
105
112
113
115
120
122
Air Interface and Switching
Virtual Session Server
Internet
135
130
125
Communication Server
Application Program
Network Server

FIG. 1

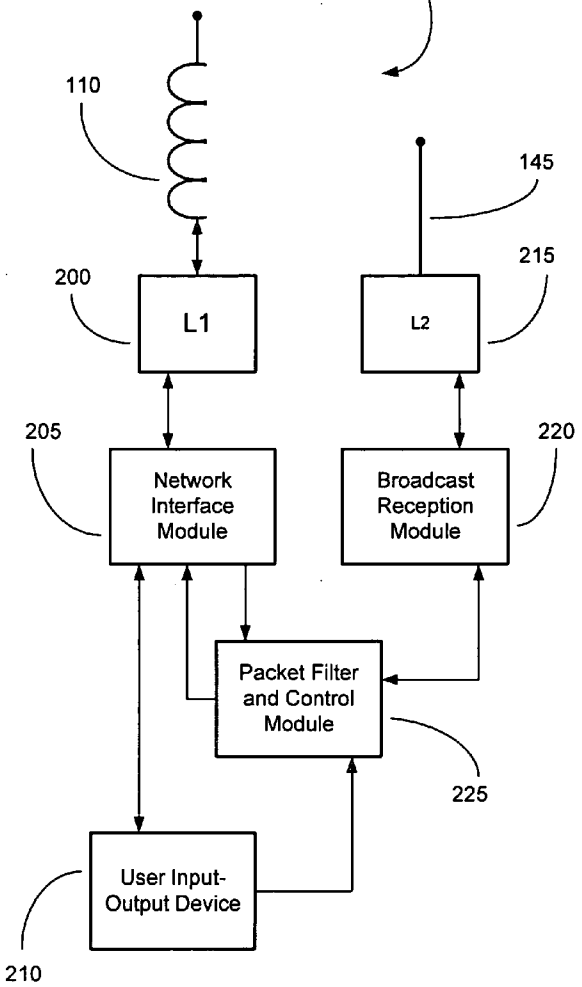

105
110
145
200
L1
L2
215
205
Network Interface Module
Broadcast Reception Module
220
Packet Filter and Control Module
225
User Input-Output Device
210

FIG. 2

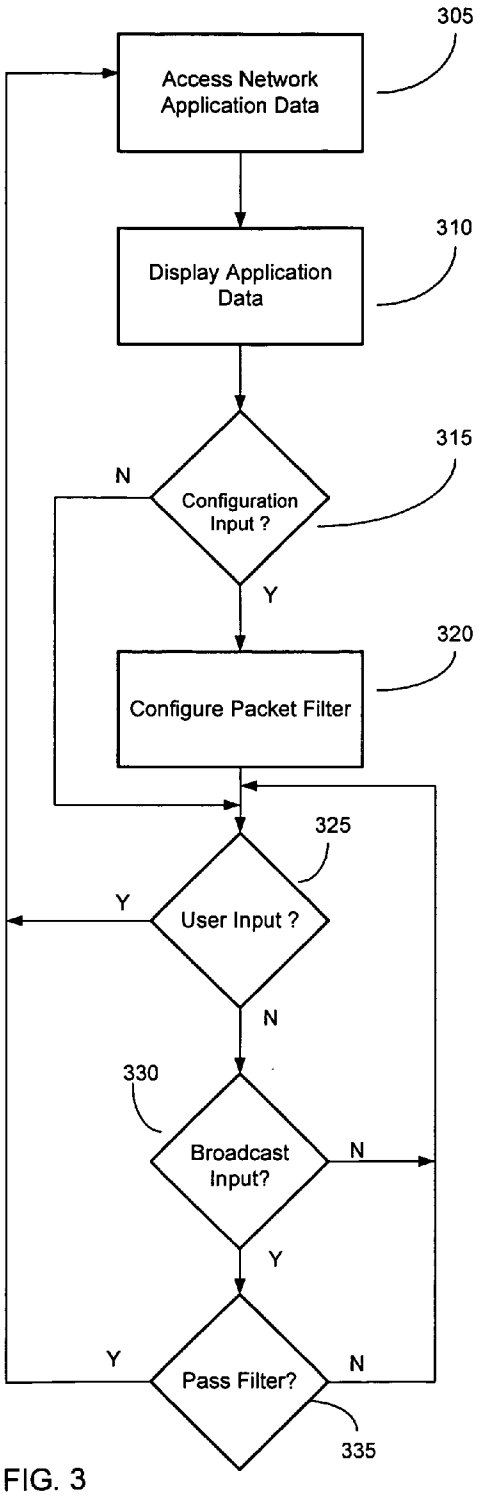

300
305
Access Network Application Data
310
Display Application Data
315
Configuration Input ?
N
Y
320
Configure Packet Filter
325
User Input ?
Y
N
330
Broadcast Input?
N
Y
Pass Filter?
Y
N
335

