DECLARATION OF SCOTT ANDREWS

I, Scott Andrews, declare as follows:

1. I hold a B.Sc. degree in Electrical Engineering from University of California–Irvine and a M.Sc. degree in Electronic Engineering from Stanford University. In various positions at, among others, TRW and Toyota, I have been responsible for research and development projects relating to, among others, numerous vehicle navigation systems, information systems, and user interface systems. My qualifications are further set forth in my *curriculum vitae* (Exhibit A). I have been retained by Volkswagen Group of America, Inc. in connection with its petition for *inter partes* review of U.S. Patent No. 8,065,156 (the "'156 patent"). I have over 35 years of experience in fields relevant to the '156 patent, including telecommunications systems and navigation systems.

2. I have reviewed the '156 patent, as well as its prosecution history and the prior art cited during its prosecution. I have also reviewed U.S. Patent No. 6,202,023 ("Hancock"), the Richard Lind et al. publication, *The Network Vehicle – A Glimpse into the Future of Mobile Multi-Media*, 17th DASC, The AIAA/IEEE/SAE Digital Avionics Systems Conference – Bellevue, WA – Oct. 31-Nov. 7, 1998 – Proceedings ("Lind"), U.S. Patent No. 6,401,112 ("Boyer"), U.S. Patent No. 6,230,132 ("Class"), Chapter 11 of the AUTOMOTIVE ELECTRONICS HANDBOOK, by Ronald Jurgen (ed.), U.S. Patent No. 5,274,560 ("LaRue"), and the

article *IBM's Corporate High Flier*, published in the Sydney Morning Herald on September 29, 1997.

<u>The '156 Patent</u>

3. The '156 patent describes an elevator information system, shown generally in Figs. 1 and 2. '156 patent, col. 5, lines 39-40. The system 100 includes an input device 102, a speech recognition (SR) module 104, and a central processor 106 with associated components. '156 patent, col. 5, lines 41-49. In this system, keypads 116 and/or touch sensitive displays 113 (Fig. 2) are disposed within an elevator car 180 to facilitate "easy access and viewing by passengers." '156 patent, col. 6, lines 47-50. The system also includes a central server 170 located remotely from the elevator car and connects to the elevator car "clients" 180 via a local area network. '156 patent, col. 7, lines 39-42; Fig. 3. In an alternative embodiment, data may be transferred between the elevator cars 180 and the remote server 170 via a wireless interface 310. '156 patent, col. 7, lines 51-58.

4. According to the '156 patent, the system 100 can include one or more data terminals 702 which allow the user to plug in a personal electronic device (PED) 704 having a standardized interface into the system to obtain a download of information. '156 patent, col. 11, lines 9-15. A representation of this embodiment is shown in Fig. 7:

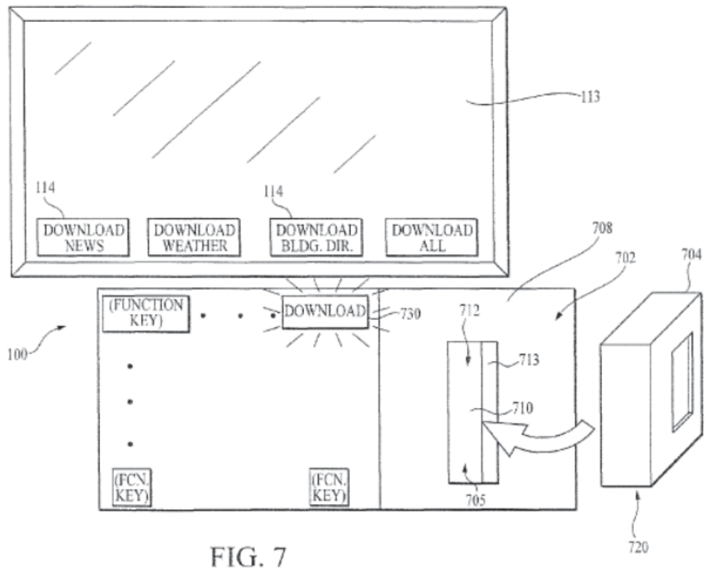


FIG. 7

5. According to the ’156 patent, “the term ‘PED’ includes, but is not limited to, personal digital assistants (PDAs) such as the Apple Newton®, US Robotics/3COM PalmPilot®, or Palm III®, laptop computer, notebook computer, or the like.” ’156 patent, col. 11, lines 16-19. Furthermore, the data terminal, via which the PED 704 may be plugged into to the system 100, “includes a connector 712 which is a 9-pin RS-232 serial connection of the type well known in the electronic arts, although other types of connectors and protocols may be used.” ’156 patent, col. 11, lines 19-23.

<u>The Combination of Hancock and Lind – Claims 10, 15, 18, 20, 21, 22, and 23</u>

6. The combination of Hancock and Lind describes all of the limitations of claims 10, 15, 18, 20, 21, 22, and 23 of the ’156 patent.

Claim 10

7. Hancock describes a remote database that can provide services over a computer network, such as the Internet, to users in vehicles. Hancock, Abstract. The remote database described in Hancock may be queried by the user of a vehicle via, for example, a cellular base station. Hancock, Fig. 13.

8. Lind describes an SUV, referred to as the "Network Vehicle," containing hardware and software that allows it to wirelessly connect to, for example, the Internet. Lind, page I21-2. This allows the vehicle described in Lind to retrieve information wirelessly. Lind, page I21-2 and Fig. 3. The system disclosed in Lind can receive inputs from a user, via voice or via a touch screen, access a remote server wirelessly based on that input, receive information responsive to the user's input, and implement the desired function. For example, the information requested by the user may be a retrieval of e-mails, which may be displayed to the driver on an LCD screen or read aloud. Lind, page I21-7.

9. Lind also describes the use of an ad hoc communication link between the vehicle's computer and a user's portable device, such as the IBM WorkPad PDA. Lind, page I21-5. Further, e-mails that are retrieved from the Internet can be downloaded to the IBM WorkPad PDA. Lind, page I21-7.

10. Hancock describes a computer readable apparatus comprising a storage medium, including a "general or special purpose computer system" that includes a

CPU and various types of storage, including RAM and/or ROM. Hancock, col. 25, lines 30-38. Additionally, Hancock describes that this storage medium contains a computer program, as it uses "non-volatile ***program*** memory." Hancock, col. 25, lines 30-38 (emphasis added). Therefore, Hancock discloses a "computer readable apparatus comprising a storage medium, said storage medium comprising at least one computer program with a plurality of instructions," as claimed in claim 10 of the '156 patent.

11. Lind discloses that the system makes use of software applications and microprocessors on-board the vehicle. Lind, pages I21-1, I21-2, I21-6. In order to run software on a microprocessor, a storage medium such as a hard drive, RAM, or ROM is used. Therefore, Lind discloses a "computer readable apparatus comprising a storage medium, said storage medium comprising at least one computer program with a plurality of instructions," as claimed in claim 10 of the '156 patent.

12. At the time the '156 patent was filed, it would have been understood that the computer programs disclosed in Hancock and Lind include "a plurality of instructions," as claimed in claim 10 of the '156 patent. Chapter 11 of the Automotive Electronics Handbook, for example, describes automotive computers and microcontrollers, as they existed in the mid-1990s. It was known, for example, in the mid-1990s that microcontrollers include an "instruction set," which "consists

of a set of unique commands which the programmer uses to instruct the microcontroller on what operation to perform." Jurgen, pages 11.12-11.13. Additionally, the Automotive Electronics Handbook includes a discussion of the common types of programming languages used in the automotive field, including high level languages, such as C, and low level languages, such as assembly language, each of which permit a microcontroller or CPU to execute machine instructions. Jurgen, pages 11.15-11.17.

