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(71) Applicant *(for all designated States except US)*: **SOUTH LAND COMMUNICATIONS PTY LTD** [AU/AU]; ACN 103 758 872, 36 Garden Drive, Tullamarine, Victoria 3043 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **NESBIT, Peter** [AU/AU]; 187 Darling Road, MALVERN EAST, Victoria 3145 (AU).

(74) Agent: **PIPERS PATENT AND TRADE MARK ATTORNEYS**; EARLEY Martin, CHANDLER Warren, ROSE Ian, PIPER James, Level 18, 500 Collins Street, MELBOURNE, Victoria 3000 (AU).

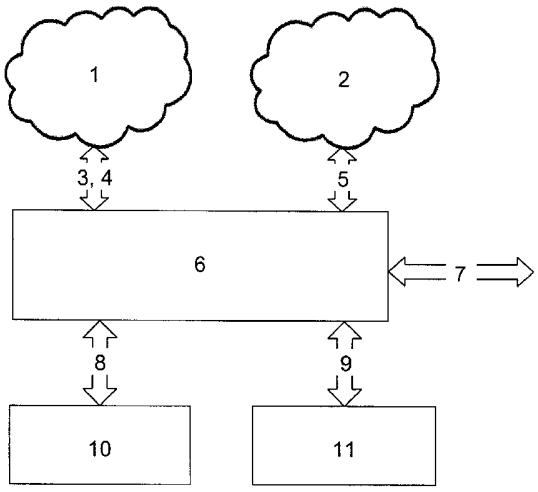
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(54) Title: A SYSTEM TO DELIVER INTERNET MEDIA STREAMS, DATA & TELECOMMUNICATIONS



(57) Abstract: A system for delivering broadcast and communications (2) services, including various Internet media streams (3), to fixed, mobile and portable recipients, including one or more gateways (6) providing connection to external communications networks (2) and nodes and internal loop-backs, each gateway (6) including selection means to selectively establish communication channels with the nodes and loop-backs to establish an individual bi-directional channel between each node network and allow recipients to obtain the channel of their choice, and processing means for processing the channels containing the services into digitised packaged data format including addressing means for identifying, storing and updating in real time the location of each recipient and applying routing information to each packet of digitised packaged data to enable the packets to be correctly routed to each recipient. Also claimed is a portable modem for use by mobile or portable recipients and a set-top-box for connection to recipients at a fixed location for delivering broadcast and communication services.

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A SYSTEM TO DELIVER INTERNET MEDIA STREAMS, DATA & TELECOMMUNICATIONS

BACKGROUND TO THE INVENTION

Free-to-Air Radio Broadcasting

Most people listen to radio broadcast stations at some time during the day. This may occur in the car, a commuter vehicle, at work, at home on fixed or portable receivers, and in recreational areas. Although most radio stations originally transmitted in the amplitude modulated (AM) broadcast band, many have migrated to the frequency modulated (FM) broadcast band, due to the better audio quality. Unfortunately, their wide bandwidth limits the number of FM stations able to be accommodated in any one area. In capital cities one typically finds about 30-35 stations, most of which provide a reasonable quality of service. Although more channels are available, it is difficult to allocate them without reducing the quality of service, unless transmission ranges are strictly limited.

This shortage of channels has pushed the cost of commercial FM licences well beyond the means of most aspirants, and often approaches or exceeds a hundred million dollars. Unfortunately, the need to recover such high costs and remain in business makes it risky to experiment with non-mainstream formats. Consequently there is little variety amongst most commercial FM stations, which have tended to become less diverse through mergers and networking. Although more variety is found amongst community broadcasters and lower power FM stations, licenses are few and rarely traded. Furthermore, low power FM stations can be difficult to receive, especially on common indoor receivers using whip antennas.

The remaining group comprises low power open narrowcast FM stations, which in metropolitan areas are limited to 1 watt output and a 5 km range. With many such stations scattered around metropolitan areas and a high level of frequency re-use, service areas are limited and interference is often severe. Except for special stations with a local audience, most of them cannot satisfy more than a fraction of their potential audience at any one time.

Internet Radio Broadcasting

Internet radio has grown strongly in recent times, and is poised to become the broadcasting medium of the future. Anyone can set up and operate an Internet radio station, at a much lower cost than a free-to-air radio station. Because licences are not required, there is no limit to the number of such stations which can simultaneously operate.

Unlike free-to-air stations, Internet stations have worldwide range. Those on the far side of the world can be heard just as clearly as those operating locally. This makes available a huge variety of programming and music styles. Unfortunately, Internet broadcasting has limitations which unless resolved, will continue to limit its mainstream acceptance, for example:

(a) most people still connect to the web using dial up modems, which due to limited speed, cause poor audio quality and buffering. Although cable modems and ADSL connections usually resolve these problems, they are considerably more expensive to install and use;

(b) many Internet service providers charge according to the amount of time connected and/or amount of data downloaded, inhibiting long periods of listening to Internet radio. Furthermore, few people want to tie up their telephone line or computer for long periods to listen to radio;

(c) unlisted stations are hard to find, URLs are complicated to enter, and it can be difficult to maintain a reliable connection;

(d) computers are often located away from living areas, making Internet radio less practical when working or moving around the house;

(e) computers lack the ergonomic appeal of traditional radio receivers;

(f)Internet radio is not economically available in vehicles, where much listening takes place.

Television

Despite general agreement that the existing free-to-air system needs updating, a better system has been slow in coming due to controversies over technical standards, high station upgrade costs, and the reluctance of most consumers to replace their television receiver, which for many is an expensive asset. As for Internet television, it is hard enough to get real-time video in a window on a computer monitor, let alone full quality video on a large television screen. High definition Internet television is even further away.

Telephony

For the mobile telephone service, problems include limited coverage, and community concern over telephone towers, complex charging schemes, and call costs. For the fixed telephone service, concerns are often voiced relating to rural areas, including poor line quality and reliability, low data rates, and limited penetration.

Summary

Technological developments in the broadcasting and telecommunications industries are generally driven by corporate goals, which may or may not align with the public interest. Because these goals differ from one company to the next, there is no clear and compelling direction for the industry as a whole. This inherent competitiveness of private industry makes it difficult to achieve the high degree of cooperation between major players, which is necessary to realise the full potential of existing technology. On the other hand the community has an acute need for an integrated system of broadcasting and telecommunications, which offers greater freedom of choice than currently exists, and which is able to deliver services to any location, fixed and mobile. The invention disclosed herein approaches and at least partially fulfils that need.

DESCRIPTION OF THE INVENTION

In accordance with the invention there is provided a system for delivering broadcast and communications services through connection means to fixed, mobile and portable recipients, wherein said services include provision of one or more Internet media streams including Internet audio streams and Internet video streams, Internet data including the world-wide-web and email, and telecommunications; the system including one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, each of said one or more gateways including:

(a) selection means to selectively establish communication channels with said external communication nodes networks and preferably said loopbacks to establish an individual bidirectional channel between each said node network and allow recipients to obtain the communication channel of their choice;

(b) processing means including high speed matrix switching, buffering, packeting, and addressing means; processing said channels containing said services into digitised packaged data format and said addressing means identifying, storing and updating in real time the location of each recipient, whether fixed or mobile, and applying routing information to each packet of said digitised packaged data to enable said packets to be correctly routed through the system to reach each recipient.

The system also can include multiplexing means wherein said packets for multiple recipients are combined together to enable said packets to be conveyed to recipients using a single connection means, said packets remaining identifiably separate from each other and being routed to each said recipient according to the routing information contained in or applying to each said packet.

The system can include a plurality of gateways and the system allows connection between said gateways to share the load and introduce redundancy. One or more gateways include repository means for storing system software required by downstream devices, and enabling downloading of said system software to said devices to remotely refresh or upgrade said downstream devices.

Splitting means can be connected with at least one of said connection means and able to split said Internet media streams or data or packets derived therefrom into as many duplicates as necessary to satisfy the number of recipients for each said stream.

Channel optimisation means are used for gathering and processing real-time or near real-time ionospheric propagation data, automatically determining suitable channels for high frequency radio links used by this system, and managing said channels to maximise the quality of service and efficiency of spectrum utilisation by remotely controlling transmitter frequencies, powers and other parameters used by the equipment providing said high frequency links.

The gateways can include monitoring means for collating the time of day and day of the week when particular Internet media streams are requested, and using fuzzy logic as a means of prediction, for the selection means to open an individual bidirectional channel with one of said external communications node

or network from which said stream is obtainable in advance of the predicted likely time of request to eliminate or minimise the time required to establish said stream with said external source.

The connection means for connecting recipients to processing means includes any combination of a plurality of optical fibre, hybrid-fibre coax, coaxial or other cable, satellite relay links, wideband radio links, and narrowband radio links, and further that said connection means for connecting recipients includes all necessary routing, multiplexing and demultiplexing, signal regeneration, radio transmission and reception, automatic link establishment, and means of duplex or semi-duplex operation and further that said connection means also allows digitised packaged data to be conveyed from each recipient to the gateway as required.

The connection means for connection to mobile and portable recipients is provided by short-range radio modems, said modems placed at regular intervals around the localities where wireless connections to mobile and portable recipients are to be provided, said modems including means of a multi-access technique to enable said modems to establish individual wireless connections with multiple recipients.

Alternatively the connection means for connection to mobile and portable recipients is provided by transponders, said transponders providing a means of decoding Internet media streams, modulating same onto individual radio-frequency carriers of appropriate frequency, and transmitting said modulated carriers to one or more recipients within range of said transponder, said transponders including means of sending information containing the frequency of requested streams to a radio modem near the requestor of that stream, said modem passing said frequency information to the requestor's equipment causing automatic tuning to the stream and receipt on said radio frequency.

The system can include portable modems wherein mobile and portable recipients are able to be wirelessly connected by short-range radio, said portable modems including:

(a) storage means for receiving and storing and editing URLs for said broadcast and communications services;

(b) input means which in response to an action performed by the recipient, recalls the URL of a desired Internet media stream and sends the URL to the gateway to cause said stream to be obtained by the gateway and delivered to said recipient via the connection means;

(c) converting means able to convert packets received from said gateway to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external transducer or other external equipment.

The invention also provides a portable modem for use by mobile or portable recipients which enable wireless connection to fixed short-range radio modems for delivering broadcast and communications services including provision of one or more Internet media streams, Internet audio streams and Internet video streams, Internet data, the world-wide-web and email, and telecommunications and for connection to one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, said portable modems including:

(a) storage means for receiving and storing and editing URLs for said broadcast and communications services;

(b) input means which in response to an action performed by the recipient, recalls the URL of a desired Internet media stream and sends the URL to the gateway to cause said stream to be obtained by the gateway and delivered to said recipient via the short range radio modem;

(c) converting means able to convert packets received from said radio modem to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external transducer or other external equipment.

The portable modem can include receiving means for receiving signals on free-to-air radio or television frequencies, demodulating said signals to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external transducer or other external equipment.

In one form modulation means are used to modulate an analogue or digital baseband signal obtained from an Internet media stream or a free-to-air station onto a radio-frequency carrier of appropriate frequency for reception by an external receiver tuned to the same frequency.

In another form the portable modem includes a means of making and receiving telephone calls through short-range radio modems.

The portable modem can include a means of establishing a Bluetooth short-range wireless link with a handset enabling the user to make and receive telephone calls using said handset. The means of establishing a Bluetooth short-range wireless link with a portable handset enables the user to select a desired Internet media stream or station and function as a portable listening device for said stream or station.

The portable receiver including a means of accessing the Internet including the world-wide-web and email through said short-range radio modems. In another form a connection to an external computer, enables a user of said computer to access the Internet including the world-wide-web and email through said modem. Alternatively a connection means to an external computer enables the computer to function as an additional front panel for the modem.

The portable modem can include a means of monitoring the power drain of external equipment such as a radio receiver, such that if said external equipment is switched on or off, said modem will automatically switch on or off in unison.

Also in accordance with the invention the system includes portable modems having a means of very-high frequency or ultra-high frequency radio transmission and reception including antenna means, to enable the means of connection to be completed using a single-user point-to-point radio link if no other path is available, and operating duplex or semi-duplex and employing means of automatic link establishment.

The portable modems include a means of high frequency radio transmission and reception including antenna and antenna tuning means, to enable the means of connection to be completed using a single-user high frequency point-to-point radio link if no other path is available, and operating duplex or semi-duplex and employing means of automatic link establishment.

The system as defined hereinabove can includes a relay means for relaying a group of bidirectional channels from one or more nearby radio modems to multiple recipients located inside a shared space such as commuter vehicle, wherein:

(a) recipients are using handsets ;

(b) the connections to said handsets are made using a shared multi-access technique such as Bluetooth;

(c) to the extent allowed by the handsets, recipients are able to independently access the service of their choice, including the ability to make and receive telephone calls, the ability to select and listen to Internet media streams, and the ability to connect a portable computer to their handset and access the Internet including the world-wide-web and email through said handset.

The group of channels is obtained from a satellite relay link in lieu of nearby radio modems and the recipients are located on board an aircraft.

The invention also provides a system wherein the connection means for connecting recipients at fixed locations is provided by modems which receive packets from the means of distribution and converts said packets into a form which is recognised by a set-top-box, said set-top-box functioning as a hub for the recipient's external media, computing and telecommunications equipment, wherein it provides a means of converting Internet media streams to analogue or digital baseband signals as appropriate, and also performing all necessary processing and amplification to enable same to either drive the recipient's external media equipment through wires, or else to be modulated onto a radio-frequency carrier of suitable frequency and transmitted wirelessly for reception by said equipment on the same frequency.

Still in another form the invention provides a set-top-box for connection to recipients at fixed locations by modems for delivering broadcast and communications services including provision of one or more Internet media streams, Internet audio streams, Internet video streams, Internet data, the world-wide-web and email, and telecommunications; and connecting to one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, said set-top-box including receiving means which receives packets of said services

processed into digitised packaged data format from a means of distribution and converts said packets into a useable form for said set-top-box to function as a hub for the recipient's external media, computing and telecommunications equipment, wherein the set-top-box provides a means of converting Internet media streams to analogue or digital baseband signals as appropriate, and also performing all necessary processing and amplification to enable same to either drive the recipient's external media equipment through wires, or else to be modulated onto a radio-frequency carrier of suitable frequency and transmitted wirelessly for reception by said equipment on the same frequency.

The set-top-box include receiver means for receiving signals on free-to-air radio or television frequencies, demodulating them to analogue or digital baseband signals as appropriate, and performing all necessary processing and amplification to enable driving of the recipient's external media equipment through wires, or to be modulated onto a radio-frequency carrier of suitable frequency and transmitting wirelessly for reception by said equipment on the same frequency. The set-top-box can include means of connection to an external computer to enable it to access the Internet including the world-wide-web and email through said set-top-box. Further the set-top-box includes a means of physical connection to an external telephone to enable it to make and receive telephone calls through said set-top-box.

The set-top-box can include a means of establishing a Bluetooth wireless link with a portable handset to enable the user to make and receive telephone calls through said set-top-box. The means of establishing a Bluetooth wireless link with one or more remote control units can enable the user to control the selection of Internet media streams and free-to-air stations delivered to the recipient's external media equipment. There can be included a means of requesting information from one of the gateways and downloading received information to the recipient's remote control units, to enable control of the recipient's external media equipment through the infrared links of said equipment.

Receiver means can be included enabling services to be obtained from a satellite relay link, and to direct said services to a means of radio transmission and reception, said means of transmission and reception providing the means to

forward said services to an outlying recipient using a high-frequency or ultra-high frequency radio link.

Remote control units are able to transmit commands using both Bluetooth and infrared, to enable said units to control the recipient's external media equipment separately from the set-top-box. The remote control units can have a means of being associated with more than one type of external media equipment, and being able to be quickly and easily switched between infrared command sets applicable to each type of said equipment. The remote control units could include a means of storing combinations of commands which are retrieved and transmitted as a group.

The system of the invention can have one or more of external media equipment including a means for the recipient to store information and notes on program or content, and to send an order via the means of connection to purchase items heard or viewed using the modem version; said equipment including handsets, mobile versions of the short-range radio modems, and set-top-boxes.

One or more means of receiving services can be from a modem or satellite relay link, said means being spatially arranged in a grid or other suitable pattern across the area to be covered, said means being able to relay services to multiple recipients using any suitable frequency including high-frequency and ultra-high frequency radio links, said radio links operating duplex or semi-duplex and employing means of automatic link establishment.

In variations of the system there is included equipment able to respond to remote commands to change frequency band, scan channels, test channel quality, adjust transmitter power, and report to the optimisation means for the purpose of optimising channel quality and efficiency of spectrum utilisation.

The system could includes a means of connecting two set-top-boxes using a broadband duplex radio link, such that said set-top-boxes operate as if sharing a common bus.

In a particular form of the invention there is provided a method of semi-duplex communication of a signal on a single narrowband channel for use in the above system or separately from the above system wherein the receiving party is able to break-in on the transmitting party at any time, and including the features of:

(a) a radio link connectable between two stations herein called 'A' and 'B';

(b) 'the signal to be modulated is in analogue or digital format;

(c) at station 'A', the signal to be modulated is sampled and formed into blocks of fixed duration;

(d) at station 'A', the blocks are individually re-clocked to slightly speed them up, to produce blocks of shorter duration with gaps in between;

(e) at station 'A', the re-clocked blocks are converted to analogue and transmitted, such that transmissions comprise periods of signal interspersed with short periods of silence at regular intervals;

(f) during the periods of silence, station 'A' switches to receive and listens for a transmission from station 'B';

(g) if station 'B' wishes to break in, it transmits an interrupt code during a silent period of station 'A', said interrupt code comprising an easily recognised signal such as parallel audio tones;

(h) if station 'A' hears an interrupt code during a silent period, it temporarily pauses transmission and attempts to perform a handshake with station 'B' to check the validity of the interrupt;

(i) if handshaking confirms the interrupt to be valid, station 'A' ceases transmission, discards further blocks, and listens for station 'B' to transmit;

(j) if the interrupt is found to be false, after a designated period of time station 'A' reverts to the regular transmission of blocks;

(k) at station 'B', the signals from station 'A' are received, demodulated, and sampled;

(l) at station 'B', the sampled received signal is re-clocked to slow it down by the same amount by which it was originally sped up, such that the gaps between blocks are caused to exactly disappear, and the signal is restored to a similar waveform to that initially applied to station 'A';

(m) stations 'A' and 'B' can swap roles at any time;

(n) contention is avoided if stations 'A' and 'B' are synchronised such that their silent periods alternate and are approximately equally spaced;

(o) during extended transmissions, stations 'A' and 'B' may periodically interrupt each other to confirm that the channel is still open and the traffic is valid.

The invention also provides a system which includes a means of automatic link establishment wherein:

(a) links are established for any reason including a request for service or a request to pass traffic;

(b) the device which initiates link establishment is herein called the requestor;

(c) in the absence of a link, each device continuously monitors its allocated ultra-high frequency wireless channel;

(d) in the absence of a link, each device scans the high-frequency paging channels, said channels reserved for signalling and spaced across the allocated high frequency range;

(e) in the absence of traffic, each device simultaneously monitors the high-frequency and ultra-high frequency channels;

(f) when service is required, the requestor initially transmits a request for service on the allocated ultra-high frequency channel;

(g) if the requestor does not receive an acknowledgment from the other device within a reasonable time period, it repeats the request a designated number of times;

(h) if the requestor has sent a request for service on the allocated ultra-high frequency channel the designated number of times without receiving an acknowledgement, it changes to a high-frequency paging channel chosen according to an algorithm which attempts to determine the channel with the highest probability of success, based on parameters including one or more of the frequency and time of the most recent high frequency communication, the

current time, the current date, blocked channel list, and any other relevant information;

(i) if the requestor fails to receive an acknowledgement on this channel within the designated period of time, it switches to the next paging channel and repeats the process until it receives an acknowledgement from the other device;

(j) when the requestor receives an acknowledgement, it performs a handshaking sequence with the other device;

(k) after handshaking and at any time thereafter, the devices test other channels which have been notified as available, to find the best one and change to it;

(l) during the process of link establishment, the requestor and provider check that each is authorised to communicate with the other;

(m) during the process of link establishment, the uplink device contacts the gateway to obtain a list of channels which can and cannot be used, and any other data or parameters such as maximum authorised power on each channel;

(n) during the process of link establishment, the devices adjust their transmitter power to the minimum needed for reliable communication;

(o) if the link has been established in response to a need to send traffic in the uplink direction, said traffic is then forwarded;

(p) if the link has been established in response to a need to send traffic in the downlink direction, the downlink device notifies the uplink device that it is ready to receive said traffic, which is then forwarded;

(q) if a high-frequency wireless link has been established and either device determines that no traffic has been passed for a designated time period, said device pings the other device and waits for a response to determine whether the link is still open and available;

(r) if the device fails to receive a response after sending a designated number of pings, it reverts to the idle state;

(s) if the device which reverts to the idle state is at the uplink end of the link, it notifies the gateway that the channel is no longer in use to enable it to be allocated to other users of the system;

(t) to minimise the probability of contention between users of the system, pings are allocated specific time slots which, to the extent possible, are unique for each device;

(u) the technique is substantially as herein defined.

The system can deliver Internet media streams, Internet data, telecommunications and third party services to fixed mobile and portable recipients.

This invention can be seen to disclose a method of delivering Internet media streams, Internet data and telecommunications to fixed and mobile users in any location, said media streams including Internet audio, Internet video, Internet radio and Internet television, and said Internet data including the world-wide-web, email, news, Internet relay chat, and similar services. With appropriate scaling, the invention can also deliver video streams of quality approaching or equalling high definition television (HDTV).

This invention also discloses a technique to enable two-way semi-duplex communication to take place on a single narrowband high-frequency radio channel, without significantly increasing the occupied bandwidth or reducing the communications efficiency. This technique is an integral part of the invention disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention is more readily understood an embodiment will be described by way of illustration with reference to the drawings with the features specified in Appendix A wherein:

Figure 1 is a diagrammatic view of the overall system for delivering broadcast and communications services in accordance with an embodiment of the invention;

Figure 2 is a block diagram of a gateway of the overall system for delivering broadcast and communications services of Figure 1:

Figure 3 is a broad view of distribution network of the overall system for delivering broadcast and communications services of Figure 1;

Figure 4 is a detailed block diagram of distribution network of the overall system for delivering broadcast and communications services of Figure 1;

Figure 5 is a diagrammatic view of a catenary mounted modem for use in one form of the overall system for delivering broadcast and communications services of Figure 1;

Figure 6 is a diagrammatic view of a pole mounted modem for use in one form of the overall system for delivering broadcast and communications services of Figure 1;

Figure 7 is a block diagram of connection to radio transponders in the overall system for delivering broadcast and communications services of Figure 1;

Figure 8 is a front diagrammatic view of a vehicle unit for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 9 is a diagrammatic view of vehicle unit connections for the vehicle unit of Figure 8;

Figure 10 is a block diagram of the vehicle unit of Figure 8;

Figure 11 is a diagrammatic front view of a handset for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 12 is a functional block diagram of the handset of Figure 11;

Figure 13 is a diagrammatic front view of a set-top-box for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 14 is a functional diagrammatic view of connections to the set-top-box of Figure 13;

Figure 15 is a functional block diagram of the set-top-box of Figure 13;

Figure 16 is a diagrammatic view of a group repeater for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 17 is a functional block diagram of the group repeater of Figure 16;

Figure 18 is a diagrammatic block diagram of remote links showing private and public access in the overall system for delivering broadcast and communications services of Figure 1;

Figure 19 is a functional block diagram of the connections of a long range set top box in the overall system for delivering broadcast and communications services of Figure 1;

Figure 20 is a functional block diagram of a long range transceiver in use the connection of long range set top box of Figure 19;

Figure 21 is a diagrammatic view of a long range vehicle unit for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 22 is a functional block diagram of as long range adaptor for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 23 is a diagrammatic perspective view of an antenna tuning unit for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 24 is a functional block diagram of the antenna tuning unit of Figure 23;

Figure 25 is a diagrammatic block diagram of a relay site with co-located high frequency transmitters and receivers for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 26 is a diagrammatic block diagram of a relay site with separate high frequency transmitters and receivers for use in the overall system for delivering broadcast and communications services of Figure 1;

Figure 27 is a diagrammatic view of an aircraft installation of connection for use in the overall system for delivering broadcast and communications services of Figure 1;

The diagrams and descriptions herein are functional, and disclose general principles of operation.

