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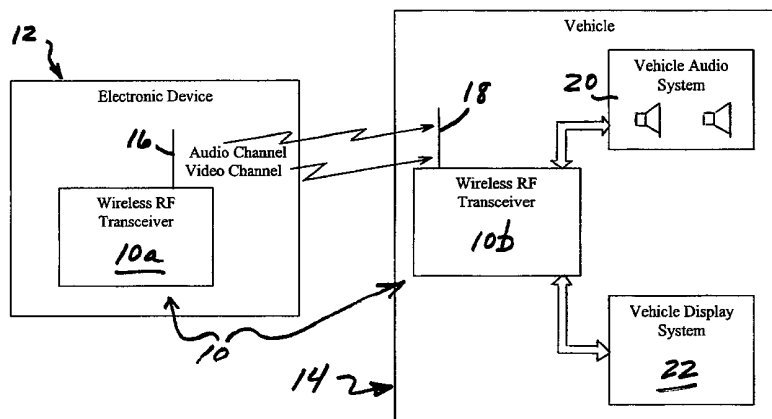
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: WIRELESS COMMUNICATIONS SYSTEM AND METHOD



(57) Abstract: A wireless communications system and method adapted for use in automotive applications for enabling automatic, high-speed, wireless voice and/or data communications links to be established between a wide variety of external devices and various electronic subsystems of a vehicle. The apparatus includes first and second RF transceivers which are operated in accordance with a communications specification to enable a seamless, automatic communications link to be created when the two RF transceivers come within a pre-determined proximity of one another, for example, within up to 100 meters of one another. Information from one device is then automatically transmitted over the wireless communications link to the other device. In various implementations the apparatus is used to obtain information from a home PC, a work PC, a notebook PC and various other electronic devices, as well as information from the Internet, which is displayed and/or played back for the user by various subsystems of the vehicle while traveling in the vehicle. Other applications involving retail and manufacturing applications are disclosed by which the apparatus is used to facilitate and/or expedite manufacturing processes or retail transactions via one or more high-speed, secure, wireless communications links which are created automatically and seamlessly between the RF transceivers of the apparatus of the invention.



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WIRELESS COMMUNICATIONS SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

5 This invention relates to wireless communications devices, and more particularly to a wireless communications system and method which facilitates an automatic wireless connection and wireless communication of voice and/or data information between various electronic components such as notebook computers, cellular telephones, hand held computing devices, pagers, audio devices, display terminals and other electronic systems.

10 With the dramatically increasing popularity of various personal electronic information and computing devices, there has been an increasing need to conveniently integrate the operation, and more specifically the transfer of information, between one or more of such devices. These electronic devices may include notebook computers, desktop computers, hand-held computing/organizer devices often termed "personal digital assistants" ("PDAs"), cellular
15 phones, pagers, audio systems, display devices, cordless headsets, digital cameras and virtually any other electronic or electromechanical device that use electronic information for its operation.

In many environments, such as within an automobile, it would be highly desirable to be able to communicate voice and/or data in wireless fashion between various subsystems of the vehicle, such as an overhead display subsystem of the vehicle, and a cellular phone, notebook
20 computer, PDA, pager or other personal electronic device which is carried on the person of an individual. The ability to transfer information between various subsystems of the vehicle and the user's personal electronic devices, in wireless fashion, would greatly increase the ease and convenience of use of such personal devices when travelling in the vehicle.

Until the present, transferring information between one or more of these devices has most
25 often required that specific cabling be connected between the devices. Usually the cabling is "application specific", meaning that the cabling used to connect, for example, a notebook computer and a hand-held PDA, is specifically designed for only these two components. Thus, the same communications cabling needed for connecting two specific electronic components often can only be used to connect those two components, and not to connect different
30 combinations of other electronic components. Thus, interconnecting different combinations of

electronic devices for intercommunication is often possible only with specific and often expensive cabling.

Communication between more than two electronic devices at one time via cabling presents even greater difficulty. Usually some form of hub or "T" connector, together with a mechanical switch and a suitable plurality of external cables is needed. Thus, the user often has
5 very limited flexibility in linking more than two electronic devices together for communication.

In certain environments, such as within an automobile, it is often impractical for the user to manually connect and disconnect cabling between two or more electronic devices, especially
10 when the electronic devices are portable devices which the user desires to carry with her when leaving the vehicle. Additionally, it would be extremely impractical to attempt to connect such personal electronic devices to existing subsystems of a vehicle, such as an overhead display console, with physical cables that would be loose within the vehicle. Such cabling could easily interfere with the driver's convenient operation of the various controls of the vehicle or with the
15 comfort and convenience of other passengers in the vehicle.

In some instances wireless communications, such as by infrared or radio frequency (ARF@) signals, have been used to permit communications and information sharing between two electronic devices. However, previously developed implementations of these methods of information transfer have suffered from significant drawbacks. For example, infrared data
20 transmission requires a "line of sight" between the communicating sensors of the two devices. Such a line of sight is often not practical and/or difficult to maintain in certain operating environments, such as while travelling in an automobile. This also constrains the use of portable electronic devices to positions where the sensor on the portable device is in the line of sight of the other device with which the portable device is communicating.

Radio frequency data communication has traditionally been hampered by the lack of a
25 standard communications protocol for data transfer which permits data to be transmitted between two or more independent electronic devices. A further limitation with RF data transfer systems has been the lack of a low cost, low power RF transceiver able to be inexpensively integrated with compact, portable electronic devices such as notebook computers, cellular telephones, hand-
30 held PDAs, pagers, etc., to enable convenient RF information transfer between two or more of such devices over short distances of up to, for example, about ten meters.

Still another limitation with traditional methods for transmitting data between electronic devices has been the lack of an "automatic" or "unconscious" connection when the devices are in proximity with one another. By "automatic" or "unconscious" it is meant an immediate communications link which is established between two or more electronic devices as soon as the devices are within a certain range, for example, ten meters, of each other without any command being input to any of the devices by the user. This limitation has up until the present required the user to provide one or more commands to at least one of the electronic devices to begin the process of transferring data between the two devices.

In view of the foregoing, it would therefore be desirable to provide a wireless communications system adapted for use in automotive applications to permit the wireless exchange of voice and/or data between various portable electronic devices and various electronic subsystems of a motor vehicle. Such a system would preferably include a first electronic component which could be readily integrated with a wide variety of electronic devices such as notebook computers, pagers, PDAs, cellular phones, etc., and a second component which could easily be integrated with various electronic subsystems of a motor vehicle such as an audio system, microphone, in-dash or overhead display system, on-board navigation system, etc. The first and second components would also preferably be extremely compact, lightweight, have low power requirements, and would therefore be very easily integrated into the various portable electronic devices described above, as well as into the various electronic subsystems of the vehicle. The components would preferably be able to automatically establish a wireless communications link as soon as the electronic device incorporating the first component comes into proximity with the vehicle, where the vehicle incorporates the second component. Such a system would completely obviate the need for any external cables to be attached between the electronic device(s) and the subsystem(s) of the vehicle.

Another example of an application where such a system would be highly useful is in the manufacturing of an automobile. If pertinent information concerning one or more of the vehicle's components or electronic subsystems could be quickly and automatically accessed and transmitted, via a high speed wireless communications link, to an electronic diagnostic/verification test system stationed along side an assembly line on which the vehicle is moving, then real time verification tests could be performed on the various electronic

subsystems of the vehicle as it being manufactured. Such automatically created wireless communications links would significantly enhance a wide range of other applications.

Furthermore, it would be highly desirable if such a wireless communications system could be provided which does not add appreciably to the overall costs of such portable electronic devices or to the costs of various electronic subsystems of the vehicle. Preferably, the system would provide a manner of transmission that also ensures very secure wireless transmissions to limit the possibility of the devices being susceptible to electronic "eavesdropping" or the data being intercepted by other RF devices operating in the same frequency spectrum.

SUMMARY OF THE INVENTION

The present invention is directed broadly to a wireless communications system and method for transmitting information between two or more electronic devices. In one preferred embodiment a miniature RF transceiver is integrated into each electronic device. The RF transceivers are low power, short range transceivers that enable the exchange of voice and/or data information between the two devices. The wireless communications link between the devices is established automatically when the devices come within a predetermined proximity to each other. Thus, information can be transmitted automatically from one device to the other without any action from an individual monitoring or possessing one of the devices and without the user having to connect one or more external cables between the devices.

In one preferred embodiment the present invention makes use of the Bluetooth communications standard for establishing a wireless communications link between two devices, where each device is equipped with a RF transceiver operating in accordance with the Bluetooth communications standard. This enables two or more devices to be connected via high speed, wireless communications links to permit voice and/or data information to be exchanged between the various devices. The devices communicate on the 2.4GHz ISM frequency band and employ encryption and authentication schemes, in addition to frequency hopping, to provide a high measure of security to the transmission of data between the devices. Advantageously, the wireless communications link is created automatically as soon as the two devices come into proximity with each other.

In each embodiment of the present invention, the RF transceivers each comprise low power components providing a limited range of up to about 100 meters. Each RF transceiver

has a negligible power consumption, as compared with the device with which it is integrated. Each RF transceiver can automatically form ad hoc communications links with other RF transceivers passing within the predetermined transmission range.

The various preferred embodiments of the present invention enable voice and/or data information to be transmitted between a wide variety of devices without any command or intervention by the user. The preferred embodiments lend themselves especially well to applications involving the transfer of information between various portable electronic devices and the various electronic subsystems of a motor vehicle. The preferred embodiments further enable the transfer of information between a motor vehicle and other electronic systems outside of the vehicle, which makes the present invention ideally suited to applications involving assembly of the vehicle, assisting in transmitting diagnostic information to and from a vehicle, and a wide variety of other applications where it is desirable to transmit information to a user traveling in a motor vehicle.

The various preferred embodiments are also ideally suited to establishing wireless communications links for a wide variety of other home, business, and commercial applications. A wide variety of electronic devices can thus be networked together for information sharing.

BRIEF DESCRIPTION OF THE DRAWINGS

The various advantages of the present invention will become apparent to one skilled in the art by reading the following specification and by referencing the following drawings in which:

FIGURE 1 is a block diagram drawing of a wireless communications system in accordance with a preferred embodiment of the present invention being used to transfer information between an electronic device of the user and an audio system and a display system of a motor vehicle;

FIGURE 2 is a block diagram illustrating the wireless communications system of the present invention being used to perform vehicle diagnostics on a motor vehicle by creating a wireless communications link between a notebook computer running diagnostics software and a vehicle interface circuit associated with a motor vehicle;

FIGURE 3 is a block diagram of the wireless communications system of the present invention being used in an assembly operation in which information is transmitted from RF

transceivers located in each vehicle to an assembly line monitoring system such that information needed for the manufacture of each vehicle can be requested in advance and thereafter made ready as needed during assembly of the vehicle;

FIGURE 4 is a block diagram of the wireless communications system being used to
5 create a high speed data link between a drive-through restaurant menu and the various electronic subsystems of the motor vehicle to enable information from the drive through menu to be broadcast and/or displayed by the vehicle's electronic subsystems;

FIGURE 5 is a block diagram of the wireless communications system being used in
10 connection with a key FOB to enable data to be transmitted from the key FOB to a vehicle bus interface of a motor vehicle to control various subsystems of the vehicle;

FIGURE 5A is a block diagram of the major components of the key FOB of FIGURE
5;

FIGURE 6 is a block diagram drawing illustrating a wireless communications link
15 created between a key FOB carried by the user and a work PC to enable data files to be transmitted in wireless fashion between the PC and the key FOB;

FIGURE 7 is a block diagram of the key FOB of FIGURES 5 and 5A being used to
transmit files in wireless fashion from the key FOB to a home PC;