13. Hancock discloses a computerized information system disposed within a transport apparatus that transports at least one person from one location to another, e.g., an automobile. For example, the "portable-computing device 1302" disclosed in Hancock is located inside a vehicle. Hancock, col. 23, lines 44-43. Therefore, Hancock discloses "the storage medium being part of a computerized information system disposed on or within a transport apparatus configured to transport at least one person from one location to another," as claimed in claim 10 of the '156 patent.

14. Lind also discloses a computerized information system disposed within a transport apparatus that transports at least one person from one location to another. For example, Lind discloses an "on-board network," including a network computer, which is located "on-board" the vehicle, in this case an SUV. Lind, Figures 1, 2. Therefore, Lind discloses "the storage medium being part of a

computerized information system disposed on or within a transport apparatus configured to transport at least one person from one location to another," as claimed in claim 10 of the '156 patent.

15. Hancock discloses that the computer program receives an input related to a desired function. For example, Hancock discloses a keypad device 1414 that is coupled to the portable-computing device 1302 for inputting data. Hancock, col. 25, lines 43-45. Additionally, Hancock discloses the use of a speech interface 1418 that accepts spoken commands. Hancock, col 25, lines 47-48. Therefore, Hancock discloses "said at least one program being configured to: receive an input from a user of the transport apparatus, the input relating to a desired function," as claimed in claim 10 of the '156 patent.

16. Lind also discloses that the computer programs receive inputs relating to a desired function. For example, the ViaVoice program, which is one of the software programs described in Lind, receives voice inputs that can be used to check e-mail and voicemail. Lind, page I21-3. Therefore, Lind discloses "said at least one program being configured to: receive an input from a user of the transport apparatus, the input relating to a desired function," as claimed in claim 10 of the '156 patent.

17. Hancock discloses that the vehicle accesses a remote server via a wireless interface in order to access and receive information. For example, Hancock

describes that a “wireless transceiver 1402 is used to send and receive data between the portable-computing device 1302 and other devices such as the servers 1314 and 1315 coupled to the Internet 1318.” Hancock, col. 26, lines 8-11. Therefore, Hancock discloses “at least one program being configured to” (a) “cause access of a remote server via an associated wireless interface to access information relating to the desired function” and (b) “receive accessed information via the wireless interface,” as claimed in claim 10 of the ’156 patent.

18. Lind also discloses that the vehicle accesses a remote server via a wireless interface in order to access and receive information. Lind describes an antenna, Lind, page I21-2, that connects the vehicle to the outside world using “high-bandwidth communications,” Lind, page I21-3. Lind describes that the vehicle can use the wireless interface to access an Internet service provider, and via the Internet, can connect to, for example, an IBM web server or a home/office computer. Lind, Fig. 3. The system described in Lind may access information related to the desired function, for example, checking e-mail, via Internet access to these servers. Therefore, Lind discloses “at least one program being configure to” (a) “cause access of a remote server via an associated wireless interface to access information relating to the desired function” and (b) “receive accessed information via the wireless interface,” as claimed in claim 10 of the ’156 patent.

19. Hancock discloses that the desired function is implemented using the received information. For example, according to Hancock, “the process retrieves the results from the database query and sends them to the client, as indicated by step 1620.” Hancock, col. 28, lines 6-8. Additionally, Hancock describes that the received information, such as maps and driving directions, can be “presented to users.” Hancock, col. 32, lines 37-39. Therefore, Hancock discloses “at least one program being configured to” “implement the desired function using at least a portion of the received information,” as claimed in claim 10 of the ’156 patent.

20. Lind also discloses that the desired function (receiving e-mail messages) is implemented using the information received via the wireless link. For example, the vehicle disclosed in Lind can read e-mail messages out loud or display a waiting e-mail indication on the heads-up display. Lind, pages I21-2, I21-3. Therefore, Lind discloses “at least one program being configured to” “implement the desired function using at least a portion of the received information,” as claimed in claim 10 of the ’156 patent.

21. As discussed above, the ’156 patent describes that a user can plug a personal electronic device (PED) into the system to obtain a download of information. ’156 patent, col. 11, lines 13-16. Examples of these personal electronic devices (PEDs), according to the ’156 patent, include various PDAs and laptops, ’156 patent, col. 11, lines 16-19 (“As used herein, the term ‘PED’ [personal electronic device]

includes, but is not limited to, personal digital assistants (PDAs) such as the Apple Newton®, US Robotics/3COM PalmPilot®, or Palm III®, laptop computer, notebook computer, or the like.”), and the PED can be connected to the system using, e.g., an RS-232 serial connection. ’156 patent, col. 11, lines 19-23.

22. Hancock describes that “[a]ny type of general or special purpose computer system can be used to implement the portable-computing device 1302,” Hancock, col. 25, lines 29-31, and that “[e]xamples of such devices include … personal digital assistant devices (PDAs),” Hancock, col. 25, lines 31-33. Hancock further describes that the portable-computing device 1302 may be coupled to external devices, such an ALI (automatic location identifying) device 1406, e.g., a GPS device, and/or a wireless transceiver 1402, via external ports, e.g., RS-232 ports. Hancock, col. 25, lines 15-21.

23. Lind discloses that the network computer, which includes software programs, establishes an ad hoc communication link with a portable computerized device. According to Lind, a portable computerized device or “removable personal digital assistant (PDA)” (Lind, page I21-2), such as an IBM WorkPad (which is a Palm device, like the PalmPilot and Palm III devices described in the ’156 patent as examples of a PED, and which is a personal digital assistant device (PDA), like that described by Hancock), can be placed in a slot built into the center console. Lind, page I21-5. Additionally, the diagram of the on-board network in Lind shows

the “PDA Dock” for the WorkPad PDA being connected to the network computer via an RS-232 connection (which is identical to the type of connection described in the ’156 patent between the personal electronic device (PED) 704 and the system 100, and to the type of connection described by Hancock between the portable-computing device 1302 and the ALI device 1406 and/or the wireless transceiver 1402). Lind, page I21-2, Figure 2. Therefore, Lind discloses that “at least one program is … configured to: establish an ad hoc communication link with a portable computerized device of a user of the transport apparatus,” as claimed in claim 10 of the ’156 patent.

24. Lind discloses that a portion of the received information (e.g., e-mails) can be downloaded to the portable computerized device via communication link. Lind describes that “E-mails and appointments can be downloaded to the docked Workpad PDA, for review after leaving the vehicle.” Lind, page I21-7. Therefore, Lind discloses that “at least one program is … configured to” “download at least a portion of the received information to the portable computerized device via the communication link,” as claimed in claim 10 of the ’156 patent.

Claim 15

25. Hancock discloses that the database includes names of business entities, and is searchable by the name of a business entity. For example, the database can be searched by categories of interest, such as restaurants, banks, ATM machines, etc.

The points of interest can be located by customers by common name, for example, "MacDonalds." See, e.g., Hancock, col. 8, line 56-col. 9, line 17. Therefore, Hancock discloses that "said remote server is in communication with a database of business entities, said database being searchable at least by a name of a business entity," as claimed in claim 15 of the '156 patent.