1 DESCRIPTION OF PREFERRED EMBODIMENT

1.1 System

As shown in figure 1, access to the nodes for the Internet (1) and external telecommunications networks (2) are concentrated into one or more gateways (6). Internet services include Internet media streams (3) and Internet data (4).

Telecommunications (5) includes telephony, facsimile, short message service (SMS), and generalised packet radio service (GPRS). The gateways serve local service areas (10) using local links (8), and remote areas (11) using remote area links (9). Gateways may be linked using broadband trunks (7) to share resources and provide redundancy in the event of external link or node failure.

1.2 Gateway

As shown in figure 2, the gateways include multiple servers (16) and (17) to access Internet media streams and Internet data respectively. Gateways include internal loopback means (14) to enable traffic to originate and be received within the system, without having to exit the system. Gateways may include additional interfacing (18) and (19) to access external telecommunications networks and other gateways. Gateways may also include a system software server (20), the function of which is to store operating software for devices included in the system, to be downloaded to them when necessary.

The uniform resource locators (URLs) for the Internet media servers (16) are provided by a URL predictor, register and generator (15). This attempts to anticipate when particular media streams are likely to be requested, based on previous user requests, and issue the corresponding URLs to a spare Internet media server before the expected time of request. Its purpose is to ensure that streams are present before users select them, to maximise system responsiveness. The URL predictor, register and generator includes a means of identifying the type of service available from that URL, to ensure that only URLs associated with streaming are stored and predicted.

Each incoming Internet media stream, Internet data transaction, telecommunications service, or system software module is buffered and re-clocked by buffering and re-clocking devices (22), according to timing information supplied by the master clock generator (21). The buffered and re-clocked stream or data is then routed to virtual user ports (25) by a non-blocking matrix switch (24), according to information supplied by an address generator (23). Each virtual user port contains high-speed serial data which is multiplexed for all users currently accessing that port. The streams and data for each user is packeted by packeting and de-packeting devices (27), to add extra bits containing the destination address or routing information, type of data, checksum, and any other necessary information. To ensure correct routing

through the matrix switch and packeting, the processing modules mentioned in this paragraph are required to remain perfectly synchronised at all times.

The packets from the packeting and de-packeting devices (27) are then forwarded to a bank of demultiplexers (29) and encryption devices (31). The purpose of the demultiplexers is to divert packets to the particular local or remote link which corresponds to the routing information and destination address in the packet, and the purpose of the encryption devices is to ensure privacy for users and also to prevent unauthorised use of the system.

Packets entering the gateway from a local or remote link are decrypted by (31), multiplexed by (29), and de-packeted by (27). The type of data in each packet is examined by the service identifier (26) from the packeting information. If the packets contain user-generated traffic such as Internet media streams, Internet data or telecommunications, they are multiplexed by (29) and fed to the virtual user ports on the matrix switch. The matrix switch reduces this traffic to individual streams, data or telecommunications channels as applicable, and feeds it to the appropriate buffering and re-clocking device (22) according to the address supplied by the address generator. The buffer and re-clocking device then feeds this traffic to the corresponding server or other external interface (16) (17) (18) or (19).

If the packets contain user-generated requests for a different stream or type of service, or if they contain system-generated data, they are instead routed to the service identifier which identifies the nature of the data and passes it to the main processor (28). The main processor passes new URLs to the URL predictor, raw routing information to the address generator, and processes other information according to its type.

The system supervisor (30) continuously compares the routing information for outgoing packets with the known location of each user, as reported by downstream devices. If downstream devices report a changed user location, the system supervisor updates the routing information for that user to ensure that outgoing packets are always correctly addressed. The functions of home and visitor location registers are provided by (36) and (38) respectively.

The system is monitored and controlled through an engineering interface (33). System diagnostics are provided by (37). A customer website and dial-in service

are provided by (39) and (41) respectively, and subscriber records and billing by (40). Other administrative functions or information paths may also be required.

To connect users in remote areas, who cannot be connected by other means such as optical fibre or terrestrial microwave radio, a multi-channel satellite transceiver (35) passes data via one or more satellite transponders (417). These comprise the first part of each remote link. Further downstream, the remote links may also employ ultra-high frequency (UHF) and high frequency (HF) radio links.

1.3 Frequency Management Sub-System

To ensure the efficient allocation of HF frequencies used by remote area links, a frequency management sub-system (FMS) (34) continuously seeks to optimise HF channel allocation in terms of quality and availability for re-use. To achieve this, data from ionospheric sounders installed at various locations around the remote area is processed to provide real-time prediction parameters for those locations. If the gateway receives a request for service on an HF channel, it first instructs the FMS to select the prediction parameters applicable to the user's location, and then calculates the optimum frequency. The FMS then compiles a list of channels around this frequency, where the chance of interference to or from other users is minimal, and downloads the list to the user. The user's equipment scans these channels, selects the best one, sets the transmitter to the minimum power needed for good communication, and notifies the channel and power to the FMS. To prepare for requests from other users, the FMS then calculates the minimum re-use distance for this channel, and stores the result in its database of current HF links. At the end of a radio or telephone session or after a certain period of inactivity in Internet data mode, the user's equipment notifies the FMS that the channel is free for reallocation. In addition, the FMS may periodically interrogate users to see if their channels are still in use, and if it finds one which has been relinquished, may set it aside for reallocation.

To allow for variations in propagation with time of day, the FMS may periodically reassess all HF frequencies in current use. If changes are found to be required, the FMS will forward frequency change commands to those users affected. Likewise if a user experiences poor conditions or interference on a particular channel, he or she can manually request a new one from the FMS.

HF is used by several devices disclosed herein, including the long-range vehicle unit (423), long-range handset (424), long-range transceiver (449), and similar devices used by a facility herein disclosed and called a relay site (426). These devices include a means of recognising commands sent from the FMS, which preferably includes a combination of parallel and/or sequential audio tones, and a handshaking routine to provide a means of confirmation.

1.4 Local Links

As shown in figure 3, local links may employ optical fibre, hybrid-fibre-coax (HFC), or other broadband communications technology to connect users in local service areas to gateways. To enable these links to be shared with other services, for example existing pay TV services, local links may employ time and/or wavelength division multiplexing, to avoid interference between services.

Local links include routers (50), radio modems (51) and set-top-box modems (52), in a daisy chain formation. They may also include devices herein disclosed and called media transponders (53). The links are preferably meshed to provide redundancy and improve system reliability.

The function of the routers is to demultiplex the data coming from the gateway, and direct it to the modem or media transponder which is closest to each user. Each router feeds a certain number of adjacent modems. The routers also multiplex data coming back from users and forward it upstream to the gateway. Most such data comprises telecommunications, requests for different Internet media streams, and Internet data generated by users (mainly web browsing and email). Other data emanating from the routers and modems, which is fed upstream, may include status reports, user location, key exchange, etc.

The function of the radio modems is to connect mobile and portable users, the function of the set-top-box modems is to connect fixed users, and the function of the media transponder is to connect additional mobile and portable users for Internet media streams only.

1.5 Radio Modem

As shown in figures 4, 5 and 6, the radio modems may be mounted on catenary wires (56), utility poles (61), and other convenient locations along roads, in

railway tunnels, industrial estates, shopping centres, recreational venues, public buildings, and any other place requiring radio modem coverage. Their spacing and radio frequency output power is preferably adjustable so that during peak usage, they are utilised as fully as possible, while maintaining sufficient margin to accommodate peak usage. In most metropolitan locations, the spacing of radio modems may be typically tens to hundreds of metres. The transmitter output power of each radio modem is preferably adjustable from the gateway.

Data arrives at the modems in the form of packets, and enters through a coaxial or optical baseband interface (57). Circuitry in the modems examines the address of each packet, and if any are found which correspond to the address of user being serviced or likely to be serviced by that modem, the packet is extracted, buffered and re-clocked to reduce the data rate.

In the preferred implementation, the data for each user is modified by a unique spreading code, and modulated onto a radio frequency carrier wave using code division multiple access (CDMA). To ensure orthogonality, the codes may be obtained from pools shared by modems in the same general vicinity. The modulated carrier wave is then amplified and transmitted using an omnidirectional antenna (58), over a short-range wireless link (54) to mobile and portable devices (55) within range of the modem. These devices are disclosed herein, and include various types of handsets, and various types of vehicle unit.

In the reverse direction, radio signals received from users are separated out, fed to a CDMA receiver, and de-spread using the code corresponding to each user. The data signal from each user is then shaped, buffered, multiplexed, and passed upstream to the router associated with that particular radio modem.

It is preferred that each radio modem services at least 25 people, and desirably 50. These numbers are subject to revision. It is also preferred that the modems be located to provide blanket radio coverage of all potential listening locations throughout the service area, except inside and around fixed residences and buildings, where hardwired or set-top-box modems may be used instead of radio modems.

Due to the short communications distances, radio modems are preferably not mounted very high, except to connect elevated users. Figures 5 & 6 show catenary and pole mounting respectively.

Radio modems require a frequency allocation which allows the use of short antennas, has limited range, and does not interfere with other services. Frequencies displaying these characteristics include the region around 2 GHz and above. To avoid mutual interference, nearby radio modems should operate on different centre frequencies, following similar techniques for frequency re-use as employed in cellular telephone networks.

Data may be transferred at various rates, for example approximately 9.2 kb/s per user for telecommunications and Internet data uploads, approximately 100 kb/s per user for Internet audio streams and Internet data downloads, and approximately 10 Mb/s per user for high definition Internet video. A slow speed downlink channel may be obtained by subdividing a medium speed downlink channel into approximately ten sub-channels. Except for telecommunications, data rates are not symmetrical. These rates are subject to revision.

For portable and mobile users, it is preferred that all services except Internet video are handled by radio modems, and that Internet video be handled by media transponders. For fixed users, it is preferred that all services be handled by set-top-box modems.

If an Internet media stream is being received by more than one user of a particular radio modem, the same access code may be provided to each of these users, allowing them to access the same stream. Also, to ensure graceful degradation under overload conditions, radio modems may automatically reduce the per user data rate if the total number of users exceeds the rated modem capacity.

1.6 Media Transponders

1.6.1 Radio Transponder

Many locations experience a highly diurnal or seasonal population, for example beaches, recreational areas, small tourist towns and holiday resorts. If these were to be served only by standard radio modems, a large number of modems could be required to accommodate the peak usage, which is greatly under-utilised the rest of the time. This would be inefficient and expensive.

To overcome this problem, it is preferred that radio modems be able to hand off excess Internet audio streams, which would exceed the rated modem capacity, to low power FM transmitters covering the same general location. These transmitters are herein called radio transponders. Their range may significantly exceed that of a standard radio modem, possibly up to a km or more, depending on the situation. Therefore to allow the range to be tailored, it is preferred that the transponder power be remotely adjustable from the gateway. The power per channel may be tens to hundreds of mW (indicative). Although FM is mentioned here, medium frequency AM could also be used, subject to its greater susceptibility to interference and the need for a larger transmitter antenna. Note that transponders have no ability to receive radio signals from users.

As shown in figure 7, it is preferred that radio transponders be connected to local links (8), from which they receive, decode and retransmit Internet audio streams for that particular location. If a user in that location requests or changes an Internet audio stream, his or her vehicle unit or handset sends a request to the nearest radio modem, which forwards it to the gateway. The gateway may respond by sending the requested stream to the modem. Upon receiving the stream, the radio modem may check to see if it has sufficient capacity to transmit it. If it has, it transmits the stream to the vehicle unit or handset making the request. If not, it sends details of the requested stream to the radio transponder serving that area. Upon receiving these details, the transponder checks to see if it is already transmitting the stream, and if so, notifies its transmission frequency to the radio modem. If the transponder is not already transmitting the stream, the transponder decodes it from the local link (because it already exists on the local link), allocates a frequency, and commences transmitting it. The transponder also notifies the requesting radio modem of the frequency of the stream. In turn, the modem forwards details of the frequency to the vehicle unit or handset, which activates its internal radio receiver and tunes to the frequency where the stream is being transmitted. Alternatively, the radio modem and transponder may exchange data and commands via the gateway instead of directly to each other.

Since the streams are only for Internet audio, and the transmitted signals cannot be associated with any particular user, there is no need for encryption. This avoids a source of significant audio distortion, and allows each transmitted stream to have more than one user. It also simplifies the receive path of the user's vehicle unit or handset, which helps to minimise size and weight

Although the absence of encryption allows reception by an ordinary receiver, an eavesdropper has no control over the program he or she might hear on any particular frequency, and in the absence of a station announcement, will not even know what it is. Since streams and frequencies will often change without warning, eavesdropping will be a frustrating experience, which few people are likely to pursue for any length of time. These FM links are also usually short range, in most cases inaudible beyond a few km.

In an alternative implementation, the transponder does not decode Internet audio streams, but may transmit them over the FM channel using a bandwidth-efficient form of digital modulation.

Although the number of spare FM channels is currently limited, this invention may accelerate the migration of free-to-air radio stations to the Internet, creating spare channels on the FM broadcast band. If all stations were to migrate, the number of channels could exceed 100 for mono or 50 for stereo, assuming full use of 87.6 to 108 MHz, and 200 kHz or 400 kHz channel spacing for mono and stereo respectively. Note that the absence of high power FM stations would eliminate receiver intermodulation distortion, which currently limits the number of FM channels which can be allocated.
To minimise interference between areas served by adjacent transponders, and also the need to change frequency if a vehicle unit or handset moves from one area to another, the streams common to these transponders are preferably allocated the same frequency where practical. This requires streams and frequencies to be centrally coordinated, and rearranged from time to time to optimise allocation.

1.6.2 TV Transponder

TV transponders provide the means of receiving Internet video streams in vehicles. They operate similarly to radio transponders, except that they convert Internet video streams to individual radio frequency signals with frequencies, bandwidth and modulation corresponding to those used for normal UHF TV transmission. Also, if a mobile user requests an Internet video stream, the gateway determines the TV transponder which is closest to the user, commands the transponder to commence transmitting a radio frequency signal at a particular frequency, forwards the stream to the transponder for modulating onto this signal, and also commands the vehicle unit which issued the request to

activate its free-to-air TV receiver and tune to the nominated frequency. Another difference to a radio transponder is the need to be able to scramble or encrypt nominated video streams, to prevent viewing of restricted material on an ordinary TV receiver by a third party. For such streams, this implies one viewer per transmitted stream, unless provision is made to share keys. This restriction does not apply to unscrambled or unencrypted video streams.

TV transponders are likely to have relatively few users, allowing their range to exceed that of the average radio transponder. This, together with the wider channel bandwidth, means they are likely to transmit at a higher power than the average radio transponder.

1.7 Vehicle Unit

1.7.1 General Description

As shown in figure 8, radio modem signals are received in vehicles by vehicle units, preferably mounted within easy reach of the driver. Vehicle units function as a hub, and may include the ability to:

(a) search for a radio modem, establish a wireless connection thereto, and exchange packets containing services described herein with said modem;
(b) if the service comprises an Internet audio stream, decode said stream to audio;
(c) activate an internal free-to-air radio receiver or optional TV receiver, tune to AM, FM and TV signals as applicable, and demodulate them to audio or audio/visual (A/V) baseband as applicable;
(d) perform any additional processing and amplification needed to drive an external speaker system, an external audio device, or a low power FM modulator for feeding to the antenna input of an external radio receiver;
(e) perform any additional processing and amplification needed to drive an internal video display and speaker, an external video device, or a low power TV modulator for feeding to the antenna input of an external TV receiver;
(f)connect to a computer via a cable, Bluetooth wireless link or infrared link (100), said computer being able to send and receive Internet data using this system, and preferably other functions such as setting up the vehicle unit and functioning as an extended front panel for said vehicle unit;

(g) connect to a handset (105) via a Bluetooth wireless link (101), said handset being able to initiate and receive telephone calls, send and receive SMS messages, and provide other telecommunications services;

(h) connect to a handset via a Bluetooth wireless link, said handset being able to select Internet audio streams and free-to-air radio stations and play them through an acoustic transducer associated with said handset;

(i)preferably be controlled by a remote control unit.

Vehicle units may include a station selection knob (77), display (78), keypad or buttons (79), and computer port.

Figure 9 shows the vehicle unit connections, and figure 10 shows a functional block diagram. Although these diagrams show various output possibilities, including low-level baseband signal, low level modulated radio frequency signal, and high level audio signal, in practice not all such options need to be installed.

As shown in figure 10, signals from a radio modem are received on antenna (81), routed through a transmit-receive diplexer (110), and downconverted and processed by a receiver (112). The bandwidth control (111) selects wide receiver bandwidth or high data rate for Internet audio streams and Internet data downloads, and narrow receiver bandwidth or reduced data rate for telecommunications. The receiver output signal is digitised by a baseband receive modem (120) and decrypted by (126). Although this provides medium level security, sufficient to protect user privacy and prevent unauthorised use of the system, it is not intended to replace the encryption built into the handset.

After passing through a programmable logic device (PLD) or other processor (129), which switches the signal paths and provides other functions including glue logic, the stream is decoded by audio codec (134) and switched by (143).

The vehicle unit may also include an internal AM/FM receiver (118); suitable for receiving signals on free-to-air radio frequencies. The audio output of this receiver is switched by (143), and provision for receiving digitally modulated signals is provided by the analog to digital convertor (ADC) (128) and codec (134). The selected audio signal may be fed to a low power FM modulator (145) for reception by an external FM receiver (93), or to a low-level audio output (94)

for unspecified external equipment (95), or to an audio amplifier (146) to drive external speakers (97).

The vehicle unit may also include a TV receiver (117); suitable for receiving signals on free-to-air TV channels. The baseband output of this receiver is switched by (142), and provision for receiving digitally modulated TV signals is provided by ADC (127) and codec (133). The selected A/V signal may be fed to a low power TV modulator (144) for reception by an external TV receiver (86), or to a low-level A/V output for unspecified external equipment (88), or to a small internal video display.

In the reverse direction, transmitted signals are encrypted by (126), converted to a form suitable for modulation by the baseband transmit modem (121), modulated and amplified by a transmitter (113), and routed through the diplexer (110) to the modem antenna (81).

The frequency generator (116) controls the receive and transmit frequencies, and the CDMA spreading code (122) is preferably orthogonal to others accessing the same radio modem.

The Bluetooth wireless link (101) provides a short-range wireless connection to an external laptop or handheld computer (104) and a handset (105). To avoid signal dropouts due to multipath within a vehicle, this link may include frequency diversity. A data connector (102) is included, to allow the use of computers which do not possess Bluetooth. An infrared interface (103) may be included for suitably equipped computers.

The baseband input/output expansion port (98) is reserved for use by the long-range adaptor (497), and preferably uses standard high-speed bus architecture such as USB or Firewire.

The PLD (129) identifies and processes user requests, gateway commands, incoming telephone calls, and incoming email. It also selects the receiver bandwidth according to the type of service, manages the key, applies the CDMA spreading code, switches signal paths, and manages data buffering such as the background downloading of emails.

Memory includes the receive and transmit buffers (123) to maintain a steady data flow, station memory (138), scratchpad memory, and non-volatile or flash memory for system use. The system is locally controlled by the system controller (139) and the user interface comprising keypad, display and beep (150).

The vehicle unit may also include a DC current sensing circuit (151) to measure the current taken from the DC power source (99) by an external receiver (93). If the user switches on said external receiver, its current drain is detected by the current sensing circuit, which in turn activates DC power switch (140) and switches the vehicle unit on. The purpose of this feature is to eliminate the need to separately switch the vehicle unit on and off, when used with the existing generation of vehicular radio receivers.

Possible utilities include a scheduler, scratchpad memory to enable the user to store information like artist name, song title and other details, and a quick purchase utility.

1.7.2 Radio Mode

If the vehicle unit drives a speaker directly or is connected to an external amplifier and speaker, no external receiver is needed. Otherwise the vehicle unit requires an external receiver, said receiver being tuned to an unused frequency through which Internet audio streams and signals on free-to-air frequencies are conveyed at radio frequency (RF) by said vehicle unit.

Stations may be selected on the vehicle unit by turning the knob, pressing a station button, or other means described or claimed herein. Stations can be any mix of Internet and free-to-air. The display may also show radio data service (RDS) or similar piggybacked data when receiving a station which carries this service.

If the user selects an ordinary free-to-air radio station, the frequency of the internal receiver (118) is under his or her control. If the user selects an Internet audio stream which is handed off to a radio transponder, the receiver frequency is not under said user's control, but is controlled by commands originated by the transponder or other system device.

The ability to receive digitally modulated FM signals provides a growth capability, for next generation FM broadcast stations employing digital modulation, and also for digitally modulated signals transmitted by the radio transponders described herein, if implemented at a future date.

Due to the limited size of the display and keypad, the vehicle unit software preferably includes a custom browser. The purpose of this browser is to allow the user to interact meaningfully with web pages, by interpreting information from said web pages, and also by interpreting the keys and buttons to enable the user to move the cursor, select hypertext links and other screen controls, and enter information into the windows and forms found on some web pages.

Although a larger screen and keyboard would eliminate the need for a special browser, it would make the unit large and cumbersome. Since the vehicle unit's main purpose is to receive Internet media streams, not browse the web, a large screen and keyboard are therefore not preferred. As a compromise solution, it is therefore preferred that an attached external computer be able to display complete web pages in parallel with the interpreted version shown on the vehicle unit's display, allowing the user to interact with said web page using the computer and its keyboard if desired.

1.7.3 TV Mode

To be able to view TV signals, functional blocks including (83) (117) (127) (133) (142) and (144) must be installed in the vehicle unit. Also, either an external vehicular TV receiver (86) must be connected, or the vehicle unit must include a small internal viewing screen.

TV stations are selected on the vehicle unit by turning the knob, pressing a station button, or other means described herein. Stations can be any mix of Internet and free-to-air. The display may also be used to show Teletext or other piggybacked data when receiving a station which carries this service.

If the user selects an ordinary free-to-air TV station, the frequency of the internal TV receiver (117) is under his or her control. If the user selects an Internet video stream, the receiver frequency is not under the user's control, but is automatically tuned to the frequency of the stream transmitted by the TV transponder, by commands received through a nearby radio modem.

1.7.4 Internet Data Mode

Normal web URLs can be stored as radio channels, even if they are unrelated to streaming. To recall them, the user can turn the knob or press the appropriate station select button on the vehicle unit, upon which the requested page will be presented to the computer.

It is preferred that the vehicle unit allow email and other low speed data to be transferred in the background, without interrupting radio or TV reception. Email can be identified by its unique TCP/IP port address.

It is preferred that by pressing a particular key sequence, the vehicle unit sends a specific command to the computer, to cause it to perform whatever action the user may have programmed into it. It is further preferred that the computer be able to enter or edit station settings on the vehicle unit, and change certain other parameters. To minimise size and cost, a web-only version may be possible, in which only the circuit blocks required for Internet data are installed.

1.7.5 Telecommunications Mode

Incoming calls are identified by the packet header, which is recognised by the vehicle unit causing an audible alert to be emitted by the handset. When the user answers the call on the handset, the vehicle unit halts its current activity and changes to telecommunications mode, to enable two-way telephony to commence. When the call finishes, the vehicle unit switches back to its previous activity, requests the previous stream or service from the gateway, and resumes whatever it was doing before the call arrived. Outgoing calls preferably cause the vehicle unit to change to telecommunications mode when the dialling code is sent. Note that signals received from a media transponder should need to be interrupted by telecommunications traffic, because they follow a different circuit path through the vehicle unit to that used for telecommunications.