FIG. 3

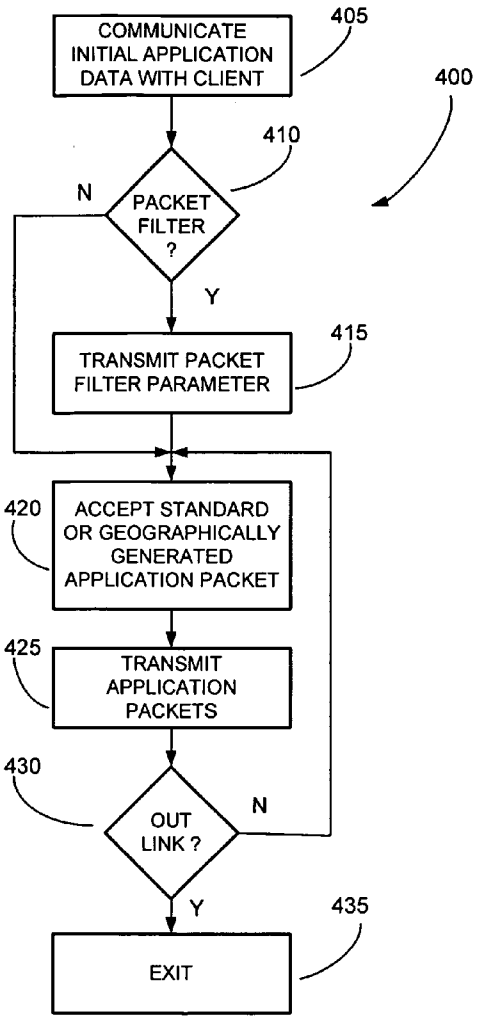


FIG. 4

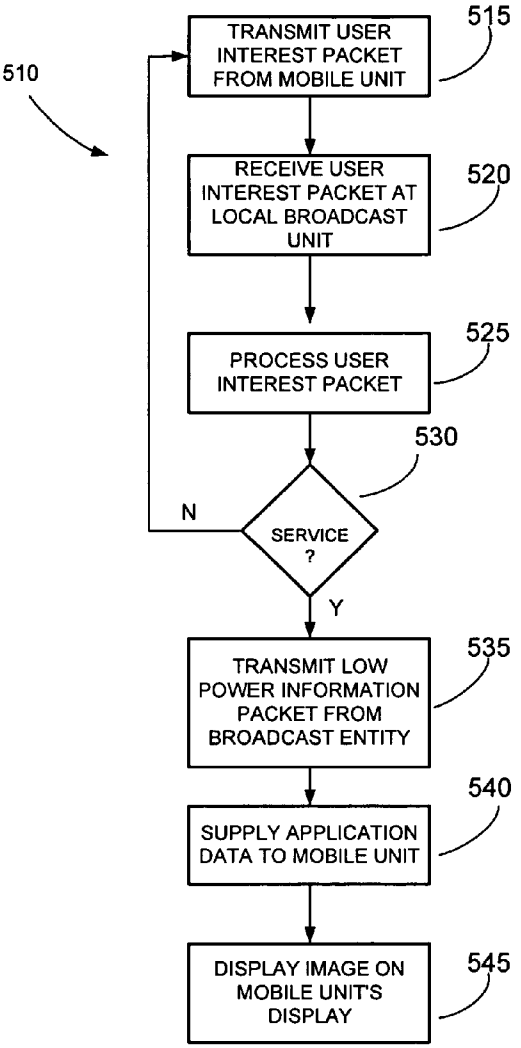


FIG. 5b

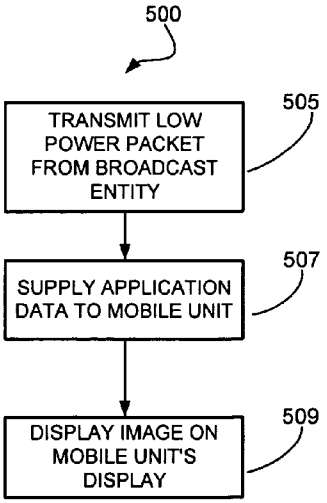


FIG. 5a

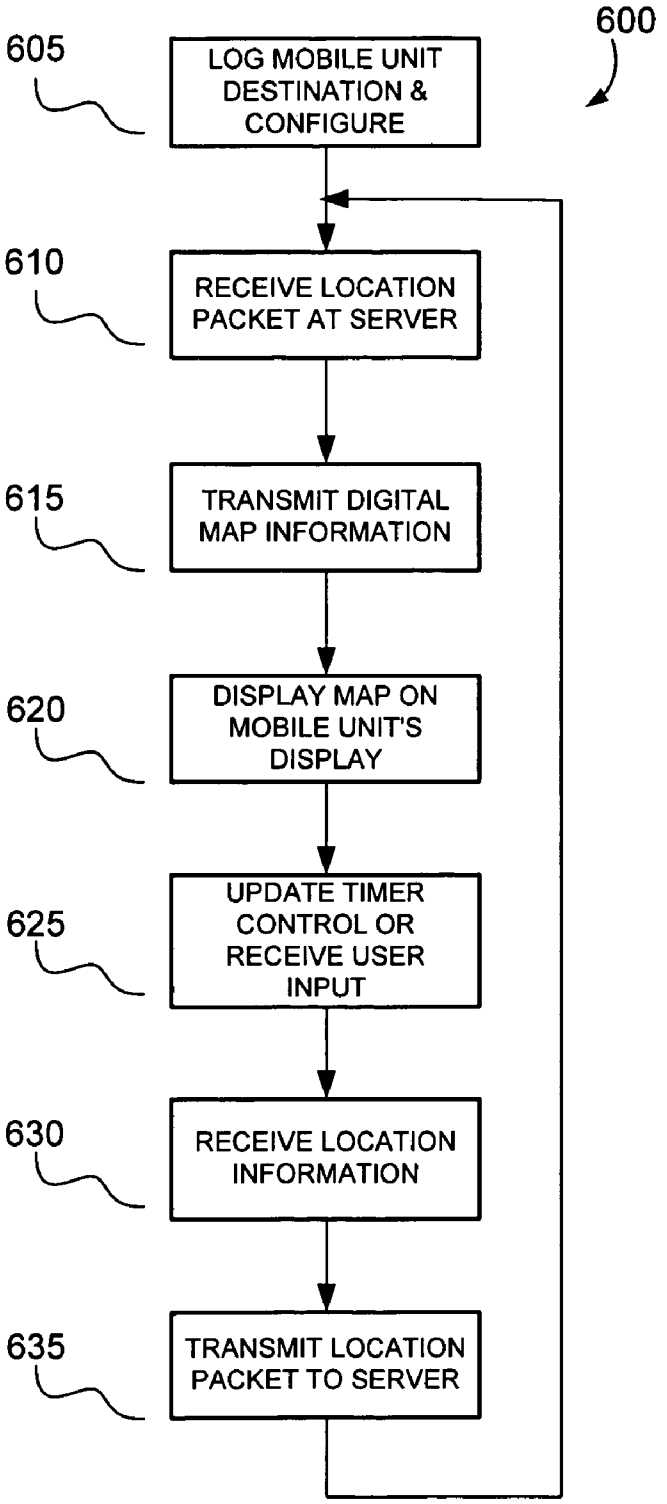

600
605
LOG MOBILE UNIT DESTINATION & CONFIGURE
610
RECEIVE LOCATION PACKET AT SERVER
615
TRANSMIT DIGITAL MAP INFORMATION
620
DISPLAY MAP ON MOBILE UNIT'S DISPLAY
625
UPDATE TIMER CONTROL OR RECEIVE USER INPUT
630
RECEIVE LOCATION INFORMATION
635
TRANSMIT LOCATION PACKET TO SERVER

FIG. 6

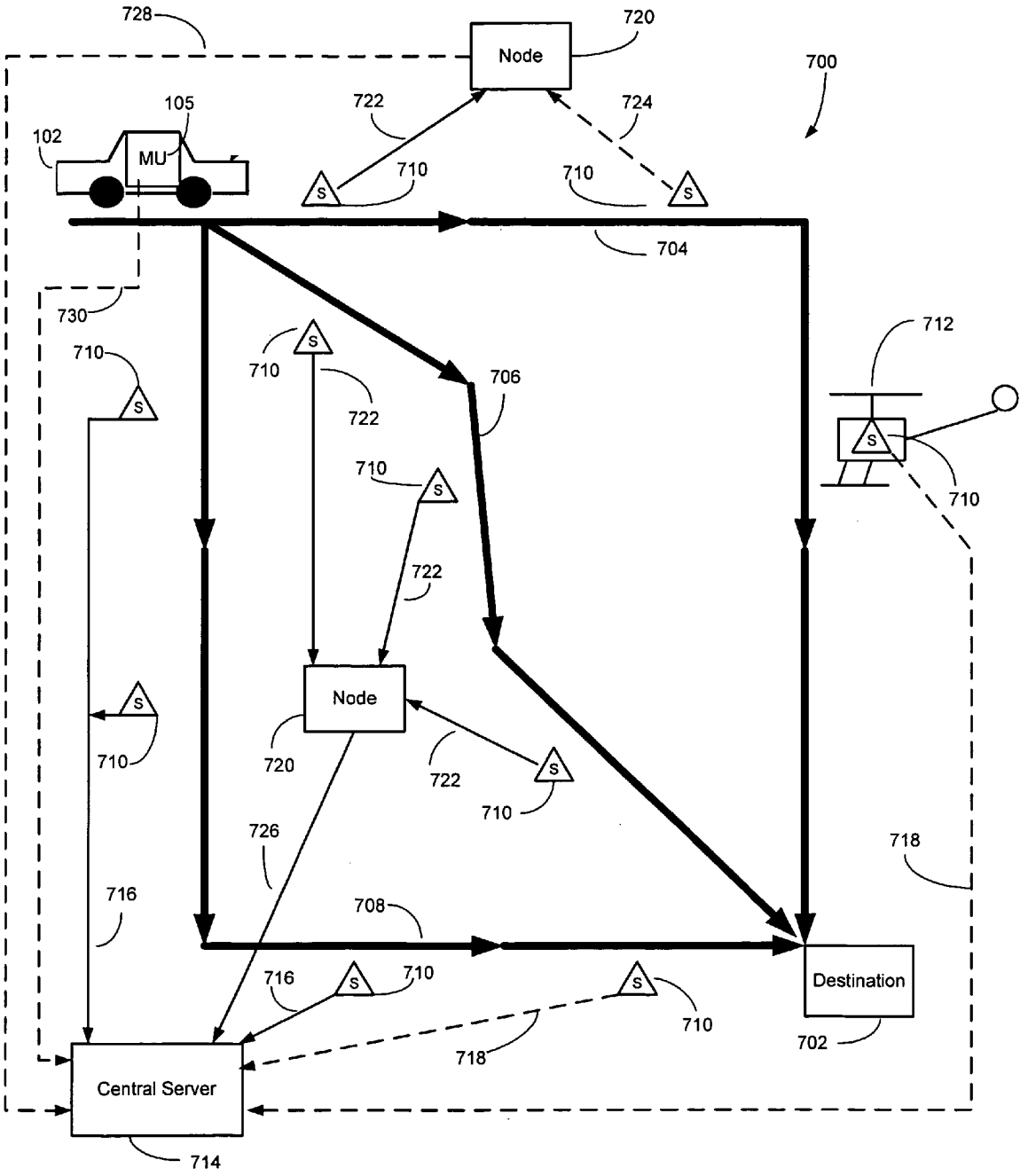

728
720
Node
700
105
722
724
102
MU
710
710
704
730
712
710
706
722
710
722
Node
720
722
710
710
726
718
716
708
716
710
710
Destination
718
702
Central Server
714

FIG. 7

GEOGRAPHICAL WEB BROWSER, METHODS, APPARATUS AND SYSTEMS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to mobile data networks. More particularly, the invention relates to a network application program such as a web browser which allows a user to navigate a set of network web pages based on a user's location and the setting of one or more auxiliary control parameters.

[0003] 2. Description of the Related Art

[0004] The concept of providing a local broadcast domain through which a mobile unit passes is well known. For example, when on a cross-country trip, an automobile passes through various areas of FM radio coverage. In the art of cellular communications it has become common practice to reduce the size of a given broadcast domain. This allows frequencies to be efficiently reused. In spread spectrum communications, it is also recognized that multiple users may share frequency within a small-area broadcast domain using differently encoded waveforms for different users. Companies such as Nokia Inc. have proposed systems whereby information is broadcast to mobile subscribers within a telecommunications cell. In some envisioned methods, this broadcast information is accessible from a network application such as a web browser. A mobile subscriber is able to click on an icon and view, for example, restaurants located in the vicinity of the telecommunications cell occupied by the mobile subscriber.

[0005] Recently systems have been introduced whereby a mobile unit such as an automobile passes through a series of very small broadcast domains. Each broadcast domain is called a "picocell". For example, as a mobile user in an automobile travels along a road, the automobile encounters a sequence of network air-interface transceivers that are mounted on telephone poles and periodically placed along the roadside. The vehicle can maintain a network connection by accessing the nearest air interface at any given time. Similar picocell based systems allow a user walking through a building or campus environment to stay connected to a wireless local area network (LAN). The term "air interface" is used in the art to mean a set of physical layer protocols used to communicate information via radio and other forms of wireless connections.

[0006] Data networks are also available whereby a mobile unit maintains a wireless network connection with a central server. For example, cellular digital packet data (CDPD), Internet packet Data Network (IPDN) and related technologies exist to allow a mobile unit to interact with an application such as a database. In other systems, radio frequency (RF) modems allow a mobile unit to maintain a network connection to stay connected to the Internet or some other type of network. For example, Global System Mobile (GSM) and Personal Communication Systems (PCS) technologies also allow wireless data connections to be established. Pico-cell based systems also provide wireless networks for similar use within buildings and campus environments.

[0007] A co-pending application, Ser. No. 09/167,698 by Eric M. Dowling and Mark N. Anastasi is incorporated herein by reference and is referred to as the "Dowling reference" hereinafter. In the Dowling reference, a method is disclosed to allow a mobile unit to maintain a virtual session with a central server. In a virtual session, an application layer program maintains a communication session in the absence of a physical communication path. When the session is inactive, no communication path exists. When data needs to be communicated, a physical connection is automatically established. This allows a remote unit to maintain a presence with a central server using, for example, a cellular connection. The virtual session only establishes the cellular connection when it is actually being used for network communications. In the context of the present disclosure, the "remote unit" as defined in the Dowling reference is termed a "mobile unit." In a virtual-session based system, the mobile unit uses a cellular connection to maintain a virtual session with a network server attached to a network. The mobile unit runs an application program such as a web browser to communicate with a web site, an Internet site, an intranet site or other application program provided by the network server. Only when the user is actively selecting a link or downloading information is a physical communication path established to support the virtual session.

[0008] Another known technology is the global positioning system (GPS). GPS receivers use telemetry information broadcast form satellites to calculate a set of grid coordinates to provide positional information. A mobile unit equipped with a GPS receiver can thereby maintain a fix on its geographical position.