26. Lind also discloses that the driver may issue verbal commands to operate the vehicle. For example, Lind states that "voice recognition technology allows drivers and passengers to verbally request and listen to e-mail messages, locate a restaurant or hotel, ask for navigation help or for specific music or sports scores, and use voice-activated telephone services, all done safely without interfering with driving." Lind, page I21-2. Lind further describes that the Network Vehicle's advanced speech recognition system "allows the driver to access virtually all the vehicle's features through voice commands" and that the "driver can: execute vehicle system commands such as … request travel directions and traffic updates from the Web or other sources, check e-mail and voicemail, request news, sports, and stock information." Lind, page I21-3. It is well-known that in systems that accept voice commands, the speech input is digitized for analysis. For example, when using software to process speech, the speech is passed through a microphone, amplifier, and digital-to-analog converter in order to process and analyze the speech. LaRue, col. 5, lines 17-30. The speech recognition system described in

Lind also includes a microphone. Lind, pages I21-3 and I21-6. Therefore, Lind discloses that "said input comprises a digitized representation of a speech input, the speech input being received via a microphone located within said transport apparatus, the speech comprising said name of said business entity," as claimed in claim 15 of the '156 patent.

Claim 18

27. Lind discloses that the desired function (e.g., the user receiving e-mails) can be implemented by "synthesizing speech for playout." For example, Lind discloses that drivers and passengers can listen to e-mail messages, Lind, page I21-2, and also discloses that the ViaVoice system included in the Network Vehicle "enables the vehicle to talk back using synthesized speech," Lind, page I21-3. Figure 2 of Lind discloses that the system includes amplifiers and speakers. Therefore, Lind discloses that "the implementation of the desired function comprises synthesizing speech for playout over one or more speakers disposed within said transport apparatus, the speech being synthesized based at least in part on said received information," as claimed in claim 18 of the '156 patent.

Claim 20

28. Hancock discloses that the received information can be configured into a "travel profile" specifically for the user. Hancock, col. 9, lines 48-64. For example, a user can select and sort the necessary data (such as destinations) to create a travel

profile, which can be downloaded to the navigational unit. Hancock, col. 9, lines 59-60. This pre-stored travel profile is "configured specifically for the user," as claimed, because it is particular to user selections, and/or to preferences the user has stored in the central repository. Hancock, col. 9, lines 55-58. Therefore, Hancock discloses that "said received information is configured specifically for the user," as claimed in claim 20 of the '156 patent.

29. Lind also discloses that a user can use the system to "set up a profile, including preferences like radio stations, personalized audio content, service records, and emergency service numbers." Lind, page I21-5. Therefore, Lind discloses that "said received information is configured specifically for the user," as claimed in claim 20 of the '156 patent.

Claims 21 and 22

30. Hancock discloses that the "travel profile," which is configured specifically for the user, is based at least in part on data stored on a remote server that relates specifically to that user. For example, Hancock discloses that the personal configuration is based on "information in the central repository 65," which is located on a remote server. Hancock, col. 9, lines 48-64. The data in the remote central repository, such as geographic data, is used to create the travel profile. Hancock, col. 9, lines 48-64. The central repository may also "store preferences for the user." Hancock, col. 9, lines 58-59. Therefore, Hancock discloses that "said

configuration specifically for the user is based at least in part on data stored on a remote server, the data relating specifically to that user," as claimed in claim 21 of the '156 patent, and that "said data stored on a remote server relating specifically to that user is based at least in part on one or more previously supplied user-selected configuration parameters," as claimed in claim 22 of the '156 patent.

Claim 23

31. Hancock discloses that the user may make an input to obtain information relating to a particular destination or entity. For example, Hancock describes that the user may conduct a database search for "restaurants that accept a particular type of credit card, have a particular dress code, or provide goods within a particular price range." Hancock, col. 29, lines 2-5. These attributes of the various destinations constitute "information relating to a particular destination or entity." Therefore, Hancock discloses that "said input relating to a desired function comprises an input to obtain information relating to a particular destination or entity," as claimed in claim 23 of the '156 patent.

32. Lind also discloses that the user may use the system to obtain the location of a particular destination or entity, e.g., a restaurant or hotel, Lind, page I21-2, and that the driver can "request travel directions and traffic updates from the Web or other sources," Lind, page I21-3. The location of a destination or entity is "information relating to" that destination or entity, and travel directions and traffic

updates typically relate to particular destinations and entities. Additionally, Lind discloses that "[t]he driver can … check e-mail and voicemail, request news, sports, and stock information," Lind, page I21-3, and that "[t]he Network Vehicle is an extension of your office, seamlessly offering access to … e-mail and address book," Lind, page I21-7. E-mails, voicemails, news, sports, stock information, and address books relate to, for example, particular entities. Therefore, Lind discloses that "said input relating to a desired function comprises an input to obtain information relating to a particular destination or entity," as claimed in claim 23 of the '156 patent.

Reasons to Combine Hancock and Lind

33. At the time the '156 patent was filed, it would have been obvious to combine Hancock and Lind to achieve the systems claimed in claims 10, 15, 18, 20, 21, 22, and 23 of the '156 patent.

34. For example, both Hancock and Lind describe systems that provide information conveniently and safely to the driver of an automobile. Lind, page I21-1; Hancock, col. 2, lines 54-56. Additionally both Hancock and Lind describe systems that obtain information from remote sources at the user's or driver's request and output the obtained information to the user or driver. Further, Lind states that the system could assist the user in locating a "restaurant or hotel." Lind, page I21-2. Thus, the system in Lind is provided with navigation information, as

also described in Hancock. It would have been obvious that different types of information could be downloaded to the Workpad PDA docked in the Network Vehicle, such as the navigation information that is provided to the car in Hancock. At the time of the alleged inventions of the claims of the ’156 patent, a person of ordinary skill in the art would have understood that digital data for providing information to the driver could have been supplied to the docked PDA, without any modification to the system of Lind.

Industry Activity

35. Additionally, several years before the earliest filing date referred to on the face of the ’156 patent, as well as contemporaneously to the filing of the ’156 patent, other companies developed, and were developing, vehicles with Internet connectivity (allowing users to, for example, retrieve information wirelessly from remote databases while inside their vehicles), speech-recognition functionality, and connectivity to portable electronic devices. This industry activity further demonstrates that the systems claimed in the ’156 patent would have been obvious to a person of ordinary skill in the art, and that it would have been obvious to combine Hancock and Lind.

36. For example, as described by Lind, the Network Vehicle was developed by a group of companies including Delphi Delco Electronics Systems, IBM, Netscape Communication, and Sun Microsystems. The Network Vehicle developers loaded

several computing and communications devices into a vehicle, to show that the technology could successfully be used in a variety of ways. The Network Vehicle included a roof-mounted antenna to provide a satellite connection to the Internet. Lind, page I21-2. The system associated with the Network Vehicle included an off-board network architecture, including, for example, a home/office computer and an IBM web server. Lind, page I21-2. As described by Lind, the Network Vehicle developers provided a web site for users of the Network Vehicle to remotely access the computing systems located in the vehicle. The vehicle web site allowed users to "plan trips on the vehicle web site, then download them to your vehicle." Lind, page I21-7.

37. Lind also describes systems in which a user can receive various types of information inside the vehicle, including e-mail. Lind states that the Network Vehicle was demonstrated at the Computer Dealer's Exhibits (COMDEX '97) in Las Vegas, Nevada on November 17-19, 1997. At this demonstration, the presenters of the Network Vehicle (Delphi, IBM, Netscape, and Sun Microsystems) presented the vehicle website that is described by Lind, as noted above.

38. I have reviewed screenshots of the Network Vehicle web site; those screenshots are attached as Exhibit B. I acquired these screenshots pursuant to my work as an expert witness engaged by Volkswagen Group of America, Inc. in

connection with *Affinity Labs of Texas, LLC v. BMW North America, LLC, et al.*, Case No. 9:08-cv-00164 (E.D. Tex.).