FIGURE 8 is a block diagram of the present invention being used to create a wireless
20 communications link between a cellular phone and a proprietary voice recording/playback system manufactured by the assignee of the present application and presently used on motor vehicles;

FIGURE 9 is a block diagram of the wireless communications system being used to
25 create a wireless data link between a home PC linked to the Internet and various electronic subsystems of a motor vehicle to thereby enable information from the Internet to be transmitted to the subsystems of the vehicle automatically;

FIGURE 10 is a block diagram of the wireless communications system of the present
invention being used to establish a wireless communications link between a cellular phone and various electronic subsystems of a motor vehicle after the cellular phone has linked with a wireless service organization;

30 FIGURE 11 is a block diagram of the wireless communications system of the present invention being used to establish a wireless data link between a cellular phone of a user and one

or more subsystems of a vehicle, where the cellular phone is linked with a wireless service organization so that "push" services from an Internet service provider can be used to provide personalized traffic, weather or other information automatically from the Internet to the user as the user travels in the vehicle;

5 FIGURE 12 is a block diagram of the wireless communications system of the present invention being used to create a wireless data link between a gas pump kiosk of a service station and the subsystems of a vehicle, where the gas pump is linked to the Internet, such that information from the Internet can be transmitted in wireless fashion to one or more electronic subsystems of the vehicle while the vehicle is parked near the gas pump;

10 FIGURE 13 is a block diagram of the wireless communications system of the present invention being used to create a wireless data link for downloading map directions downloaded onto a home PC off of the Internet directly to one or more electronic subsystems of the vehicle while the vehicle is in close proximity to the home PC; and

15 FIGURE 14 is a block diagram of the wireless communications system of the present invention being used to transmit corporate information or messages from a wireless service organization to a fleet vehicle, where the information is provided over the Internet from a corporate computer system, and such that the information can be provided via a wireless data link directly to the various subsystems of a fleet vehicle.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, a wireless communications system 10 in accordance with a preferred embodiment of the present invention is illustrated. The present invention is broadly directed to a wireless communications system 10 in which at least one pair of RF transceivers 10a and 10b are used to create a wireless communications link between at least two independent
25 electronic devices. Each RF transceiver 10a and 10b operates in accordance with a suitable wireless communications protocol or standard to enable wireless communications between the transceivers 10a and 10b. The specific protocol or standard used also preferably enables the wireless communications link to be established automatically when the two RF transceivers come into proximity with each other. The specific protocol or standard may be the Bluetooth
30 communications standard or the Shared Wireless Access Protocol-Cordless Access (SWAP-CA)

specification, or any other suitable wireless communications specification that enables voice and/or data information to be transmitted between the two RF transceivers 10a and 10b.

The Bluetooth communications standard was established for creating small form factor, low-cost, short range RF links between mobile telephones, notebook computers, PDAs and other portable electronic devices. It is the result of a joint effort between several major commercial organizations to develop a RF communications standard for creating secure, wireless communications links between portable electronic devices such as cellular phones, PDAs, computers and other electronic devices. The Bluetooth communications standard is presently an "open" standard that enables short range, secure, RF transmission of voice and/or data information between such portable electronic devices to thus eliminate the need for physical cables for interconnecting the devices. Its implementation is based on a high performance, but low cost, integrated RF transceiver chip set. The Bluetooth standard further provides the potential for automatic and rapid "ad hoc" wireless connections when two or more devices equipped with RF transceivers operating in accordance with the Bluetooth standard come into proximity with each other.

The Bluetooth standard makes use of the free, universal 2.4 GHz Industrial, Scientific, and Medical (ISM) band and a frequency hopping scheme using 1600 hops/second. Encryption and authentication are built into the Bluetooth standard along with an automatic "output power adaption" feature that automatically reduces the output power of the RF transceiver to only (and exactly) that amount of power which is needed to accomplish the data transmission.

The Bluetooth standard specifies a minimum RF receiver sensitivity of -70dBm and the nominal output power is specified as 0 dBm (i.e., 1 mW), which eliminates the need for an off-chip power amplifier. With a 0 dBm transmit power, the typical range for the RF transceiver is up to about 10 meters. The range can be extended to about 100 meters by augmenting the RF transceiver chip set with an external power amplifier to increase the transmit power to a maximum of 20dBm. The maximum data transfer rate between two Bluetooth transceivers is slightly under 1Mbits/sec. The data rate for a voice channel is 64 kbits/sec (GSM-13kbits/sec). A suitable RF transceiver for use with the Bluetooth standard can be formed relatively inexpensively as a single CMOS integrated chip. As such, the RF transceiver can be manufactured sufficiently small such that it can be readily incorporated into virtually all portable electronic devices without adding appreciably to the size, cost, weight and power consumption

of such devices. Additional information on the Bluetooth standard can be obtained at URL address *www.bluetooth.com*.

Advantageously, the Bluetooth standard presently supports wireless communications networks termed "piconets" of between two to eight devices actively communicating with each other. Additional devices can be "parked" and accessed as needed. Within a piconet, one of the devices acts as the "master" device, which determines the frequency hopping pattern, packet timing, and which coordinates transmissions to the other "slave" devices. The slave devices can also be members of more than one piconet at a time, thus forming an ad hoc arrangement of multiple piconets termed a "scatternet". Thus, networked communication of notebook computers, PDAs, mobile phones, and other devices are provided for with the Bluetooth standard.

The SWAP-CA specification is another wireless communications standard that potentially could be employed by the RF transceivers 10a and 10b. The SWAP-CA specification also is intended to use integrated transceivers on a 2.4 GHz frequency hopping scheme for wireless communications between various products and appliances used in homes. With this standard, the data transfer rate for information is 2Mbits/sec.

Accordingly, while the Bluetooth or SWAP-CA specifications may be referenced throughout the discussion of the various preferred embodiments, the present invention should be understood as not being limited to the use of one or the other of these specifications, or necessarily to any specific communications specification.

In FIGURE 1, one RF transceiver 10a is integrated into a first electronic device 12 while the other RF transceiver 10b is disposed within a motor vehicle 14. The electronic device 12 may comprise a notebook computer, a hand-held PDA, a cellular phone, a pager, or any other portable electronic component. The first RF transceiver 10a includes an antenna 16 for enabling two way communications with the RF transceiver 10a. Likewise, the second RF transceiver 10b also includes its own antenna 18 for enabling two way communications. The vehicle 14 typically includes an audio system 20 and a display system 22. The display system 22 may be mounted in a dashboard, an overhead console, a floor mounted console, a visor, a rear view mirror or at a wide variety of other locations inside the vehicle 14. The display 22 may comprise a small cathode ray tube ("CRT"), a liquid crystal display ("LCD") or various other forms of displays which are easily visible in daytime as well as nighttime driving conditions.

Each of the RF transceivers 10a and 10b are preferably formed as integrated circuit components which have an extremely low power consumption relative to the device with which they are integrated. Accordingly, the RF transceivers 10a and 10b can be maintained in an "on" state even when the electronic device with which it is associated is turned off. The RF transceivers 10a and 10b are further extremely compact and relatively inexpensive such that the overall dimensions of the electronic device are not appreciably increased by the inclusion of one of the transceivers 10a or 10b, and further such that the overall cost of the electronic device does not increase appreciably.

In FIGURE 1, when the electronic device 12 comes into the vicinity of the vehicle 14, a high speed, automatic, wireless data link is created between the two RF transceivers 10a and 10b. The required proximity will vary depending upon the power output of each transceiver 10a and 10b. For a 0 dBm (1mW) power output, a transmission range of up to about 10 meters is provided. Providing a suitable external amplifier to increase the output power of each RF transceiver 10a or 10b to a maximum of 20 dBm will increase the transmission range up to about 100 meters. It will be appreciated, however, that with even greater power amplifiers an even greater transmission range can be expected. Currently, the Bluetooth standard identifies a 20 dBm maximum power output.

Once the wireless communications link is established between the two RF transceivers 10a and 10b, information from the electronic device 12 can be transmitted to transceiver 10b and then output to the vehicle's audio system 20 and/or to the display system 22. Thus, the user is not required to type in or otherwise give any commands to the electronic device 12 before the wireless communications link is established. Once established, the communications link enables information from the electronic device 12 to be automatically transmitted via RF transceiver 10a to the receiving RF transceiver 10b. In this manner, a wide variety of useful information such as personal calendars, e-mail messages, telephone directories, and virtually any other form of text information can be displayed on the vehicle's display system 22. If an external "text-to-speech" module is incorporated for operation with the second RF transceiver 10b, then text information can be converted into audio before being transmitted to the vehicle's audio system 20 for playback. Thus, if the electronic device 12 comprises a notebook computer with a CD player, any information available on the CD can potentially be converted to speech via the external text-to-speech module and the vehicle's audio system 20. Thus, a wide variety of CD-

based or Internet-based audio material such as books, educational materials, etc. could be played over the vehicle's audio system 20 while the user is in the vehicle 14.

VEHICLE DIAGNOSTICS IMPLEMENTATION

5 Referring to FIGURE 2, another implementation of the wireless communications system
10 of the present invention is shown. This implementation is used to facilitate performing
diagnostics on a motor vehicle 14 via the electronic device 12. In this example, the electronic
device may comprise a notebook computer or other electronic instrument loaded with diagnostic
software specifically suited to the vehicle being tested. The first RF transceiver 10a is integrated
10 into the electronic device 12 and the second RF transceiver 10b is integrated for communications
with a vehicle interface system 24. The vehicle interface system 24 is in turn coupled for two
way communications via a data bus 26 with various electronic subsystems of the vehicle 14 such
as the vehicle's Electronic Control Module (ECM) 28, a fuel sensor 30, an exhaust sensor 32, a
wheel speed sensor 34 or virtually any other form of sensor which provides an electronic output
15 signal related to its operation.

The wireless data link may be created automatically as soon as the vehicle 14 enters a
service bay or other designated service area. The first RF transceiver 10a automatically begins
transmitting diagnostics information stored in an associated memory (not shown) to the second
RF transceiver 10b to begin the diagnostics testing. Information is transmitted back to the first
20 transceiver 10a by the second transceiver 10b as information is received from the vehicle
interface 24 from each of the sensors/components 28-34 under test. This information is then
used by service personnel to determine the operational status of each of the sensors/components
28-34 on-board the vehicle 14. While the electronic device 12 has been described as a notebook
computer, it will also be appreciated that the device 12 could just as readily comprise a personal
25 computer or other form of non-portable computer adapted to run the diagnostics software.

It will be appreciated that the automatic wireless communications link enables various
diagnostics to be performed on a motor vehicle even while other operations, for example, an oil
change, are being performed simultaneously with the running of the diagnostics. This
implementation can significantly reduce the manpower required to perform various service-
30 related operations on a motor vehicle as well as decrease the length of time needed to perform

a full service checkup/tuneup on a vehicle when the vehicle is brought in for routine maintenance such as oil changes, wheel alignments, air and fuel filter changes, wheel balancing, etc.

IMPLEMENTATION INVOLVING A VEHICLE ASSEMBLY OPERATION

5 Referring now to FIGURE 3, an implementation of the wireless communications system 10 is shown being used in the assembly process of a motor vehicle. In this implementation, the first RF transceiver 10a of the system 10 is integrated with an assembly line computer/monitoring system 36. Each one of a plurality of vehicles 14₁-14_n traveling on assembly line conveyor 38 includes a module 40 having the second RF transceiver 10b
10 integrated therewith. The module 40 can be programmed to include information regarding the specific options that its associated vehicle 14 is to include. Such options could comprise the type of interior, audio system options, interior trim package, powertrain options or any other equipment that will be needed to complete the manufacture of that particular vehicle 14.