[0009] Systems have been introduced by several automobile manufacturers that use a GPS receiver to control the display of digital map information in automobiles. The map data includes locations of various types of business establishments. The map and business establishment data for these systems is stored in a PROM or EPROM memory. Typically these storage devices contain data pertinent to one state. In order to update this data the owner of the vehicle must return to the dealer once a year to have change the PROM or reprogram the EPROM. A traveler wishing to travel between states must purchase additional memory modules programmed with data for the states to be traveled in advance of an out-of-state trip. While the aforementioned technologies provide valuable services and capabilities, these systems are lacking in various ways. For example, consumer radio broadcast technology still uses large broadcast domains such as AM and FM radio stations. While next generation systems have been proposed that will effectively broadcast information such as local advertisements and service announcements to vehicles or pedestrians passing through a telecommunications cell, small locality, no technology exists to provide local broadcast information to automatically control a network application such as a web browser by selectively filtering broadcast information using a packet filter. Current approaches require a user to select an icon or navigate a browser application via conventional means to access information specific to a local area. Also, systems do not exist which allow information processed by a GPS receiver to control the flow of information on a network connection with a server. For example, no web browsers exist which process GPS transmissions to determine geographical position, and use this geographical position information to control what web pages are displayed by the browser. Likewise, no systems exist which accept locally

broadcast transmissions such as from a local telephone pole and use this information to control information displayed by the web browser.

[0010] It would be desirable to have a system that could provide a user with a means to receive information from a first connection to a network based on the user's position. It would be desirable to allow an application such as a web browser to control a flow of information comprising web pages based on a locally received broadcast. It also would be desirable to allow an application such as a web browser to control the flow of web pages based on processed GPS data. It would be desirable to have a mobile unit that could receive one or more transmissions via a second connection and then generate a request packet on a first connection to navigate an application program such as a web browser. It also would be desirable to have a network server that is operative to receive request packets that are generated based on information received from these transmissions.

[0011] Systems currently envisioned by telecommunication firms rely on the knowledge of the user's operating wireless cell. As a position or location measurement system, this knowledge is coarse. Further, as a means for regulating pertinent information, reliance solely on cell data is limiting. Cell coordinates are too coarse to allow data such as direction of travel, speed of travel, etc to be used to predict items of interest to the user. It would therefore be desirable to base broadcast content on detailed user information including, but not limited to, past and present GPS location data.

[0012] For certain applications it would be desirable to be able to effectively use a relatively small broadcast domain to produce an "electronic sign." As defined herein, an "electronic sign" involves a system whereby a transmitter broadcasts one or more data packets to be received by a mobile unit as carried by a vehicle or a pedestrian. For example, instead of a passenger looking out of a window to see a billboard, the passenger looks at a computer display screen associated with a dashboard computer device within the vehicle. Alternatively it would also be desirable to make use of the relatively small broadcast domain to produce an "indirect electronic sign." As is also defined herein, an "indirect electronic sign" involves a system whereby a transmitter broadcasts at least one data packet to the mobile unit that then extracts information from the packet and uses it to access an associated web page. In such a system, it would be desirable to download the web pages from the server using the first network connection which is preferably a CDPD connection or a virtual session connection. Moreover, it would be desirable for the mobile unit to be able to supply a filter parameter to allow locally received broadcast packets to be selectively rejected (e.g. based on content or subject matter) and thereby not alter the web page displayed by the mobile unit.

[0013] Currently in cities and on major highways there are deployed updateable billboard sized displays that are used to inform drivers of upcoming traffic and road conditions. This information may potentially add convenience to the drivers and allow the roadway to be better utilized more efficiently. For example, a large, updateable billboard sized display can inform drivers of an accident on the roadway ahead. This information is used to prompt lane selection or alternate route selection. However, the information contained on these displays is limited in amount, and allows no dialogue or multilevel queries. It would therefore be desirable to have a display system capable of displaying detailed information in a structured manner to allow for navigation, route planning and advanced traffic management.

[0014] In other applications it would be desirable to update a large memory device within the mobile unit with current information directly from the network without the need to change memory modules or reprogram memory modules. These on-board memory devices could then be accessed for information without the necessity to access an internet connection. It would thus be desirable to be able to update this stored information by downloading information from the Internet or some other convenient and accessible network.

SUMMARY OF THE INVENTION

[0015] The present invention solves these and other problems by providing systems and methods to enable a mobile unit to maintain a first network connection with a central server and to control information flow on this connection using information received on an auxiliary channel. In one example, a mobile unit travels along a road and is exposed to a plurality of locally broadcast packets as the mobile unit enters into a local broadcast domain. A local broadcast domain includes the range of a transmitter that broadcasts data packets to mobile units within this range. When a packet of interest is received, information is automatically transferred via the first network connection and a web page or related application information is thereby accessed. Instead of the user needing to click upon a hyperlink to access a web site, a packet filter is configured to selectively pass packets according to a predefined criterion. When a packet passes through the packet filter, a web site is automatically accessed.

[0016] Because the received packet is transmitted from within a local broadcast domain, this packet carries with it geographically related information. For example, if a geographical web browser according to the present invention is currently set to a "movies" Internet site, when the mobile unit passes into an area with several movie theaters, the passed packet will include a pointer to the associated movie theaters' web pages. In some systems the web pages will be automatically downloaded into a buffer within the mobile unit, while in other systems a set of hyperlinks to these local theaters will appear.

[0017] In another aspect of the present invention, the mobile unit also maintains the network connection, but derives geographical information from a GPS receiver. The network connection preferably is an Internet connection or a connection to a central server such as a database server. GPS information is received and processed in the GPS receiver. Periodically, processed GPS information may be transmitted via the mobile network connection to the network server. When this processed GPS information is received, the network server is operative to control the flow of information to the mobile unit based upon the processed GPS information. In some embodiments the mobile unit maintains a list of local sites and sends information to the server based on a configuration parameter. This information may be specific to the requested areas of interest or it may contain a complete update to the mobile unit's database.

[0018] The mobile unit is thereby able to navigate the Internet based on the mobile unit's geographical position in addition to prior art methods employing mouse and keyboard inputs. When a virtual connection is being used, GPS information need only be transmitted at pre-specified intervals or upon the detection of pre-specified events. For example, a filter is preferably employed to cause the network connection to only be activated when the mobile unit enters a locality associated with a web site of interest. For example, a hungry user entering a new city is interested in seeing web pages for local restaurants. Based upon the GPS position indication a list of restaurants in surrounding localities is downloaded into a memory of the mobile unit. When the GPS receiver indicates the mobile unit is in a designated locality, web pages for those restaurants in the local area are downloaded or retrieved from memory and displayed.

[0019] The present invention provides a means for a user to "surf the web" or otherwise navigate a network application program based on geographically related information such as locally broadcast packets and GPS information. One or more filter parameters are used to screen information of interest to a user. A set of information deemed to be of interest to a user is called an "information class."

[0020] The present invention also enables a road-navigation or traffic management system. For example, the user maintains a virtual connection to a central server that provides real-time best-route information through a navigation or traffic management web page. A plurality of sensors measures road conditions based on vehicle speeds as measured by sensors such as laser or infrared continuity sensors dispersed along the roadways. Additionally, special traffic data is monitored, or manually entered, including weather advisories, accident locations and effects and special event locations and effects. The central server thereby keeps track of road conditions and is able to display such information and to assign "costs" to route segments. The mobile unit stays virtually connected to the navigation web page and is updated with digital maps indicating the best current route leading from the mobile unit's current position to a selected destination.

BRIEF DESCRIPTION OF THE FIGURES

[0021] The various novel features of the present invention are illustrated in the figures listed below and described in the detailed description that follows.

[0022] **FIG. 1** is a block diagram representing an embodiment of a system involving a mobile unit passing through a locality and maintaining a network connection.

[0023] **FIG. 2** is a block diagram illustrating the architecture of a mobile unit designed in accordance with the present invention.

[0024] **FIG. 3** is a flow chart illustrating a method of processing carried out in a mobile unit to provide a geographically controlled client-side application program.

[0025] **FIG. 4** is a flow chart illustrating a method of processing carried out by a network server to provide a geographically controlled server-side application program.

[0026] **FIG. 5***a* is a flow chart illustrating a method of processing carried out by a system comprising a mobile unit, a local broadcast domain entity and optionally a network server to support a geographically controlled client-side application program in the mobile unit.

[0027] **FIG. 5***b* is a flow chart illustrating a method of processing carried out by a system comprising a mobile unit, a local broadcast domain entity and optionally a network server to provide customized information to the mobile unit.

[0028] **FIG. 6** is a flow chart illustrating a method of processing carried out between a mobile unit and a network server to provide road navigation and traffic management information to the mobile unit.

[0029] **FIG. 7** is a block diagram representing an embodiment of the invention applied to traffic management applications.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] **FIG. 1** is a block diagram representing an illustrative embodiment **100** of a system configuration used to support the present invention. A vehicle **102** includes a mobile unit **105**. The mobile unit **105** may be designed similarly to the remote unit in the Dowling reference. The architecture of the mobile unit **105** is also discussed in more detail in connection with **FIG. 2**.

[0031] The mobile unit **105** is connected to a first antenna **110** which is used to maintain a first network connection **112**. The first network connection **112** is preferably a wireless network connection and may be implemented in several ways. For example the wireless network connection may employ an air interface and protocol stack to interface with an IPDN, a CDPD network, a wideband CDMA data network, or a virtual session oriented network. The antenna **110** is operatively coupled to an air interface and switching module **115**. In many applications, the air interface and switching module **115** is provided by a telephone company which provides mobile communication services. In the illustrative embodiment **100**, the air interface and switching module **115** is coupled via a communications interface to a virtual session server **120**. The virtual session server **120** is discussed in more detail in the Dowling reference. In other embodiments, the virtual session server **120** may be replaced with any available network technology used to provide a network connection to a mobile unit via an air interface. The virtual session server **120** is preferably coupled to a network such as the Internet **122**. A network server **125** is coupled to the virtual session server **120**. The network server **125** may be co-located with and directly coupled to the virtual session server **120** as an application program **130**, or may be coupled across a network such as the Internet **122** as shown in the illustrative embodiment **100**. That is, in any of the embodiments as discussed herein, the network server **125** may be optionally implemented as the application program **130**.