39. Moreover, in 1997, I personally attended a demonstration of the Network Vehicle, conducted by Delphi and a Delphi supplier exhibition at Toyota's headquarters in Toyota City, Japan. At that event, the developers of the Network Vehicle demonstrated its features to me, and explained the system operation.

40. Referring to Exhibit B, as illustrated in, e.g., the "Driver profile" page, the vehicle maintains a set of profiles for each driver, including personal data, entertainment preferences, information preferences, vehicle preferences, and a personal address book. The Network Vehicle therefore demonstrates that it would have been obvious to configure the information specifically for the user.

41. Additionally, referring to Exhibit C (*VW is working on a multimedia car*, Reuters AG, April 22, 1996), Volkswagen was working on a "multimedia car" and presented its "Infotainment Car," in Hannover, Germany in 1996; the Infotainment Car included, for example, a PC with Internet connectivity.

42. In the Connected CarPC, which is described, for example in Exhibit D (*In-Car Computing and Communication Enables Entertainment, Productivity and Information*, Dedicated Conference on ATT/ITS Advances for Enhancing Passenger, Freight & Intermodal Transportation Systems, p. 411-417 (1997)), in 1997, communication links were being used in automobiles to provide, for

example, traffic information, Internet access to find hotels, restaurants, and travel guides, and to schedule maintenance, perform remote diagnostics and receive software updates. The "Connected CarPC environment" provides, for example, speech recognition functionality and Internet access.

43. The Daimler-Benz Internet Multimedia on Wheels Concept Car, also referred to as the Internet Car, which is described, for example, in Exhibit E (Jameel et al., *Internet Multimedia on Wheels: Connecting Cars to Cyberspace* (IEEE 1998)) and Exhibit F (Jameel et al., *Web on Wheels: Toward Internet-Enabled Cars* (IEEE January 1998)), included "an on-board, integrated wireless communication system and the computing infrastructure to provide Internet connectivity from the car to any specific server on the Internet while stationary or in motion." The Internet Car allows for "Personal device (smart cards, HPCs) [to] be used to personalize car seats, climate, phone numbers, Internet services bookmarks, and computing man machine interface." The Internet Car allows drivers to "access … voice-mail, e-mail, and travel-related information such as restaurant guides and movie theater locations" "in a hands-free, eyes-free manner through voice commands and speech technology." The Internet Car also allows drivers and passengers to "use their personal devices like Smart Phones, Personal Digital Assistants (PDAs), Hand-held PCs (HPCs), etc., in an integrated fashion."

Figure 1, reproduced below, illustrates a PDA among "Personal Devices" that may be connected to the Internet Car via an IrDA (infrared) transceiver.

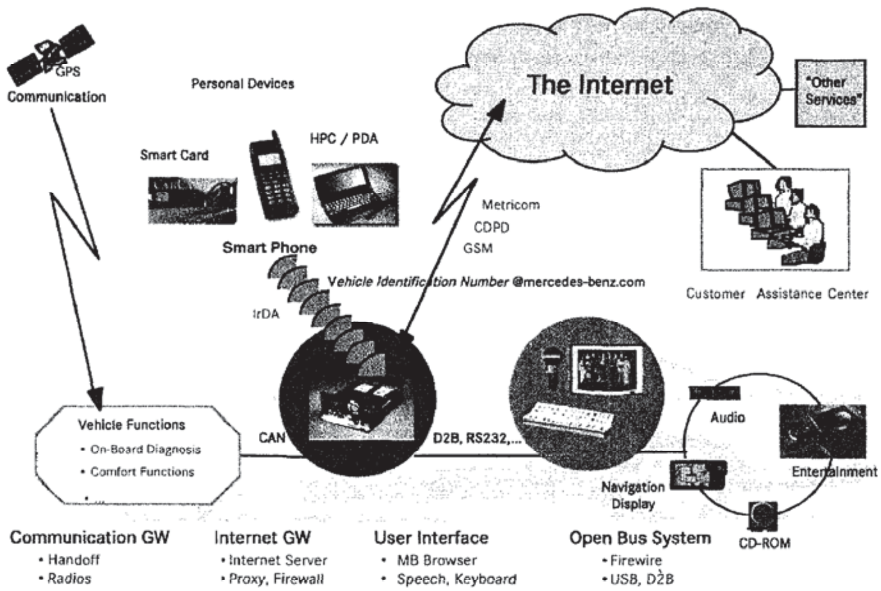


Figure 1: A systems view of the Internet Multimedia on Wheels concept.

44. Microsoft's Auto PC, which is described, for example, in Exhibit G (Jost, *The car as a mobile-media platform*, Automotive Engineering International, pp. 49-53 (May 1998)), "brings the benefits of interactive speech technology, connectivity, information on demand, and enhanced entertainment to the automobile." The system is designed so that "users can share information between their Auto PC and Handheld and Palm PCs."

45. Visteon's ICES system, which is also described in Exhibit G, includes a voice-activated control system that "allows drivers to control vehicle functions that are usually operated manually." Using the Visteon ICES system, "[t]hrough speech recognition, the driver can send e-mail, obtain turn-by-turn Global Positioning

Satellite (GPS)-based navigation to a specific destination, ask for traffic and weather conditions, locate a restaurant or hotel, or change the musical selection on the stereo." Wireless Internet connectivity "can be used for vehicle-to-roadside assistance or to receive e-mail and Internet information." Additionally, the Visteon ICES system includes an infrared data link to connect to Windows CE-based devices, "such as Handheld and Palm PCs or another personal handheld Digital Assistant, for transferring data to and from the vehicle."

The Combination of Hancock, Lind, and Boyer – Claim 11

46. Boyer (assigned on its face to Palm, Inc.) discloses a PDA docking system that allows connection and synchronization with a personal computer. Boyer, col. 2, lines 55-59. As described in Boyer, the synchronization program is "resident on the portable device." Boyer, col. 2, lines 55-59.

47. This synchronization of information is initiated by the software resident on the portable device, as claimed in claim 11 of the '156 patent. As described in Boyer, the PDA (the "portable computer system 160") is docked in a cradle, and the user presses a synchronization button 185 on the cradle to activate a synchronization program called "HotSync." Figure 1B, reproduced below, shows that "[t]he synchronization cradle 180 has a button 185 that activates a synchronization Program (HotSync) 161 in the portable computer system 160." Boyer, col. 3, lines 2-5. As shown in Figure 1B, the synchronization program (the

HotSync Program 161) is resident "in the portable computer system 160." The synchronization of the two devices involves transfer of data to and from both devices. Boyer, col. 2, lines 59-61. Therefore, data is downloaded to the PDA during this synchronization.