As each vehicle 14₁-14_n moves along the assembly line conveyor 38 into proximity with
15 the computer/monitoring system 36, an automatic wireless communications link is established between each RF transceiver 10b, one at a time, and the RF transceiver 10a of the computer monitoring system 36. Information regarding the options that each particular vehicle 14₁-14_n is to include is then transmitted via the wireless communications link to the computer/monitoring system 36, which in turn is transmitted over a communications link 42 to an inventory
20 management computer 44. It will be appreciated that the communications link 42 could be a wire-based link or could even be formed by an additional pair of RF transceivers in accordance with the teachings of the present invention to form a second wireless link. The only limitation here would be the distance to the inventory computer system 44 from the assembly/monitoring computer system 36.

25 The above-described implementation enables the wireless communications system 10 to thus be used to synchronize the supply of needed equipment and materials to each vehicle 14₁-14_n moving on the assembly line conveyor 38 to ensure that exactly the proper equipment is provided for each vehicle.

It will also be appreciated that the implementations described in connection with
30 FIGURES 2 and 3 could be combined to enable various electronic modules and subsystems of the vehicle to be tested immediately as the vehicle moves along the assembly line conveyor 38.

This feature would enable a vehicle diagnostics computer located adjacent to the assembly line conveyor 38 to run tests on the vehicle's modules and electronic subsystems to detect defective components before the vehicle proceeds to the next step of the assembly process. This feature would save the significant costs associated with manually removing various electronic modules and components from the vehicle for testing and repair when a defective component is detected after assembly of the vehicle is complete.

HIGH SPEED DATA LINK CREATED FOR A RETAIL TRANSACTION

Referring now to FIGURE 4, yet another implementation of the wireless communications system 10 is illustrated. This implementation is in connection with a retail transaction in which a drive-through menu board 46 has a first RF transceiver 10a of the wireless communications system 10, in addition to a secure transaction RF transceiver 48, integrated therewith. The vehicle includes the second RF transceiver 10b in addition to a secure transaction transceiver 50.

As the vehicle 14 approaches the drive-through menu board 46, the RF transceivers 10a and 10b automatically establish a high-speed wireless communications link. A secure datalink is established between transceivers 48 and 50 by which electronic payment can be authorized by the driver of the vehicle 14. Menu information is then automatically downloaded over the high-speed communications link between the RF transceivers 10a and 10b onto a system control device 50. The system control device 50 acts as an interface to transmit the information to the vehicle's display system 22 and/or the vehicle's audio system 20 for playback. If a suitable microphone 58 is provided in the vehicle 14, authorization for the transaction may be provided verbally by the driver and transmitted via the communications link between the secure transaction transceivers 48 and 50 back to the drive-through menu board 46.

It will be appreciated that the above-described implementation could be modified to enable drive-through banking transactions, drive-through prescription ordering-or a wide variety of other retail transactions made from within a vehicle without the need for the driver to leave the vehicle 14 to effect the transaction. Other applications could include toll collecting, fuel purchases at service stations and other transactions that could potentially be made more conveniently and more quickly by the use of the wireless communications system 10 of the present invention.

KEY FOB COMMUNICATING WITH A VEHICLE

Referring to FIGURE 5, an implementation involving a programmable key FOB 60 is illustrated for setting and adjusting various components of the vehicle 14. The key FOB 60 is shown in greater detail in FIGURE 5A and includes the first RF transceiver 10a of the wireless communications system 10, the antenna 16, a suitable battery 62 for providing power and a suitable memory 64. The second RF transceiver 10b of the system 10 is integrated into the vehicle electronics to communicate with the vehicle bus interface 24 via the vehicle bus 26, and further with various modules 66-72 for controlling various components of the vehicle 14.

As the user approaches the vehicle 14 when carrying the key FOB 60, a high speed, wireless communications link is automatically established between the two RF transceivers 10a and 10b. Information stored in the memory 64 of the key FOB 60 is then transmitted to the second transceiver 10b and used to control various modules of the vehicle 14 in accordance with preprogrammed settings by the user. Thus, information relating to the precise position of a power seat, volume and channel information of the radio 72, climate control information for the HVAC 70, rearview mirror or external mirror position information, etc., can all be stored in the memory 64 and automatically transmitted to the vehicle 14 as the user approaches the vehicle. The seats of the vehicle 14, climate control settings, radio channel and volume settings, mirror positions, etc. can all be automatically adjusted by suitable vehicle electronics even before the user enters the vehicle 14.

KEY FOB COMMUNICATING WITH WORK AND HOME PCs

Referring to FIGURE 6, another implementation of the wireless communications system 10 using the programmable key FOB 60 is illustrated. In this implementation the key FOB 60 is used to interrogate a PC 74 at the user's place of business. Selected files stored on the hard drive or in random access memory (RAM) of the PC 74 can be transmitted via a wireless communications link established between the RF transceiver 10a of the key FOB 60 and the second RF transceiver 10b, which is integrated with the work PC 74. The information is stored in the memory of the key FOB 60 before the user leaves his/her place of business.

Referring to FIGURE 7, as the user arrives at his/her home, a home PC 76 is automatically linked with the key FOB 60 by the RF transceiver 10a of the key FOB 60 and a second RF transceiver 10b integrated with the home PC 76. The automatically created wireless

communications link is used to transmit information stored in the memory 64 (FIGURE 5a) of the key FOB 60 to the individual's home PC 76.

WIRELESS SPEAKERPHONE USING PROPRIETARY SPEECH
RECORDING/PLAYBACK SYSTEM

5

Referring now to FIGURE 8, yet another implementation of the wireless communications system 10 of the present invention is shown in which a cellular phone 78 is linked with a proprietary speech recording/playback system 80 available commercially from the assignee of the present application and marketed under the trademark "Travelnote®". The Travelnote® system enables the driver or other vehicle occupant to speak directly into a microphone 82 to record any notes or other information which the user would otherwise write down on paper, but which cannot be accomplished easily while driving the vehicle 14. The notes or other information can be played back from the Travelnote® recording/playback system 80 over a speaker 84 once the user reaches his/her destination and prior to exiting the vehicle 14. The Travelnote® recording/playback system 80 is described in detail in 5,810,420, the disclosure of which is hereby incorporated by reference.

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In this implementation, the RF transceiver 10a is integrated with the cellular phone 78 and the second RF transceiver 10b is integrated with the Travelnote® recording/playback system 80. The Travelnote® recording/playback system 80 may be located within a visor or rear view mirror 86. Alternatively, it may be located on the dashboard, overhead console, or any other convenient location within the vehicle 14. The wireless communications system 10 provides a high-speed, wireless communications link between the cellular phone 78 and the Travelnote® recording/playback system 80 to enable "hands free" use of the cellular phone 78. Thus, the user need not hold the cellular phone 78 in one hand while driving; the phone 78 can be placed on a console or seat 82 adjacent to the user while the user carries on a hands-free conversation via the microphone 82 and speaker 84 of the Travelnote® playback/recording system 80.

20

25

A further advantage is that the wireless communications link between the RF transceivers 10a and 10b is created automatically when the cellular phone 78 comes into proximity with the second RF transceiver 10b within the vehicle 14. Thus, the user need only dial a number from the cellular phone 78 to place a call and the conversation thereafter can be conducted via the Travelnote® system 80. Alternatively, a call could even be placed via commands and numbers spoken into the microphone 82 and transmitted via the wireless communications link to the

30

cellular phone 78. Useful information received by the cellular phone 78 could even be displayed on a small portion of a rearview mirror. Such information could include auxiliary phone annunciators, a "low battery" warning indicating a low battery power condition for the cellular phone 78 or other incoming call information received via the phone 78.

5 A modification of this implementation involves modifying the above-described Travelnote® system to send and/or receive digital information such that the Travelnote® system can be used to pass digital information to and from a computing device 79 such as a hand-held computing device or a laptop computer. With this capability, the Travelnote® system could be used to transmit information received by a facsimile transmission or email communications to
10 the computing device. This digital information would be first received by the user's cellular phone 78. Preferably, an infrared communications link 79a is also established by suitable hardware between the cellular phone 78 and the computing device 79. The infrared link is used to transmit digital information between the computing device 79 and the cellular phone 78. Preferably, an infrared link 79b is also established between the Travelnote® system and the
15 computing device 79 so that digital information can just as easily be transmitted directly between the computing device 79 and the Travelnote® system. Messages sent to the Travelnote® system could be stored therein for future downloading to another computer. The computing device 79 could also send stored phone numbers stored to the Travelnote® system to simplify the dialing of phone numbers.

20

As will be appreciated, other implementations of the present invention could be made in connection with a home and/or vehicle. For example, RF transceiver 10a could be disposed in a cellular phone while RF transceiver 10b is disposed in a Homelink® system which is proprietary to the assignee of the present application. The Homelink® system can be
25 programmed to interface with, for example, a garage door opener to open the garage door when a control unit of the Homelink® system is actuated by a user. By incorporating RF transceiver 10b into the Homelink® system, the user could enter a predetermined code in the cellular phone which is received by the Homelink® system and which causes the Homelink® system to open the garage door. In this manner, if an individual was not in his/her car own vehicle as he/she
30 approached their house, the garage door could still be easily opened without the user having the garage door opener unit.

In another implementation, one or more RF transceivers 10a are used in connection with various devices in a home. A second RF transceiver 10b is placed in a garage. The second transducer 10b serves as a portal from the user's car to those devices in the home that are equipped with RF transceivers 10a. The garage-based RF transceiver 10b is able to interface and interact with those devices incorporating a RF transceiver 10a, such as a home PC, appliances, etc.

In still another implementation, one RF transceiver 10a could be located within a vehicle while a second RF transceiver 10b could be associated with a computer located either at a vehicle dealership or at a home. When a vehicle is manufactured, all parts could be tagged in the plant so it is known which specific parts are installed on the vehicle. This information could be stored in a database stored in a memory device in the car. In addition, warranty information for those parts, as well as for the car as a whole, could be stored in this database.

When the vehicle is in proximity to the first RF transceiver 10a while the vehicle is being serviced at a dealership, service personnel could easily access information stored in the memory device via the wireless link between RF transceivers 10a and 10b. This would provide immediate access to information on the various components of the vehicle, as well as warranty information.

In yet another implementation similar to that described immediately above, only the Vehicle Identification Number ("VIN") is delivered to the computer from the RF transceiver 10b located in the vehicle. The VIN is then used by the computer to access a database which is remote from the vehicle to obtain warranty and part information. It will be appreciated that this information could also be accessed through a web site of the manufacturer of the vehicle.

In still another variation of the above-described implementation, if a cellular telephone is located in the vehicle, and the telephone is equipped with an RF transceiver 10b, then any vehicle malfunctions could be reported to the vehicle manufacturer or dealer via a wireless link established between the computer and the cellular phone. This information can be used to facilitate repair of the vehicle or the tracking of warranty information pertaining to the vehicle.

The computer could also be used to personalize the vehicle operation. For example, the vehicle owner could access a manufacturer's website to select the desired operating parameters for the vehicle. These parameters could include selecting a 12 hour or 24 hour clock time display, establishing station pre-selects for the vehicle radio operation, selecting parameters

related to the operation of the vehicle lights, enabling voice interactive messages generated by the vehicle, or a variety of other vehicle operating parameters. Once the operating parameters are selected by the vehicle owner, the website could cause the owner's home computer (which is equipped with RF transceiver 10a) to generate an RF signal that is sensed by the vehicle
5 causing the parameters to be stored in a memory device in the vehicle. Alternatively, a compact disc could be provided to the vehicle owner upon purchase of the vehicle, which can be used with the individual's home computer to personalize the vehicle's functions. This information can then be transferred from the home computer to the vehicle via a wireless link between the two RF transceivers 10a and 10b.