[0032] A communication server **135** may also be coupled to the virtual session server **120** to provide the mobile unit **105** with a virtual communication presence at the virtual session server **120**. This allows calls and other communications received at the virtual session server **120** to be forwarded to the mobile unit **105**. The communication server **135** is most applicable in systems where the mobile unit **105** and the virtual session server **120** are entities within an enterprise, and the mobile unit **105** needs to maintain a virtual presence with the enterprise computing and commu-

nications resources. Details of this type of operation are described in the Dowling reference. The communications server **135** is optional and may be omitted in some embodiments of the invention.

[**0033**] The mobile unit **105** is also optionally coupled to a satellite antenna **140**. This antenna, though depicted as a dish antenna, may be implemented with other types of antennas. The satellite antenna **140** may be used to receive satellite communications information. The satellite antenna **140** may also be used to receive GPS transmissions. In some systems, the satellite antenna **140** may be used to both receive and transmit satellite communications data and receive GPS transmissions.

[**0034**] The mobile unit **105** is also optionally coupled to a local broadcast domain antenna **145**. The local broadcast domain antenna is coupled to receive locally broadcast transmissions from a local broadcast domain entity **150**. The transmission from the local broadcast domain entity **150** may emanate from a building, telephone pole, street light, store front, and the like. In terms of cellular communications technology, the local broadcast domain entity **150** is similar to a picocell level communication system. The local broadcast domain entity **150** may be optionally connected to a network such as the Internet **122** via a second connection **113**. In a preferred embodiment, the broadcast domain of the broadcast domain entity **150** is defined by the range of a low-power radio frequency channel. Depending on the system configuration, the range may vary from as low as 50 feet to as high as a few miles. In some embodiments, the low power radio channel is defined by a spread spectrum air interface such as the one used by cordless phones or PCS systems.

[**0035**] The illustrative embodiment **100** shows a mobile unit **110** with a full set of communication channels. In other embodiments, only a subset of these communication channels need be implemented. For example, in a simplest embodiment, only the local broadcast domain antenna **145** is implemented. This simple embodiment may be used to implement methods of processing as discussed in connection with **FIGS. 3, 5***a,* and **5***b.* Some aspects of the present invention require the mobile unit **105** to include the network connection antenna **110** and at least one of the local broadcast domain antenna **145** or the satellite antenna **140**. In general, an "air-interface antenna" generically applies to any antenna used to maintain a network connection, receive satellite data, transmit local broadcast domain data, receive local broadcast domain data, or perform other related air-interface functions.

[**0036**] The illustrative embodiment **100** may also be altered in other ways. For example, while three distinctly protruding antennas **110**, **140**, **145** are illustrated, these antennas may be combined into one and may be built into the body of the vehicle so that no actual antennas will be visible as shown. Also, while the illustrative embodiment shows the mobile unit **105** connected into a vehicle, the mobile unit **105** may equally be implemented as a hand-held unit or in some other form convenient to the particular use desired. The present invention may be implemented as a dash-mounted vehicle computer or a hand-held unit such as a palm-pilot, a personal digital assistant or a laptop computer. Also, in some systems the antenna **110** may be used to implement both the network connection **112** as well as the connection to the local broadcast domain entity **150**. In some systems the local broadcast domain entity **150** may be implemented as a part of the same cell site as used to provide the network connection **112**. In this type of embodiment, the cell site provides mobile telecommunication services, network services, and local broadcast services within the same cell. Layered systems whereby a cell site provides mobile telecommunication services to a cell coverage and the local broadcast domain entity provides broadcast services within a picocell are also contemplated by the system **100**. **FIG. 1** thus serves as a general background scenario to understand the context of the present invention. The operation of the illustrative embodiment **100** is discussed in more detail in connection with **FIGS. 2-6**.

[**0037**] Referring now to **FIG. 2**, an embodiment of the mobile unit **105** is shown. This embodiment includes the mobile network connection antenna **110** and the local broadcast domain antenna **145**. A variation of the mobile unit **105** will be discussed herein below whereby the local broadcast domain antenna **145** is replaced with the satellite antenna **140**. Still another variation of the mobile unit **105** will be discussed which only employs the local broadcast domain antenna **145**. Yet another variation involves a system where the antenna **110** is used for both the network connection **112** and to communicate with the local broadcast domain entity **150**. In such systems the local broadcast domain entity may be embodied by the same equipment used to provide the network connection **112**.

[**0038**] As illustrated in **FIG. 2**, the mobile unit **105** includes the network connection antenna **110** which is coupled to a first link interface controller **200**. The first link interface controller **200** is preferably implemented as a cellular or PCS transceiver capable of transferring data traffic. The first link interface controller **200** provides a physical layer air interface to support the first network connection **112**.

[**0039**] The first link interface controller **200** is coupled to a network interface module **205** which preferably implements one or more software layers within a protocol stack and is able to receive and transmit packet data. Protocol stacks are well known in the art, as is the construction of network interface equipment to implement a network connection. The network interface module **205** preferably includes a virtual session layer software module. The virtual session layer software module directs a physical layer network connection to be established only when it is needed as discussed in the Dowling reference to reduce air-time costs. Other technologies and protocol stacks as implemented in CDPD, GSM, PCS and wideband CDMA data networking systems may alternatively be employed within the first link interface controller **200** and the network interface module **205**. Some of these technologies may be augmented with a virtual session server to establish and maintain virtual sessions to achieve the same effect as a constant connection but at a greatly reduced cost due to saving on otherwise wasted airtime.

[**0040**] The network interface module **205** is coupled to a user input-output device **210**. The user input-output device is commonly implemented as a display with a mouse and/or keyboard input. Some embodiments make use of other forms of input and/or output such as human speech. When human speech is used as an input, it is received via a

microphone, digitized, and processed by a speech recognition circuit to produce a coded command signal representative of a user command.

[0041] The local broadcast domain antenna **145** is coupled to a second link interface controller **215**. The second link controller **215** provides an air interface to receive and possibly transmit data packets or other signals within a local broadcast domain. The second link interface controller **215** preferably includes radio frequency circuits used to receive a locally broadcast data packet. Some embodiments may receive locally broadcast data packets by means other than radio frequency. For example data may be locally broadcast using microwave or laser signals. In some embodiments, the second link controller **215** provides a physical layer radio connection to receive the locally broadcast data packet. One preferred embodiment implements the second link controller **215** as a spread spectrum transceiver in the 900 MHz range of frequencies. In an alternative embodiment, the second link controller **215** is coupled to the antenna **110** and the second antenna **145** is not used. In this embodiment, the local broadcast domain entity **150** may be co-located with the telecommunication cell's network equipment.

[0042] The second link controller **215** is coupled to a broadcast reception module **220**. The broadcast reception module preferably receives a baseband data signal from the second link controller **215** and performs framing operations to extract the broadcast information packet therefrom. The process of extracting a packet from a received bit stream is called formatting the data. In some applications the broadcast reception module also includes a transmit data path and the second link controller **215** is able to transmit data packets. In these embodiments, the broadcast reception module **220** is more properly termed a "broadcast transceiver module."

[0043] The broadcast reception module **220** is coupled to provide the received and reconstructed data packet to the input of a packet filter **225**. The packet filter **225** is preferably coupled to receive a packet-filter parameter from the network interface module **205** and/or the user input-output device **210**. Coupling to the network interface module **205** allows the use of web pages to set the parameters for certain types of filters with minimal user intervention. The output of the packet filter **225** is coupled to provide an input to the network interface module **205**. In embodiments involving a GPS receiver, the packet filter **225** operates as a control module and performs comparisons of GPS coordinate information with pre-specified boundary information.

[0044] A physical processing circuit as used to implement the mobile unit **105** may be implemented in a variety of ways. The preferred way to implement the mobile unit **105** is using a bus-oriented processor architecture whereby a central processing unit is coupled to a memory via a bus. Likewise, the bus couples the central processing unit to peripheral devices such as the user input-output device **210** and the first and second link controllers **200** and **215**. The modules **205**, **220**, and **225** are thereby implemented in software and are controlled by a control program (not shown). Using this standard computer architectural approach, a timer may be used to generate interrupts at timed intervals in order to control the sampling of inputs and the processing performed by the central processor unit. The mobile unit **105** may also be implemented, for example, using custom or semi-custom logic blocks configured within an application specific circuit.

[0045] The mobile unit **105** is operative to maintain the first network connection **112** via the network connection antenna **110**. Preferably, the first network connection **112** comprises a virtual session or another type of intermittently used data network protocol such as the protocol employed by a CDPD network. The mobile unit **105** preferably moves about in a geographic region, for example carried by the vehicle **102** moving about in a city. As the mobile unit **105** enters the vicinity of the local broadcast domain entity **150**, a radio frequency signal is coupled onto the local broadcast domain antenna **145**. The local broadcast domain entity **150** is operative to transmit a broadcast-data packet. The second link controller **215** is operative to extract an information signal from the local broadcast domain antenna **145**, and to supply the information signal to the broadcast reception module **220**. The information signal is preferably supplied as a baseband bit stream to the broadcast reception module **220**. The broadcast reception module **220** is operative to extract framing-related data bits from the information signal. The framing bits and possibly other bits such as network layer packet bits are then used to also extract the broadcast-data packet.

[0046] The broadcast-data packet is next routed from the broadcast reception module **220** into the input of the packet filter **225**. The packet filter **225** is operative to selectively pass the broadcast-data packet if it meets a criterion encoded into one or more packet-filter parameters. The packet-filter parameters may be derived from information supplied from either the network interface module **205** and/or the user input-output module **210**. The packet filter parameter typically includes one or more packet-header bit masks. If the header of the broadcast-data packet matches the bit mask, the packet is passed through the packet filter. If the header of the broadcast-data packet does not match the bit mask of the packet-filter parameter, the packet is rejected and no output packet is produced at the packet filter output. In this way, the packet filter selectively passes the broadcast packet, passing it if it matches the mask and rejecting it otherwise. The set of information deemed to be of interest to the user that will pass through the packet filter is called an "information class." Alternatively, the broadcast-data packet may contain keywords. The keywords are compared to a list of keywords provided from either the network interface module **205** and/or the user input-output device **210**. If the keyword in the keyword list of the broadcast-data packet matches a keyword list, the packet is passed through the packet filter. If no match is found, the packet is rejected.