For partial compatibility with the Generalised Packet Radio Service (GPRS), the unit may increase the incoming data rate and RF bandwidth up to the limit of the modem wireless link. To avoid disrupting other activities, short message service (SMS) text strings may be handled as background tasks. The small size of most SMS text strings should make this fairly easy to achieve.

1.8 Handsets

Several handset versions are disclosed. The simplest and most basic version is herein disclosed and called a short-range handset, wherein all communication takes place using a Bluetooth wireless link. Therefore this handset can only be used in the vicinity of a compatible device belonging to this system, said devices including a vehicle unit, set-top-box and group repeater described herein. Despite this limitation, the short-range handset should be adequate for many applications, where minimum size, cost, and power consumption are important.

The next version up is herein disclosed and called a standard handset. This version includes the capabilities of the short-range version described herein, plus the ability to wirelessly connect to a radio modem in a similar manner to a vehicle unit, making it usable on the street. One implementation may be limited to telephony, and be similar in appearance to a standard GSM handset. Another implementation (160) may include telephony, Internet media streaming, and free-to-air radio reception, and be similar in appearance to a portable radio receiver, as shown in figure 11. The inclusion of free-to-air radio reception allows reception of signals from radio transponders, which in some locations may be the primary means of stream delivery. As shown in figure 11, the audio transducer (162) and microphone (164) are preferably located diagonally opposite, allowing the unit to be held against the cheek when making or receiving telephone calls. Alternatively, a headset with a cord or small boom microphone may be plugged into the unit's audio jack (204), and used instead of the internal audio transducer and microphone. The unit preferably includes a keypad (161) with a standard telephony layout.

Other versions may include SMS, GPRS, a computer port, and TV reception. Prospective viewing options include an inbuilt screen, the ability to feed the baseband A/V signal to an external TV receiver, and the ability to modulate the baseband A/V signal onto a radio-frequency carrier and feed it to the antenna input of an external TV receiver.

As shown in figure 12, handset operation is generally similar to that of the vehicle units described herein. Significant differences include the provision of an inbuilt ferrite loop antenna (173) to enable reception on the medium frequency broadcast band; and the use of the Bluetooth wireless link (205) to receive services, not deliver them.

Other handset versions include the medium-range handset and long-range handset, which include the capabilities of the standard handsets disclosed herein, plus additional capabilities to allow them to be used in remote areas where radio modems are not present. These versions are described in a subsequent section herein.

It is preferred that by entering an appropriate code into the keypad, two handsets of any version should be able to connect directly to each other using Bluetooth, to permit them to communicate in intercom mode without going through the network. If an external telephone call arrives during an intercom session, it is preferably announced by a short background tone, similar to the call waiting facility used in the present generation of handsets. Upon hearing the alert, the user can choose to take the call, or else ignore it and continue the intercom session. Note that the Intercom mode is limited to Bluetooth.

1.9 Handset Numbering Scheme

The ability of handsets to transfer seamlessly between Bluetooth and a radio modem means that a telephone call could commence inside a vehicle and continue while the user alighted, walked down the street, entered his or her dwelling, and came within range of the Bluetooth link belonging to a set-top-box (210). In this example, the call would commence using the Bluetooth link to the vehicle unit, then be handed off to a radio modem in the street, and finally be handed off to the Bluetooth link belonging to the set-top-box. This blurring of the distinction between fixed and mobile telephony produces significant benefits.

First, it eliminates the need for a separate series of telephone numbers for fixed and mobile telephony, which would in fact be unworkable. The system allows any number of digits to be allocated to any handset, regardless of whether it is fixed, mobile or portable. In fact the distinction between fixed, mobile and portable handsets is irrelevant as far as the rest of the system is concerned, because the same signal path is used for all handsets, up to the final modem. Numbers could also be allocated without reference to location, and need not be constrained by area codes.

Second, it eliminates a major security flaw with the present numbering system, in which the numbers for fixed telephones are tied to fixed locations. This makes it is possible for third parties to identify whether dwellings are occupied, by ringing the telephone number to see if it is answered. With the system described herein, users would receive telephone calls regardless of their location; meaning third parties would have no way of ascertaining this information by ringing the number.

1.10 Set-Top-Box Modem

As shown in figure 14, fixed users in local service areas are connected by set-top-box (STB) modems (52), which feed set-top-boxes (210) located within the user's premises through coaxial cable (213). STB modems may be located near the user's premises and serve a single set-top-box, or distantly located and serve multiple set-top-boxes using a multiplex technique.

STB modems may also include circuitry to enable users to select services from third party providers sharing the local link (8), for example cable TV, cable Internet data, and telecommunications. If the user selects such a service, the modem preferably converts it into packets similar to those used by this system, to enable said services to be intermingled with those delivered by this system.

From the viewpoint of upstream hardware such as the gateway and routers, STB modems appear similar to radio modems (51), except that they can also deliver Internet video streams.

1.11 Set-Top-Box

1.11.1 General

As shown in figure 13, the set-top-box (STB) (210) functions as a hub for the user's radio receivers (214) (231), TV receivers (215) (232), handsets (160), fixed telecommunications equipment (217), computing equipment (216), remote control unit or units (230), and external antennas (222) (223) for receiving free-to-air radio and TV signals. The STB should preferably be able to:

(a) receive Internet media streams from an STB modem and decode them;

(b) activate one or more internal receivers, tune them to free-to-air radio and TV signals, and demodulate them to audio or A/V as applicable;

(c) forward audio and A/V signals to the user's equipment using low-level audio or modulated RF signals;

(d) be able to deliver Internet data to an attached computer, which should preferably also be able to set up the STB and function as an extended front panel for said STB;

(e) connect to one or more handsets via Bluetooth radio links (229), said handsets through the STB being able to make and receive telephone calls, send and receive SMS text strings and other traffic, and preferably to select and listen to Internet audio streams;

(f)be physically connected to fixed telecommunications equipment;

(g) be controlled by multiple remote control units.

The STB includes a keypad (211) and display (212) to enable the user to enter or edit URLs frequencies and TV channels, and also to set up other parameters. It accommodates multiple remote control units to allow independent selection of the desired URL, frequency or channel for each radio and TV receiver driven by the STB. The remote control units are not needed for Internet data or telecommunications.

The STB preferably accommodates eight slide-in cards, each able to operate independently, to enable said STB to be customised to various user requirements. Figure 15 shows a functional block diagram of an STB containing two Internet audio cards, two Internet video cards, two Internet data cards, one card for fixed telecommunications, and one card for portable telecommunications and remote control using a Bluetooth wireless link.

1.11.2 Provision for Radio

Each STB audio card is able to store Internet URLs, issue the desired URL in response to a station select command from the user, and when the audio stream arrives from the gateway, to decode it to baseband audio. To enable the reception of free-to-air radio signals, each card preferably also includes a free-to-air radio receiver, which can receive both very-high frequency FM signals and medium-frequency AM signals, and demodulate it to audio.

The desired audio signal is selected, and directed either to a direct audio output (252) (272) for connection to an external amplifier, or else modulated onto a spare frequency using a low power frequency generator and modulator (248) (268). The modulated signals thus obtained may be fed either to coaxial connectors (251) (271) for distribution to the user's radio receivers via coaxial

cable, or else transmitted by a small antenna mounted on the STB (225). Provision for external antennas for the free-to-air radio receiver is made by connectors (250) (270).

To listen to an Internet audio stream on an external receiver, the user first tunes said receiver to a fixed frequency corresponding to the modulated RF source on the audio card, and then selects the desired station using the remote control unit (230). If desired, free-to-air stations can be intermingled with Internet audio streams, so that the changeover from one type of station to the other is completely transparent. If a free-to-air station is selected, the audio card automatically selects the external antenna connector (250) (270), to maximise reception quality. To allow an external antenna to be connected to either the external receiver or the on-card receiver, it is preferred that the software allows the user to configure antenna switching accordingly, so that it is always switched to the desired receiver when listening to a free-to-air station.

1.11.3 Provision for TV

The provision for TV is similar to that for radio, except that the frequency of the low power TV modulator (288) (308) corresponds to a spare channel, preferably in the UHF TV broadcast band. It is also preferred that the user is able to select the desired type of modulation, for example PAL, NTSC, or other desired format.

1.11.4 Provision for Internet Data

Each Internet data card removes packeting information added by this system, buffers and reformats the data signal to standard TCP/IP format, and presents it to a data transceiver (324) (334). The data transceiver is connected to (325) (335), to which an external computer may be connected. The computer will therefore see the STB as a standard modem, similar to a medium speed cable modem with asymmetrical download vs. upload speeds.

1.11.5 Provision for Telecommunications

The fixed telecommunications card includes a hybrid (348), level convertor (349) and connector (350) for connecting fixed telephone and facsimile equipment, and the portable telecommunications card includes a Bluetooth port (371) (372) to allow the use of any handset described herein, for example (160), and a remote control unit. It is preferred that the Bluetooth port accommodates

multiple handsets and multiple remote control units, all of which can be used simultaneously, providing the aggregate data rate for the whole STB is not exceeded.

1.12 Remote Control Unit

1.12.1 General Description

The remote control units (230) preferably use Bluetooth to control the STB, and infrared to control the user's radio and TV equipment. If the user uses the remote control unit to select an Internet media stream or send any other command recognised by the STB, the command is sent via the Bluetooth link (229) to the STB. If the user uses the remote control unit to adjust anything which is specific to his or her equipment, for example sound or picture characteristics, the command is sent via the infrared link directly to said equipment.

Because the user's equipment may be in more than one room, the system preferably accommodates multiple remote control units, each of which is customizable to a particular piece of equipment, and can be used independently. The remote control units preferably include an LCD screen which is able to display station details, program and content information, and any other information considered useful.

1.12.2 Customisation

Before first use, the infrared commands for each remote control unit must be customised to the equipment to be controlled. This may be performed in various ways, such as activating a configuration menu on the STB and entering details of the equipment to be controlled, causing the STB to forward the details to the gateway, or else by logging onto the system website (39) and selecting from a list of equipment brands and type numbers. Upon receiving the equipment details, a server at the gateway may look up the settings for said equipment in a database, and download them through the system to the user's STB. Upon receiving these settings, the STB then forwards them to the remote control units via the Bluetooth link.

Another method is to point the remote control unit at the one provided with the user's equipment, and selecting learn mode wherein by pressing pairs of buttons, commands from the user's remote control unit may be transferred to the one

disclosed herein. This mode may be used for equipment not listed in the database at the gateway.

To allow a single remote control unit to control more than one item of equipment, remote control units may include "hotkeys" to quickly change from one customisation to another. The display may show the name associated with the current customisation. It is preferred that the remote control units also be able to store sequences of keypresses, and save them as macros.

1.13 Group Repeater

Figure 16 shows a group repeater (379), which may be used to connect groups of handsets belonging to passengers in commuter vehicles. The purpose of these repeaters is to overcome the shielding effect of the vehicle and external environment such as railway tunnels, which could make it difficult for said handsets to maintain reliable connections with radio modems outside the vehicle. Group repeaters operate by establishing a group of two-way radio connections with radio modems outside the vehicle, said group being sufficient to provide each person inside the vehicle with the service of their choice. The connections to users inside the vehicle are made using a multiplexed Bluetooth signal.

Group repeaters may also provide coverage to fixed spaces inside buildings and other communal areas, which are beyond the reach of nearby radio modems, and where additional fibres and modems may be impractical or uneconomic.

Group repeaters preferably provide each person in a compartment with a separate full speed Internet audio stream, up to the authorised carrying capacity of that compartment. To avoid signal dropouts due to multipath inside the compartment, it is preferred that the Bluetooth link uses frequency diversity.

To avoid dropping streams if a heavily loaded compartment moves into an area of insufficient modem capacity, it is preferred that group repeaters employ a voting scheme to determine which streams are delivered to vehicle occupants. In such a scheme, Internet media streams are allocated to pre-determined categories, and delivered according to the number of requests by people using that particular group repeater. If a user requests a stream which is below the threshold of popularity in its allocated category, it is preferred that he or she be

offered a choice of alternatives in the same category, which are above the threshold of popularity.

Figure 17 shows a functional block diagram of an eight channel repeater. For more than eight channels, separate group repeaters with separate antennas (377) are preferred. These repeaters preferably share a common frequency reference, and also obtain the spreading codes from a common pool (409) to ensure orthogonality. Each channel operates in a generally similar manner to the vehicle unit (80), with the Bluetooth port being provided by antenna (380).

1.14 Remote Links

1.14.1 Satellite Transceiver (Gateway Version)

Each gateway may feed at least two types of microwave satellite transceiver (35). One type may provide bidirectional links for Internet audio, Internet data, telecommunications and system commands, for users in remote areas. Another type may provide an uplink for Internet video. To maximise the number of users without exceeding the capacity of the satellite link, it is preferred that the bandwidth or data rate per user be flexibly allocated.

To alleviate the possibility of a remote link being unable to supply all requested streams, it is preferred that the gateway employs a voting scheme to determine which streams are delivered to the remote link. It is further preferred that this voting scheme relies upon Internet media streams being allocated to pre-determined categories, and that voting occurs within each category, such that a minimum level of choice exists at all times across the range of categories. It is further preferred that if a remote user requests a stream which is below the threshold of popularity for sending through the link, he or she be offered a choice of other streams in the same category which are above the threshold, and therefore meet the criteria for delivery.

To improve redundancy and flexibility, it is preferred that more than one gateway should be equipped for satellite transmission and reception.

1.14.2 Satellite Transponder

In the downlink direction, one type of transponder (417) may relay Internet audio, Internet data, telecommunications and system commands, and another may relay Internet video. A third transponder may be provided to relay traffic generated by users including requests for service, Internet data and telecommunications, and also data generated by downstream equipment.

1.14.3 Satellite Transceiver (Private Use)

Satellite transceivers for private use (431) may receive a satellite downlink signal containing at least one Internet audio stream, telecommunications channel and Internet data channel, together with necessary system commands. This transceiver may include an additional means of receiving a satellite downlink signal sufficient to accommodate at least one Internet video stream. This transceiver may also include the means to transmit at least one telecommunications channel and Internet data channel, together with data generated by downstream equipment, up to a satellite transponder.

This transceiver is connected to the high-speed data bus (432) of a long-range set-top-box (437), said bus conveying services, data and commands between all devices connected to the bus.

1.14.4 Satellite Transceiver (Public Use)

A satellite transceiver for public use (551) may be similar to that for private use, except that it should possess sufficient capacity to provide a separate Internet audio stream, Internet data channel or telecommunications channel to multiple users, the number of multiple users being equal to that serviced by the relay site described herein. This transceiver may include an additional means of receiving a satellite downlink signal sufficient to accommodate one or more Internet video streams, for relaying to users via a locally connected TV transponder, if they are within range of the transponder.

1.14.5 Long-Range Set-Top-Box

The long-range set-top-box for private use (437) may be similar to a standard set-top-box (210), except that the user side communicates over a high-speed data bus (432) which preferably uses a standard protocol. This bus provides a means of peer-to-peer transfer of services; data and commands between all equipment connected to the long-range set-top-box, and are managed by the long-range set-top-box.

The long-range set-top-box includes a Bluetooth radio link (447) to wirelessly connect the various handset versions (160) (453) (456) and also remote control units (446). The long-range set-top-box includes a means of assessing signal strength and channel quality, so that if a handset moves out of range of the Bluetooth link, the long-range set-top-box hands communications off from the Bluetooth link to a local transceiver (451) or long-range transceiver (449) depending on the type of handset and distance.

The long-range set-top-box may also be connected to a second long-range set-top-box using a cable or bus extender (452), to allow two long-range set-top-boxes to share a single satellite antenna (430) and transceiver (431)

1.14.6 Local Transceiver

The local transceiver (LT) (451) is a low power duplex UHF transceiver, which provides a means of communication with a medium-range handset (453) or a long-range handset (456) which is outside the range of the Bluetooth radio link (447) belonging to a long-range set-top-box. The maximum communication range of an LT depends on its transmitter power, but is preferably at least 1 km. The radio link is digitally encrypted. The LT does not communicate with a standard handset (160), due to the lack of suitable UHF capability in said standard handset.

The LT is connected to the high-speed data bus (432) of a long-range set-top-box, said bus conveying services, data and commands in both directions. The LT preferably operates with an omnidirectional UHF whip antenna, which may be mounted on its case.

1.14.7 Long-Range Transceiver

1.14.7.1 General

The long-range transceiver (LRT) (449) is a duplex medium power HF/UHF transceiver, which provides a means of communication with long-range vehicle units (457) and long-range handsets (456). The maximum communications range depends on transmitter power, antenna characteristics and propagation, but in good conditions may extend to several hundred km. One LRT is required for each long-range vehicle unit or long-range handset.

If signals are strong and channel quality is good, the LRT automatically uses UHF. If signals are too weak or channel quality too poor for UHF, the LRT changes to HF. The method of establishing a UHF or HF link is described in the section titled "Automatic Link Establishment", and a technique for achieving single frequency HF duplex is described in the section titled "Semi-Duplex".

The LRT is connected to the high-speed data bus (432) of a long-range set-top-box, said bus conveying services, data and commands in both directions.

Referring to figure 20, the high-speed data bus contains address information, digitised audio, and type of service. The input/outport (476) extracts audio addressed to the LRT, and passes it to the audio switch (474) for routing to either the UHF or HF section of the transceiver as required.

Signals which are routed to the UHF section are processed as follows. Telecommunications signals may bypass the digital encryption unit (467), because they are already encrypted. Internet audio streams and Internet web pages may be low-level encrypted by (467), sufficient to protect privacy. Email may receive high level encryption. The signal is then shaped and passed to the UHF transceiver (468) for transmission.

Signals which are routed to the HF section are processed somewhat differently. Internet audio streams are analog encrypted (480), and then broken into a series of blocks with silence in between by the "block time compandor" (482) as described in "Semi-Duplex". The blocks are then applied to the HF transceiver (483). Internet audio and Internet data bypass the A5 encryption device (477), and Internet data bypasses the block time compandor (482).

Although the ultra-high frequency transceiver preferably handles data at the same rate as a standard vehicle unit, spectrum limitations applying at high-frequency mean that the transmitted high-frequency signal cannot exceed three to five kHz bandwidth. Although this is acceptable for telecommunications and passable for data, it will noticeably limit the quality of music delivered by an Internet audio stream. However there is no practical alternative for long-distance delivery and in practice the quality could equal or surpass that of a weak medium-frequency AM station, which is received over a long distance.

The central processor (475) monitors signal strength and channel quality, processes gateway commands and user requests, calculates the expected signal strength according to frequency, controls the transceivers (468) (483), controls and monitors the antenna tuning unit (471), and performs other necessary supervisory and control functions.

On HF, the LRT automatically reduces the output power to the lowest level which provides acceptable channel quality, to minimise interference to other users.

The HF section (483) of the LRT preferably operates in conjunction with an antenna optimised for near-vertical incidence skywave, such as a delta. The UHF section of the LRT preferably operates in conjunction with an elevated omnidirectional whip.

To minimise the UHF feedline loss, it is preferred that the LRT front panel be removable, to enable the LRT to be located close to the antenna, and the front panel to be conveniently located for the user. When removed in this manner, it is preferred that the front panel and the LRT communicate with each other via the high-speed data bus (432).

1.14.7.2 Group Broadcast and Intercom Modes

Where a user has more than one LRT, said LRTs must operate on different frequencies in order to supply independent services to outlying users. However there may be occasions when outlying users wish to share the same transmission from an LRT, or else communicate directly with each other. These modes are called group broadcast and intercom respectively.

To achieve group broadcast mode, the outlying receivers are automatically tuned to the same frequency. The associated transmitters are also tuned to the same frequency, and set to voice operated transmit to allow voice break-in. The broadcast is channelled through a single LRT.

To achieve intercom mode between two outlying users, the HF receive and transmit frequencies of both users are automatically set to be the same, and the UHF receiver of one user is automatically tuned to the UHF transmitter of the other user and vice versa.

To operate in these modes, the equipment needs a common encryption key, and also be synchronised as a group.

1.14.8 Bus Extender

The bus extender (452) is a low power duplex UHF transceiver, which allows a two or more long-range set-top-boxes to share a single satellite transceiver as shown in figure 19. The bus extender preferably has sufficient bandwidth to convey at least one of each service, which include Internet audio, Internet video, Internet data, and telecommunications. The link is encrypted. Local spectrum regulations may require the bus extender to operate in conjunction with a narrow beamwidth antenna such as a yagi, to minimise the risk of interference to other spectrum users.

1.14.9 Medium-Range Handset

The medium-range handset (453) generally possesses the capabilities of a standard handset, with the addition of a duplex UHF transceiver. This additional transceiver operates similarly to a local transceiver (451), and may comprise a repackaged version of said local transceiver.

Upon switch-on and occasionally thereafter, the medium-range handset initially searches for a Bluetooth signal from a compatible device belonging to this system. If it finds a Bluetooth signal of sufficient strength and quality, it automatically establishes a Bluetooth radio link with said device. If it is unable to find a Bluetooth signal of sufficient strength and quality, it then searches for a signal from a radio modem. If it finds one of sufficient strength and quality, it automatically establishes a wireless link with the modem. If it is unable to find a modem signal of sufficient strength and quality, the handset activates its internal UHF transceiver and searches for a signal from a compatible device belonging to this system, such as a local transceiver. If it finds a UHF signal of sufficient strength and quality from said compatible device, it automatically establishes a UHF link with said device.

The medium-range handset preferably uses a case-mounted UHF antenna.

1.14.10Long-Range Handset

The long-range handset generally possesses the capabilities of a medium-range handset, with the addition of a duplex UHF/HF transceiver. This additional transceiver operates similarly to a long-range transceiver (449), and may comprise a repackaged version of said long-range transceiver.

Signal acquisition is initially the same as a medium-range handset. If this acquisition fails, and the long-range handset cannot establish a satisfactory UHF link, it then activates its internal HF transceiver and searches for an HF signal from a compatible device belonging to this system, such as a long-range transceiver, or similar equipment in a relay site. If it finds an HF signal of sufficient strength and quality from said compatible device, it automatically establishes an HF link with said device. The establishment and maintenance of the HF link is similar to that described in "Automatic Link Establishment".

Note that the UHF frequency corresponds to that of a long-range transceiver, not a local transceiver, which normally uses different frequencies. For greater flexibility, the long-range handset may therefore include a means of changing the UHF frequency between that belonging to a long-range transceiver, and that belonging to a local transceiver.

The long-range handset requires an HF antenna preferably optimised for near-vertical incidence skywave, such as a low horizontal element or delta. The handset also requires a UHF antenna, which may be an omnidirectional whip.

1.14.11Long-Range Vehicle Unit

1.14.11.1 General

The long-range vehicle unit (423) (457) 564) comprises a standard vehicle unit (80) fitted with additional items (490) including a long-range adaptor (497), antenna tuning unit (493), high-frequency mobile antenna (491), and ultra-high frequency mobile antenna (496). These additional items provide the ability to remain connected to the system when travelling in remote areas which are devoid of radio modems, using ultra-high frequency radio for medium distances, and high-frequency radio for long distances. To further increase utility, the long-range adaptor includes an additional low-power ultra-high frequency transceiver, to relay services to a medium-range handset which is taken some distance away from the vehicle, preferably a kilometre or more. The changeover between the various frequencies is determined by several factors, which may include channel

availability, signal strength and channel quality. Figure 21 shows the configuration of a long-range vehicle unit.

1.14.11.2 Long-Range Adaptor

Figure 22 shows the long-range adaptor. This device includes a duplex UHF transceiver (509) and a simplex HF transceiver (528), which provides the means of communicating with an LRT at medium to long distances. These items operate similarly to the corresponding sections of an LRT.