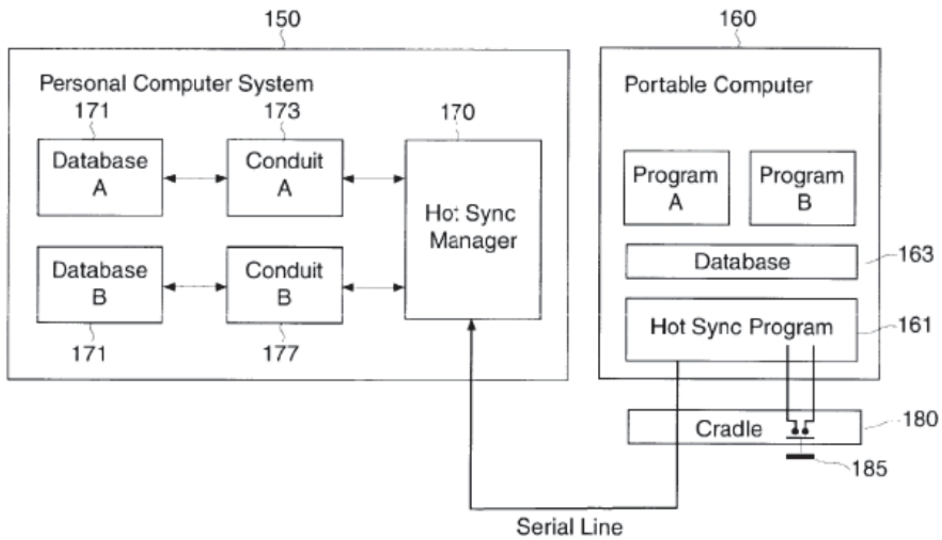


FIG. 1B

48. Once the button is pressed, indicating that the synchronization should begin, the HotSync software resident on the PDA initiates the synchronization process, which includes a download of information to the PDA. Boyer, col. 3, lines 2-5; Figure 1B. Therefore, Boyer discloses that "said download of said at least a portion of the received information to the portable computerized device via the communication link is initiated by software resident on the portable device," as claimed in claim 11 of the '156 patent.

49. It would have been obvious to combine Hancock, Lind, and Boyer to achieve the system claimed in claim 11 of the ’156 patent.

50. The rationale for combining Hancock and Lind is described above.

51. Lind discloses synchronizing, e.g., e-mail between a portable computing device, such as the IBM WorkPad (a Palm device), with a host device, such as the vehicle’s computer. Lind, page I21-5. Boyer describes a method for synchronizing a PDA with a host device. A person of ordinary skill in the art would have found it obvious to use software resident on the IBM WorkPad, as disclosed by Lind, to initiate the download of information, as described by Boyer. Indeed, the ’156 patent describes that the personal electronic device may be a Palm device (’156 patent, col. 11, lines 18-19). Boyer, assigned on its face to Palm, Inc., describes a method for synchronizing a Palm device with a host computer. Additionally, the IBM WorkPad disclosed by Lind is a “rebadged version of the popular 3com/US Robotics PalmPilot handheld.” *IBM’s Corporate High Flier*, p. 1. In effect, the ’156 patent, Lind, and Boyer are all discussing the same type of portable device: a Palm device. Thus, it would have been obvious to provide the IBM WorkPad disclosed in Lind with the synchronization software disclosed in Boyer, in order to “provide a palmtop computer system that is fully integrated with common email systems used by desktop personal computers.” Boyer, col. 1, lines 48-51.

<u>The Combination of Hancock, Lind, and Class – Claim 24</u>

52. Class discloses a system that allows real-time speech input of a destination address into a navigation system. Class, Abstract. In order to determine what the speaker meant, the system in Class creates an ambiguity list that identifies multiple potential matches by probability. Class, col. 8, line 16-col. 9, line 11. The system engages in a dialogue with the user to resolve the ambiguity, such as by asking a "question as to whether or not [the place name with the highest recognition probability] corresponds to the desired input destination location." Class, col. 8, lines 16-35. Therefore, Class discloses that "said at least one program is further configured to receive a second digitized representation of speech input relating to the particular destination or entity in order to resolve one or more ambiguities associated therewith," as claimed in claim 24 of the '156 patent.

53. It would have been obvious to combine Hancock, Lind, and Class to achieve the system claimed in claim 24 of the '156 patent.

54. The rationale for combining Hancock and Lind is described above.

55. Lind, Hancock, and Class all disclose speech recognition systems for automobiles. Hancock, col. 25, lines 47-48; Lind, page I21-2; Class, Abstract. Class discloses a system that allows the voice inputs to a speech recognition system to be easier and more accurate, by resolving ambiguities that arise when computers interpret human speech. Class, col. 2, lines 31-34 ("Another object of

the invention is to provide such an arrangement which enables faster speech input of a destination address in a navigation system, improving operator comfort.”). Thus, it would have been obvious to include Class’s ability to resolve ambiguities in the combination of Hancock and Lind to, for example, enable faster speech input and to improve operator comfort.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code.

Dated: 10/5/2015

Scott Andrews

EXHIBIT A

Scott Andrews

915 Western Ave.
(650) 279-0242 Petaluma, CA 94952

Summary

Creative, energetic, and innovative internationally recognized executive experienced in general management, systems engineering, advanced product development, advanced technology, business development, strategic planning, and program management

- Vehicle Electrical/Electronics Systems
- Vehicle Information Systems
- Communications Systems
- ITS and Related Industries
- Program and Project Management
- Enterprise Software
- Multimedia/Internet Computing
- Vehicle Safety and Control Systems
- Spacecraft Electronics
- Mobile Information Technology

Experience

12/2001-Present Consultant

Systems engineering, business development and technical strategy consulting supporting automotive and information technology.

Current Engagements:

- Technical consultant to ARINC for connected vehicle application systems engineering and development of high precision connected vehicle test bed for FHWA (Federal High Way Admin.)
- Technical consultant to Booz Allen for connected vehicle performance measures development project for NHTSA (National Highway Traffic Safety Admin.)
- Technical consultant to Booz Allen for connected vehicle standards for FHWA
- Technical consultant to American Association of State Highway Transportation Officials (AASHTO) for connected vehicle deployment analysis and strategy
- Technical consultant to Michigan State DOT (Enterprise Pooled Fund) to develop a system architecture and deployment strategy for Rural ITS
- Expert witness for Toyota in a case brought by American Vehicular Sciences (AVS)
- Expert witness for Toyota in a patent case brought by Affinity Labs
- Expert Witness for TomTom in a patent case brought by AVS
- Expert witness for Liberty Mutual, Geico and Hartford in a patent case brought by Progressive Insurance
- Expert witness for Ford in a patent case brought by Medius.
- Expert witness for Ford in a patent inventorship case brought by Berry.
- Expert witness for Ford and GM in a patent case brought by Affinity Labs
- Expert witness for M/A Com in a patent case against Laird
- Expert witness for VW/Audi in a patent case brought by Velocity
- Expert witness for VW/Audi in a case brought by Beacon, GmbH.
- Expert witness for Wasica in a patent case against Shrader and Continental

Recent Engagements:

- Expert Witness for Samsung, Nokia, ZTE and Sony in an ITC patent case brought by Pragmatus
- Expert Witness for TomTom in a case brought by AOT/Adolph
- Expert Witness for TomTom in a case brought by Cuozzo
- Expert Witness for Navico in a case brought by Honeywell

- Expert witness for Bentley in a case brought by Cruise Control Technologies.
- Expert witness for Google in a case brought by Walker Digital
- Expert witness for Emtrac in a case brought by GTT (3M)
- Expert witness for Motorola in a case brought against Microsoft
- Co-Principal investigator for Integrated Advanced Transportation System; research program funded by FHWA
- Expert Witness for Volkswagen/Sirius-XM in patent infringement case relating to traffic information systems
- Expert Witness for Pioneer in patent infringement related International Trade Commission matter
- Expert Witness for Volkswagen in patent infringement case relating to the iPod interface
- Chief System Architect for the Vehicle Infrastructure Integration (VIIC) program (BMW, Chrysler, Daimler Benz, Ford, GM, Honda, Nissan, Toyota, VW);
- Expert Witness for Honda in patent infringement lawsuit); 14 asserted patents dealing with telematics equipment interfaces and functions
- Expert Witness for Alpine, Denso and Pioneer Corporation in patent infringement related International Trade Commission matter relating to navigation systems
- Telematics delivery architecture development for a Fortune 100 service provider
- Technical consultant to the Vehicle Safety Consortium developing Dedicated Short Range Communications (DSRC) standards for safety systems;
- Expert Witness for BMW in patent infringement lawsuit (American CalCar, Inc. v BMW) included prior art search, invalidity & non-infringement reports, rebuttals reports, depositions, etc for 12 patents with 200+ asserted claims.
- Toyota Motor Sales – 10 year technology survey;
- Connected Vehicle Trade Association- Transferred AMI-C specifications to ISO TC 22, TC 204 AND OSGi. Developed OSGi Vehicle Interface Specification;
- Personal navigation device product feature and opportunity analyses for Thales-Magellan and Rand McNally