[0047] A packet filter parameter is similar to a network address in that a particular network entity will receive a packet if information contained therein (such as a network address) matches a criterion and reject it otherwise. However, a packet filter differs from a network address in that a packet may be filtered based on other criteria as well. For example a packet filter may be constructed to reject packets sent from a particular network address, or to pass packets only marked to contain specific types of information. Hence packet filters allow information to be selectively received based upon other criteria beside network addresses.

[0048] The output of the packet filter is coupled to the network interface module **205**. The output of the packet filter

includes any broadcast-data packet that passes through the packet filter. The packet filter output is then used to control information flow on the first network connection **112**. For example, the vehicle **102** has recently entered a new city at lunchtime and the user input-output module is manipulated by a user to navigate to a web page for restaurants. This may be done using standard techniques by entering a network address such as a URL, by entering keywords into a search engine or by clicking upon a bookmark in a web browser display. When the user connects to the web page for restaurants, a packet filter mask is downloaded from the web page for restaurants and loaded into the packet filter. Next the network connection is placed in an inactive state whereby the restaurant page is displayed with no physical network connection being needed. The restaurant web page is displayed until the vehicle enters the range of the local broadcast domain entity **150** which broadcasts possibly a complete packet stream comprising a plurality of different types of broadcast-data packets. Only the broadcast-data packets relating to restaurants are allowed to pass through the packet filter **225**. These data packets are then passed to the network interface module **205** which sends one or more application request packets to the network server **125**. The network server **125** then preferably downloads a set of web pages containing the menus and other information related to the restaurants associated with the received broadcast-data packets. This downloading occurs over the network connection antenna **110**.

[**0049**] Note the above system allows a user to log into a web page using known methods. Subsequently the system is operative to navigate to selected web sites, such as those associated with local restaurants, based on the physical location of the mobile unit **105**. As the mobile unit **105** enters a new local broadcast domain, a new set of associated web pages will be downloaded. Hence the user need not click on links to find an Internet site but rather drive about geographically to navigate the Internet.

[**0050**] When multiple web pages are downloaded, the browser is preferably configured with a "next" button that advances a displayed image to the next downloaded web page. The "next" button is different from the "forward" button on a conventional web browser. When the "forward" button is selected, the conventional browser goes to a previously viewed web page from which the "back" button was clicked. In the present invention, the "next" button navigates to the next entry in a list of pages that were downloaded because they met the packet-filter criterion but were not yet viewed. Alternatively, the browser could be configured to present a "pick list" menu from which the user can select a hyperlink to an associated set of information.

[**0051**] The foregoing discussion represents a preferred mode of operation, but other preferred modes are also contemplated. For example, in an enterprise environment, a plurality of mobile units carried by vehicles is used by a service providing fleet based within a geographical area. An on-going problem relates to finding the location of the next customer. For example, before setting out for a destination, a user enters information via the input-output device **210** to establish a virtual session with a navigation web page. The user also enters information relating to a desired destination into the navigation web page. Alternatively, the user may enter information to access a scheduling web page from which a worklist generated by a scheduling system is presented, in which case location information may be downloaded via the network interface module **205**. The navigation web page then downloads a packet-filter parameter. The packet filter parameter includes a packet-header bit mask that is used to configure the packet filter **225** to selectively pass navigation data. When the navigation system is enabled, the current location of the vehicle is logged and a map is displayed on the user input-output device **210**. The displayed map preferably indicates a currently best available route to the destination. The best route is preferably determined by calculating a distance which takes into account current traffic loads, number of traffic lights, average speed along a road and the like. When the user enters the range of a new local broadcast domain entity **150**, a navigation packet is received and is selectively passed through the packet filter and a new location is logged. More details regarding how the present invention may be used in navigation applications is discussed in connection with **FIG. 6**.

[**0052**] In another preferred mode of operation, the mobile unit **105** is modified to include the satellite antenna **140** in lieu of the local broadcast domain antenna **145**. In this embodiment, the second link controller **215** and the broadcast reception device **220** are a part of a GPS receiver system. The GPS receiver system provides a set of geographical positional information to the packet filter **225**. The packet filter **225** now operates as a control module **225**. The control module **225** is operative to perform a comparison of the mobile unit's geographical position to a control parameter, and when the comparison provides an affirmative result, the control module is operative to request a signal comprising image information such as web pages to be transmitted. The control parameter preferably includes an interest designator indicative of an information class. The interest designator, like the packet mask indicates the user's current interest, such as restaurants. For example, when the user enters a new locality as defined by a grid granularity, information related to the mobile unit **105**'s location is uploaded via the first network connection **112** and the network server **125** downloads the set of restaurant web pages registered for the current locality. Preferably, the control module **225** is loaded with a list of web site designators within the scope of the interest designator. With each web site designator is a geographical coordinates mask. When the mobile unit's GPS coordinates are within the range of the web site's domain, either a stored web page is displayed or the virtual session is activated and the associated web pages are downloaded.

[**0053**] To implement this functionality, a memory module operative to hold a list is provided within the control module **225**. This memory module may include a storage unit such as a large memory or a disk in some embodiments. The list includes one or more entries. Each entry preferably includes a first field indicative of a set of application data available on the network server **125** and a second field indicative of a set of boundaries. When the mobile unit's GPS coordinates are within the set of boundaries, a geographical packet is sent to the network server **125**. Hence the same result as the previous embodiment is achieved in a different way.

[**0054**] In yet another embodiment of the current invention, the mobile unit's GPS coordinates are used to designate a geographical area of interest. Boundaries of the are set based upon a selected algorithm, such as a radius about the mobile unit's current location or political boundaries such as

a state, county or city. All data for the designated area, including map data and business establishment or tourist attraction data, for example, would be downloaded without filtering to a memory device. As inquiries are made by the user or the system using previously described methods, data from this stored database would be filtered by the packet filter **225** based upon the inquiry parameters without the need to re-establish a connection to the internet pages.

[**0055**] An embodiment preferred for low cost systems does not involve the first network connection **112**, so it does not include the network connection antenna **110** nor the first link controller **200**. In this system, the local broadcast domain entity **150** broadcasts a packet stream containing application data as opposed to pointers to application data. For example, the local broadcast domain entity **150** transmits an HTTP (Hypertext Transfer Protocol) packet stream that includes the web pages themselves. As in the foregoing systems involving locally broadcast packets, the packet filter is configured to selectively pass received packets according to a filter criterion as determined by a packet header bit mask. When the packet filter **225** selectively passes the received packet stream, only the desired web pages are loaded into the browser and optionally displayed. The network connection **112** is not needed and no airtime costs are incurred. Like the previous embodiments, if the packet filter **225** passes packets relating to more than one web page, the web pages are loaded into a buffer that the user preferably navigates using the aforementioned "next" button or pick list.

[**0056**] Note the foregoing low cost system implements a form of a selective "electronic sign." The user selects an area of interest and information related to this area of interest is allowed to be displayed on the user input-output device **210**. In some systems of this nature, the second link controller **215** may also be used to transmit an application-request packet such as an HTTP packet transmitted in response to a user clicking a mouse upon a hyperlink. In such systems, the mobile user transmits a request packet indicating its interest to the local broadcast domain entity **150**. The local broadcast domain entity **150** then supplies the desired information relating to locally available resources. In other embodiments the application-request packet is forwarded to the network server **125** via the second network connection **113**. Downstream application data is then passed to the mobile unit **105** from the network server **125** via the second network connection **113**. While the above discussion focused on a web browser application, other types of user interfaces and applications may be equivalently employed. For example, the display of the user input-output device **210** may be made of a simple LED array or a text-only LCD display. Other display options include projection displays and heads-up displays. The displays themselves can be reconfigurable and in some instances, such as is the case of touch-screen displays, would form the whole or a part of the human-machine interface. In this case the application program is operative to simply display a text message instead of a web-page image.

[**0057**] Another example of an electronic sign is an electronic real estate sign. When the vehicle **102** drives up in front of a property with a "for sale" sign, a set of data such as multiple listing information is transmitted to the mobile unit **105**. In some systems a full set of photographs may be displayed within the vehicle **102**. In one such example, the electronic real estate sign transmits information packets containing price and other information. A simple radio frequency transmitter placed within a window of the house may be used as the local broadcast domain entity **150**. In systems where the mobile unit **105** includes the network connection antenna **110**, a low cost transmitter may be used to broadcast an HTTP address packet so the full set of graphical data relating to the property may be downloaded to the mobile unit via the network connection **112**. Additional filtering could be employed based upon client interests (e.g. price range, size of property desired, etc.) compared to data transmitted from the web page or from the broadcast domain entity **150**.

[**0058**] Referring now to **FIG. 3**, a method **300** of processing **105** is illustrated in flow chart form. The method **300** is carried out by an application program such as a geographical web browser running on the mobile unit **105**. The method **300** is designed to control the mobile unit **105** as configured according to **FIG. 2**. The method **300** represents a client-side method used to communicate and interact with a server-side method as discussed in connection with **FIG. 4**. When the mobile unit **105** is implemented in alternate embodiments, the method **300** is modified as well. These modifications are discussed after the following discussion relating to the mobile unit **105** as configured according to **FIG. 2**.

[**0059**] In a first step **305**, a set of network application data is accessed. Application data may include, for example, web pages or database information. Application data is transmitted as application data packets using an application layer protocol such as HTTP. The application data is preferably downloaded from the network server **125** into the mobile unit **105** and then displayed on the user input-output device **210**. Typically, the network application data involves web pages provided in hypertext mark-up language (HTML) but other forms of network application data may be equivalently used. In many cases, the network application data includes a packet-filter parameter. In some embodiments, to limit airtime, the first step **305** accesses the set of network application data from a memory or other form of storage unit accessible to the mobile unit **105**. Control next passes to a second step **310** whereby information related to the network application data is displayed. In a preferred embodiment, the second step **310** involves displaying a web page on a web browser display screen that is a part of the user input-output device **210**. Operational data such as the packet-filter parameter need not be displayed in the step.