The long-range adaptor also includes a second duplex UHF transceiver (517), which provides the means of communicating with a medium-range handset up to a km or more away. This transceiver is similar to an LT, but differently packaged. It operates similarly to a Local Transceiver.

The long-range adaptor includes antenna diplexers (510) (518) (512) to allow both UHF transceivers to operate simultaneously. The high-speed data bus (506) is connected to the input/output expansion port (98) of a vehicle unit, said port providing the means of transferring all services, data and commands between the adaptor and the host vehicle unit. The long-range adaptor can also control an antenna tuning unit (493).

Upon switch-on and occasionally thereafter, the host vehicle unit searches for a signal from a radio modem. If it finds a modem signal of sufficient strength and quality, it ensures that any long-range adaptor which might be connected is deactivated, and automatically establishes a short-range radio link with said modem. If it is unable to find a modem signal of sufficient strength and quality, it deactivates its RF front-end and commands the long-range adaptor to become active.

When the long-range adaptor becomes active, controller (521) causes transceiver (509) to search for a UHF signal from an LRT. If it finds a UHF signal of sufficient strength and quality from an LRT, it performs a handshaking sequence in which each unit attempts to authenticate the other unit, and if authentication is successful, transceiver (509) establishes a UHF radio link with said LRT. If it is unable to find a UHF signal of sufficient strength and quality, or if authentication fails, the adaptor deactivates transceiver (509), activates HF transceiver (528), and searches for an HF signal from an LRT. If it finds an HF

signal of sufficient strength and quality from an LRT, it performs a handshaking sequence in which each unit attempts to authenticate the other unit, and if authentication is successful, transceiver (528) establishes an HF radio link with said LRT. HF link establishment is further described in the section herein titled "Automatic Link Establishment".

1.14.12Antenna Tuning Unit

The antenna tuning unit (ATU) (493) provides the means of tuning and matching the high frequency mobile antenna (491) to the HF transceiver (483) contained in the long-range adaptor (497). The ATU, or a version thereof, may also be used in fixed installations, to tune the high-frequency antenna associated with a long-range transceiver (449) (553) or version thereof (573) (588).

The ATU is preferably able to be pre-tuned prior to transmission, according to settings stored in non-volatile memory (547). After transmission commences, the central processor (545) monitors the reflected power using a directional coupler means (544), and adjusts the tuning and matching circuitry (546) until the reflected power at the transmitter port (494) is minimised or preferably zero. The means of tuning and matching may be provided by series and shunt reactive elements, and possibly transformers, which are switched in and out using relays or other devices. Figure 23 shows a physical representation of the ATU, and figure 24 an internal block diagram.

The ATU preferably includes a frequency splitting network (541), and if necessary a high frequency bandstop filter (540), to allow the vehicle unit (80) to receive signals on the medium-frequency AM broadcast band and the very-high frequency FM broadcast band.

1.14.13High-Frequency Mobile Antenna

The high-frequency mobile antenna (491) is required to operate with reasonable transmit efficiency over the frequency range used by the high-frequency transceiver (483) belonging to the long-range adaptor, and is preferably optimised for near-vertical incidence skywave (NVIS) propagation. Prospective antennas for mobile use include an inclined whip, and a roof-mounted horizontal element. The antenna may include frequency selective networks to enhance reception on the medium-frequency and/or very-high frequency broadcast bands.

1.14.14Mobile UHF Antenna

The ultra-high frequency mobile antenna (496) may be an omnidirectional whip mounted high on the vehicle, for example on the roof, gutter, or windscreen.

1.15 Remote Links (Public Use)

1.15.1 Access via Private Facility

The long-range vehicle units and long-range handsets disclosed herein are preferably able to transmit an alert signal on a high-frequency paging channel, the purpose of which is to request emergency access to a private facility.

The owner of a private facility is preferably able to set his or her equipment to accept or reject such access requests, or to alert said owner. If the request is granted, it is preferred that the owner retains priority, if he or she so desires. To provide an incentive for owners to grant access requests, it is preferred that the system includes a means to adjust the user's account, in order to compensate them for the loss of use of their facility during third-party access such as this.

1.15.2 Access via Isolated Modem/s

In remote areas, to provide local access where people tend to congregate, a satellite transceiver capable of handling multiple channels of Internet audio, Internet data and telecommunications may be installed to feed one or more local radio modems (51), said modems allowing standard vehicle units and handsets to be used in their vicinity. In like manner, a satellite transceiver capable of handling Internet video streams may feed a media transponder for TV (53), said transponder allowing Internet video streams to be received and viewed by users in the vicinity as disclosed herein.

1.15.3 Access via Relay Site

To deliver services to travellers and other itinerant users in remote areas, relay sites may be installed across such areas in a grid formation. These sites preferably include a satellite transceiver (551) or modem (558) capable of handling at least four independent narrowband channels, together with one long-range transceiver version per channel (553) (554) (555) (556). Although more than four channels are preferred, it is unlikely that they could be accommodated at a single site, due to swamping of the receivers at HF by the high-frequency transmitted signals. As with the long-range transceiver, transmitted HF signals

will be narrowband. Users will need a long-range vehicle unit or long-range handset to access relay sites.

Relay sites include a system controller (552), which may be a cut-down version of the controller used in the long-range set-top-box disclosed herein. For equipment commonality purposes, it is preferred that relay sites use a similar bus to a long-range set-top-box. Figure 25 shows the general configuration of a relay site.

The HF section of a relay site preferably operates in conjunction with an antenna suitable for near-vertical incidence skywave (NVIS), such as a delta or similar antenna. Separate antennas may be used for transmit and receive. The UHF section of the relay site preferably operates in conjunction with an elevated omnidirectional whip.

Figure 26 shows a version of the relay site which uses separate transmit and receive sites for HF, to alleviate costing problems. In this example, the transmit and receive sites are wirelessly connected using bus extenders (577) (586), and the unused HF receive and transmit sections are eliminated from the LRTs.

1.15.4 Aircraft Passengers

As shown in figure 27, to deliver services to passengers in an aircraft (610), one or more gateways may feed satellite transceivers (600) capable of delivering multiple channels to a satellite transponder (603), said transponder possessing a footprint which covers the flight path of the aircraft.

The satellite downlink (602) is received by an omnidirectional or electrically steered antenna (604), which feeds a satellite transceiver (605). The transceiver is connected to group repeater (606), which translates all services, data and commands to a form suitable for transmission to passengers in the aircraft using a Bluetooth wireless link (607). To use these services, said passengers may use any of the handsets described herein which possess Bluetooth capability (609), or similar devices provided by the airline.

1.16 Semi-Duplex

This section only applies to HF.

Due to the requirement for frequency agility, it would be very expensive to build duplex transceivers for both ends of the link, where the same antenna is used for transmit and receive. Such transceivers would be complex, power hungry, less reliable, and likely to suffer from noisy and blocked receive channels. The only alternative is to use simplex transceivers, which alternately transmit and receive on the same channel.

Because good analog encryption employs time interleaving, which causes the gaps between words to become filled in, the output signal is (or should be) spectrally similar whether or not audio traffic is being passed. This makes it incompatible with voice operated transmit (VOX), because there are no gaps in the modulating signal to allow periodic changeovers from transmit to receive. Therefore for both Internet audio and telecommunications, the transmitter digitises the encrypted audio signal, forms it into blocks, re-clocks the blocks to speed them up slightly, and converts the blocks back to analog. This has the effect of splitting up the audio into fixed length segments, at a slightly higher pitch and tempo, with short periods of silence between each segment. During these silent periods, the transmitter switches to receive and listens for a special interrupt code from the user. If none is received, it switches back to transmit and sends the next segment.

At the receiving end, the demodulated audio is similarly processed, except that the blocks are slowed down and rejoined. Providing the transmitter and receiver are properly synchronised, the resulting signal has no audible disruption.

If the user at the receiving end speaks during a telephone conversation, his equipment sends an interrupting code to the transmitting end during one of the silent periods. If the transmitting end receives this code, it stops sending. This allows the person who was speaking to hear the interruption and pause naturally. The effect is similar to normal VOX.

To avoid the possibility of both users speaking continuously at the same time, causing the system to rapidly shuttle back and forth, algorithms at each end monitor the number of break-in attempts, so that if they detect an extended period of contention, they assert the channel in one direction or the other.

If the interrupt is sent because the user selects a different station or service, the interrupting code may be followed by data and checkbits. The transmitting end

pauses as before, allowing this lengthier code to be received, which includes details of the required station or service. After validating the request by comparing it against the checkbits, and possibly by performing a handshake routine, the transmitting end forwards the request to the gateway.

Because Internet data is normally sent as TCP/IP packets, it is straightforward to periodically change over to receive for short periods between said TCP/IP packets, to allow the other party to break in. In this case the receiver synchronises itself to the transmitted TCP/IP packets, so that it knows exactly when to break in. The time compression technique referred to above is therefore not necessary in this case.

1.17 Automatic Link Establishment

1.17.1 New Session

In the absence of traffic, the long-range transceiver (LRT) continuously monitors the allocated UHF channel and scans the HF paging channels. The HF paging channels are shared channels, used for signalling only, which are spaced across the HF operating frequency range.

To commence a new session, a long-range vehicle unit or long-range handset, herein called an outlying unit, transmits a request on a UHF paging channel. If the LRT receives this request, it checks its database and performs a handshaking routine to see if the outlying unit is authorised. If it finds the user is authorised, the LRT sends an acknowledgement to the outlying unit, and forwards the request to the gateway. The gateway responds by allocating the required service, which the LRT forwards to the outlying unit.

If the outlying unit does not receive a response, indicating that it is outside the range of the UHF link, it tries again a certain number of times. If there is still no acknowledgement, it then attempts to determine the most likely HF paging channel, and resends the request there. This channel is determined from an algorithm based on the time and frequency of the most recent HF session, current time and date.

If the outlying unit fails to receive an acknowledgement on said HF paging channel, it switches to the next HF paging channel and repeats the process, cycling through each HF paging channel until it receives an acknowledgement.

When the LRT receives the request, it proceeds as for UHF, except that the service is transferred to an HF channel nominated by the FMS.

1.17.2 Modify Session

If traffic is already being passed, and an outlying user wishes to change station or service, his unit requests the appropriate station or service on the current channel, which may be either UHF or HF. Upon receiving and verifying this request, the LRT sends an acknowledgement to the user and forwards the request to the gateway. The gateway responds by allocating the required station or service which the LRT forwards to the user.

1.17.3 Check Link

If an HF link is open but not passing traffic, the LRT may periodically 'ping' the outlying unit and listen for a response, to see if the path is still open. If the LRT fails to receive a response after a specified number of pings, it assumes that the path has closed or interference exists. It then notifies the gateway and reverts to the idle state. To minimise interference to other users, pings may be granted specific time slots by the FMS.

It can be seen that the invention provides an improved overall system for delivering broadcast and communications services. In particular it allows delivery of Internet media streams including Internet audio streams and Internet video streams, Internet data including the world-wide-web and email, and telecommunications. It should be understood that other variations to the invention which are readily understood by a person skilled in the art without any inventiveness is included within the scope of this invention. In particular the above is a description by way of illustration only and the scope of the invention is as defined broadly in the following claims.

APPENDIX A

FEATURES IN FIGURES DENOTED BY REFERENCE SIGNS

1 Internet
2 External telecommunications networks
3 Internet media streams
4 Internet data
5 Telecommunications
6 Gateway
7 Trunk to other gateways
8 Local links
9 Remote area links
10 Local service area
11 Remote area
14 Loopback Means
15 Uniform resource locator (URL) predictor, register and generator
16 Multiple servers (for Internet media streams)
17 Multiple servers (for Internet data)
18 Telephone network interface
19 External gateway server
20 System software server
21 Master clock generator
22 Buffering and re-clocking devices
23 Address generator
24 Matrix switch
25 Virtual user ports
26 Service identifier
27 Packeting and de-packeting devices
28 Main processor
29 Multiplexing and demultiplexing devices
30 System supervisor
31 Encryption and decryption devices
32 Router and modem controller
33 Engineering interface
34 Frequency management sub-system
35 Satellite transceiver or transceivers
36 Home location register
37 Diagnostics
38 Visitor location register
39 Customer website
40 Customer records and billing
41 Customer dial-in service
42 Data from ionospheric sounders
50 Router
51 Radio modem
52 Set-top-box modem
53 Media transponder (radio or TV)
54 Short-range radio links
55 Handsets or vehicle units
56 Catenary wire
57 Baseband interface
58 Antenna
59 Hook
60 Hose clamp
61 Utility pole
62 Front view of modem

63 Side view of modem
65 Baseband interface
66 Multiple stream decoder
67 Frequency modulated exciter (one per stream)
68 Radio frequency combiner
69 Radio frequency power amplifier
70 Very high-frequency antenna
71 Frequency control line
72 Multiple frequency generator
77 Station selection knob
78 Display
79 Keypad or buttons
80 Vehicle unit
81 Modem antenna
82 AM/FM antenna
83 TV antenna
84 Low-level radio-frequency signal (Internet TV or video stream and free-to-air TV)
85 Antenna input on vehicular TV receiver
86 Vehicular TV receiver
87 Low-level audio/visual baseband signal
88 Unspecified audio/visual equipment
89 Low-level radio-frequency signal (Internet radio or audio stream and free-to-air radio)
90 Antenna input on radio receiver
91 DC power output to external radio receiver
93 External radio receiver
94 Low-level audio signal
95 Unspecified audio equipment
96 High-level audio signal
97 External speakers
98 Input/output expansion port
99 DC power input
100 Bluetooth wireless link (101), data connection (102), or infrared link (103)
101 Bluetooth wireless link
102 Data connection
103 Infrared link
104 External computer
105 Handset
110 Diplexer
111 Bandwidth control
112 Receiver
113 Transmitter
114 Receive local oscillator signal
115 Transmit local oscillator signal
116 Frequency generator
117 Internal TV receiver
118 Internal radio receiver
119 Bandwidth control line
120 Baseband modem (receive)
121 Baseband modem (transmit)
122 CDMA spreading code
123 Receive and transmit buffers
124 High-speed data transceiver
125 Encryption and decryption key
126 Encryption and decryption device
127 Analog to digital convertor (TV)
128 Analog to digital convertor (radio)

129 Programmable logic device or other processing device
130 DC power to internal circuits
131 Digital TV baseband signal
132 Analog audio baseband signal
133 Audio/visual codec
134 Audio codec
135 Bluetooth transceiver
136 Data transceiver
137 Infrared transceiver
138 Station memory
139 System controller
140 DC power switch
141 Analog TV baseband signal
142 TV signal switch
143 Audio signal switch
144 Frequency generator and TV modulator
145 Frequency generator and audio modulator
146 Audio amplifier
147 Bluetooth antenna
148 Data connector
149 Infrared emitter and detector
150 Keypad, display and beep
151 DC current sensing circuit
160 Handset
161 Keypad or buttons
162 Acoustic transducer
163 Display
164 Microphone
170 Whip
171 Diplexer
172 Low pass filter
173 Ferrite rod antenna (MF broadcast band)
174 Bandwidth control
175 Receiver
176 Transmitter
177 Receive local oscillator signal
178 Transmit local oscillator signal
179 Frequency generator
180 Internal radio receiver
181 Baseband receive modem
182 Baseband transmit modem
183 CDMA spreading code
184 Receive and transmit buffers
185 Frequency control line
186 Encryption and decryption key
187 Encryption and decryption device
188 Analog to digital convertor
189 Programmable logic device or other processing device
190 Digital audio signal
191 Audio codec
192 Analog to digital convertor
193 Bluetooth transceiver
194 Data transceiver
195 Station memory
196 System controller
197 Analog audio signal
198 Audio signal switch
199 Bluetooth antenna
200 Data connector
201 Keypad, display and beep
202 Audio amplifier
203 Audio amplifier
204 Audio jack
205 Bluetooth wireless link
206 Data connection
210 Set-top-box

211 Keypad or buttons
212 Display
213 Coaxial cable
214 External radio receiver
215 External TV receiver
216 External computer
217 External fixed telephony or facsimile equipment
218 Low-level signal (audio or modulated radio frequency)
219 Low-level signal (audio/visual or modulated radio frequency)
220 Data connection
221 Telephone conductor
222 User's radio antenna
223 User's TV antenna
224 Boundary of user's premises
225 Set-top-box antenna
226 Low power radio link (VHF FM)
227 Low power radio link (UHF TV)
228 Expansion input/output port (reserved)
229 Bluetooth radio links
230 Remote control unit or units
231 External portable radio receiver
232 External portable TV receiver
238 Decoder
239 Multiplexer/demultiplexer
240 Radio card (first instance)
241 Packet router
242 Radio stream (digital)
243 Data buffering and re-clocking device
244 Analog to digital convertor
245 Audio codec
246 Signal switch
247 Internal radio receiver
248 Frequency generator and audio modulator
249 Signal switch
250 External radio antenna
251 Low-level radio-frequency output to external radio receiver
252 Low-level audio output
260 Radio card (second instance)
261 Packet router
262 Radio stream (digital)
263 Data buffering and re-clocking device
264 Analog to digital convertor
265 Audio codec
266 Signal switch
267 Internal radio receiver
268 Frequency generator and audio modulator
269 Signal switch
270 External radio antenna
271 Low-level radio-frequency output to external radio receiver
272 Low-level audio output
280 TV card (first instance)
281 Packet router
282 TV stream
283 Buffering and re-clocking device
284 Analog to digital convertor
285 Audio/visual codec
286 Signal switch
287 TV receiver
288 Frequency generator and TV modulator
289 Signal switch

290 External TV antenna
291 RF output to external TV receiver
292 Low-level audio/visual output
300 TV card (second instance)
301 Packet router
302 TV stream
303 Buffering and re-clocking device
304 Analog to digital convertor
305 Audio/visual codec
306 Signal switch
307 TV receiver
308 Frequency generator and TV modulator
309 Signal switch
310 External TV antenna
311 RF output to external TV receiver
312 Low-level audio/visual output
320 Internet card (first instance)
321 Packet router
322 TCP/IP data
323 Buffering and re-clocking device
324 Data transceiver
325 Data connector
330 Internet card (second instance)
331 Packet router
332 TCP/IP data
333 Buffering and re-clocking device
334 Data transceiver
335 Data connector
340 Fixed telephony card
341 Packet router
342 Input data
343 Output data
344 Buffering and re-clocking device
345 Buffering and re-clocking device
346 Digital to analog convertor
347 Analog to digital convertor
348 Telephony hybrid
349 Level convertor
350 Telephone connector
360 Bluetooth card for handset and remote control unit
361 Packet router (telephony)
362 Packet router (remote control unit)
363 Incoming and outgoing telephony (digitized)
364 Incoming data and commands relevant to remote control unit
365 Outgoing data and commands relevant to remote control unit
366 Buffering and re-clocking device
367 Main processor for data and commands relevant to remote control unit
368 Multiplexer/demultiplexer
369 Station memory
370 Keypad, display and beep
371 Bluetooth transceiver
372 Bluetooth antenna
375 Radio modem
376 Wireless link carrying channels for multiple users
377 Antenna external to vehicle

378 Vehicle
379 Group repeater
380 Antenna inside passenger compartment
381 Passenger compartment
382 Bluetooth radio links
383 Handsets
385 Repeater section (one per user)
386 Antenna splitter/combiner
387 To diplexers (388) in other repeater sections
388 Diplexer
389 Bandwidth control
390 Receiver
391 Transmitter
392 Receive local oscillator signal
393 Transmit local oscillator signal
394 Frequency generator
395 Receive baseband modem
396 Transmit baseband modem
397 CDMA spreading code
398 Encryption and decryption key
399 Encryption and decryption device
400 Programmable logic device or other processing device
401 Bluetooth transceiver
402 Receive and transmit buffers
403 To Bluetooth transceivers (401) in other repeater sections
404 Antenna splitter/combiner
406 Control bus
407 To programmable logic or other processing devices (400) in other sections
408 System controller (shared)
409 Code pool (shared)
415 To satellite transceiver located at gateway (6)
416 Satellite antenna
417 Satellite transponder or transponders
418 Satellite links
419 Private facility
420 Ultra-high frequency wireless link
421 Medium-range handsets
422 High-frequency or ultra-high frequency wireless links
423 Long-range vehicle units
424 Long-range handsets
425 Remote area
426 Relay site for itinerant users (shared)
427 Itinerant users
428 Aircraft
430 Satellite antenna
431 Satellite transceiver
432 High-speed data bus
433 Set-top-box antenna
434 Low power radio links (VHF FM and UHF TV)
435 External radio receiver
436 External TV receiver
437 Long-range set-top-box
438 External radio receiver or other sound equipment
439 External TV receiver or other audio/visual equipment
440 External computer

441 External fixed telephony or facsimile equipment
442 Low-level radio frequency or audio signal
443 Low-level signal (audio/visual or modulated radio frequency)
444 Data connection
445 Telephone conductor
446 Remote control unit or units
447 Bluetooth wireless links
448 User's radio and TV antennas
449 Long-range transceiver
450 Same as (449)
451 Local transceiver
452 Bus extender
453 Medium-range handset
454 Ultra-high frequency radio links
455 Medium power high-frequency or ultra-high frequency wireless links
456 Long-range handset
457 Long-range vehicle unit
458 Bluetooth or ultra-high frequency wireless link
459 To second long-range set-top-box (if used)
467 Digital encryption/decryption device
468 Ultra-high frequency duplex transceiver
469 Transmit/receive diplexer
470 Ultra-high frequency antenna
471 Antenna tuning unit control line
472 To high-frequency antenna via antenna tuning unit (493)
473 Removable front panel
474 Audio signal switch
475 Central processor
476 High-speed data input/output port
477 Analog encryption/decryption device (A5 telephony or equivalent)
478 Digital to analog and analog to digital convertor (part of semi-duplex sub-system described herein)
479 Decoder for alert signals and incoming system commands
480 Analog encryption and decryption device (part of semi-duplex sub-system described herein)
481 Timing signal
482 Block time compandor (part of semi-duplex sub-system as described herein)
483 High-frequency simplex transceiver
484 Signal strength data and channel requests
485 System commands including mode, channel frequency, encryption level.
490 Additional items to convert standard vehicle unit to long-range vehicle unit
491 High-frequency mobile antenna
492 High-frequency signals (transmit); medium frequency and very high frequency signals (receive)
493 Antenna tuning unit
494 High-frequency signals

495 Medium and very-high frequency signals
496 Ultra-high frequency mobile antenna
497 Long-range adaptor
498 High-speed data bus
499 Low-level signal (audio or modulated radio frequency)
500 External receiver, speakers, or other audio equipment
506 High-speed data bus
507 Circuit blocks similar to local transceiver (451)
508 Digital encryption/decryption device
509 Ultra-high frequency duplex transceiver
510 Transmit/receive diplexer
511 Diplexer
512 Ultra-high frequency antenna
513 Antenna tuning unit control line
514 To high-frequency antenna via antenna tuning unit (493)
515 Circuit blocks similar to long-range transceiver (449)
516 Digital encryption/decryption device
517 Ultra-high frequency duplex transceiver
518 Transmit/receive diplexer
519 High-speed data input/output port
520 Audio signal switch
521 Central processor
522 Encryption device (A5 telephony or equivalent algorithm)
523 Digital to analog and analog to digital convertor (part of semi-duplex sub-system described herein)
524 Decoder for alert signals and incoming system commands
525 Analog encryption and decryption device (part of semi-duplex sub-system described herein)
526 Timing signal
527 Block time compandor (part of semi-duplex sub-system described herein)
528 High-frequency simplex transceiver
529 Signal strength data and channel requests
530 System commands including mode, channel frequency, encryption level.
535 Low-loss cable to high-frequency antenna (491)
536 Input connector
539 To long-range adaptor (490)
540 High-frequency bandstop filter
541 Frequency splitting network
542 Control signals
543 Status signals
544 Directional coupler
545 Central processor
546 Matching network
547 Non-volatile memory
550 Satellite antenna
551 Satellite transceiver (not required if services are obtained from (557))
552 System controller
553 Long-range transceiver (449)

554 Same as (553)
555 Same as (553)
556 Same as (553)
557 Optical fibre or other broadband trunk from gateway (6) (if available at this location)
558 Modem (not required if services are obtained from (418))
559 Antenna combiners (ultra-high frequency and high-frequency)
560 Ultra-high frequency antenna
561 High-frequency receive antenna
562 High-frequency transmit antenna
563 Ultra-high frequency and high-frequency wireless links
564 Long-range vehicle unit
565 Long-range handset
570 Satellite antenna
571 Satellite transceiver (not required if services obtained from (578))
572 System controller
573 Long-range transceiver (449) (receiver section not required)
574 Same as (573)
575 Same as (573)
576 Same as (573)
577 Bus extender
578 Optical fibre or other broadband trunk from gateway (6) (if available at this location)
579 Modem (not required if services are obtained from (418))
580 Antenna combiners (ultra-high frequency and high-frequency)
581 Ultra-high frequency antenna
582 High-frequency transmit antenna
583 Ultra-high frequency and high-frequency wireless links
584 Ultra-high frequency wireless link
585 High-frequency receive site
586 Bus extender
587 System controller
588 Long-range transceiver (449) (transmitter section not required)
589 Same as (588)
590 Same as (588)
591 Same as (588)
592 High-frequency antenna splitter
593 High-frequency antenna
594 Long-range vehicle units
595 Long-range handset
596 High-frequency wireless receive links
600 Satellite transceiver
601 Satellite antenna
602 Satellite links
603 Satellite transponder
604 Satellite antenna (aircraft mounted)
605 Satellite transceiver
606 Group repeater
607 Bluetooth wireless link
608 Passenger compartment
609 Handsets
610 Aircraft skin

NOT USED (Informative):
12-13; 43-49; 64; 73-79; 92; 102; 105-109; 152-159; 165-169; 205-209; 233-237; 253-259; 273-279; 293-299; 313-319; 326-329; 336-

339; 351-359; 373-374; 384; 405; 410-414; 429; 460-466; 486-489; 501-505; 531-534; 537-538; 548-549; 566-569; 597-599

CLAIMS

1. A system for delivering broadcast and communications services through connection means to fixed, mobile and portable recipients, wherein said services include provision of one or more Internet media streams including Internet audio streams and Internet video streams, Internet data including the world-wide-web and email, and telecommunications; the system including one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, each of said one or more gateways including:

   (a) selection means to selectively establish communication channels with said external communication nodes networks and preferably said loopbacks to establish an individual bidirectional channel between each said node network and allow recipients to obtain the communication channel of their choice;

   (b) processing means including high speed matrix switching, buffering, packeting, and addressing means; processing said channels containing said services into digitised packaged data format and said addressing means identifying, storing and updating in real time the location of each recipient, whether fixed or mobile, and applying routing information to each packet of said digitised packaged data to enable said packets to be correctly routed through the system to reach each recipient.