4/2000 to 12/2001 Cogenia, Inc.
President and Chief Executive Officer, Founder
Founded company in 2000 to develop enterprise class data management software system. Responsibilities included development of business concept and plan, corporate administration including financial and legal management, leadership of executive team in product development, fundraising, business development, organizational development, and investor relations. Raised $2.2M between 8/00 and 5/01 from individuals and funds;

1996 to 4/2000 Toyota Motor Corporation, Japan
Project General Manager, R&D Management Division
Responsibilities included the conceptualization and development of multimedia and new technology products and services for Toyota's future generations of passenger vehicles in the United States and Europe, Heavy emphasis on strategy for information systems, and on development of technical concepts for computing and Internet oriented systems. Working under direction of Toyota board members, established the Automotive Multimedia Interface Collaboration (AMI-C), a partnership of the world's car makers to develop a uniform computing architecture for vehicle multimedia systems, and led all early technical, planning and legal work. Past responsibilities included leading Toyota's US Automated Highway Systems program, management of technical contracts with Carnegie Mellon University Robotics Lab (Image based collision warning systems), and the development of Toyota's position on the US Intelligent Vehicle Initiative.

1983 to 1996 TRW, Inc.

Held a series of increasingly responsible positions in program management, technology development and business development.

1993 to 1996 TRW Automotive Electronics Group

Director, Advanced Product Planning/Development

Specific responsibilities included leadership and overall management of advanced development programs such as Automotive Radar, Adaptive Cruise Control, Occupant Sensing, In Vehicle Information Systems, and other emerging transportation products; Managed remotely located advanced development laboratory performing approximately $6M in annual development projects.

1983 to 1993 TRW Space & Electronics Group

Manager, MMIC Products Organization

Developed TRW's commercial GaAs MMIC business. Responsibilities included development of business strategy and business plan, and overall management of customer and R&D programs. Developed extensive international business base and took operation from start-up to $5M sales per year in under two years. Developed the first single chip 94 GHz Radar (Used for automotive cruise control and anti collision systems).

1979-1983 Teledyne Microwave

Developed high reliability microwave components. Developed CAD tools.

1977-1979 Ford Aerospace, Advanced Development Operation

Designed, tested and delivered microwave radar receiver systems

Education

MSEE Stanford University, 1982

BSEE University of CA, Irvine 1977

TRW Senior Leadership Program 1992

Publications

1. Two Dimensional Vehicle Control for Obstacle Avoidance in Multi-Lane Traffic Environments; Published in the proceedings of the 1998 IEEE International Conference on Intelligent Vehicles.
2. Automotive Multimedia Interface Collaboration; Briefing Presented to the 9th VERTIS Symposium, April 1999, Tokyo Japan.
3. Privacy and Authenticity in Telematics Systems; Published in the Proceedings of the Society of Automotive Engineers World Congress, 1999
4. Automated Highway Systems Acceptance and Liability; Briefing presented to the Automated Vehicle Guidance Demo 98 Conference, Rinjwoude, The Netherlands, June1998.
5. What is Telematics? Briefing presented at IIR Telematics Conference Scottsdale, AZ, December 2001

6. Advanced Telematics Services: A Hard Look at Reality; Briefing presented at IIR Telematics Conference Scottsdale, AZ, December 2001
7. Consumer Electronics and Telematics; Briefing presented at Eye For Auto Telematics Update Conference Las Vegas, NV, January 2003
8. The Automotive Multimedia Interface Collaboration Software and Network Architecture: Extending the Concept of Platform Independent Computing; Briefing Presented to the Future Generation Software Architectures in the Automotive Domain Conference, San Diego, CA, January 2004
9. Quality, Choice and Value: How New Architectures are Changing the Vehicle Lifecycle; Briefing presented at IEEE Convergence Conference, October 2004
10. Critical Standards for the Next Generation of Telematics Systems and Services; Briefing presented at the Telematics Update Conference, December 2004
11. VII System Overview; Briefing presented To Transportation Research Board, ITS and V-HA Committees 2007 Mid-Year Meeting; July 2007
12. Testing and Development of In-Vehicle Equipment and Private Applications (P08-1634); Briefing presented to the Transportation Research Board Annual Meeting, Washington, DC, January 2008
13. A Comparison of Communications Systems for VII; Presented at the ITS World Congress, New York, NY, October, 2008
14. Vehicle Infrastructure Integration Systems Overview; Presented at the ITS America Annual Meeting, June 1 2009, National Harbor, Maryland
15. Telematics Standards: Logical Next Steps; ITS International, August 2009
16. IntelliDrive^{SM} Overview; ITS International, May 2009
17. Time Synchronization and Positioning Accuracy in Cooperative IntelliDrive^{SM} Systems; Presented at the 2010 ITS America Annual Meeting, June 2010, Houston, Texas