[**0060**] Control next passes from the second step **310** based on a first decision **315**. In the first decision **315**, a check is made to see whether a new packet-filter configuration parameter has been received. The packet-filter parameter either enters the system as a part of the network application data, is input via the user input-output device **210**, or is loaded from a memory within the mobile unit **105**. If the packet-filter needs to be reconfigured, control next passes to a third step **320**. In the third step **320** the packet-filter parameter is loaded into the packet filter **225**. If the network application data was accessed from the network connection, the packet filter parameter is coupled into the packet filter **225** via the coupling from the network interface device **205**. If the network application data was accessed from the user input-output device **210**, the packet filter parameter is coupled into the packet filter **225** via the coupling from the user input-output device **210**. As mentioned above, in some

cases the parameter may be stored in a memory and loaded into the packet filter **225** via a coupling from the memory (not shown).

[**0061**] If the first decision **315** evaluates negatively, or after the packet filter has been configured in the third step **320**, control next passes to set of decisions that implement a wait-for-input control flow. In the embodiment shown, control passes to a second decision **325** where a check is made to see whether a user input has been detected. If a user input has been detected, control passes back to the first step **305** where the user information is processed and possibly packetize for transmission via the first network connection **112**. In the first step **305**, new information may be accessed and the aforementioned steps are repeated. If the second decision **325** is negative, control passes to a third decision **330**. In the third decision **330**, a check is made to determine if a broadcast packet has been received. If the third decision **330** evaluates to the affirmative, control next passes to a fourth decision **335** whereby the received packet's header or other associated information is checked against the packet filter's bit mask, one or more keywords, or other form of interest designator as configured in the third step **320**. If the fourth decision **335** evaluates to the affirmative, control passes back to the first step **305**. In the first step **305** information derived from the packet filter output is preferably uploaded via the first network connection **112** and used to access a new set of network application data such as web pages. If the third decision **330** evaluates to the negative, control loops back to continue to check for a valid user input or packet filter output. If the fourth decision **335** evaluates to the negative, control also loops back to continue to check for a valid user input or packet filter output.

[**0062**] In the method **300**, the decisions **325**, **330** and **335** are shown to be implemented as a sequence of binary tests. A variety of equivalent control flows may be employed to implement these decisions. For example, these three decisions may be implemented such that a processor enters a wait loop and waits for an interrupt from a user I/O device or from the packet filter.

[**0063**] The method **300** implements a geographically controlled web browser when implemented by the remote unit **105** which moves about as illustrated in **FIG. 1**. For example, the first step **305** is operative to transmit one or more hypertext transfer protocol (HTTP) request packets via the first network connection **112**. The first step **305** is also operative to download web page data so that it can be displayed in the second step **310** on the display of the user input-output module **210**. If the first network connection **112** is coupled to the network server **125**, and the network server is configured to process inputs from a geographical web browser, the server will typically download a packet-filter parameter to the geographical web browser. This packet-filter parameter tells the geographical web browser which packets to send via the first network connection **112** to the network server **125**. If a packet-filter parameter is sent by the network server **125** or otherwise made locally available, the third step **320** is operative to configure the packet filter. Now as the mobile unit **105** moves from one broadcast domain to the next, only selected packets will pass through the packet filter and thereby navigate through a set of web pages to be displayed on the display screen of the mobile unit **105**. Alternatively, the user may provide navigation commands and navigate the web browser using conventional methods such as keyboard entries, voice commands, or mouse clicks.

[**0064**] A geographical web browser has an added advantage of providing a new means for advertising locally available items such as products and services. The user interested in a certain product or service logs into a geographically controlled web site and configures the packet filter to display information related to a user's needs. In one example the mobile unit **105** enters a new city and the user is interested in finding a mall with a particular clothing store within. As the user drives along, a web page comes up and provides directions to the shopping mall and also optionally provides an inside map of the mall to include directions to the desired store. This form of advertising helps both the consumer and the storeowners. Similarly, if the mobile unit **105** is connected to a road-navigation site, new map pages may be periodically downloaded based upon the mobile unit **105**'s current position. If a user is using a hand-held unit, a similar type of scenario applies within the shopping mall, for example. A geographical web browser practicing the method **300** may also be used in systems where the local broadcast domain **150** is supplied by the same telecommunications cell site as used for the network connection **112**.

[**0065**] The method **300** operates with some modifications in systems when the mobile unit **105** uses the satellite antenna **140** and employs the GPS receiver in the broadcast reception module **220**. In such systems, the packet filter **225** does not filter packets but rather generates packets from a table based on a filter parameter and the calculated GPS positioning coordinates. The network server **125** or a memory preferably provides a set of potential pointers to web pages based on the user's current interest as defined by the web page to which the mobile unit **105** is connected. When the mobile unit crosses a boundary and enters a region within a locality, if any web page pointers are loaded for that locality and meet the packet-filter criterion, this has the same effect as if the decisions **330** and **335** were both affirmative. The comparison may be performed by subtracting from a set of reference coordinates a set of coordinates representative of the geographical location of the mobile unit and testing to see whether the difference is below a threshold. In some case the comparison may be made referenced to a man-made boundary such as a city limit or a cell coverage boundary. A "geographical packet" may be thereby generated to send a request for web pages or related application data to be downloaded. A "geographical packet" is a type of request packet sent by a geographical web browser to request application data such as web pages to be downloaded based on geographically related events. Instead of navigating an application by mouse-clicking on an icon or a hyperlink, a mobile unit automatically responds to positional and/or locally broadcast information packets. In some cases web pages may be stored locally and accessed locally using caching techniques to minimize the network transactions.

[**0066**] The method also operates with some modifications in situations where the mobile unit **105** does not include a network antenna **110** and thereby does not maintain the first network connection **112**. In this case the difference is the packet stream received at the antenna **145** includes the web pages themselves. The packet filter operates similarly and only accepts web pages that match the packet-filter criterion.

[**0067**] Referring now to **FIG. 4**, a method **400** practiced by the network server **125** is illustrated in flow chart form.

The method **400** is a server-side method that interacts with a client-side method such as the method **300**. Recall the network server **125** may also be implemented as the application program **130**. The method **400** is designed to provide the server side of a client-server application layer communication protocol. In this system the method **300** represents the client side of the connection and is practiced by the mobile unit **105**. The method **300** communicates client-side data packets to the network server **125** that responds with server-side data packets as it practices the method **400**.

[**0068**] In a first step **405**, initial communications are performed with a client such as the mobile unit **105** practicing the method **300**. For example, in a web browser application, the first step **405** involves receiving one or more HTTP request-packets and responding with packets comprising web-page data. Next control passes based on a decision **410** that checks to see whether one or more packet-filter parameters need to be downloaded to the client. If the decision **410** evaluates affirmatively, control passes to a second step **415** whereby the one or more packet-filter parameters are transmitted to the client. After the second step **415**, control next passes to a third step **420**. If the decision **410** evaluates negatively, control bypasses the second step **415** and passes directly to the third step **420**. In the third step **420**, a standardly generated or a geographically generated data application packet is received at the network server **125**. For example, a standardly generated application packet may be an HTTP packet transmitted by the method **300** after the user has clicked on an Internet link. As used herein, this type of packet is also called a "standard-request packet." A geographically generated HTTP request packet references a page to which there is not necessarily a link. Instead of selecting a link, the HTTP request is generated in the first step **305** of the method **300** after the decision **335** indicates a packet has passed through the packet filter and thereby web pages need to be downloaded. A packet generated as such is one type of "geographical packet." Another type of "geographical packet" is a request packet generated when a GPS receiver identifies the mobile unit **105** has passes into a locality and a request needs to be sent to the network server **125** as previously discussed.

[**0069**] Control next passes to a fourth step **425** whereby one or more application packets are transmitted in response to the request received in the third step **420**. Typically, the application packets transmitted in the fourth step **425** include information relating to one or more new web pages being downloaded from the network server **125** to the mobile unit **105** via the first network connection **112**. In some systems it is desirable to download a plurality of web pages into a cache within the mobile unit **105**. The user then preferably uses the "next" button in the geographical web browser to access the plurality of downloaded pages.

[**0070**] Control next passes out of the fourth step **425** based upon a second decision **430**. The second decision **430** checks to see whether the user has selected a link directing control away from the network server **125**. If the second decision **430** evaluates affirmatively, control passes to a fifth step **435** whereby the method is exited. If the second decision **430** evaluates negatively, control passes back to the third step **420** to await more standardly or geographically generated application packets.

[**0071**] Referring now to **FIG. 5***a,* a method **500** of processing within a communication system is illustrated. In a first step **505**, the local broadcast domain entity **150** is operative to transmit a low power broadcast packet that is then received by the mobile unit **105**. The mobile unit **105** selectively passes the received packet according to the packet-filter parameter as configured in the third step **320** of the method **300**. Control next passes to a second step **507**. In the second step **507**, a set of application data such as web pages are supplied by the network server **125** via the first network connection **112** to the mobile unit **105**. Depending on the system configuration, this step may also be performed by the local broadcast domain entity **150** so that the web pages or other application data is received via the local broadcast antenna **145**. In such systems, the web pages may be stored within the local broadcast domain entity **150** itself, or may pass through the local broadcast domain entity **150** after having been downloaded from the network server **125** via the second network connection **113**. Control next passes to a third step **509** practiced by the remote unit **105** whereby a set of application data such as web pages is displayed on the user input-output device **210**.