10

CAR TO HOME WIRELESS COMMUNICATIONS LINK

Referring to FIGURE 9, another implementation of the wireless communications system
10 is shown in which the system 10 includes the first RF transceiver 10a in communication with a user interface circuit 88. The user interface circuit 88 is in turn linked for communication via
15 a suitable bus 90 with a display system 22 and/or an audio system 20 of the vehicle 14. The second RF transceiver 10b is integrated with a home PC 92. The home PC 92 is linked to the Internet.

The user uses the home PC 92 to retrieve information from the Internet (e.g., audio
books, news, weather, music, etc.) at a convenient time. Once this information is received by
20 the home PC 92 it is transmitted via the high-speed wireless communications link between the two RF transceivers 10a and 10b automatically. For this to occur, it will be appreciated that the vehicle 14 will need to be parked in the proximate vicinity of the home PC 92 (i.e., within about 100 meters of the home PC 92). In this regard it will also be appreciated that a suitable amount of random access memory (RAM) is provided in association with the display 22 and/or the
25 vehicle audio system 20 for storing the information. The user can then display or play back the information while traveling in the vehicle 14 at the user's convenience. If the data is audio data, then it is played back through the vehicle audio system 20. Even text information which is received may be converted to audio information if a suitable text-to-speech conversion circuit is provided. The information stored could comprise traffic information, daily calendar
30 reminders, appointments or events, e-mail messages, etc., in addition to the book, news, weather and music information mentioned above.

OBTAINING POINT OF INTEREST INFORMATION VIA A WIRELESS LINK

Referring to FIGURE 10, the wireless communications system 10 can also be used to enable information relating to various "points of interest" along a route being traveled by the user. This information could also be "personalized" information for the user from an Internet-based information service.

In this implementation, a cellular phone 98 is used by the user to make a connection with a wireless service organization 96. The cellular phone 98 includes the first RF transceiver 10a while the vehicle 14 includes the second RF transceiver 10b. A Global Positioning System ("GPS") device 100 on-board the vehicle 14 can be used to transmit latitude/longitude information to the cellular phone 98 over the wireless communications link established between the two RF transceivers 10a and 10b. The cellular phone 98 in turn can be used to link this information back to the wireless service organization 96. The wireless service organization 96 then transmits information on various points of interest near the vehicle's latitude and longitude coordinates back to the cellular phone 98, which in turn transmits this information via a wireless, high speed data link from its RF transceiver 10a to the RF transceiver 10b. The information is then displayed on the vehicle's display 22 and/or played over the vehicle's audio system 20. The point of interest information can include a wide variety of useful information such as restaurants, shopping, service stations, hospitals and other establishments in the vicinity of the vehicle. The information could be displayed in a menu format in which the user is able to select establishments and is provided with directions on the display system 22 to each establishment selected. Additional information concerning traffic conditions, road construction, etc., could also be provided.

USING "PUSH" INFORMATION SERVICES FROM THE INTERNET

Referring to FIGURE 11, another implementation of the wireless communications system 10 is illustrated where "Push" technology is used to download information from the Internet automatically to the user traveling in the vehicle 14. A cellular phone 98 having the first RF transceiver 10a of the wireless communications system 10 establishes an automatic, high-speed wireless communications link with the second RF transceiver 10b located in the vehicle

14. The transceiver 10b is in communication with the vehicle's display system 22 and/or the vehicle's audio system 20.

The wireless service organization 96 is linked to the Internet and to the cellular phone 98. The user can use his/her home PC 92 (or alternatively a business PC) to create a "personalized" website through one of the presently available Internet-based news/search companies so that various personalized information such as selected financial information (i.e., stock price information), world or local news, traffic information along a specified route of travel, phone directory or personal calendar information, weather information, e-mail, etc., can be downloaded by the wireless service organization 96 and provided to the cellular phone 98.

10 The RF transceivers 10a and 10b can then be used to transmit the information to the vehicle's display system 22 or audio system 20.

MAP/DIRECTIONS DOWNLOADED WHILE THE VEHICLE IS AT A SERVICE STATION

15 Referring to FIGURE 12, a variation of the implementation shown in FIGURE 11 is illustrated in which existing Push technology is used to download personalized information from an Internet based information service to a suitable electronic system located at or closely adjacent to a gasoline pump 100, or at a kiosk including the gasoline pump 100, when the user's vehicle 14 comes within the vicinity of the gasoline pump 100. In this implementation, the gasoline pump 100 includes the electronic device 12 which includes the RF transceiver 10b, and the vehicle 14 includes the RF transceiver 10a. The RF transceiver 10a is in communication with the vehicle's display 22 and/or audio system 20. When the vehicle 14 comes into reasonably close proximity (e.g., within 10 meters of the gasoline pump 100), the RF transceiver 10a automatically establishes a high speed, wireless communications link with the RF transceiver 10b of the electronic device 12. The RF transceiver 10a transmits appropriate identifying information to the RF transceiver 10b via the automatically established wireless communications link. This information is then linked to the Internet-based information service. Information is then transmitted back to the electronic system 12 associated with the gasoline pump 100. The information is then transmitted over the wireless communications link to the RF transceiver 10a located in the vehicle 14. It will be appreciated that this personalized information could also be obtained from the Internet by establishing wireless communications

links with electronic devices located on road signs, freeway overpasses, at traffic lights and other points along a road or highway.

MAPS/DIRECTIONS DOWNLOADED FROM A HOME OR WORK PC

5 Referring to FIGURE 13, another implementation of the present invention somewhat similar to that described in connection with FIGURE 12 is provided. The implementation of FIGURE 13 enables the wireless communications system 10 of the present invention to provide a subset of map information needed for assisting a user of the vehicle 14 in traveling to a designated destination. In this implementation one RF transceiver 10a is located in the vehicle
10 14 and the other RF transceiver 10b is integrated with a PC 92, which may be located at the user's home or place of business. The user 14 can enter a command from either the PC 92 or from a suitable keyboard or control panel within the vehicle 14, or even from a cellular phone carried within the vehicle 14 and linked by two RF transceivers in accordance with the present invention, requesting directions for traveling to a particular destination. This request is
15 transmitted to an Internet-based information organization where it is thereafter downloaded onto the PC 92. The information is then transmitted via the high-speed wireless communications link created by the RF transceivers 10a and 10b back to the vehicle 14 where it may be displayed on the vehicle's display 22 or possibly played on the vehicle's audio system 20. Since only a limited amount of information pertaining to the specific directions requested is transmitted back to the
20 vehicle 14, this significantly reduces the amount of memory required to be located on-board the vehicle 14. It will be appreciated that this map information could just as easily be provided by linking to an electronic subsystem associated with the gasoline pump 100 (FIGURE 12) or at some other location if the user becomes lost and suddenly requires directions to a different destination.

25

INFORMATION "PUSHED" INTO FLEET VEHICLES

Referring now to FIGURE 14, another implementation of the wireless communications system 10 is provided in which information from a business or a company is "pushed" into a company vehicle 14 from a corporate message center or corporate PC 102. The information
30 from the corporate message center or PC 102 is transmitted via the Internet to the wireless service organization 96. A communications link is established between the wireless service

organization 96 and the user's cellular phone 98. The cellular phone 98 includes one RF transceiver 10a of the apparatus of the present invention 10 and the vehicle 104 includes the second RF transceiver 10b. Again, the RF transceiver 10b is in communication with the vehicle's display 22 and/or the vehicle's audio system 20. Important business information received by the cellphone 98 can then be downloaded via the wireless communications link created by the RF transceivers 10a and 10b to the user to apprise the user of important corporate news, events, scheduling or other information which needs to be transmitted to the user on a timely basis. Again, this information could be relayed through suitable electronic relaying devices provided at gasoline pumps or at other points such as intersections, freeway overpasses, etc. that the vehicle 14 is expected to pass in proximity to during use.

It will be appreciated that that an extremely large variety of useful implementations of the wireless communications system 10 of the present invention may be created. While the Bluetooth communications standard or the SWAP-CA standard may be used with the RF transceivers 10a and 10b of the present invention, it will be appreciated that other communications specifications may also be employed. Additionally, while many of the implementations described herein have made use of a motor vehicle, it will be appreciated that the RF transceivers 10a and 10b could just as easily be used to effect high-speed wireless communications links between virtually any two electronic devices which come into proximity with one another, and where it would be useful to transfer information from one device to the other.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present invention can be implemented in a variety of forms. Therefore, while this invention has been described in connection with particular examples thereof, the true scope of the invention should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings and the present specification.

WHAT IS CLAIMED IS:

1. A system for communicating information between a first device and a second device in wireless fashion, said system comprising:

5 a first, low power, radio frequency (RF) transceiver associated with said first device and a second low power, RF transceiver associated with said second device; and

each of said first and second low power, RF transceivers operating in accordance with an RF communications protocol to cause an automatic transfer of information to begin from said first low power, RF transceiver to said second low power, RF transceiver when said first and
10 second devices come within a predetermined distance of one another, such that information associated with said first device can be transferred to said second device in wireless fashion.

2. The system of claim 1, wherein said low power, first and second RF transceivers operate in accordance with a Bluetooth communications standard.

3. The system of claim 1, wherein said low power, first and second RF transceivers operate in accordance with a Shared Wireless Access Protocol-Cordless Access (SWAP-CA) communications standard.

4. The system of claim 1, wherein said first device comprises a portable computing device.

5. The system of claim 1, wherein said first device comprises a portable computer.

6. The system of claim 1, wherein said first device comprises a laptop computer.

7. The system of claim 1, wherein said first device comprises a hand-held computing device.

8. The system of claim 1, wherein said first device comprises a computing device and said second device comprises a vehicle interface system of a motor vehicle, and wherein said computing device operates to transmit and receive information to and from said vehicle interface system to facilitate diagnostic testing of at least one subsystem of said motor vehicle.

9. The system of claim 1, wherein said first device comprises a computer/monitoring device disposed adjacent an assembly line in a manufacturing assembly facility, and said second device comprises a module associated with a product undergoing assembly, and wherein information concerning said product is transmitted to said
5 computer/monitoring device as said product moves into proximity with said computer/monitoring device, to thereby facilitate assembly of said product.

10. The system of claim 1, wherein said first device comprises a display system of a motor vehicle and said second device comprises a computer of a retail establishment, and whereby a wireless RF communications link is automatically established to transfer information in real time between said motor vehicle display system and said computer as said motor vehicle
5 comes into proximity with said retail establishment.

11. The system of claim 1, wherein said first device comprises a key FOB of a motor vehicle and said second device comprises a vehicle interface of said motor vehicle, and wherein a wireless communications link is automatically established between said key FOB and said vehicle interface when said key FOB comes into proximity with said vehicle interface to thereby
5 transmit information between said key FOB and said vehicle interface.

12. The system of claim 1, wherein said first device comprises a cellular telephone and said second device comprises a wireless speakerphone having a recording/playback system.

13. A system for communicating information between a first device and a second device in wireless fashion, said system comprising:

a first, low power radio frequency (RF) transceiver associated with said first device, wherein said first device comprises a subsystem of a motor vehicle;

5 a second, low power, radio frequency (RF) transceiver associated with said second device, wherein said second device comprises a stationary device; and

wherein a wireless communications link is automatically established between said subsystem and said motor vehicle as soon as said motor vehicle moves to within a predetermined distance of said stationary device.

14. The system of claim 13, wherein said first and second RF transceivers are operated in accordance with a Bluetooth communications standard.

15. The system of claim 13, wherein the first and second RF transceivers operate in accordance with a Shared Wireless Access Protocol-Cordless Access (SWAP-CA) communications protocol.