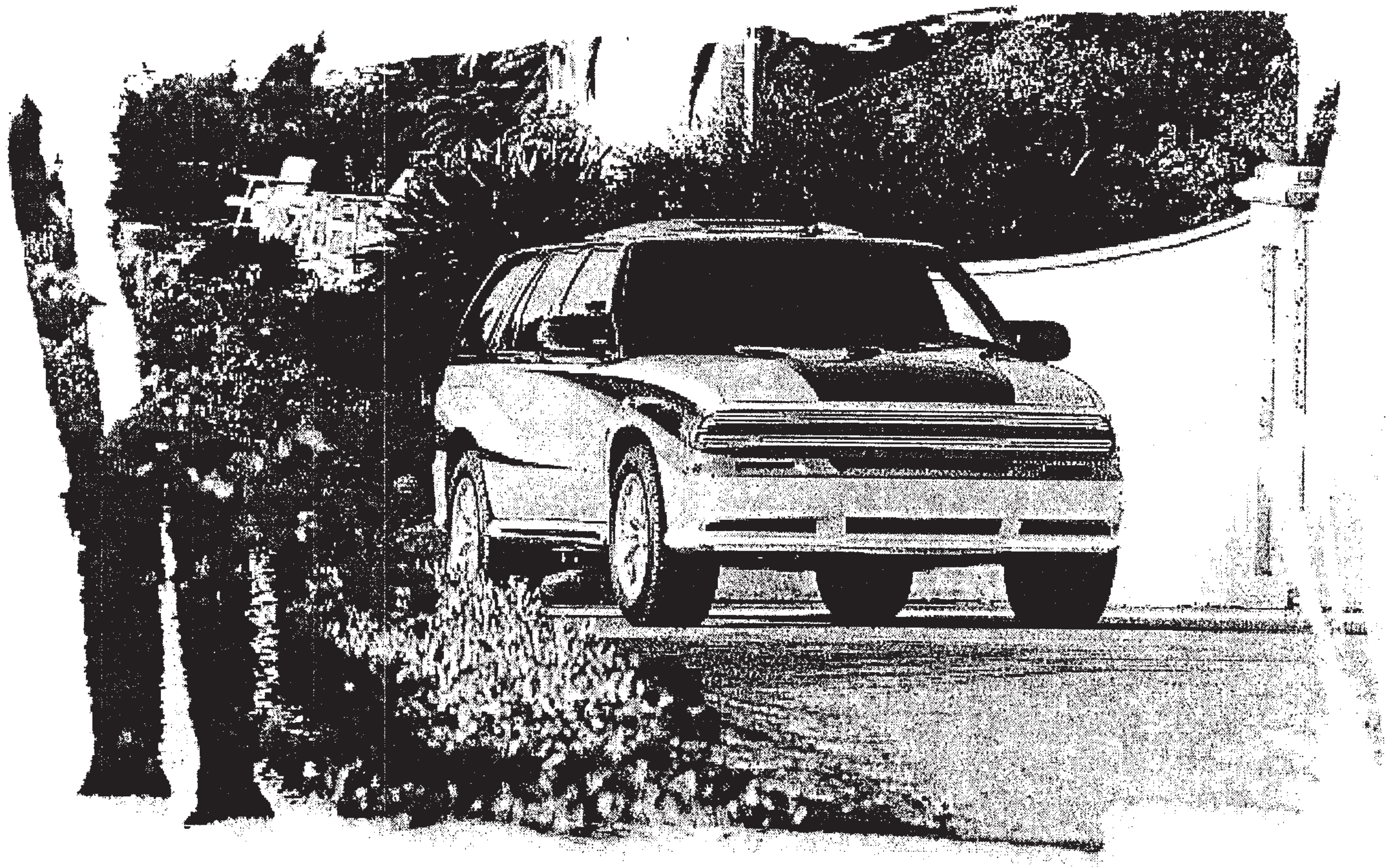
Patents

1. Mobile Body Reporting Device And Its System; Patent Number: JP11118902; 4/30/1999
2. Multiformat Auto-Handoff Communications Handset; Patent Number: US5649308; 07/15/1997

3. A Communications Terminal Device, A Communications System, And A Storing Medium For Storing A Program To Control Data Processing By The Communications Terminal Device; Patent Number: EP0867850, A3; 09/30/1998
4. Communication System For Controlling Data Processing According To A State Of A Communication Terminal Device; Patent Number: US 6122682 3/23/1998
5. Method And Apparatus For Controlling An Adjustable Device; Patent Number: US5864105; 01/26/1999
6. Automatic Brake Device; Patent Number: JP2000108866; 4/18/2000
7. Visual Field Base Display System; Patent Number: JP2000029618; 01/28/2000
8. Intersection Warning System; Patent Number: US5926114; 07/20/1999
9. Security For Anonymous Vehicular Broadcast Messages; Patent Number: US 7742603 3/27/2006
10. Digital Certificate Pool; Patent Number: US7734050 3/27/2006
11. System, Method And Computer Program Product For Sharing Information In A Distributed Framework; Patent Number: US 7802263 12/15/2003

EXHIBIT B

THE
NETWORK VEHICLE



DELPHI

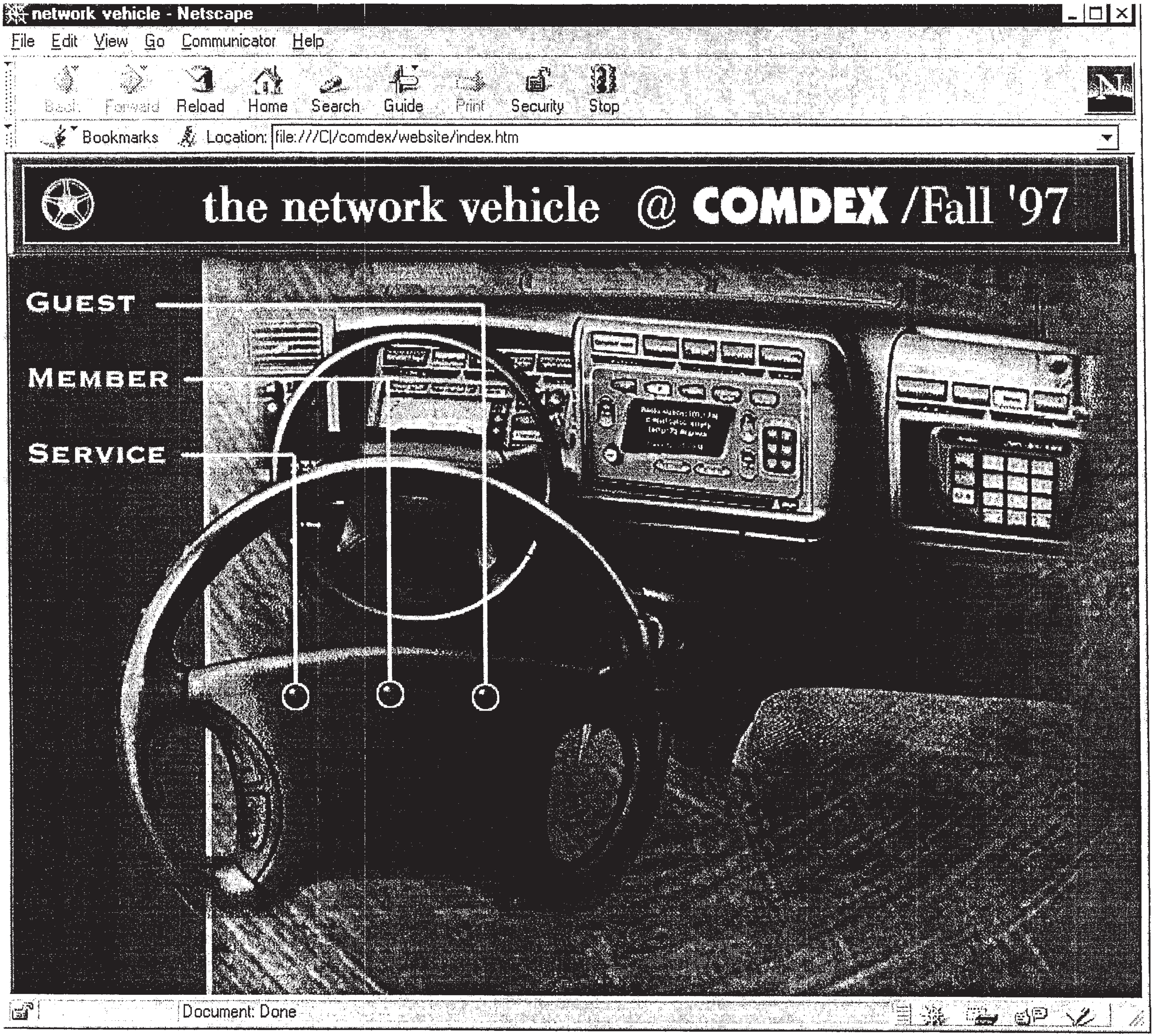
Sun microsystems

IBM

NETSCAPE

DELCO

0235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Back Forward Reload Home Search Guide Print Security Stop
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the network vehicle @ COMDEX /Fall '97
GUEST
MEMBER
SERVICE
Document: Done