2. A system as defined in claim 1 including multiplexing means wherein said packets for multiple recipients are combined together to enable said packets to be conveyed to recipients using a connection means, said packets remaining identifiably separate from each other and being routed to each said recipient according to the routing information contained in or applying to each said packet.

3. A system as defined in claim 1 including wherein there is a plurality of gateways and the system allows connection between said gateways to share the load and introduce redundancy.

4. A system as defined in claim 1 including a splitting means connected with at least one of said connection means and able to split said Internet media streams or data or packets derived therefrom into as many duplicates as necessary to satisfy the number of recipients for each said stream.

5. A system as defined in claim 1, wherein the one or more gateways include repository means for storing system software required by downstream devices, and enabling downloading of said system software to said devices to remotely refresh or upgrade said downstream devices.

6. A system as defined in claim 1 including channel optimisation means for gathering and processing real-time or near real-time ionospheric propagation data, automatically determining suitable channels for high frequency radio links used by this system, and managing said channels to maximise the quality of service and efficiency of spectrum utilisation by remotely controlling transmitter frequencies, powers and other parameters used by the equipment providing said high frequency links.

7. A system as defined in claim 1 wherein gateways include monitoring means for collating the time of day and day of the week when particular Internet media streams are requested, and using fuzzy logic as a means of prediction, for the selection means to open an individual bidirectional channel with one of said external communications node or network from which said stream is obtainable in advance of the predicted likely time of request to eliminate or minimise the time required to establish said stream with said external source.

8. A system as defined in claim 1, wherein the connection means for connecting recipients to processing means includes any combination of a plurality of optical fibre, hybrid-fibre coax, coaxial or other cable, satellite relay links, wideband radio links, and narrowband radio links, and further that said connection means for connecting recipients includes all necessary routing, multiplexing and demultiplexing, signal regeneration, radio transmission and reception, automatic link establishment, and means of duplex or semi-duplex operation and further that said connection means also allows digitised packaged data to be conveyed from each recipient to the gateway as required.

9. A system as defined in claim 1, wherein the connection means for connection to mobile and portable recipients is provided by short-range radio modems, said modems placed at regular intervals around the localities where wireless connections to mobile and portable recipients are to be provided, said modems including means of a multi-access technique to enable said modems to establish individual wireless connections with multiple recipients.

10. A system as defined in 1, wherein the connection means for connection to mobile and portable recipients is provided by transponders, said transponders providing a means of decoding Internet media streams, modulating same onto individual radio-frequency carriers of appropriate frequency, and transmitting said modulated carriers to one or more recipients within range of said transponder, said transponders including means of sending information containing the frequency of requested streams to a radio modem near the requestor of that stream, said modem passing said frequency information to the requestor's equipment causing automatic tuning to the stream on said radio frequency and receipt of said transmitted stream.

11. A system as defined in any one of claims 1 to 10 having a method of semi-duplex communication of a signal on a single narrowband radio channel wherein the receiving party is able to break-in on the transmitting party at any time, and including the features of:

(a) a radio link connectable between two stations herein called 'A' and 'B';

(b) the signal to be modulated is in analogue or digital format;

(c) at station 'A', the signal to be modulated is sampled and formed into blocks of fixed duration;

(d) at station 'A', the blocks are individually re-clocked to slightly speed them up, to produce blocks of shorter duration with gaps in between;

(e) at station 'A', the re-clocked blocks are converted to analogue and transmitted, such that transmissions comprise periods of signal interspersed with short periods of silence at regular intervals;

(f) during the periods of silence, station 'A' switches to receive and listens for a transmission from station 'B';

(g) if station 'B' wishes to break in, it transmits an interrupt code during a silent period of station 'A', said interrupt code comprising an easily recognised signal such as parallel audio tones;

(h) if station 'A' hears an interrupt code during a silent period, it temporarily pauses transmission and attempts to perform a handshake with station 'B' to check the validity of the interrupt;

(i) if handshaking confirms the interrupt to be valid, station 'A' ceases transmission, discards further blocks, and listens for station 'B' to transmit;

(j) if the interrupt is found to be false, after a designated period of time station 'A' reverts to the regular transmission of blocks;

(k) at station 'B', the signals from station 'A' are received, demodulated, and sampled;

(l) at station 'B', the sampled received signal is re-clocked to slow it down by the same amount by which it was originally sped up, such that the gaps between blocks are caused to exactly disappear, and the signal is restored to a similar waveform to that initially applied to station 'A';

(m) stations 'A' and 'B' can swap roles at any time;

(n) contention is avoided if stations 'A' and 'B' are synchronised such that their silent periods alternate and are approximately equally spaced;

(o) during extended transmissions, stations 'A' and 'B' may periodically interrupt each other to confirm that the channel is still open and the traffic is valid.

12. A system as defined in claim 1 including portable modems wherein mobile and portable recipients are able to be wirelessly connected by short-range radio, said portable modems including:

(a) storage means for receiving and storing and editing URLs for said broadcast and communications services;

(b) input means which in response to an action performed by the recipient, recalls the URL of a desired Internet media stream and sends the URL to the gateway to cause said stream to be obtained by the gateway and delivered to said recipient via the connection means;

(c) converting means able to convert packets received from said gateway to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external audio or video transducer or other external equipment.

13. A portable modem for use by mobile or portable recipients which enable wireless connection to fixed short-range radio modems for delivering broadcast and communications services including provision of one or more Internet media streams, Internet audio streams and Internet video streams, Internet data, the world-wide-web and email, and telecommunications and for connection to one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, said portable modems including:

(a) storage means for receiving and storing and editing URLs for said broadcast and communications services;

(b) input means which in response to an action performed by the recipient, recalls the URL of a desired Internet media stream and sends the URL to the gateway to cause said stream to be obtained by the gateway and delivered to said recipient via the short range radio modem;

(c) converting means able to convert packets received from said radio modem to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external audio or video transducer or other external equipment.

14. A portable modem as defined in claim 13, including receiving means for receiving signals on free-to-air radio or television frequencies, demodulating said signals to an analogue or digital baseband signal, and performing all necessary processing and amplification to enable same to drive an internal or external audio or video transducer or other external equipment.

15. A portable modem as defined in claim 13, including modulation means to modulate an analogue or digital baseband signal obtained from an Internet media stream or a free-to-air station onto a radio-frequency carrier of appropriate frequency for reception by an external receiver tuned to the same frequency.

16. A portable modem as defined in claim 13 including a means of making and receiving telephone calls through short-range radio modems.

17. A portable modem as defined in claim 13 including a means of establishing a Bluetooth short-range wireless link with a handset enabling the user to make and receive telephone calls using said handset.

18. A portable modem as defined in claim 13 including a means of establishing a Bluetooth short-range wireless link with a portable handset enabling the user to select a desired Internet media stream or station and function as a portable listening device for said stream or station.

19. A portable modem as defined in claim 13, including a means of accessing the Internet including the world-wide-web and email through said short-range radio modems.

20. A portable modem as defined in claim 13 including connection to an external computer, enabling a user of said computer to access the Internet including the world-wide-web and email through said modem.

21. A portable modem as defined in claim 13 including a connection means to an external computer wherein said computer is able to function as an additional front panel for said modem.

22. A portable modem as defined in claim 13 including a means of monitoring the power drain of external equipment such as a radio receiver, such that if said external equipment is switched on or off, said modem will automatically switch on or off in unison.

23. A system as defined in claim 10, wherein portable modems include a means of very-high frequency or ultra-high frequency radio transmission and reception including antenna means, to enable the means of connection to be completed using a single-user point-to-point radio link if no other path is available, and operating duplex or semi-duplex and employing means of automatic link establishment.

24. A system as defined in claim 10, wherein portable modems include a means of high frequency radio transmission and reception including antenna and antenna tuning means, to enable the means of connection to be completed using a single-user high frequency point-to-point radio link if no other path is available, and operating duplex or semi-duplex and employing means of automatic link establishment.

25. A system as defined in claim 1, which includes a relay means for relaying a group of bidirectional channels from one or more nearby radio modems to multiple recipients located inside a shared space such as commuter vehicle, wherein:

(a) recipients are using handsets ;

(b) the connections to said handsets are made using a shared multi-access technique such as Bluetooth;

(c) to the extent allowed by the handsets, recipients are able to independently access the service of their choice, including the ability to make and receive telephone calls, the ability to select and listen to Internet media streams, and the ability to connect a portable computer to their handset and access the Internet including the world-wide-web and email through said handset.

26. A system as defined in claim 23, wherein the group of channels is obtained from a satellite relay link in lieu of nearby radio modems and the recipients are located on board an aircraft.

27. A system as defined in claim 1 wherein the connection means for connecting recipients at fixed locations is provided by modems which receive packets from the means of distribution and converts said packets into a form which is recognised by a set-top-box, said set-top-box functioning as a hub for the recipient's external media, computing and telecommunications equipment, wherein it provides a means of converting Internet media streams to analogue or digital baseband signals as appropriate, and also performing all necessary processing and amplification to enable same to either drive the recipient's external media equipment through wires, or else to be modulated onto a radio-frequency carrier of suitable frequency and transmitted wirelessly for reception by said equipment on the same frequency.

28. A set-top-box for connection to recipients at fixed locations by modems for delivering broadcast and communications services including provision of one or more Internet media streams, Internet audio streams, Internet video streams, Internet data, the world-wide-web and email, and telecommunications; and connecting to one or more gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, said set-top-box including receiving means which receives packets of said services processed into digitised packaged data format from a means of distribution and converts said packets into a useable form for said set-top-box to function as a hub for the recipient's external media, computing and telecommunications equipment, wherein the set-top-box provides a means of converting Internet media streams to analogue or digital baseband signals as appropriate, and also performing all necessary processing and amplification to enable same to either drive the recipient's external media equipment through wires, or else to be modulated onto a radio-frequency carrier of suitable frequency and transmitted wirelessly for reception by said equipment on the same frequency.

29. A set-top-box according to claim 27 including receiver means for receiving signals on free-to-air radio or television frequencies, demodulating them to analogue or digital baseband signals as appropriate, and performing all necessary processing and amplification to enable driving of the recipient's external media equipment through wires, or to be modulated onto a radio-frequency carrier of suitable frequency and transmitting wirelessly for reception by said equipment on the same frequency.

30. A set-top-box as defined in claim 27, wherein the set-top-box includes means of connection to an external computer to enable it to access the Internet including the world-wide-web and email through said set-top-box.

31. A set-top-box as defined in claim 27 wherein the set-top-box includes a means of physical connection to an external telephone to enable it to make and receive telephone calls through said set-top-box.

32. A set-top-box as defined in claim 27 including a means of establishing a Bluetooth wireless link with a portable handset to enable the user to make and receive telephone calls through said set-top-box.

33. A set-top-box as defined in claim 27 including a means of establishing a Bluetooth wireless link with one or more remote control units to enable the user to control the selection of Internet media streams and free-to-air stations delivered to the recipient's external media equipment.

34. A set-top-box as defined in claim 27 including a means of requesting information from one of the gateways and downloading received information to the recipient's remote control units, to enable control of the recipient's external media equipment through the infrared links of said equipment.

35. A set-top-box for use in a system as defined in claims 23 or 24 the set-top-box including receiver means enabling services to be obtained from a satellite relay link, and to direct said services to a means of radio transmission and reception, said means of transmission and reception providing the means to

forward said services to an outlying recipient using a high-frequency or ultra-high frequency radio link.

36. A set-top-box as defined in claim 27 including remote control units are able to transmit commands using both Bluetooth and infrared, to enable said units to control the recipient's external media equipment separately from the set-top-box.

37. A system as defined in claim 1, including remote control units having a means of being associated with more than one type of external media equipment, and being able to be quickly and easily switched between infrared command sets applicable to each type of said equipment.

38. A system as defined in claim 36, wherein said remote control units include a means of storing combinations of commands which are retrieved and transmitted as a group.

39. A set-top-box as defined in claim 27, which includes a means for the recipient to store information and notes on program or content, and to send an order via the means of connection to purchase items heard or viewed using the modem version; said equipment including handsets, mobile versions of the short-range radio modems, and set-top-boxes.

40. A handset as defined in claim 17, which includes a means for the recipient to store information and notes on program or content, and to send an order via the means of connection to purchase items heard or viewed using the modem version; said equipment including handsets, mobile versions of the short-range radio modems, and set-top-boxes.

41. A portable modem as defined in claim 13, which includes a means for the recipient to store information and notes on program or content, and to send an order via the means of connection to purchase items heard or viewed using the modem version; said equipment including handsets, mobile versions of the short-range radio modems, and set-top-boxes.

42. A system as defined in claim 1, which includes one or more means of receiving services from a modem or satellite relay link, said means being spatially arranged in a grid or other suitable pattern across the area to be covered, said means being able to relay services to multiple recipients using any suitable frequency including high-frequency and ultra-high frequency radio links, said radio links operating duplex or semi-duplex and employing means of automatic link establishment.

43. A system as defined in claim 6 including equipment able to respond to remote commands to change frequency band, scan channels, test channel quality, adjust transmitter power, and report to the optimisation means for the purpose of optimising channel quality and efficiency of spectrum utilisation.

44. A system as defined in claim 26, which includes a means of connecting two set-top-boxes using a broadband duplex radio link, such that said set-top-boxes operate as if sharing a common bus.

45. A method of semi-duplex communication of a signal on a single narrowband radio channel wherein the receiving party is able to break-in on the transmitting party at any time, and including the features of:

(a) a radio link connectable between two stations herein called 'A' and 'B';

(b) the signal to be modulated is in analogue or digital format;

(c) at station 'A', the signal to be modulated is sampled and formed into blocks of fixed duration;

(d) at station 'A', the blocks are individually re-clocked to slightly speed them up, to produce blocks of shorter duration with gaps in between;

(e) at station 'A', the re-clocked blocks are converted to analogue and transmitted, such that transmissions comprise periods of signal interspersed with short periods of silence at regular intervals;

(f) during the periods of silence, station 'A' switches to receive and listens for a transmission from station 'B';

(g) if station 'B' wishes to break in, it transmits an interrupt code during a silent period of station 'A', said interrupt code comprising an easily recognised signal such as parallel audio tones;

(h) if station 'A' hears an interrupt code during a silent period, it temporarily pauses transmission and attempts to perform a handshake with station 'B' to check the validity of the interrupt;

(i) if handshaking confirms the interrupt to be valid, station 'A' ceases transmission, discards further blocks, and listens for station 'B' to transmit;

(j) if the interrupt is found to be false, after a designated period of time station 'A' reverts to the regular transmission of blocks;

(k) at station 'B', the signals from station 'A' are received, demodulated, and sampled;

(l) at station 'B', the sampled received signal is re-clocked to slow it down by the same amount by which it was originally sped up, such that the gaps between blocks are caused to exactly disappear, and the signal is restored to a similar waveform to that initially applied to station 'A';

(m) stations 'A' and 'B' can swap roles at any time;

(n) contention is avoided if stations 'A' and 'B' are synchronised such that their silent periods alternate and are approximately equally spaced;

(o) during extended transmissions, stations 'A' and 'B' may periodically interrupt each other to confirm that the channel is still open and the traffic is valid.

46. A system as defined in any of claims 1 to 11, which includes a means of automatic link establishment wherein:

(a) links are established for any reason including a request for service or a request to pass traffic;

(b) the device which initiates link establishment is herein called the requestor;

(c) in the absence of a link, each device continuously monitors its allocated ultra-high frequency wireless channel;

(d) in the absence of a link, each device scans the high-frequency paging channels, said channels reserved for signalling and spaced across the allocated high frequency range;

(e) in the absence of traffic, each device simultaneously monitors the high-frequency and ultra-high frequency channels;

(f) when service is required, the requestor initially transmits a request for service on the allocated ultra-high frequency channel;

(g) if the requestor does not receive an acknowledgment from the other device within a reasonable time period, it repeats the request a designated number of times;

(h) if the requestor has sent a request for service on the allocated ultra-high frequency channel the designated number of times without receiving an acknowledgement, it changes to a high-frequency paging channel chosen according to an algorithm which attempts to determine the channel with the highest probability of success, based on parameters including one or more of the frequency and time of the most recent high frequency communication, the current time, the current date, blocked channel list, and any other relevant information;

(i) if the requestor fails to receive an acknowledgement on this channel within the designated period of time, it switches to the next paging channel and repeats the process until it receives an acknowledgement from the other device;

(j) when the requestor receives an acknowledgement, it performs a handshaking sequence with the other device;

(k) after handshaking and at any time thereafter, the devices test other channels which have been notified as available, to find the best one and change to it;

(l) during the process of link establishment, the requestor and provider check that each is authorised to communicate with the other;

(m) during the process of link establishment, the uplink device contacts the gateway to obtain a list of channels which can and cannot be used, and any other data or parameters such as maximum authorised power on each channel;

(n) during the process of link establishment, the devices adjust their transmitter power to the minimum needed for reliable communication;

(o) if the link has been established in response to a need to send traffic in the uplink direction, said traffic is then forwarded;

(p) if the link has been established in response to a need to send traffic in the downlink direction, the downlink device notifies the uplink device that it is ready to receive said traffic, which is then forwarded;

(q) if a high-frequency wireless link has been established and either device determines that no traffic has been passed for a designated time period, said device pings the other device and waits for a response to determine whether the link is still open and available;

(r) if the device fails to receive a response after sending a designated number of pings, it reverts to the idle state;

(s) if the device which reverts to the idle state is at the uplink end of the link, it notifies the gateway that the channel is no longer in use to enable it to be allocated to other users of the system;

(t) to minimise the probability of contention between users of the system, pings are allocated specific time slots which, to the extent possible, are unique for each device;

(u) the technique is substantially as herein defined.

47. A system to deliver Internet media streams, Internet data, telecommunications and third party services to fixed mobile and portable recipients substantially as herein defined with reference to the accompanying drawings.