16. The system of claim 13, wherein said subsystem comprises an overhead display console.

17. The system of claim 13, wherein said subsystem comprises an in-dash mounted display system.

18. The system of claim 13, wherein said stationary device comprises a kiosk.

19. The system of claim 13, wherein said stationary device comprises a fuel filling pump at a fuel service station.

20. The system of claim 13, wherein said stationary devices comprises a desktop computer.

21. A system for communicating information in wireless fashion between a subsystem of a motor vehicle and an information providing component, comprising:

a first low power, radio frequency (RF) transceiver associated with said subsystem to provide information to said subsystem;

5 a second, low power, radio frequency transceiver operably associated with said information providing component;

wherein a wireless communications link is established automatically between said subsystem and said information providing component when said RF transceivers come within a predetermined distance of one another; and

10 wherein said RF transceivers are operated in accordance with a Bluetooth standard communications protocol.

22. The system of claim 21, wherein said information providing component comprises a cellular telephone.

23. The system of claim 21, wherein said information providing component comprises a computing device.

INTEGRATION WITH VEHICLE AUDIO/DISPLAY SYSTEM

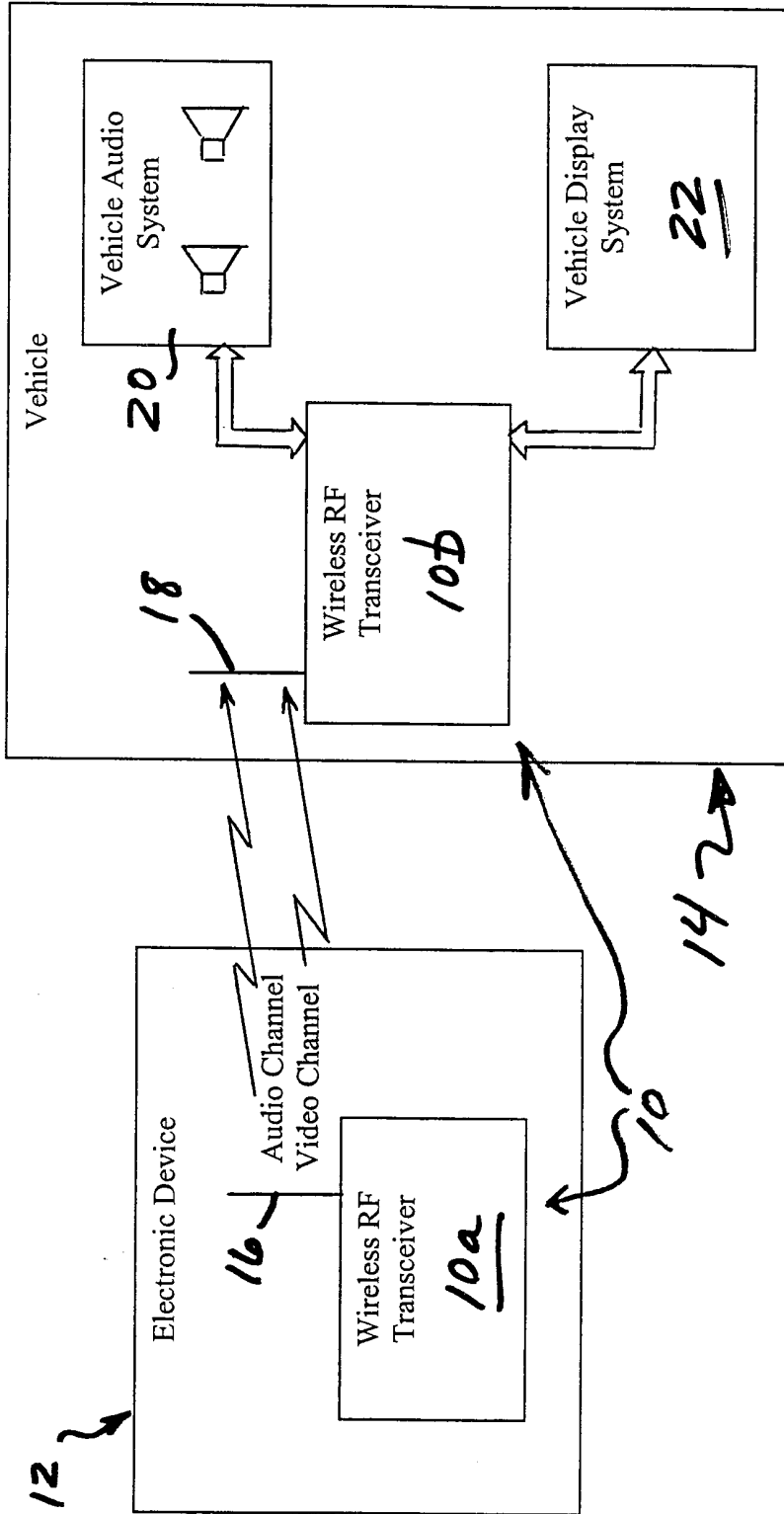


FIGURE 1

VEHICLE DIAGNOSTICS (SERVICE BAY) IMPLEMENTATION

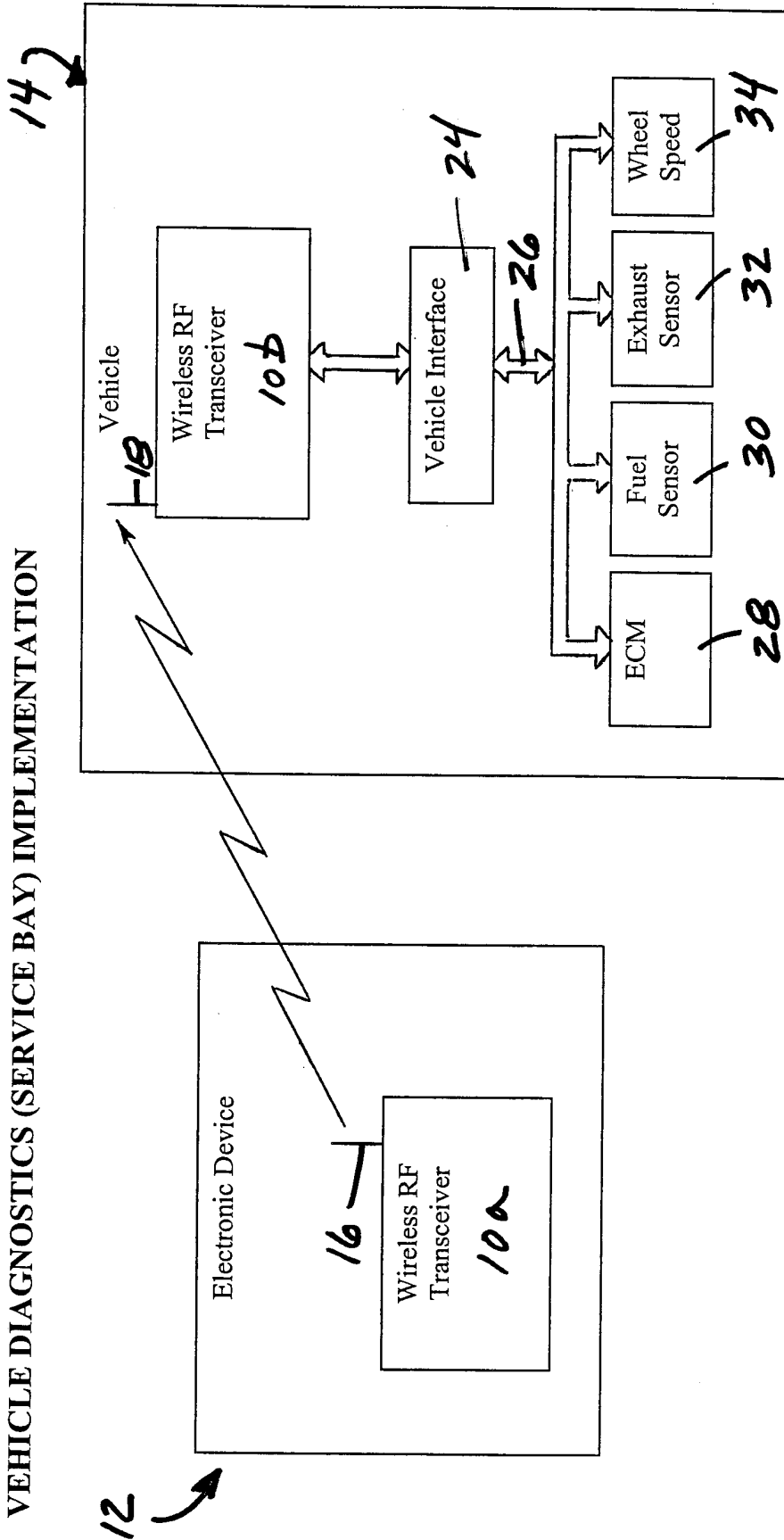


FIGURE 2

IMPLEMENTATION FOR DETERMINING VEHICLE STATUS DURING ASSEMBLY

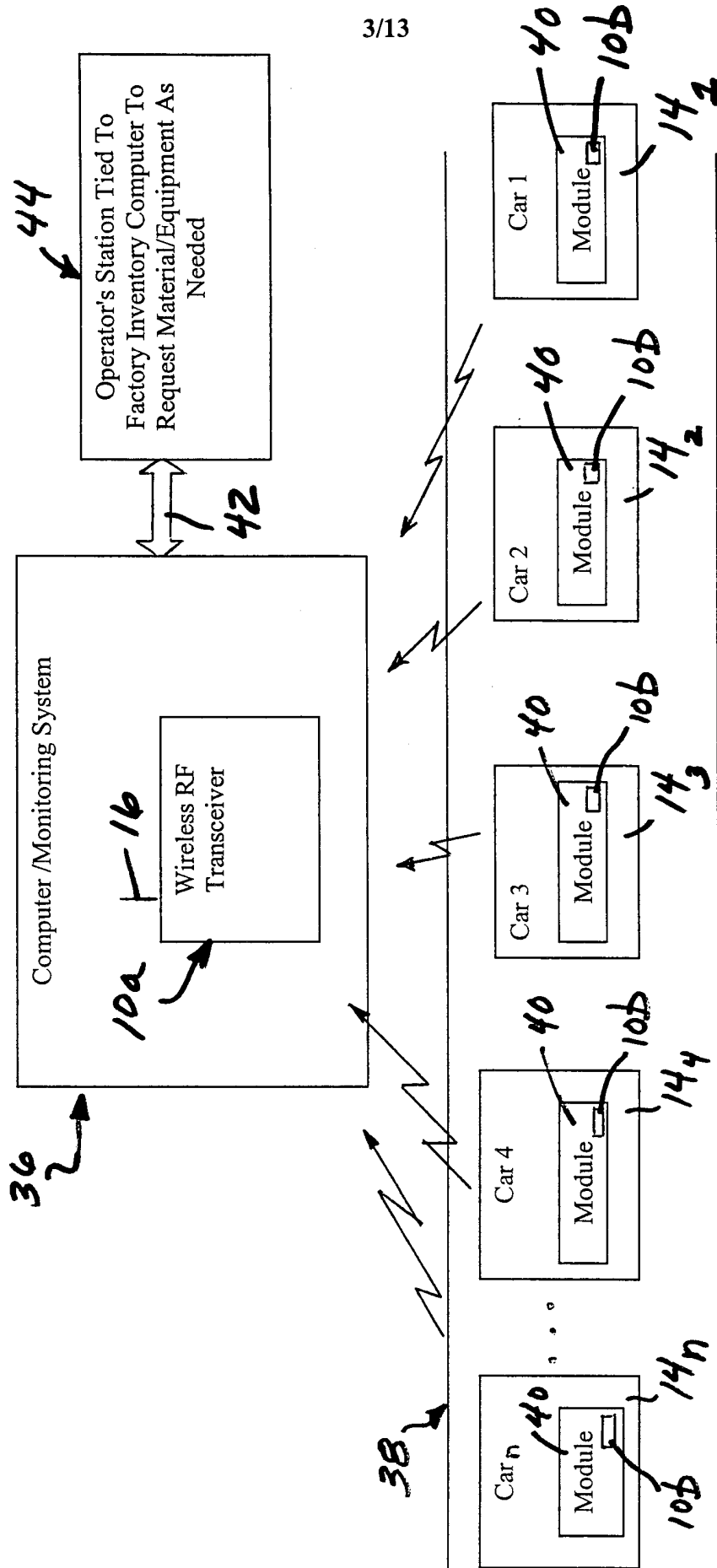


FIGURE 3

IMPLEMENTATION FOR HIGH SPEED SECURE WIRELESS TRANSACTION

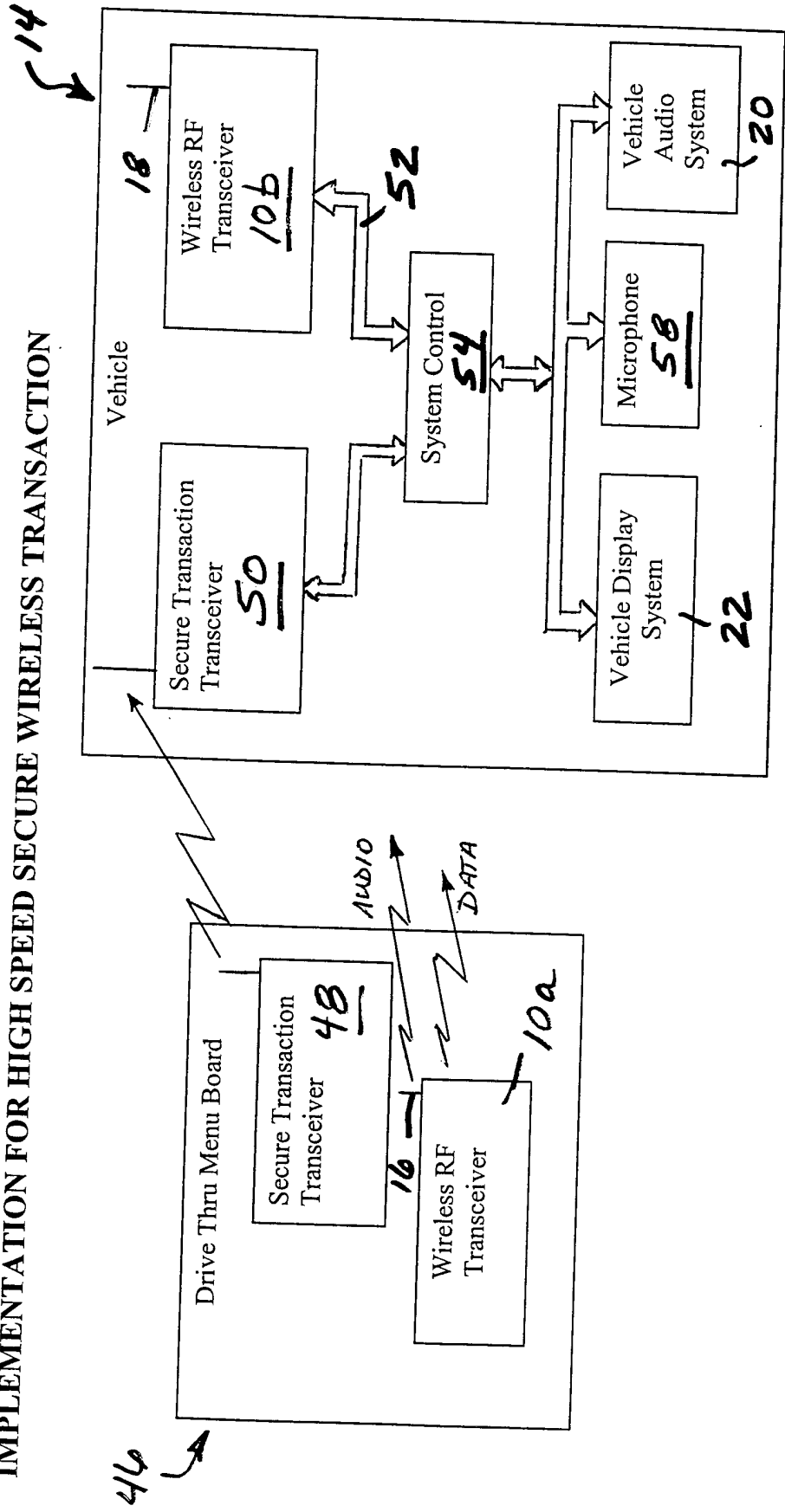


FIGURE 4

IMPLEMENTATION USING KEY FOB TO STORE VEHICLE INFORMATION

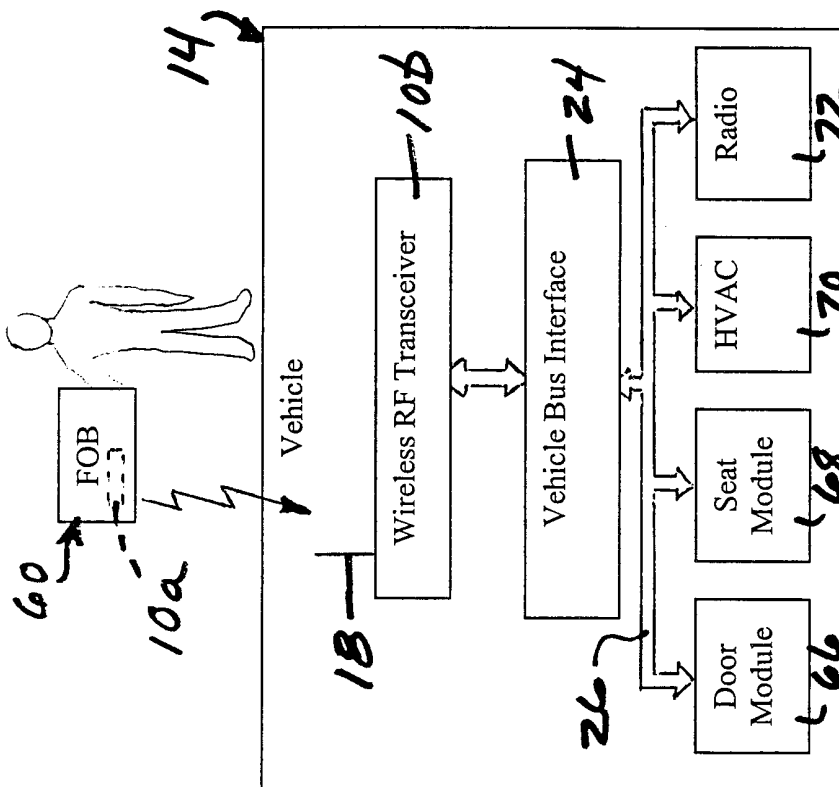


FIGURE 5

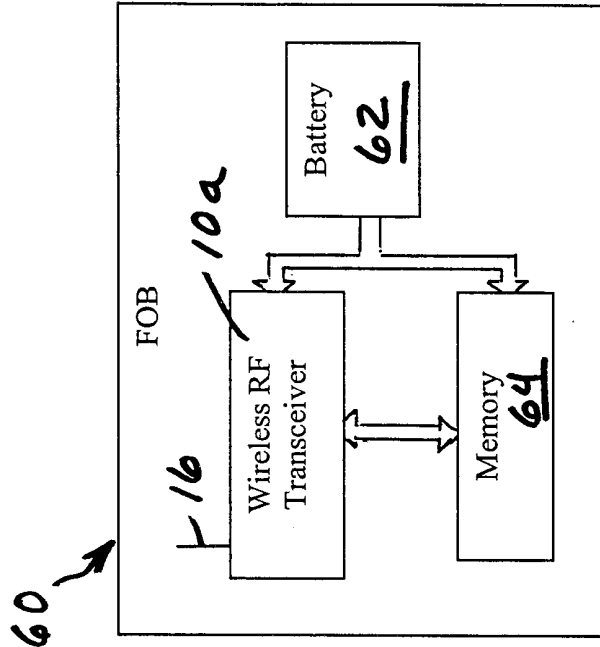


FIGURE 5A