[**0072**] Referring now to **FIG. 5***b,* a method **510** of processing practiced by the mobile unit **105**, the local broadcast domain entity **150** and optionally the network server **125** is illustrated in flow chart form. In the method **510**, the mobile unit **105** and the local broadcast domain entity **150** engage in cooperative two-way communications. In a first step **515**, the mobile unit **105** transmits a user-interest packet via the local broadcast domain antenna **145** to the local broadcast domain entity **150**. In this method, the local broadcast domain entity **150** includes both a transmitter and a receiver, i.e., a transceiver. Also, the second link controller **215** also includes a transceiver capable of both transmitting and receiving within the local broadcast domain. As discussed hereinafter, the user-interest packet may be encrypted using a scheme such as public key encryption. If an encrypted user-interest packet is used, the system may employ challenge-and-reply authentication to thereby restrict access to information

[**0073**] Control next passes to a second step **520**. While the first step **515** is practiced by the mobile unit **105**, the second step **520** is practiced by the local broadcast domain entity **150**. In the second step **520**, the user-interest packet transmitted by the mobile unit **105** in the first step **515** is received by the local broadcast domain entity **150**. Control next passes to a third step **525** practiced by the local broadcast domain entity **150** in response to the first step **515**. In the third step **525**, the user-information packet received in the second step **520** is processed. This step involves extracting the user-information packet from a signal transmitted from the antenna **145** and received by the local broadcast domain entity **150**. Once received, the third step **525** involves feeding the user-information packet to a software module for evaluation. The software module checks the received user-interest packet to determine whether or not the local broadcast domain entity **150** can supply information related to a service desired by the user. The software module checks the user-interest packet and makes a decision **530**. If the local broadcast domain entity **150** cannot supply information related to a service desired by the mobile unit **105** as indicated by the user-interest packet, control transfers back to the first step **515**. In this case the local broadcast domain entity performs no action and awaits another user-interest packet to be transmitted. In some systems, the local broad-

cast domain entity **150** may also practice the method **500** while waiting for the next user-interest packet.

[**0074**] The user-interest packet is a packet identifying a specific user interest. For example, the user within the vehicle **102** has a toothache and enters the domain of the local broadcast domain entity **150**. The user is thereby interested in finding a dentist. The user enters information via the user input-output device **210** either by mouse click, keyboard entry, or voice commands indicative of this interest. The mobile unit **105** then broadcasts this information via the antenna **145** into the broadcast domain to be received by the local broadcast domain entity **150**. If a local dentist is registered with the local broadcast domain entity **150**, the decision **530** evaluates affirmatively and a packet relating a locally available dentist will be transmitted back to the mobile unit **150** as discussed below.

[**0075**] In another example the mobile unit **105** is implemented as a palm-pilot or personal digital assistant computer. A user carrying the palm-pilot version of the mobile unit **105** enters a shopping mall and is looking for a silver plated picture frame under fifty dollars. Information to this effect is entered by the user as discussed above and a user-interest packet is transmitted according to the first step **515**. The local broadcast domain entity **150** is preferably controlled by the shopping mall authorities or a contracted advertising company. The steps **520** and **525** then are performed to determine which stores carry the item of interest. If any of the stores within the shopping mall carry the item of interest, the decision **530** evaluates affirmatively and a packet will be transmitted back to the mobile unit **150** as discussed below.

[**0076**] If the decision **530** evaluates affirmatively, control next passes to a fourth step **535**. In the fourth step **535** a reply packet is transmitted back to the mobile unit **105** in response to the user-interest packet transmitted in the first step **510**. In systems employing challenge and password authentication procedures, an exchange of packets may be required between the mobile unit **105** and the local broadcast domain entity **150** before the fourth step **535** is performed. Control next passes to a fifth step **540** whereby application data such as web pages relating to the topic of the user-interest packet is supplied to the mobile unit **105**. Depending on the system configuration, the fifth step **540** may be performed by the local broadcast domain entity **150** so that the application data is received via the local broadcast antenna **145**. In other systems, the fifth step **540** is performed by the network server **125** which downloads the application data to the mobile unit **105** via the first network connection **112**. Control next passes to a sixth step **545** practiced by the remote unit **105** whereby information related to the application data such as web pages is displayed on the user input-output device **210**.

[**0077**] In restricted access systems, transmissions of the method **510** may be encrypted and electronic challenge and reply authentication may be used. Challenge and reply authentication involves providing a digital signature so that electronic eavesdroppers cannot gain access to a password. Public key encryption methods are preferably used to allow information to be disseminated using the method **510** to authorized mobile units only.

[**0078**] In systems involving multiple users the local broadcast domain entity must receive packets possibly from multiple different mobile units **105**. One way to handle this type of situation is to use a method known as carrier sense multiple access. The mobile units transmit burst data packets infrequently and at random intervals so the channel is clear most of the time. If two mobile units attempt to transmit simultaneously, a data collision occurs and an error detection algorithm involving check-bits is employed to determine the validity of a received data packet. If the received data packet includes errors, it is dropped. The two mobile units attempt to retransmit their packets at random time delays and in all probability are able to get then through on their second try. Other multiple access techniques may also be used but are not considered further herein because they are already well known in the art. These multiple access techniques include frequency division multiple access, time division multiple access and code division multiple access.

[**0079**] Referring now to **FIG. 6**, a method **600** to assist in road navigation is illustrated in flow chart form. The method **600** may also be practiced in off-road situations such as shopping malls when the mobile unit **105** is implemented, for example, as a palm-pilot. In a first step **605**, the mobile unit **105** transmits a set of information related to the mobile unit's desired destination to a server such as the network server **125**. This information may be transmitted via the first network connection **112** or may be passed through the local broadcast domain entity **150** and to the network server **125** using the second network connection **113**.

[**0080**] Control next passes to a second step **610** whereby the information transmitted in the first step **605** is received at a navigation server. The navigation server may be implemented, for example as the application program **130**, or the network server **125**. Within building environments such as a shopping mall, a picocell architecture may be employed so that the Internet **122** is actually implemented as an intranet. For the purposes of description, an embodiment whereby the navigation server is implemented within the network server **125** will be described. Control next passes to a third step **615**. In the third step **615** a set of navigation information such as directions or a digital map is transmitted from the navigation server back to the mobile unit **105**. Control next passes to a fourth step **620** where the information transmitted to the mobile unit **105** in the third step **615** is displayed on the user input-output device **210**. This step often involves displaying an image with a digital map marking the best current route to the desired destination as defined in the first step **605**.

[**0081**] Control next passes to a fifth step **625**. The fifth step **625** may be executed after a timer has timed out, a local broadcast packet has passed through the packet filter **225**, or a user input has been entered via the user input-output device **210**. Once fifth step **625** indicates new navigational information is needed, control passes to a sixth step **630**. In the sixth step **630** new location information is received at the mobile unit **105**. This location information may be obtained using a GPS receiver, or by packet filtering local broadcast domain packets. In the navigation application, the packet filter is set to pass navigation packets that indicate the mobile unit **105**'s geographical location.

[**0082**] Control next passes to a seventh step **635** where the mobile unit **105**'s location information is uploaded to the navigation server. This step may be performed in a variety of ways. For example, the mobile unit **105** may activate a

virtual session and send the location information via the first network connection **112**. Alternatively, the mobile unit **105** may transmit a request packet to the local broadcast entity **150** which then transmits the packet via the second network connection **113**. After the seventh step **635**, control passes back to the second step **610** where the navigation server once again receives a current-location packet from the mobile unit **105** and the foregoing steps are then repeated.

[**0083**] It should be noted the navigation server preferably selects a best route when transmitting route information to the mobile unit **105** in the third step **615**. The best route information is preferably calculated based on traffic conditions and distance. For example, a set of one or more sensors is associated with local broadcast domain entity **150**. The sensors measure traffic conditions using, for example, laser continuity sensors to measure vehicle speeds. The sensor information is forwarded back to the local broadcast domain entity **150** via wireless, wireline, or optical links. The sensor information is uploaded via the second network connection **113** to the network server **125** which acts as the navigation server for the system. The navigation server preferably collects data from a plurality of local broadcast domains in order to keep up-to-date information about road conditions and routes over a wide geographical coverage. The navigation server thereby calculates the best route of travel for the mobile unit **105** for its destination and includes this information transmitted in the third step **615**.

[**0084**] Referring now to **FIG. 7**, a block diagram of system for navigation and traffic management **700** is illustrated. A vehicle **102** includes a mobile unit **105**, and is connected to a desired destination, **702** through a plurality of roadways, or routes **704**, **706** and **708**. Dispersed along the roadways, is a plurality of geographically dispersed sensors, **710**. In some instances, these geographically dispersed sensors may be deployed in a mobile unit such as the helicopter, **712**, shown in **FIG. 7**. These sensors are connected to a central server **714** through wireline links **716** and wireless links **718**. In some cases, the sensors are combined in intermediate nodes, **720**. The intermediate nodes **720** are connected to the sensors through wireline links **722** and wireless links **724**. The intermediate nodes **720** are connected to the central server **714** through wireline links **726** and wireless links **728**. A fiber optic link **726** is a special form of a wireline link and is illustrated in **FIG. 7**. The central server **714** is coupled to the mobile unit through wireless link **730**.

[**0085**] In **FIG. 7**, the vehicle **102** is proceeding towards a destination, **702**. In the case of a commuter, the vehicle may be heading to work, in an office or a factory, or home. The vehicle could also be in transit between cities or boroughs. In many instances, the operator of the vehicle has a choice among routes, **704**, **706**, or **708**. For example and without limitation, route **704** may be a busy secondary road, route **706** may be a highway or freeway with controlled access, and route **708** may be a back road. As is well known to most drivers, it may be the case where the highway, **706**, may be the fastest unless there is congestion or an accident has occurred. The operator of the vehicle may desire to know the navigational route which will allow him to arrive in the shortest time, or encounter a minimum of traffic. The controlling authority of the roadways may similarly desire to regulate traffic, encouraging travel along alternate routes and at alternate times. The controlling authority of the roadways is thus motivated to share traffic patterns with the operator of the vehicle whose interests are generally aligned. Further inducement may be offered through a systems of road usage fees or tolls where off peak travel or secondary route travel is monetarily less expensive than peak or rush hour traffic, and travel along congested roads. It will be recognized that traffic congestion fluctuations are often unpredictable due to accidents and special events. The routes considered in this invention may not necessarily include all routes, and it is envisioned that early application of this system will limit itself to major highways and interstate freeways most prone to rush hour congestion. Heavily trafficked secondary roads will be added to the system next.