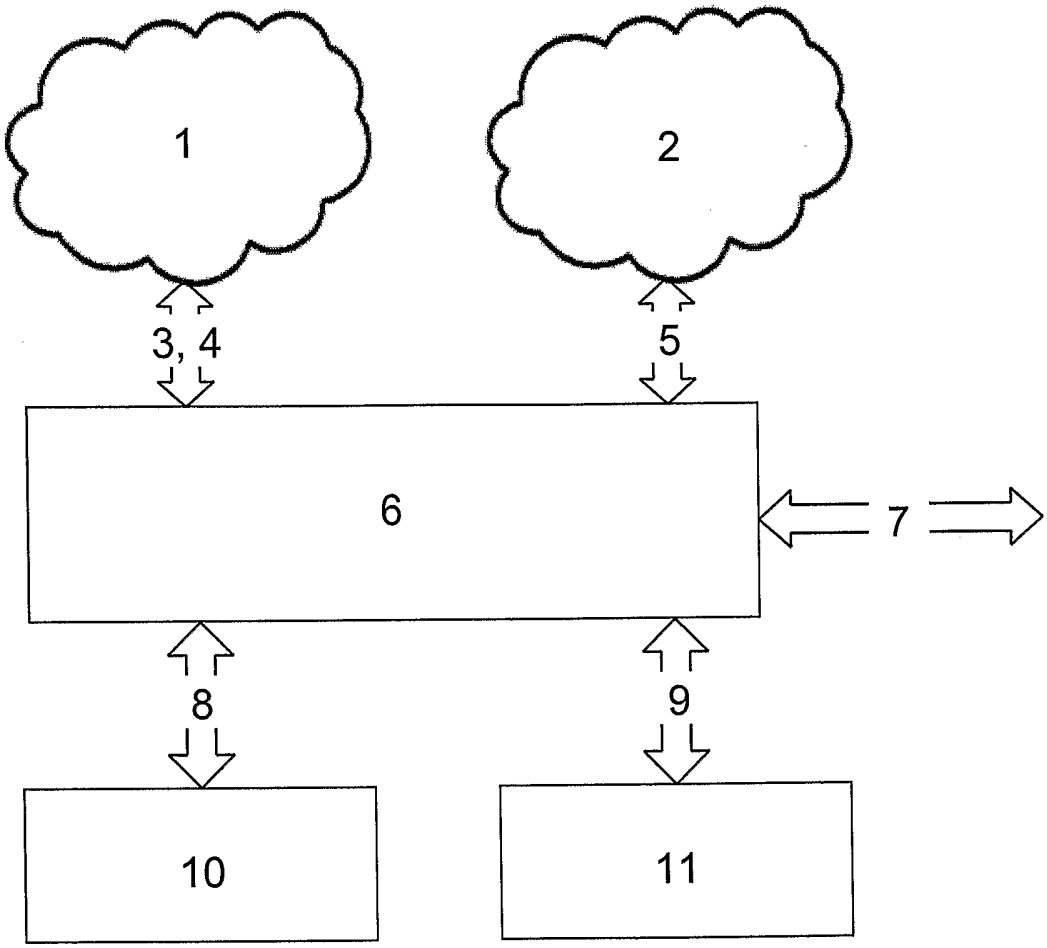


FIGURE 1

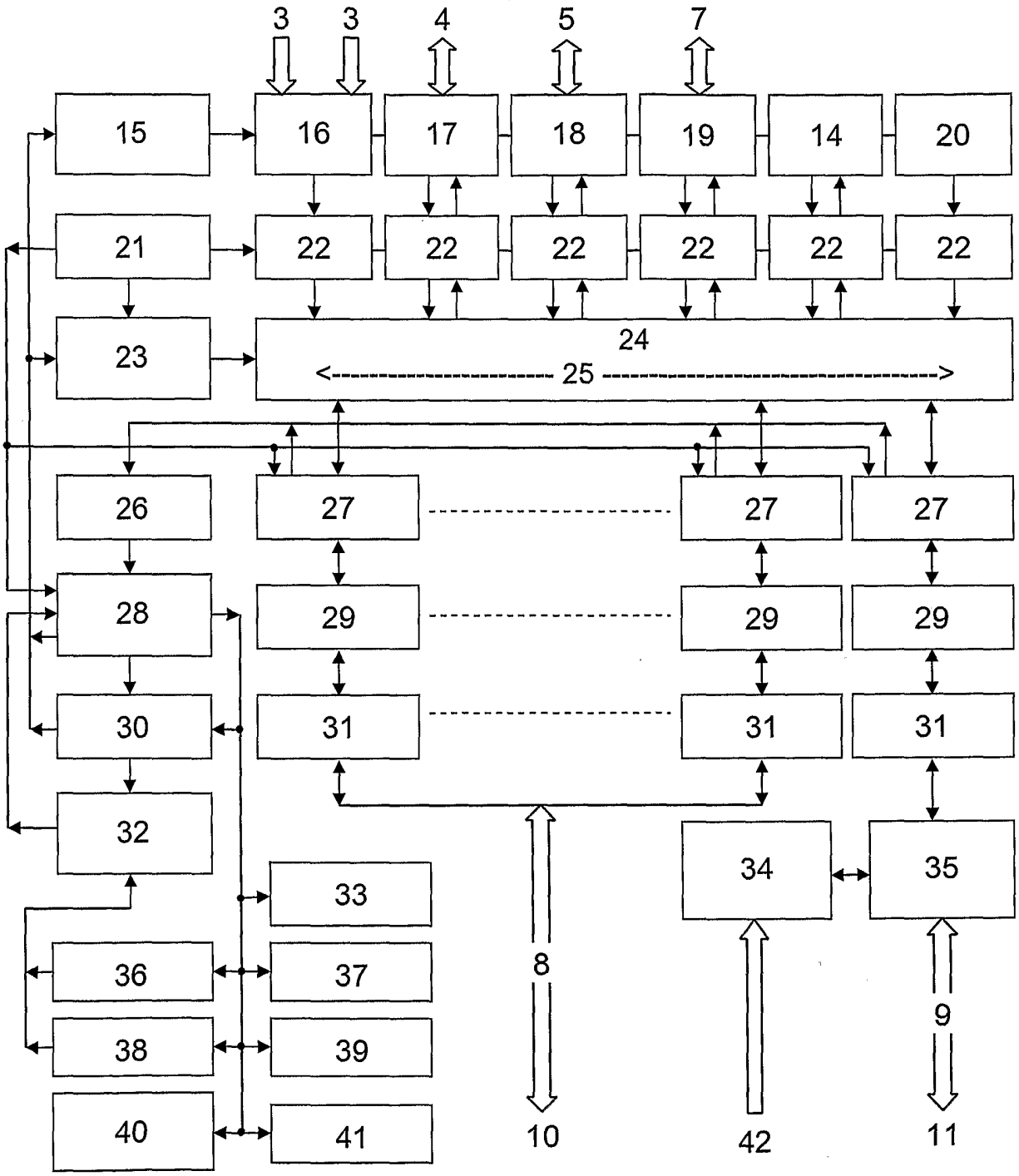

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FIGURE 2

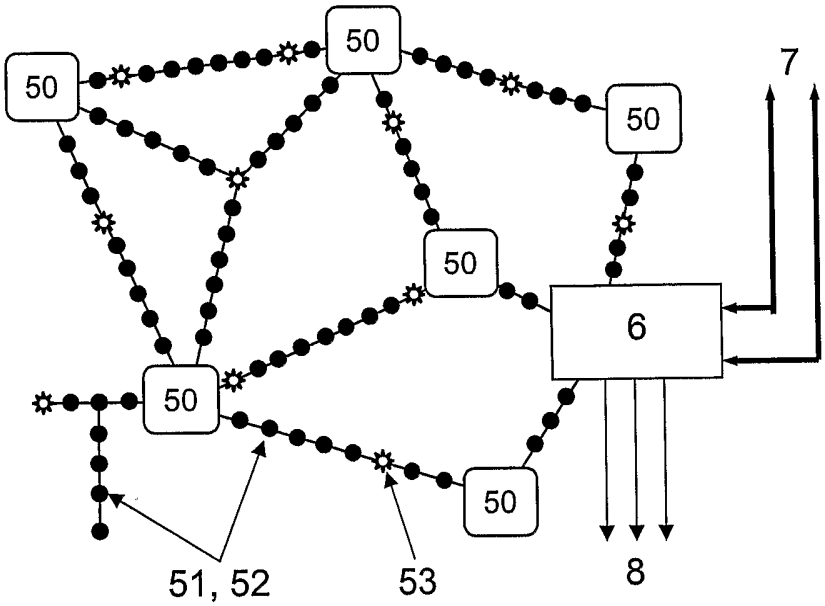


FIGURE 3

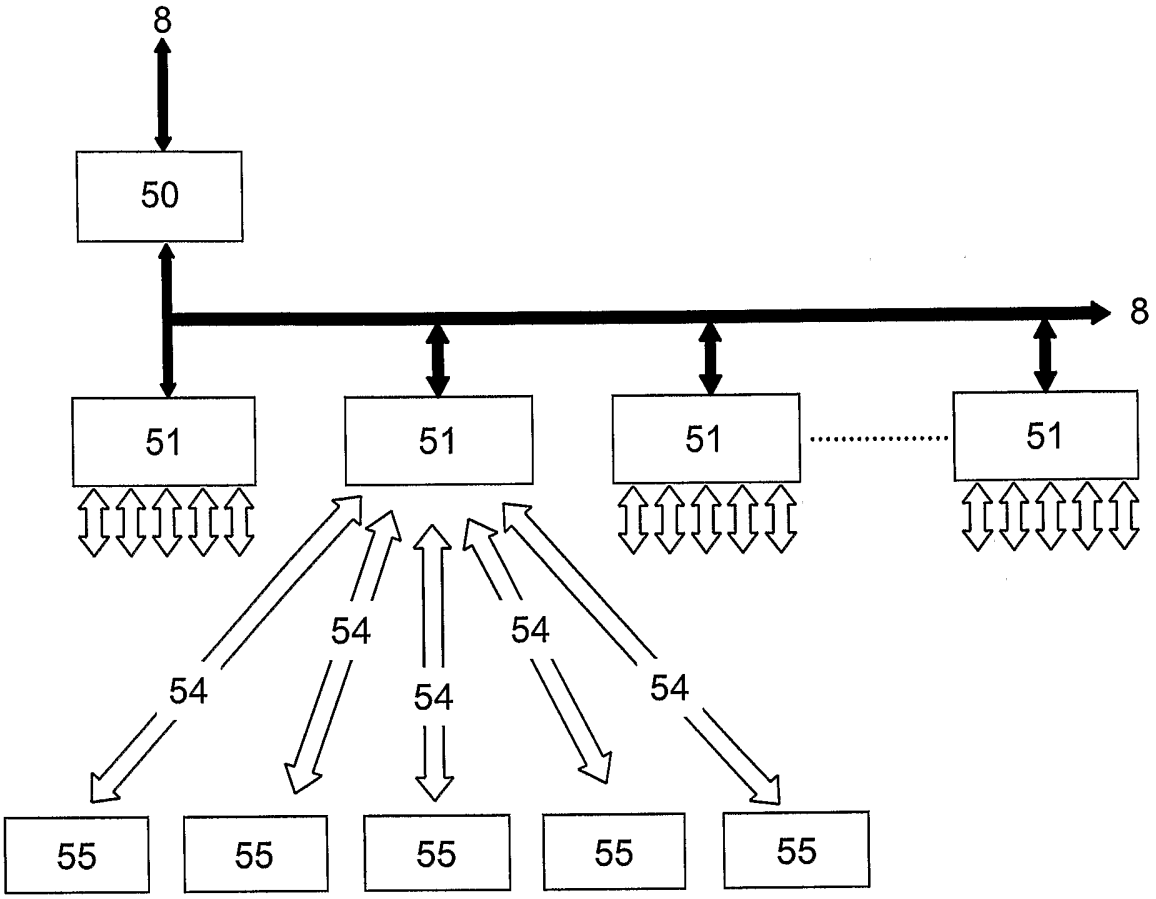


FIGURE 4

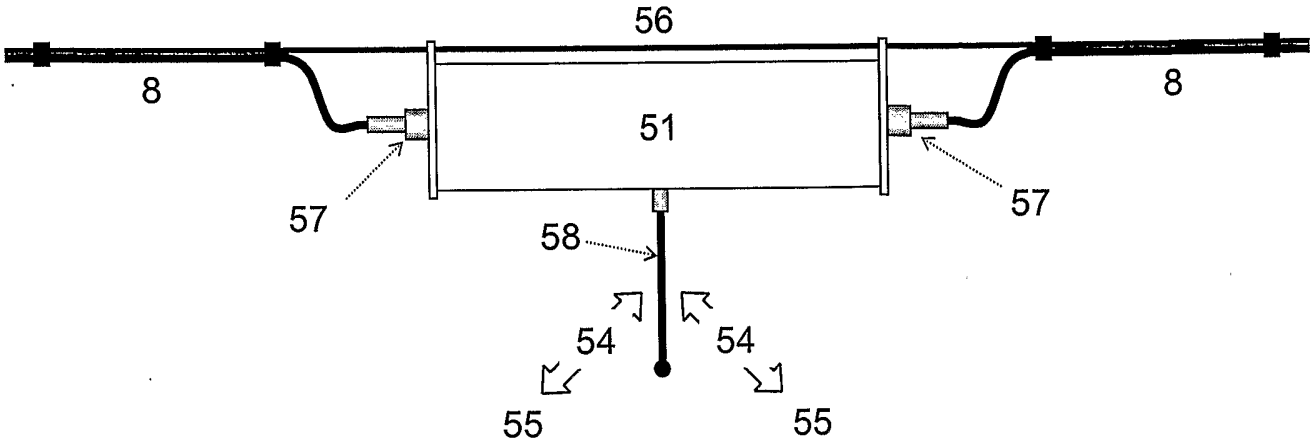


FIGURE 5

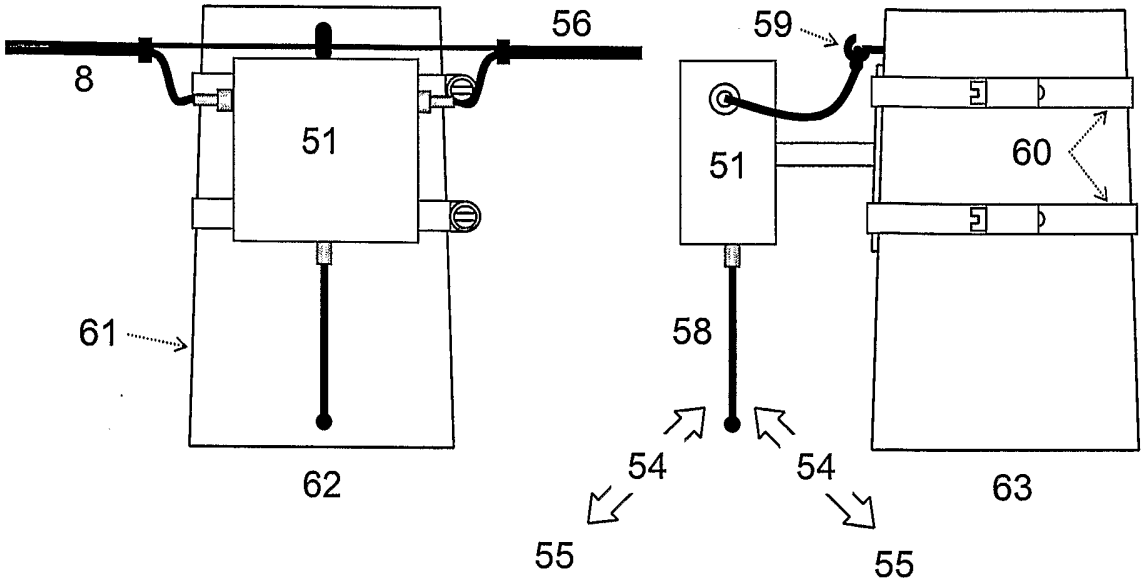


FIGURE 6

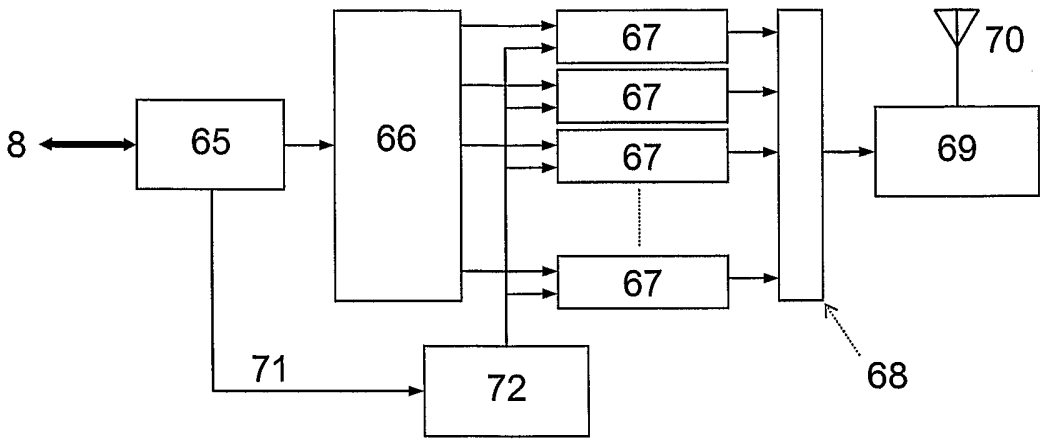


FIGURE 7

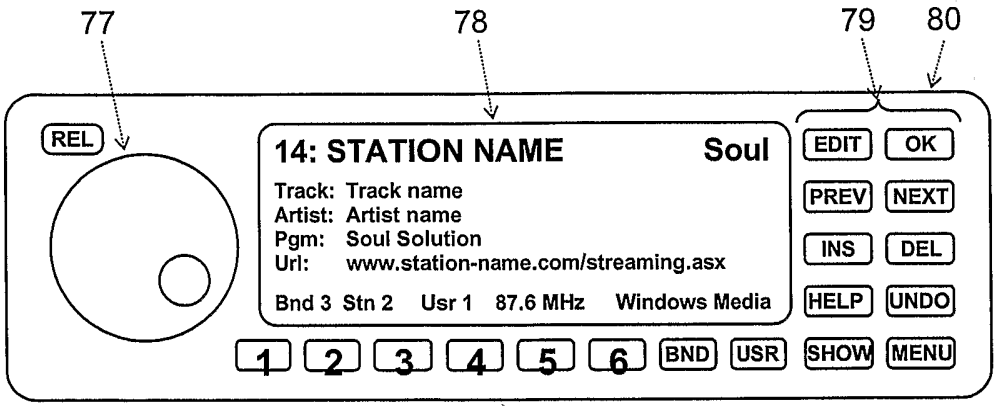

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Pgm: Soul Solution
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FIGURE 8

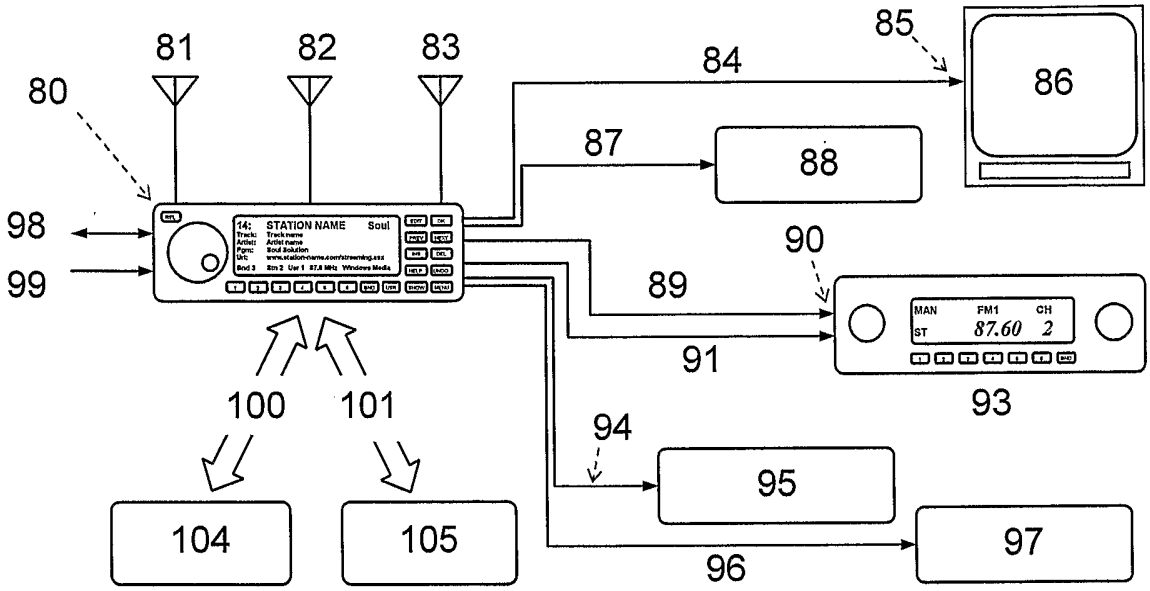

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FIGURE 9

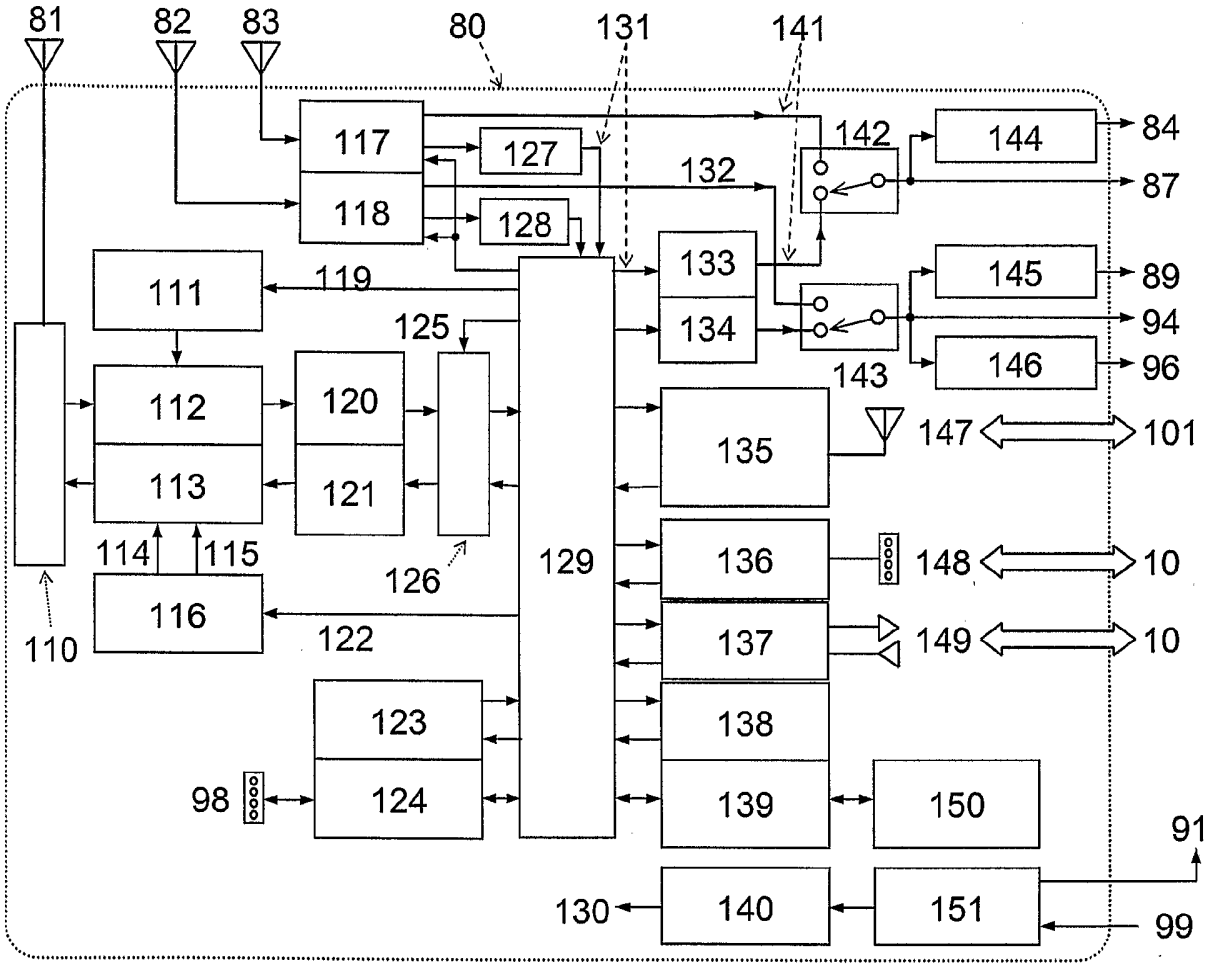

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FIGURE 10

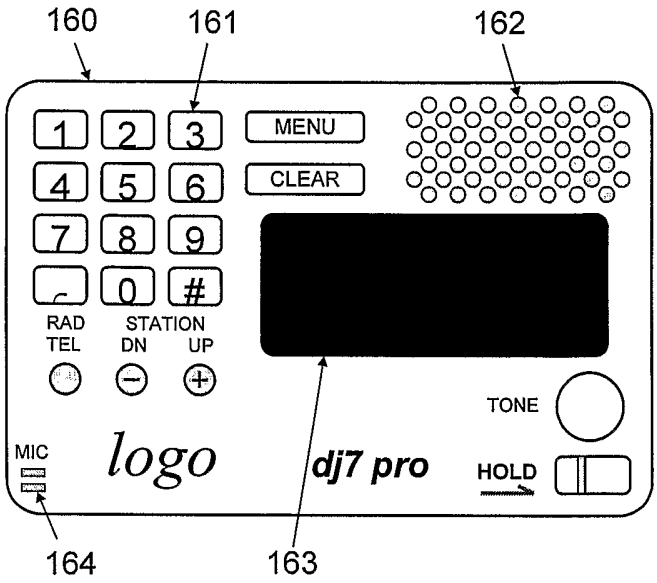

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FIGURE 11

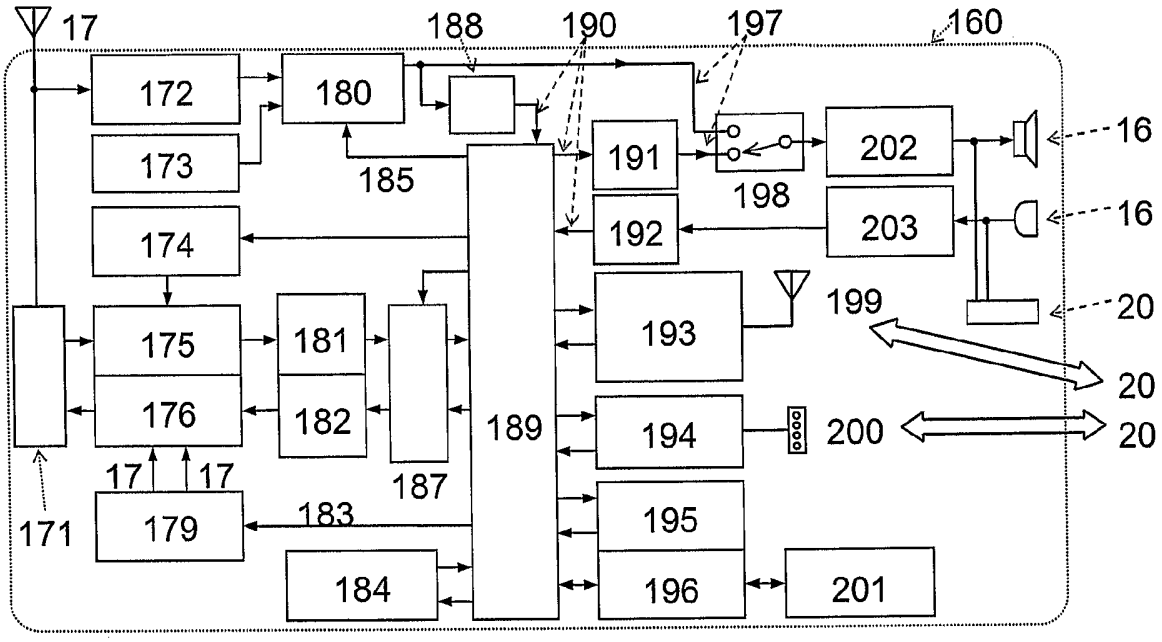

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FIGURE 12

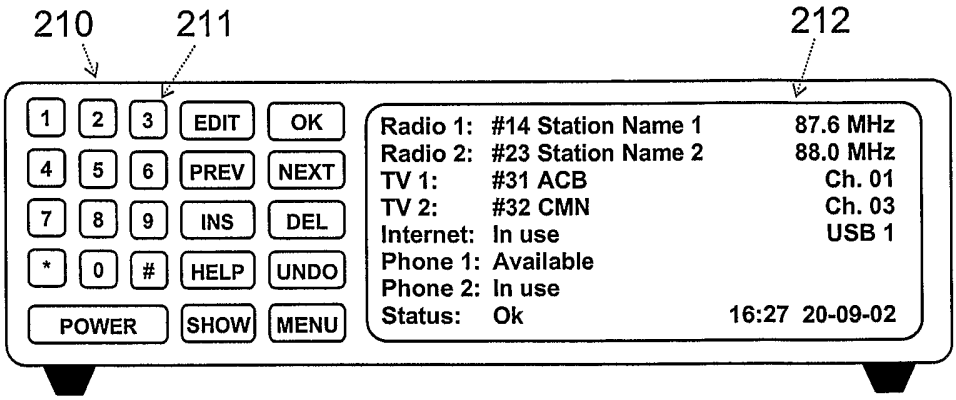

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Radio 1: #14 Station Name 1 87.6 MHz
Radio 2: #23 Station Name 2 88.0 MHz
TV 1: #31 ACB Ch. 01
TV 2: #32 CMN Ch. 03
Internet: In use USB 1
Phone 1: Available
Phone 2: In use
Status: Ok 16:27 20-09-02