IMPLEMENTATION FOR KEY FOB/PC INFORMATION EXCHANGE

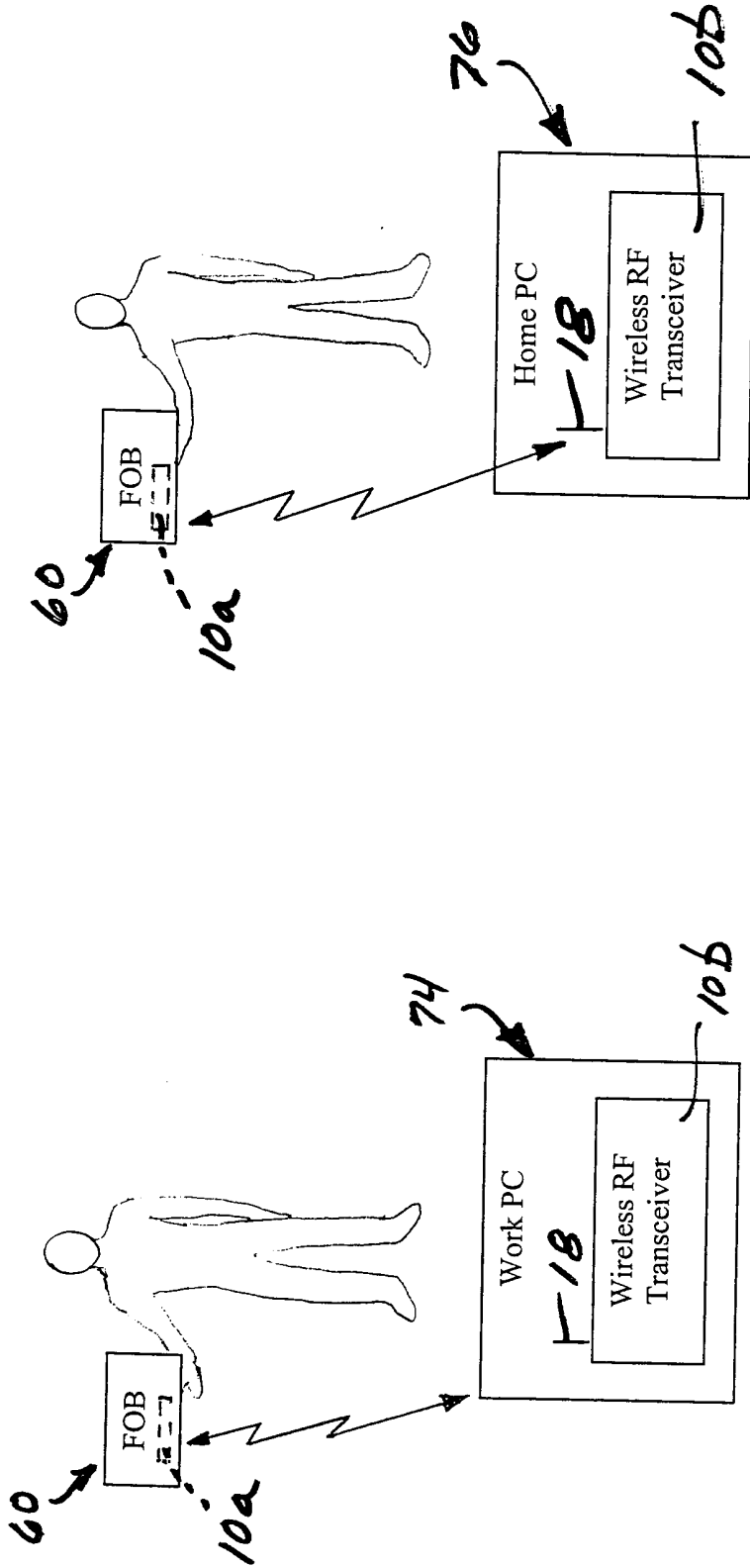


FIGURE 6

FIGURE 7

WIRELESS SPEAKERPHONE USING PROPRIETARY SPEECH RECORDING/PLAYBACK SYSTEM

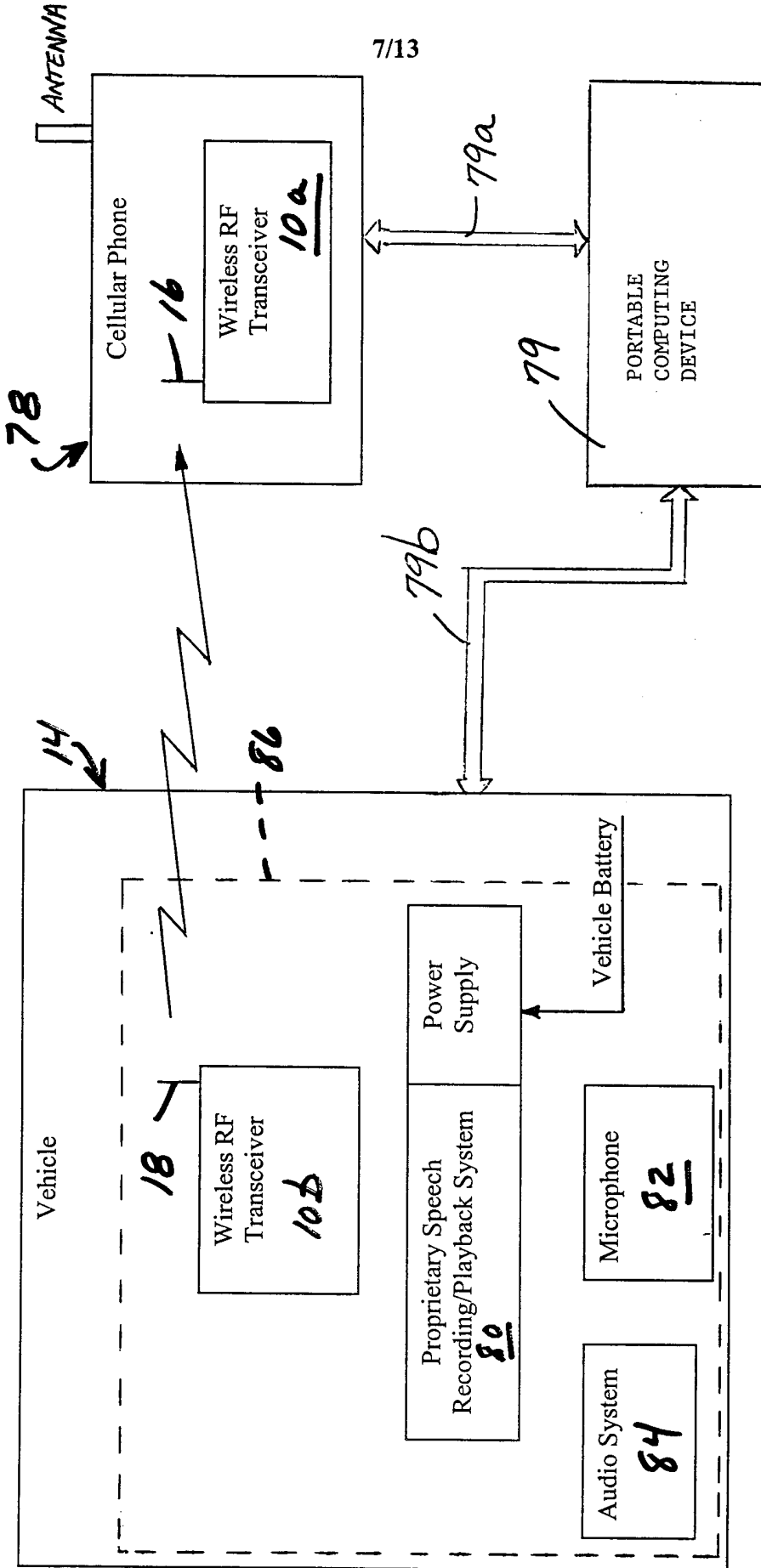


FIGURE 8

CAR TO HOME

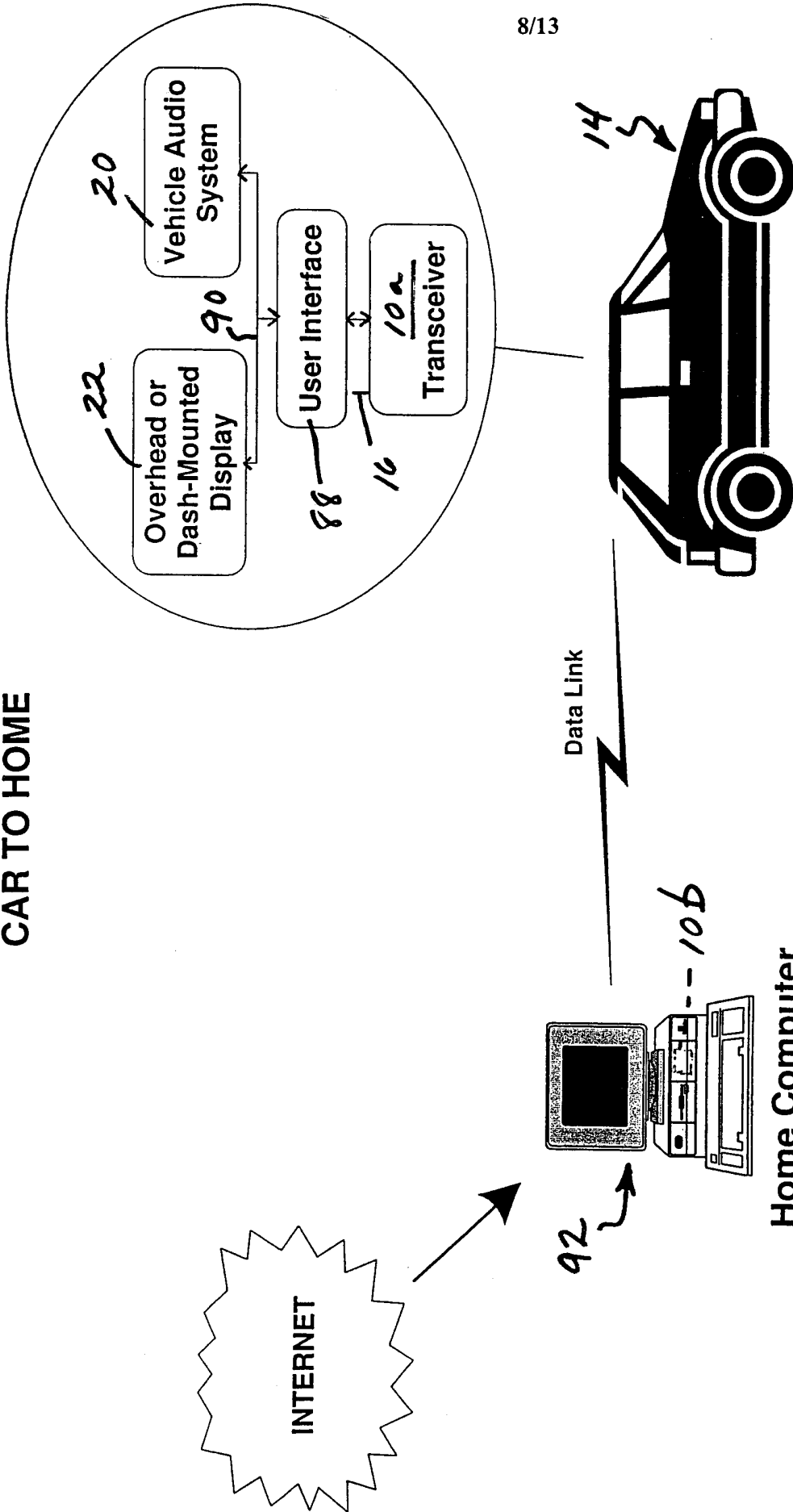


FIGURE 9

Home Node

Vehicle Node

Points of Interest Download

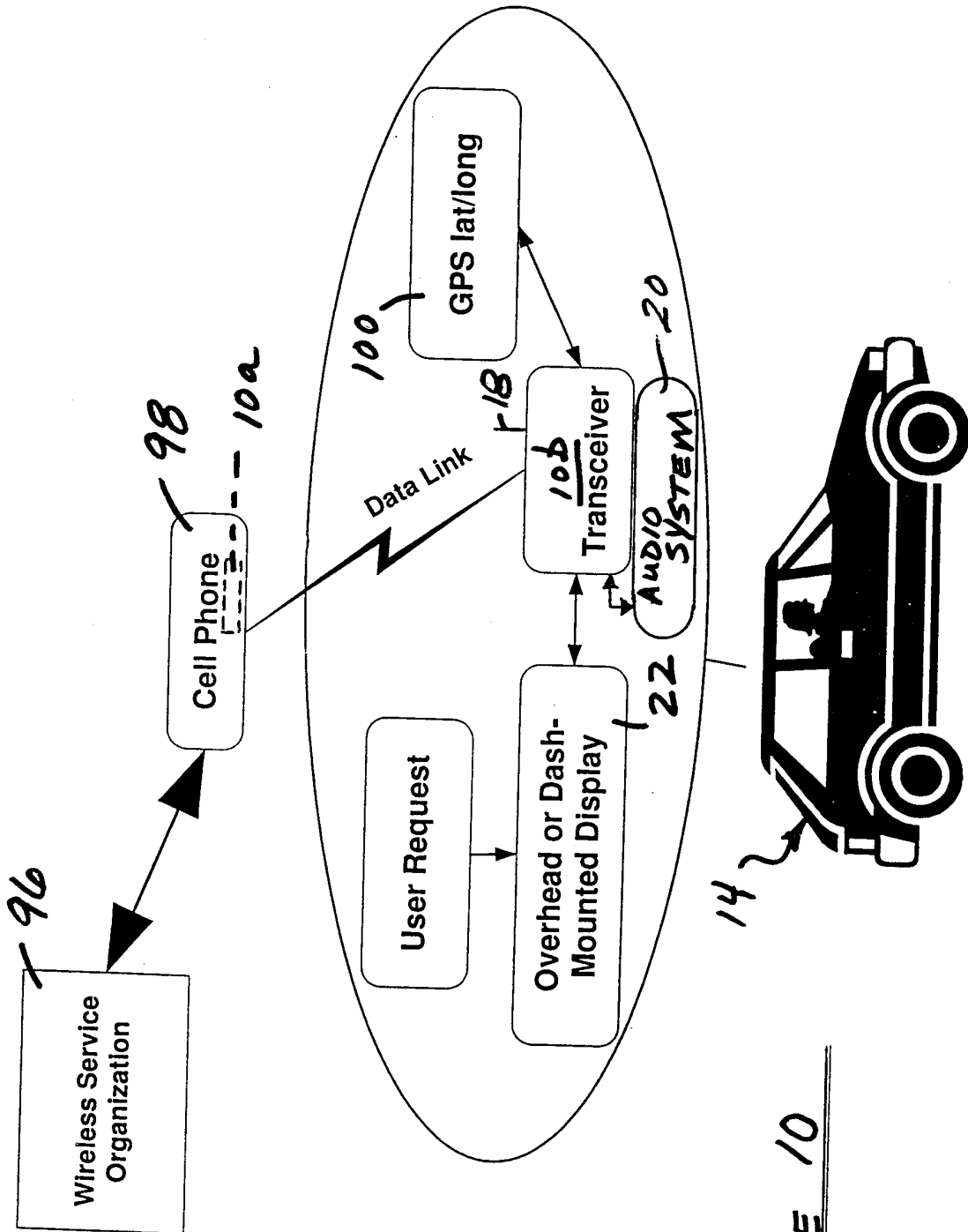


FIGURE 10

Push Services from the Internet

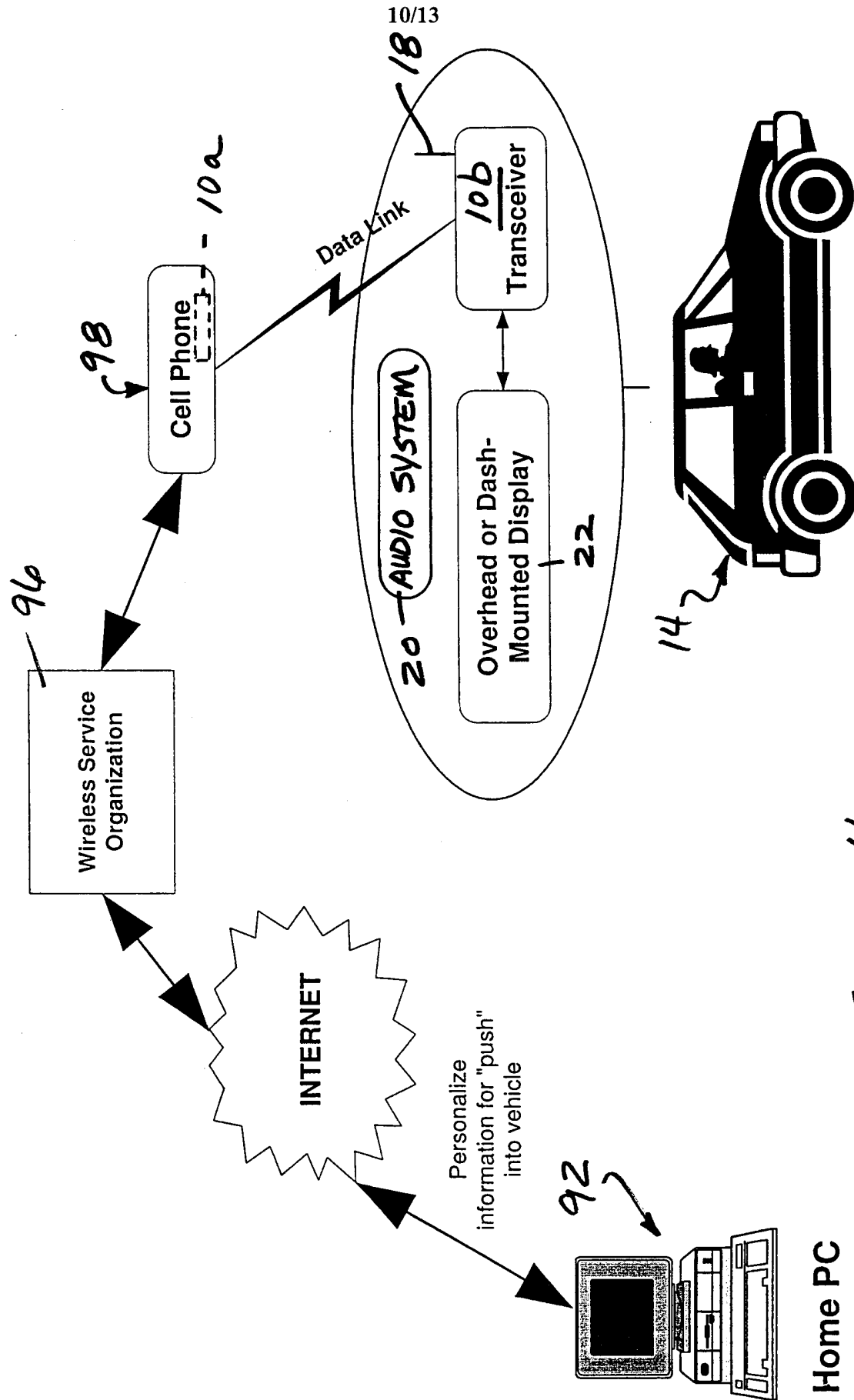


FIGURE 11

Mapping/Directions Download

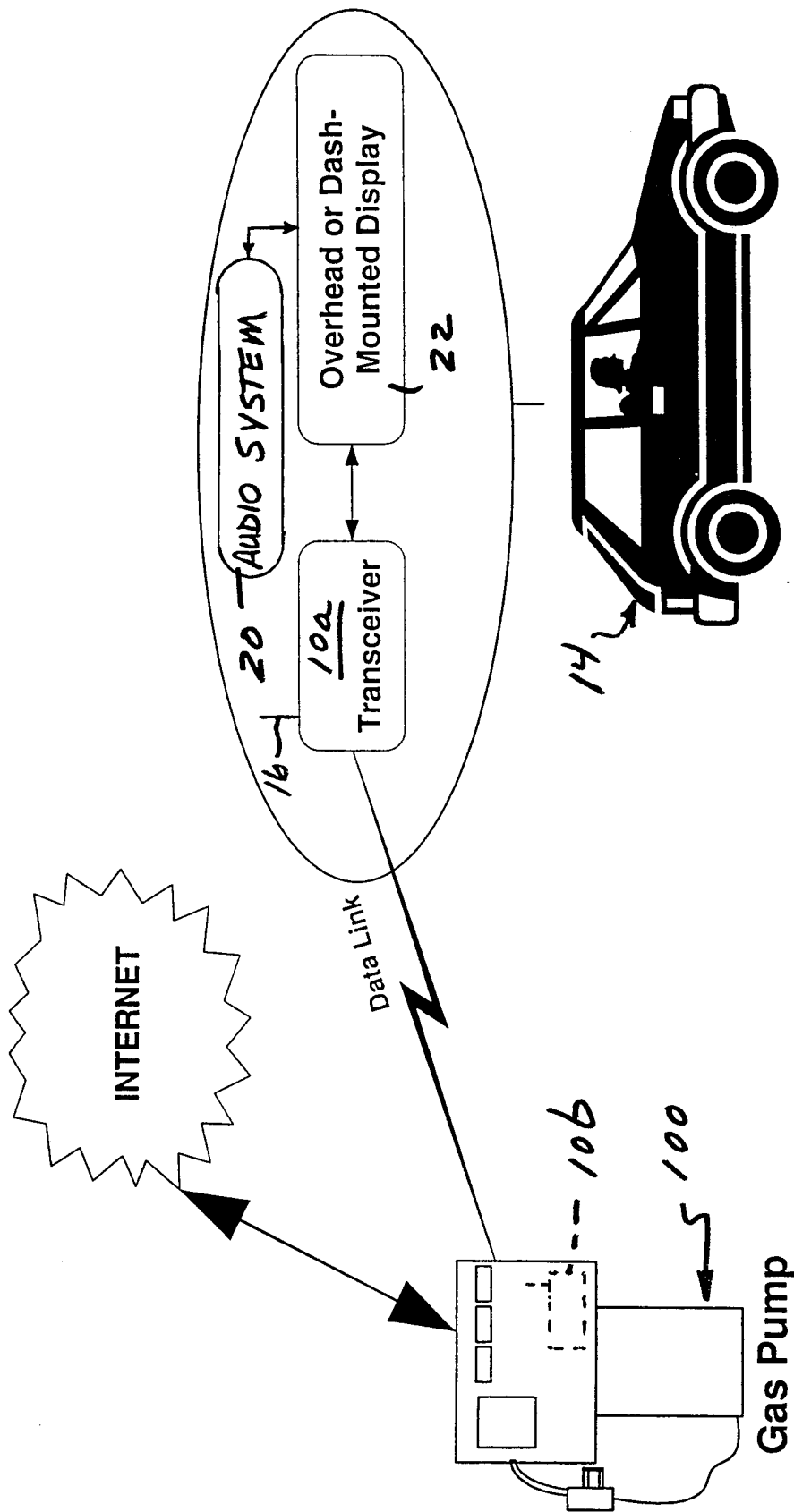


FIGURE 12

Mapping/Directions Download

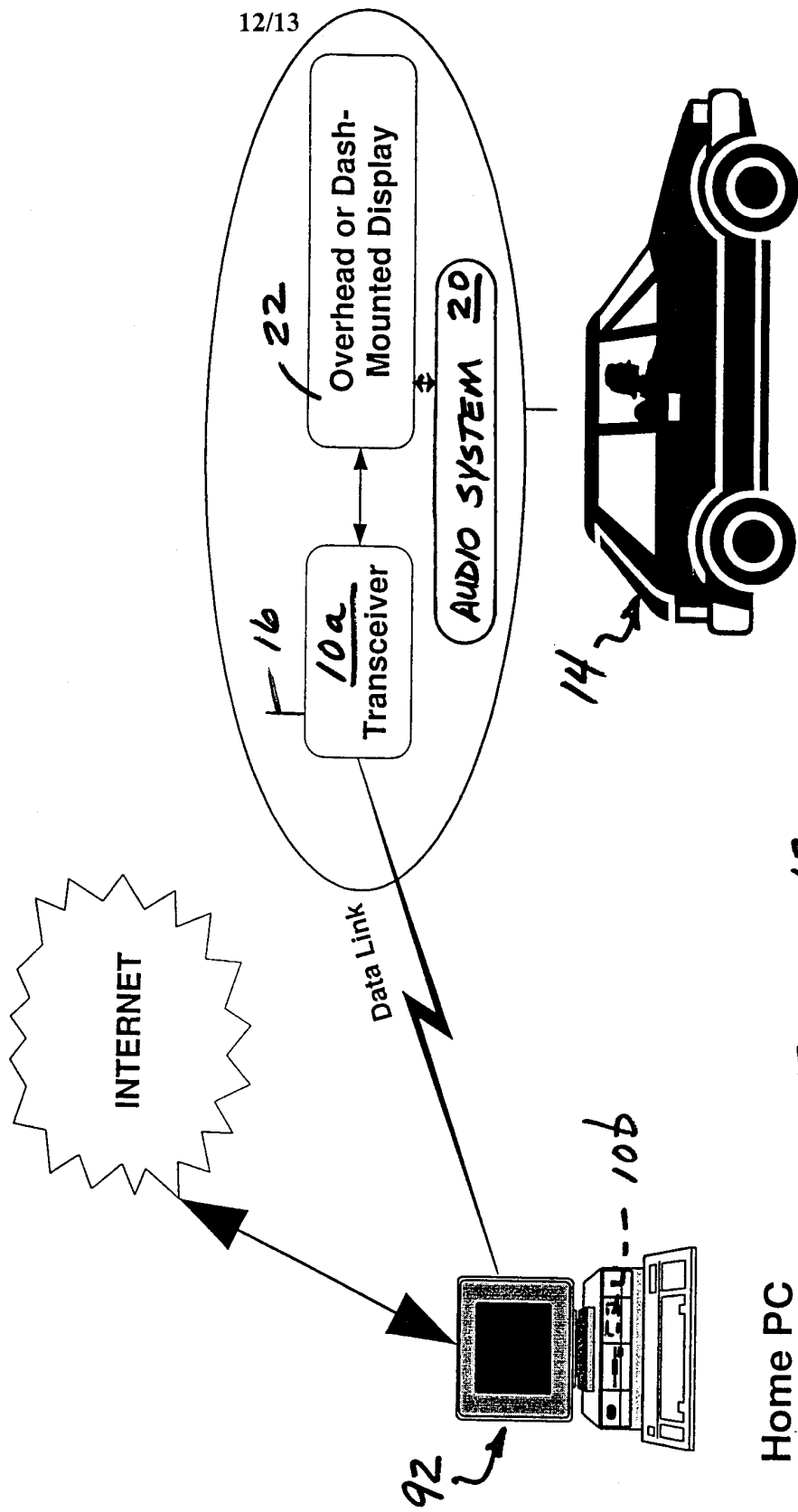


FIGURE 13

Company Bulletin Board