[**0086**] The invention disclosed herein teaches the use of sensors, **710**, which are used to measure the road conditions, including the amount and speed or traffic flow. By example and without limitation, **710** sensors may use infrared beam technology, pressure cables strung across the roadway, human observers, or electronic cameras such as CCD arrays. Further, any combination of technologies may be used. The sensors **710** may be statically mounted at an observation point, such as an intersection, or an entrance ramp, or the sensors **710** may be mounted in a mobile unit such as a traffic helicopter or a police car or other vehicle.

[**0087**] The data measured and collected by the sensors **710** are communicated in raw or processed fashion to the central server **714**. The communication links may generally be either wireless or wireline. Examples of wireline links include, without limitation, twisted pair wire, coaxial cable, plastic and glass fiber optics, and other transmission line media. Wireless links include, without limitation, RF, microwave and IR transmission between transmitting antennas and receiving antennas, or transmitting sources and receiving sources. The data collected by sensors **710** may be directly transmitted to the central server **714**, or the data may be relayed to the intermediate nodes **720** for simple multiplexing, packetizing, preprocessing and/or filtering before retransmission to the central server **714**.

[**0088**] At the central server **714**, the data is collected and analyzed. In a simple embodiment, information about traffic density and flow along different roadways may be organized and broadcast to the mobile unit **105**, to serve an announcement function similar to the existing traffic reports heard on metropolitan radio shows during rush hours. Alternatively, the analysis may entail calculating a preferred route for a vehicle **102** optimizing for distance weighted by road conditions. In yet a third embodiment, the data collected on traffic flow and road conditions may be used to set adaptive road tolls in order to use market forces to regulate the operator's choice of route. The concept of adaptive road tolls are tolls, tariffs or fees on a segment of a road or highway that change or adapt to demand. As road space becomes more in demand, the tolls preferably adjust to regulate the use of a given segment of road. The adaptive road tolls enable the use of an efficient free market mechanism to allocate the increasingly scarce resource of road space. The adaptive road tolls represent a usage fee and provide an improvement to fixed vehicle tariffs paid, for example, by county per year. The invention may be used to record and assess the adaptive road tolls through link **730** and central server **714**. Alternatively, payment may be made through existing technology such as the TollTag™ marketed by AmTech Corp.

[0089] The information collected and calculated by the central server, and in some cases, the intermediate nodes is relayed to the mobile unit **105** through a wireless link **730**. The wireless link **730** may be direct or through a plurality of local broadcast domain entities as disclosed above.

[0090] The discussion of **FIG. 7** may be used to develop an alternative embodiment of the method **600**. This alternative embodiment provides a method for traffic management. Traffic management is a process whereby a controlling authority provides an incentive system to alter and control traffic flows. The alternate version of the method **600** operates as follows. The first **605** is the same as previously discussed. The second step **610** is augmented with the process of receiving information indicative of traffic conditions related to a plurality of roads and adaptively assigning a road usage toll to at least one of these roads based upon the received information. The step **615** is augmented by also electronically providing information relating to the adaptive road usage tolls to the mobile unit. The step **620** is augmented by also showing cost information relating to one or more routes. The digital map may show several routes, estimated travel times on each route, and a monetary cost for traveling on each route. In some systems, with or without adaptive tolls, the step **620** may also display information indicative of the estimated travel time associated with each route. By displaying estimated travel times and adaptive tolls, drivers can make an educated decision as to which route to select.

[0091] The steps **625** and **630** are optional in this alternative method and the step **635** may be practiced using a reflective means such as the TollTag™ marketed by AmTech Corp. That is, the step **635** may involve the controlling authority probing to determine the mobile unit's location instead of the mobile unit transmitting this information. Alternatively, the step **635** may involve the mobile unit automatically sending information related to its geographical position to continue to accept updated route information and to be charged accordingly. As such, the step **610** is also modified to identify electronically (to include optically, with or without probing) the mobile unit's choice of roadways and automatically charge the mobile unit's associated vehicle based upon the adaptive road usage toll. Instead of charging the vehicle for taking the best route, a credit can alternatively be applied against a taxation if the vehicle selects a less desirable route and thereby lessens a traffic loading on a congested roadway.

[0092] Although the present invention has been described with reference to specific embodiments, other embodiments may occur to those skilled in the art without deviating from the intended scope. It should be noted while the foregoing examples make use of a web browser application whereby application data involves HTTP packets representative of web pages, this is not required. Rather the present invention encompasses any application layer program that may send application layer packets to support other types of applications. Also, while the preferred embodiments employ various antennas such as the antennas **110**, **140**, and **145**, other types of transducers including ultrasonic and laser sensors may equivalently be used in some systems. Also, while the present disclosure focused on a mobile unit, geographically based web browsing may be used by stationary systems as well. For example a central movies site may automatically provide links to movies in a local area based on the access number used to connect to the network. Various modules have been described as being implemented in software but could equivalently be implemented in dedicated hardware. Also, while an embodiment where separate telecommunication cell and local broadcast domain entities exist, these may be merged. Likewise, packet filters may be set up to filter packets based on a bit mask to be compared to a packet header, or packet filters may compare keywords or other information to information contained within the data field of the packet itself. In any of the traffic management techniques, adaptive toll charges may be replaced with an adaptive credit system. Therefore, it is to be understood that the invention herein encompasses all such embodiments that do not depart from the spirit and scope of the invention as defined in the appended claims.

1. For use in a mobile data network environment comprising a plurality of mobile units, an Internet, one or more network servers, and a plurality of public access wireless local area network stations each coupled to the Internet and providing a low power bi-directional wireless access connectivity in a respective restricted local coverage area, a method comprising:

maintaining a database of information, wherein the information is categorized in accordance with a set of information categories;

maintaining one or more user interest preferences associated with one or more categories of content that a particular user desires to receive;

receiving, via the Internet and via a particular public access wireless local area network station which is presently in wireless contact with a particular mobile unit operated by the particular user, a request packet that is automatically generated in the mobile unit based on a geographical event without the need for the particular user to request the information to be downloaded while connected to the particular public access wireless local area network station; and

causing a set of the information related to the one or more user preferences to be coupled via the Internet and via the particular public access wireless local area network station to the particular mobile unit;

wherein the particular user can enter into a user interface commands to access the set of information from a local storage area in the mobile unit irrespective of whether or not the particular mobile unit is thereafter connected to the Internet.

2. The method of claim 1, wherein the user interface includes an interactive GUI (graphical user interface) and at least some of the set of information is coupled to the user via the interactive GUI.

3. The method of claim 2, wherein the interactive GUI includes a pick list that allows the user to select different downloaded information items.

4. The method of claim 2, wherein the interactive GUI includes a next button that allows a user to advanced to a next downloaded information item.

5. The method of claim 1, wherein the geographical event is generated when a set of GPS coordinates cross a boundary.

6. The method of claim 1, wherein the geographical event is generated when a packet is received at the particular

mobile unit received from the particular public access wireless local area network station.

7. The method of claim 6, further comprising:

receiving from the particular mobile unit an indication of a present location of the particular mobile unit;

wherein the present location is determined based upon an output of a GPS receiver located in the particular mobile unit.

8. The method of claim 1, wherein the geographical event is generated when a navigation packet is received from the particular public access wireless local area network station.

9. The method of claim 8, further comprising:

receiving from the particular mobile unit an indication of a present location of the particular mobile unit;

wherein the present location is determined based upon the navigation packet.

10. The method of claim 1, wherein the one or more user interest preferences are received via one or more user interest packets.

11. For use in a mobile data network environment comprising a plurality of mobile units, an Internet, one or more network servers, and a plurality of public access wireless local area network stations each coupled to the Internet and providing a low power bi-directional wireless access connectivity in a respective restricted local coverage area, a method comprising:

sending to a remote network server an indication of one or more user interest preferences associated with one or more categories of content that a particular user desires to receive, wherein the remote network server has access to a database of information, and the information is categorized in accordance with a set of information categories;

detecting a geographical event;

sending, via the Internet and via the particular public access wireless local area network station, a request packet that is automatically generated in the mobile unit in response to the detection of the geographical event without the need for the particular user to request the information to be downloaded while connected to the particular public access wireless local area network station;

receiving a set of the information related to the one or more user preferences via the Internet and via the particular public access wireless local area network; and

storing at least a portion of the set of information into a local storage area;

wherein the particular user can enter into a user interface commands to access the set of information from the local storage area in the mobile unit irrespective of whether or not the particular mobile unit is thereafter connected to the Internet.

12. The method of claim 11, wherein the user interface includes an interactive GUI (graphical user interface) and at least some of the set of information is coupled to the user via the interactive GUI.

13. The method of claim 12, wherein the interactive GUI includes a pick list that allows the user to select different downloaded information items.

14. The method of claim 12, wherein the interactive GUI includes a next button that allows a user to advanced to a next downloaded information item.

15. The method of claim 11, wherein the geographical event is generated when a set of GPS coordinates cross a boundary.

16. The method of claim 11, wherein the geographical event is generated when a packet is received at the particular mobile unit from the particular public access wireless local area network station.

17. The method of claim 16, further comprising:

determining a present location of the particular mobile unit based upon an output of a GPS receiver located in the particular mobile unit; and

sending an indication of the present location of the particular mobile unit to the remote network server;

wherein the set of information relates to the user preference and is also qualified based upon the present location of the particular mobile unit.

18. The method of claim 11, wherein the geographical event is generated when a navigation packet is received from the particular public access wireless local area network station.

19. The method of claim 18, further comprising:

determining a present location of the particular mobile unit based upon information contained in the navigation packet;

sending an indication of the present location of the particular mobile unit to the remote network server; and

wherein the set of information relates to the user preference and is also qualified based upon the present location of the particular mobile unit.

20. The method of claim 11, wherein the one or more user interest preferences are received via one or more user interest packets.

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