FIGURE 13

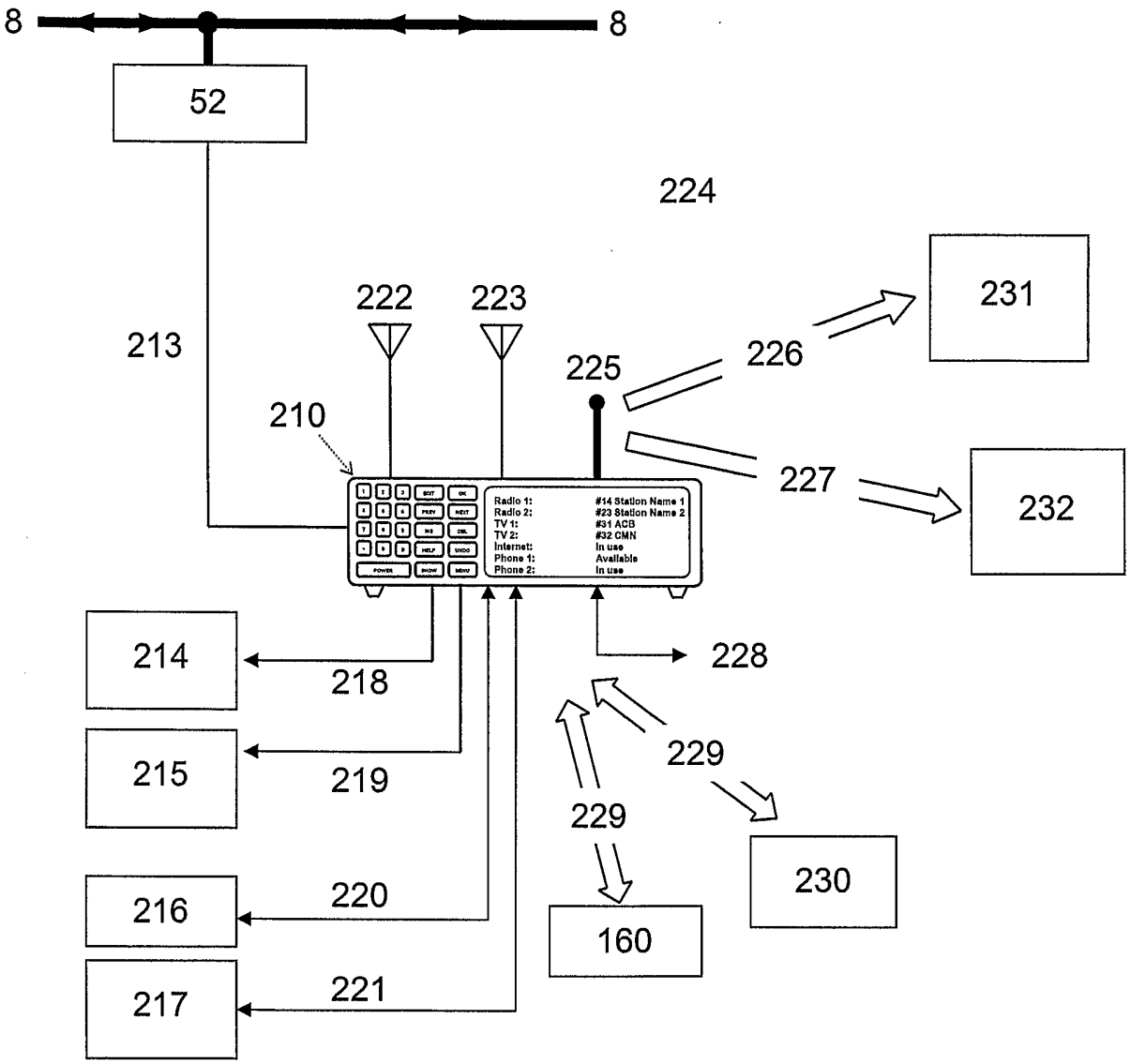

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Radio 1: #14 Station Name 1
Radio 2: #23 Station Name 2
TV 1: #31 ACB
TV 2: #32 CMN
Internet: In use
Phone 1: Available
Phone 2: In use
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FIGURE 14

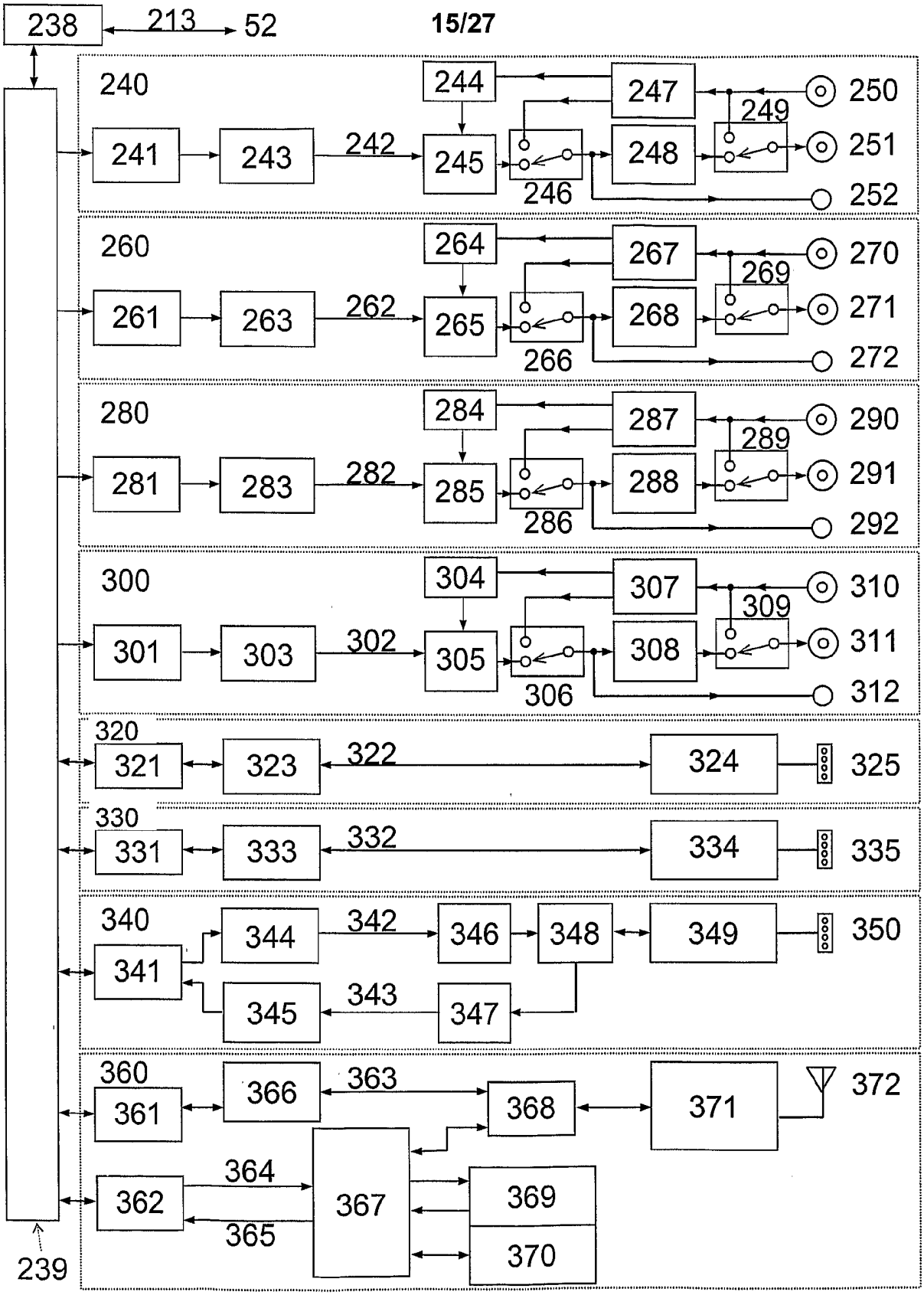

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FIGURE 15

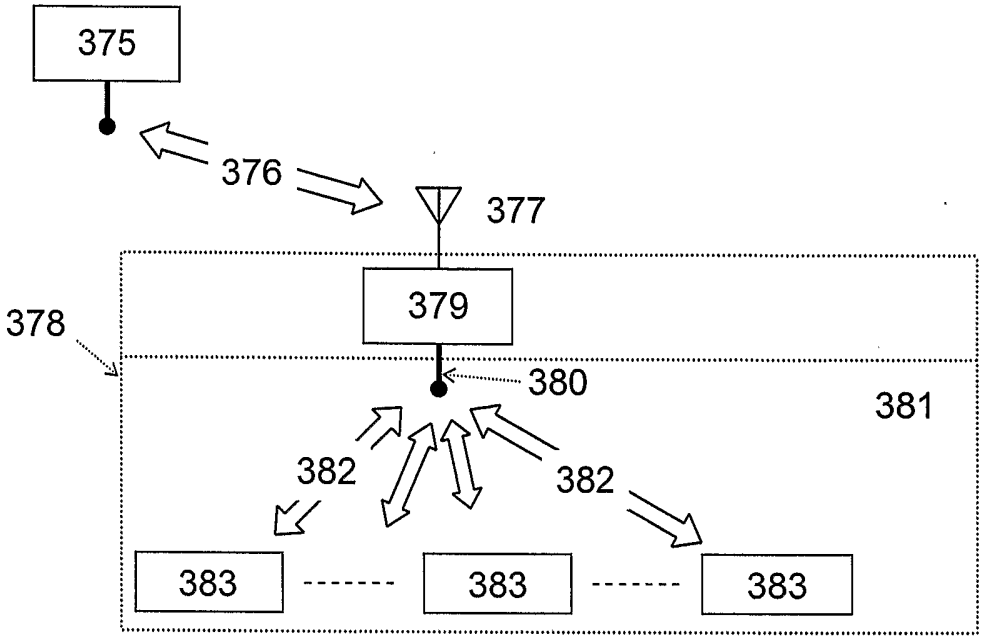


FIGURE 16

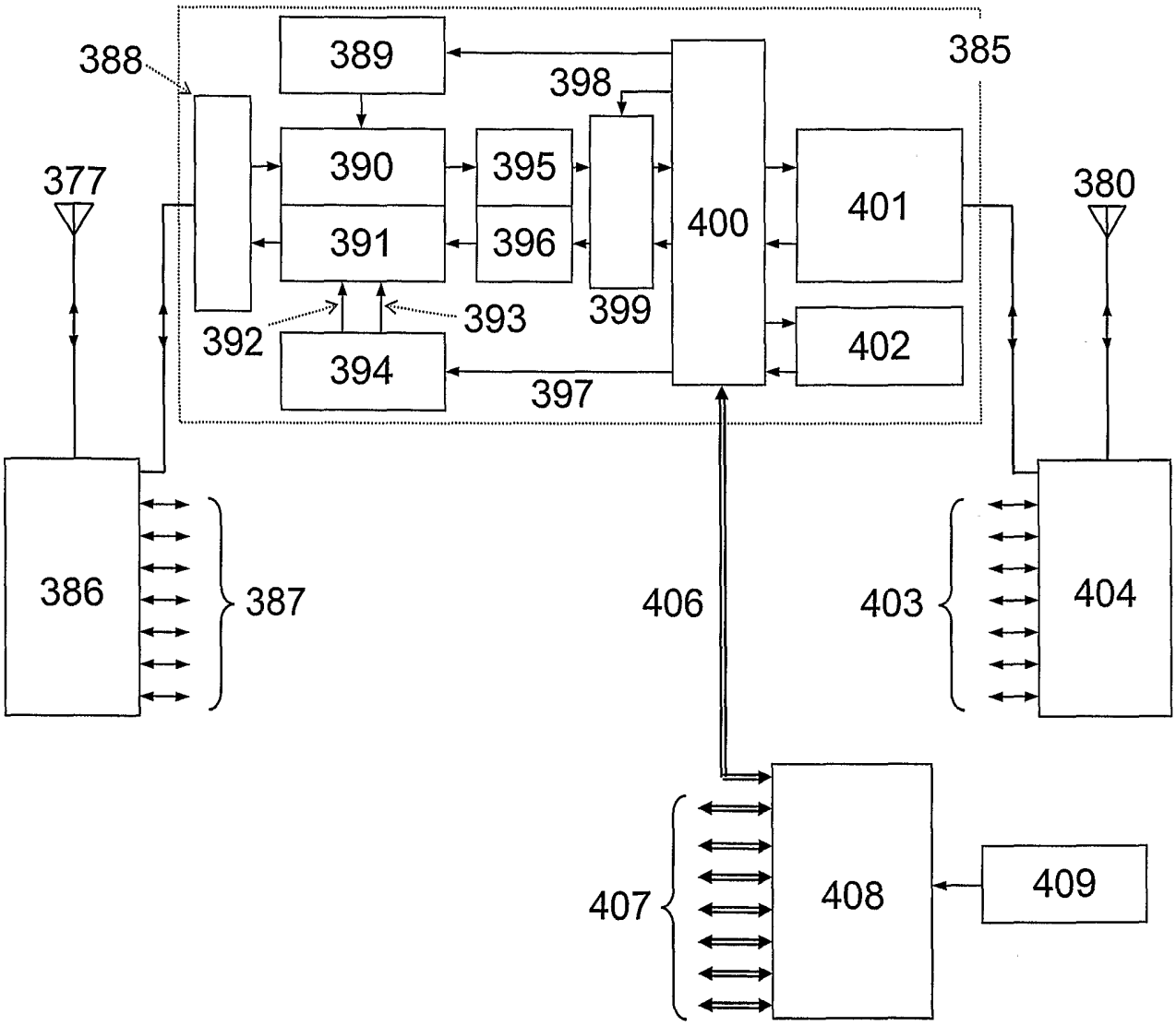

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FIGURE 17

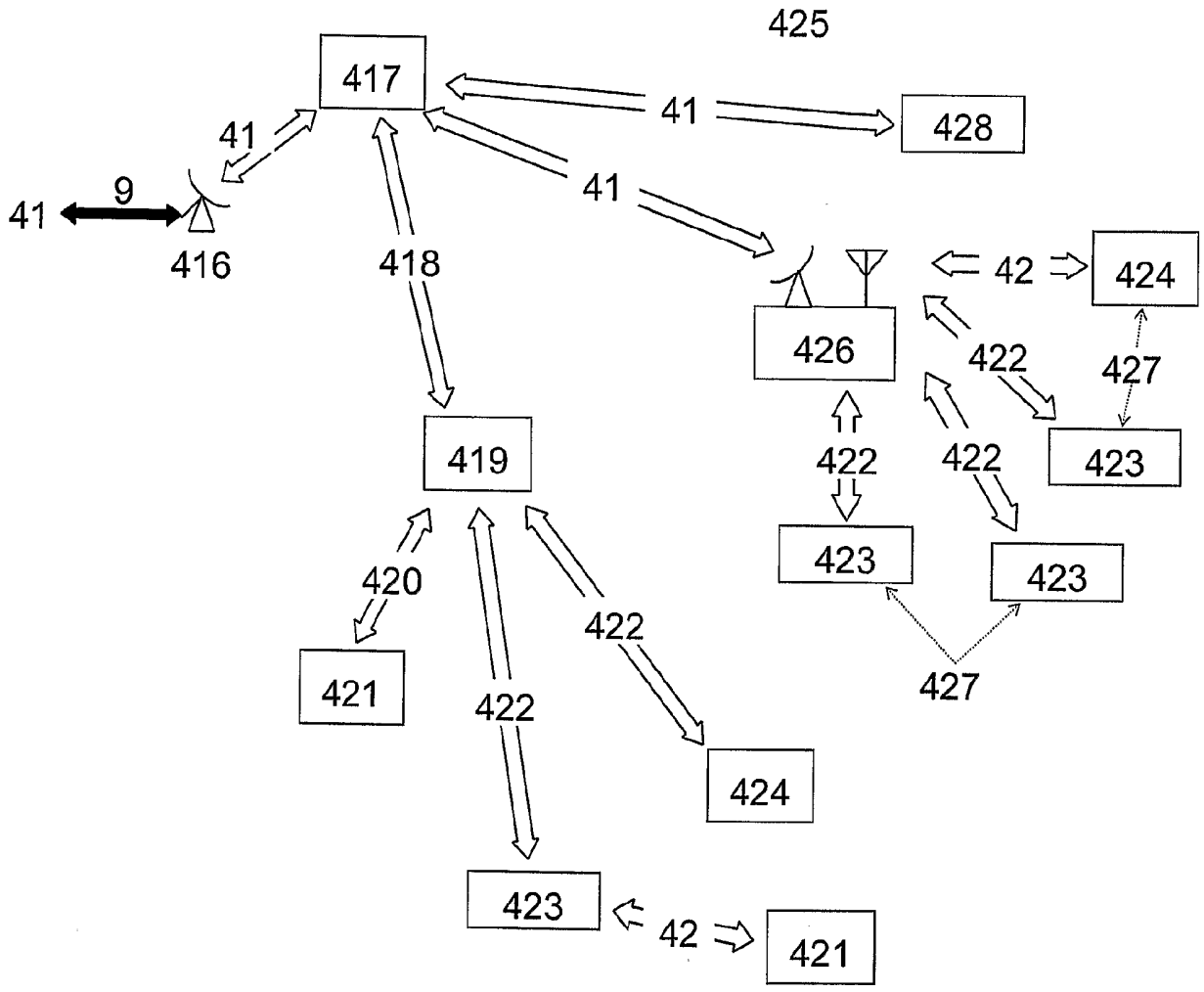

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FIGURE 18

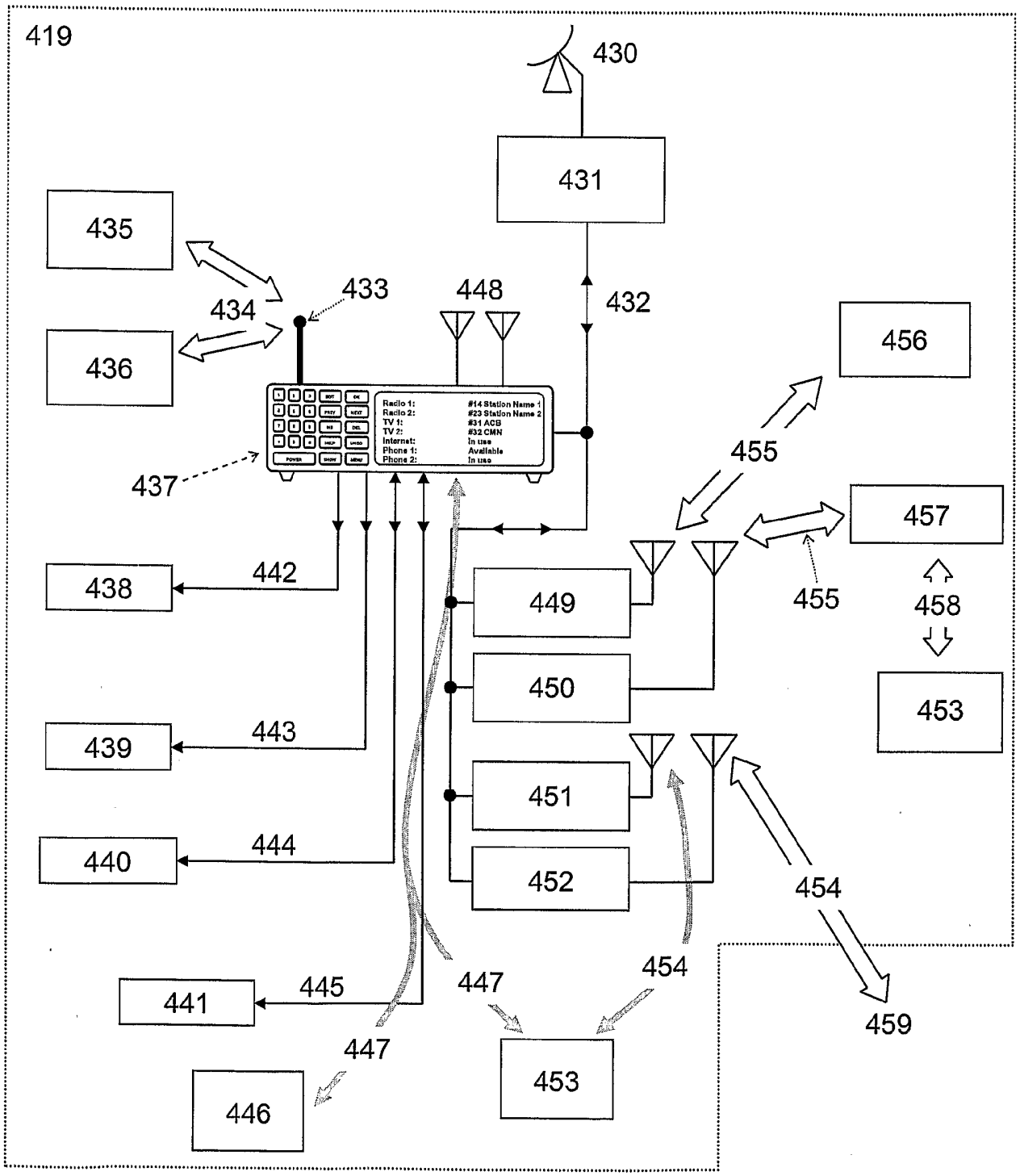

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Radio 1: #14 Station Name 1
Radio 2: #23 Station Name 2
TV 1: #31 ACB
TV 2: #32 CMN
Internet: In use
Phone 1: Available
Phone 2: In use
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FIGURE 19

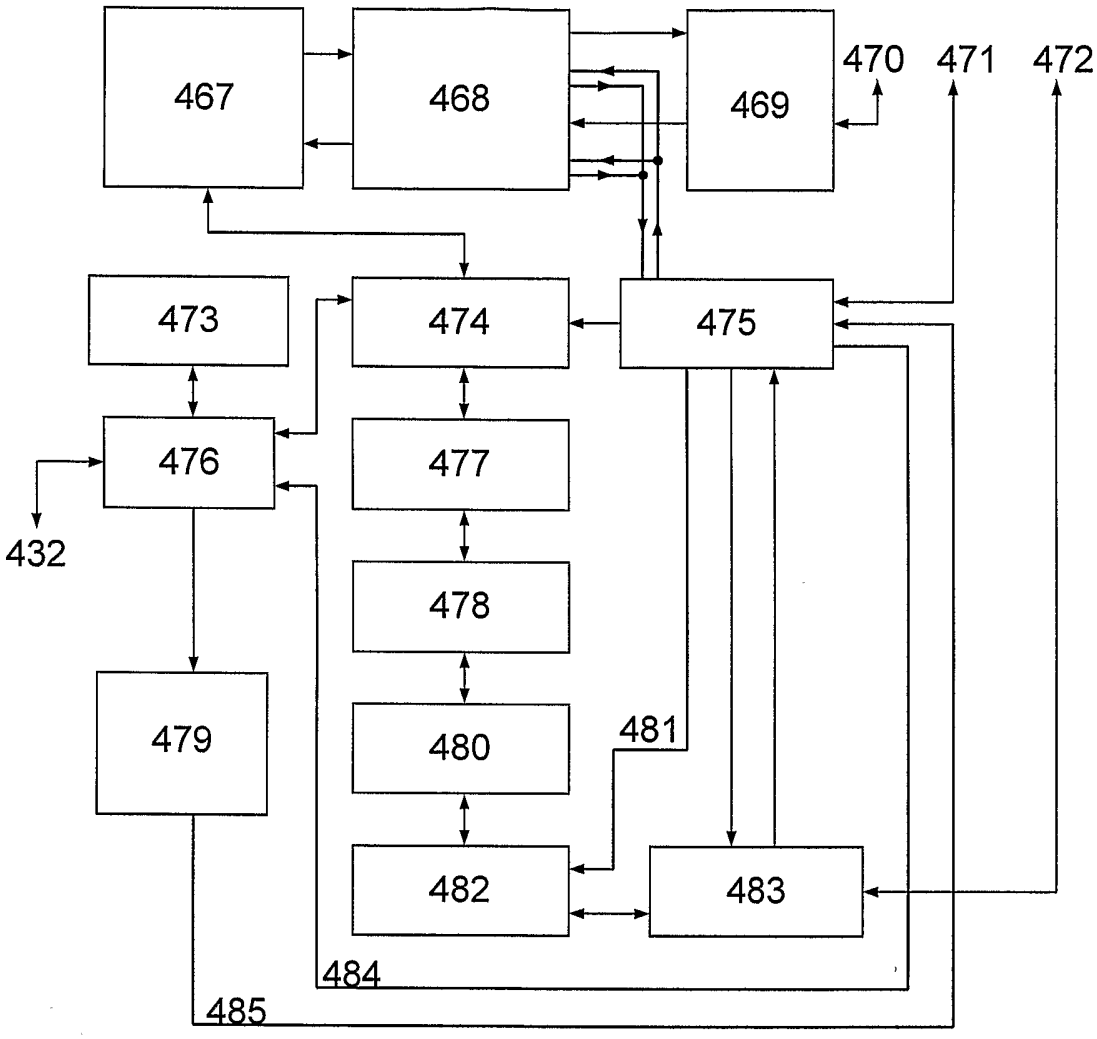

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FIGURE 20

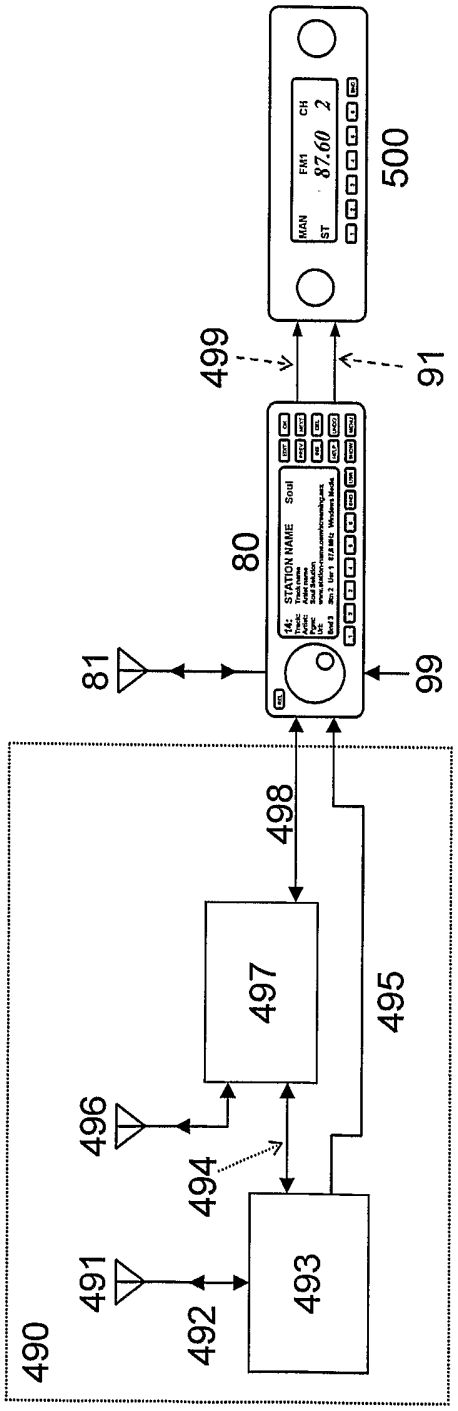

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FIGURE 21

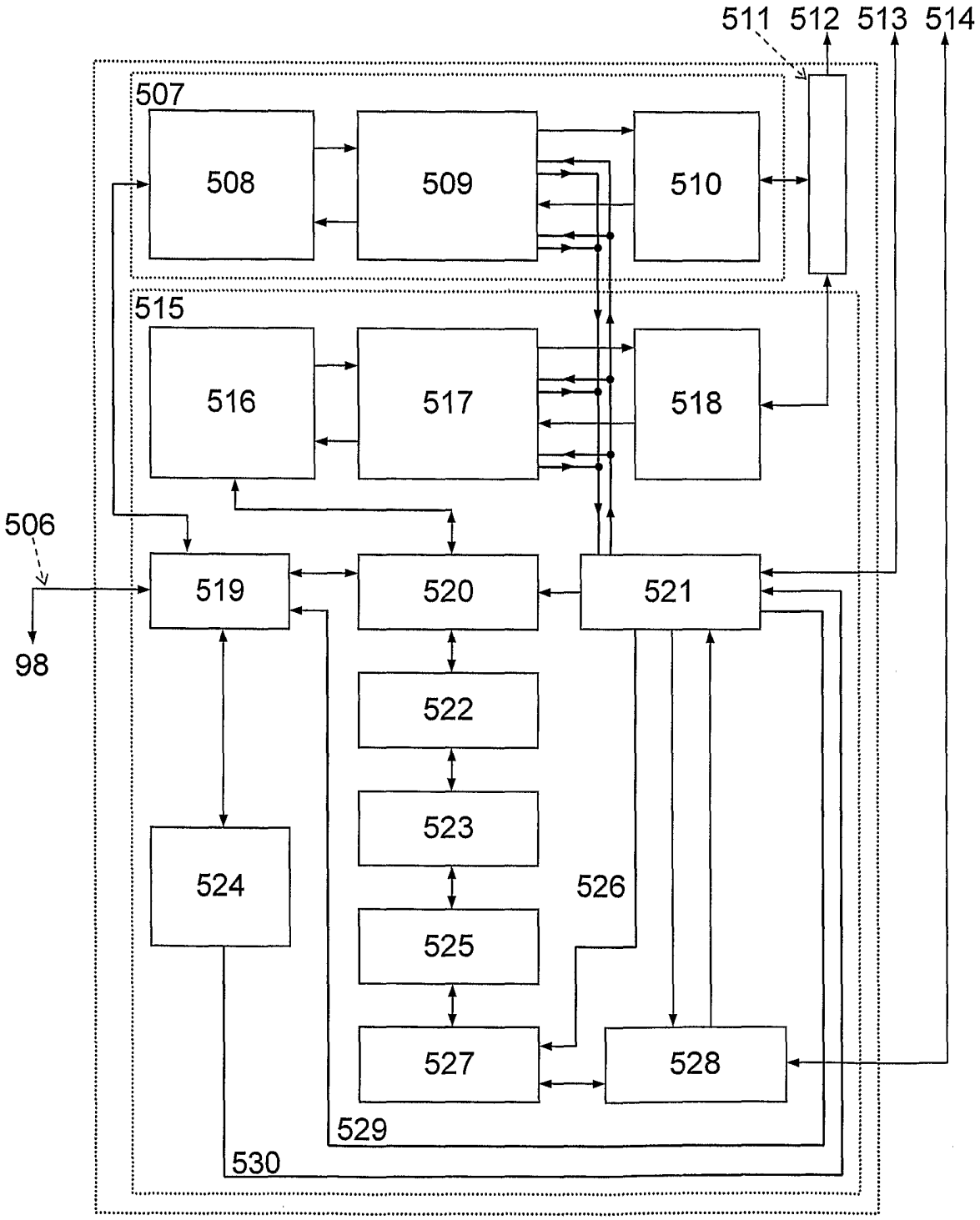

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FIGURE 22

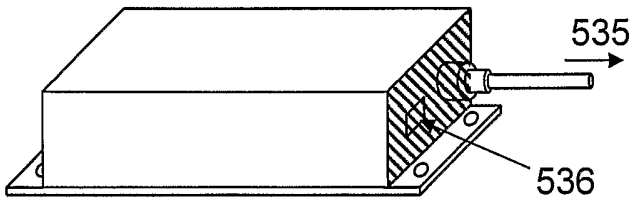


FIGURE 23

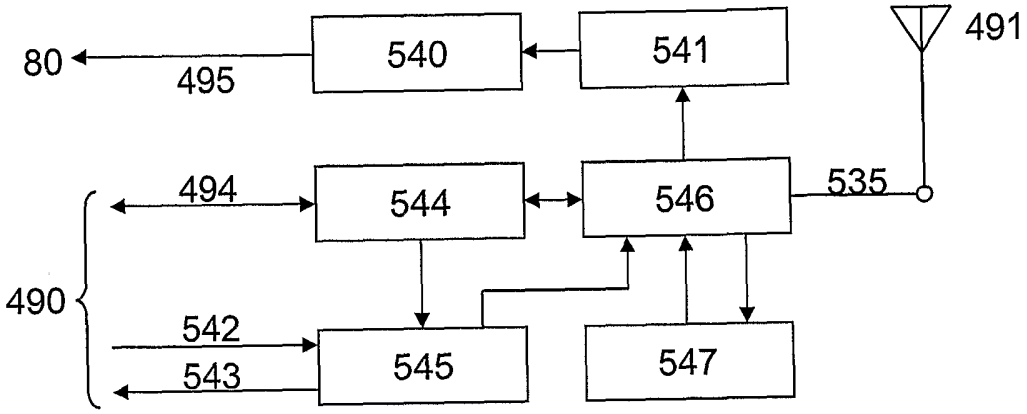


FIGURE 24

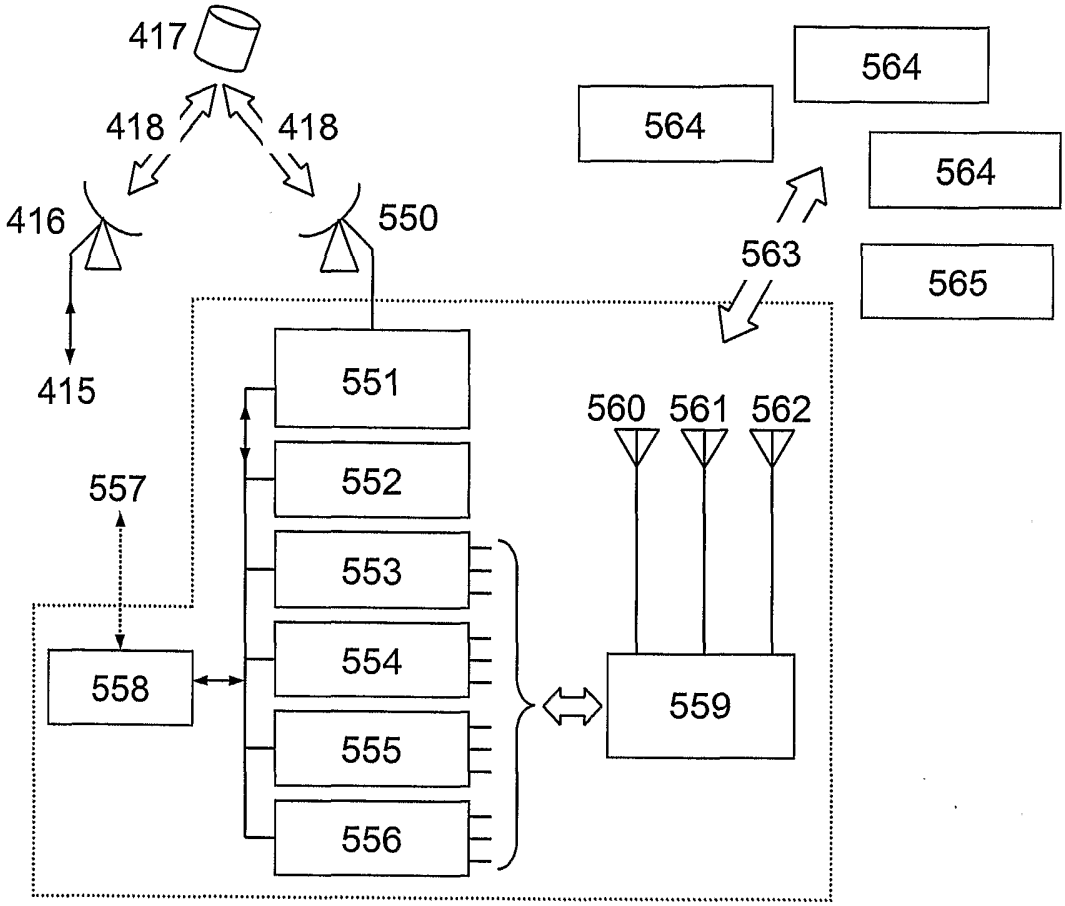

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FIGURE 25

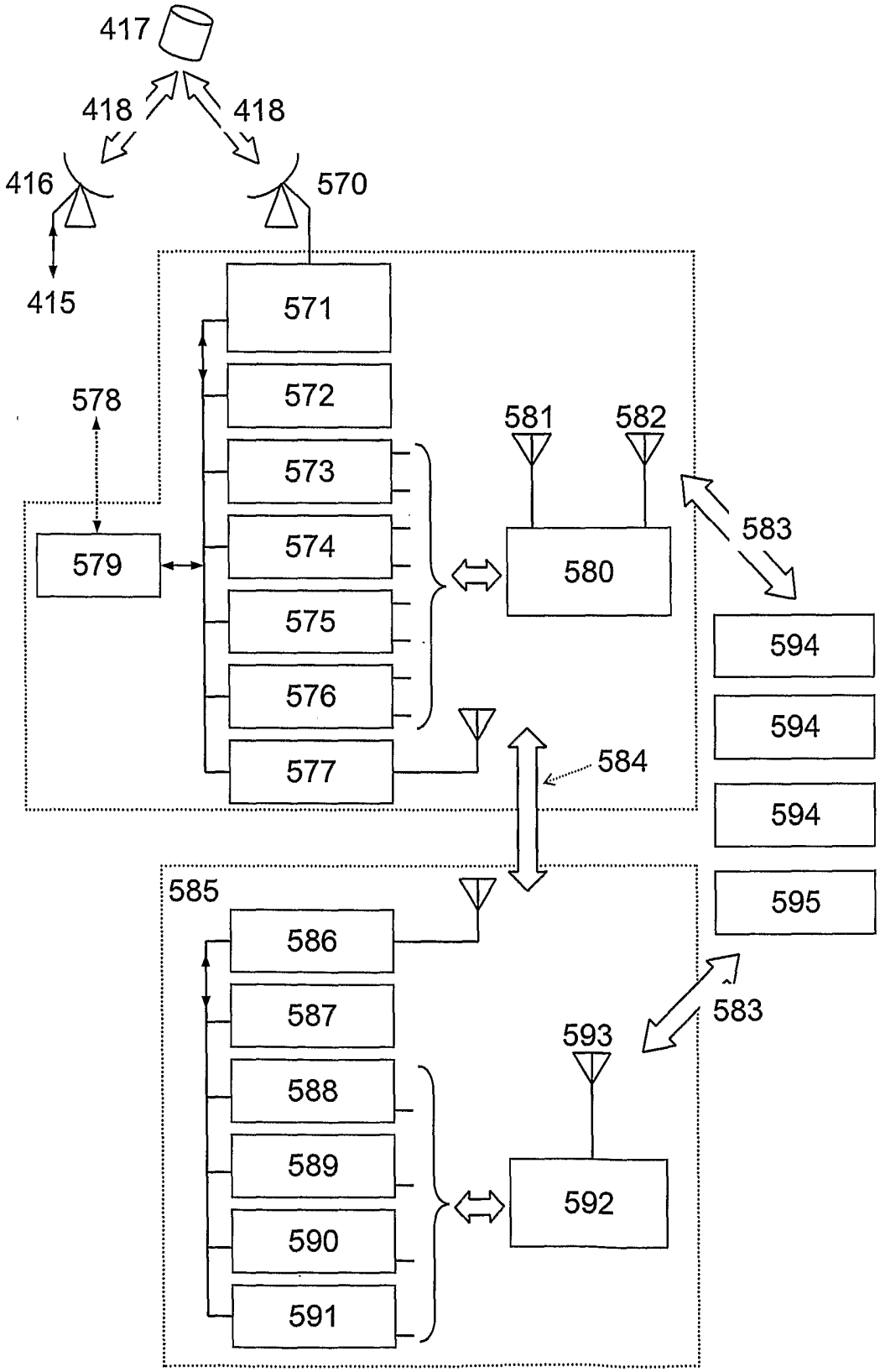

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FIGURE 26

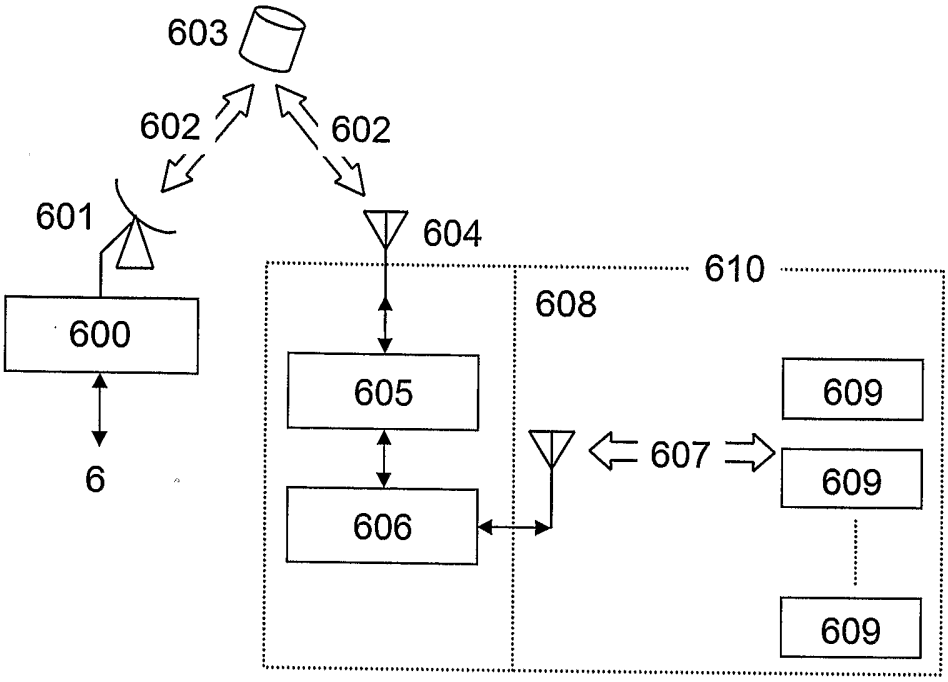


FIGURE 27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00725

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: H04L 12/66, 12/58, H04Q 7/28

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI, Inspec, USPTO + Keywords: www, web, internet, multicast, broadcast, hub, gateway, switch, bridge, tunnel, routing, L2TP, PPTP, Layer 2 tunnelling protocol, packet, address and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	WO 03/017703 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)) 27 February 2003 Whole document	1-44, 46 and 47
A, P	US 2002/0178236 A1 (PATEL et al) 28 November 2002 Whole document	1-44, 46 and 47
A	WO 02/15610 A2 (VESUVIUS, INC.) 21 February 2002 Whole document	1-44, 46 and 47

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 September 2003	22 SEP 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **DEREK BARNES** Telephone No : (02) 6283 2198

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00725

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	WO 01/58085 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)) 9 August 2001	
A	Whole document	1-44, 46 and 47
	US 6118472 A (DUREAU et al) 12 September 2000	
A	Whole document	1-44, 46 and 47

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00725

Box I **Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos :

because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos :

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos :

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II **Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:1-44, 46 and 47

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00725

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are two inventions:

1. Claims 1-44, 46 and 47 are directed to a system, modem or set-top-box for delivering broadcast and communications services including Internet services and connecting to gateways which provide connections to external communications networks and nodes and internal loopbacks from which said services are obtained, as defined in independent claims 1, 13 and 28. It is considered that this combination of features defined in each of the independent claims comprises a first "special technical feature".
2. Claim 45 is directed to a method of semi-duplex communication of a signal on a single narrowband radio channel including the features (a) to (o). It is considered that a communication method with steps (a) to (o) comprises a second separate "special technical feature".

Since the abovementioned groups of claims do not share either of the technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00725

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	03/017703	SE	200102778				
US	2002/0178236	WO	03/063010				
WO	02/15610	AU	81260/01	AU	81261/01	AU	83339/01
		AU	83341/01	AU	83342/01	AU	83352/01
		AU	86457/01	CA	2418301	CA	2418339
		CA	2419553	EP	1310116	EP	1310117
		EP	1310118	EP	1310119	EP	1310120
		EP	1310121	EP	1310123	US	6594498
		WO	02/15605	WO	02/15606	WO	02/15608
		WO	02/15609	WO	02/15611	US	2002/018450
		US	2002/019228	US	2002/028690	US	2002/037716
		US	2002/037727	US	2002/037733	US	2002/2037734
		US	2002/039907	WO	02/15607	WO	02/091765
		WO	02/054797	WO	02/061991		
WO	01/58085	AU	30656/01				
US	6118472	NIL					

END OF ANNEX