0236


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Back Forward Reload Home Search Guide Print Security Stop
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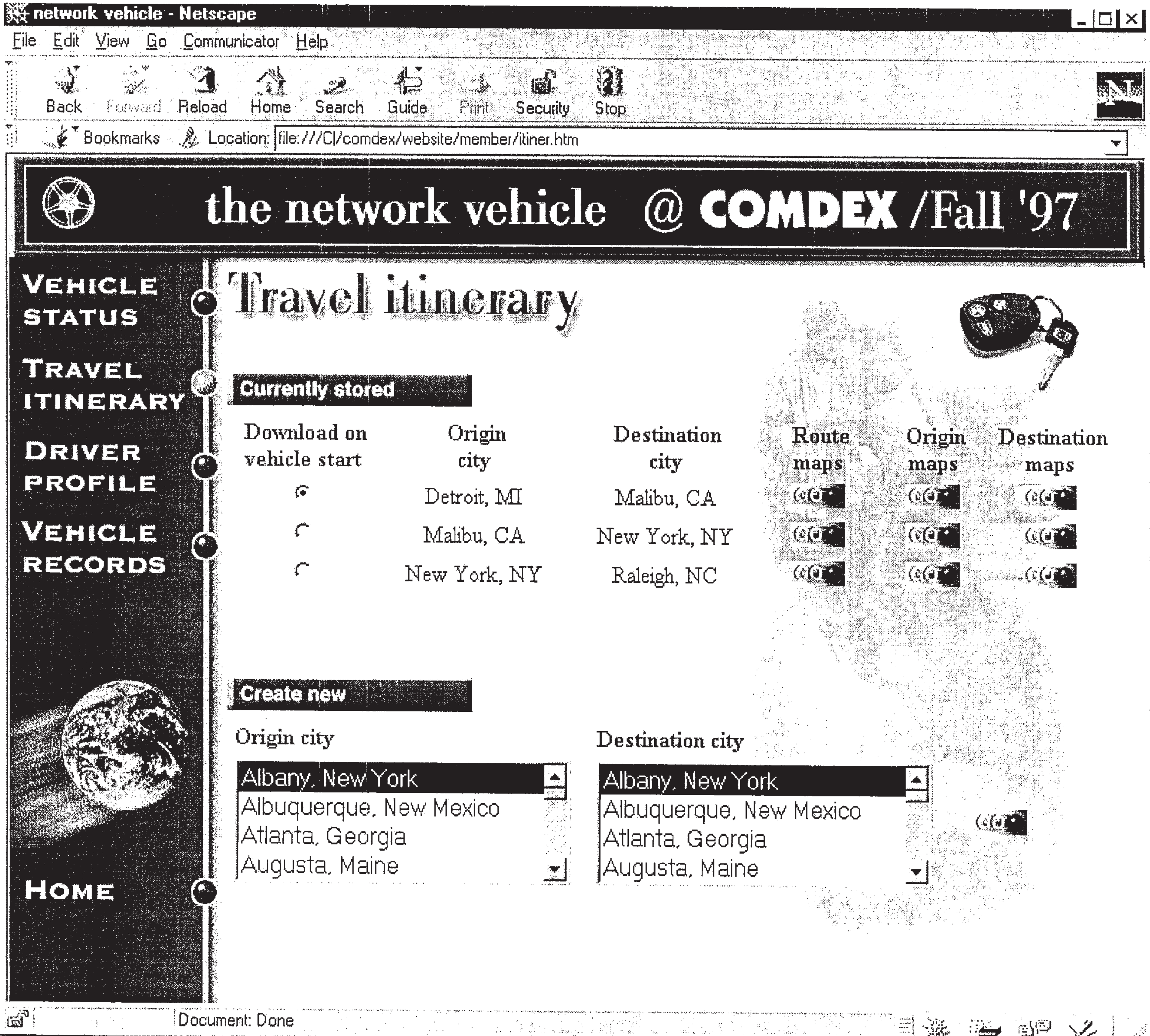
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Member home
Welcome to the network vehicle member home page.
You have logged in as one of the owners of the Comdex Fall '97 network vehicle.
Vehicle ID: J3792X04128
Start here
The member home page is where you begin your road trip through the network vehicle Web site. Move your cursor over the links at left and this space will change to show you a brief description of each network vehicle member function. When you are ready to take off, just click on one of the links.
Document: Done

0237


network vehicle - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Guide Print Security Stop
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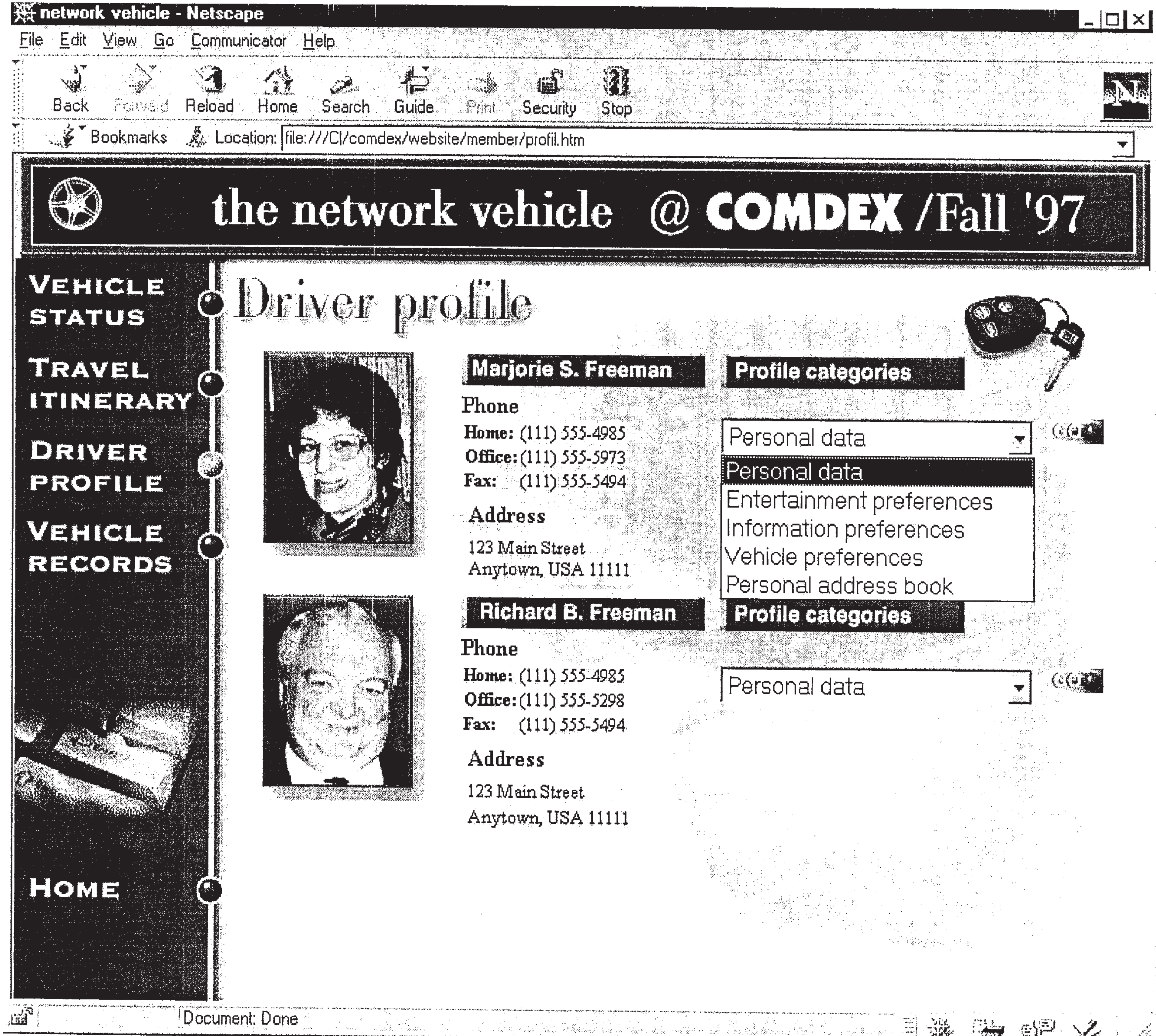
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Travel itinerary
Currently stored
Download on vehicle start
Origin city
Destination city
Route maps
Origin maps
Destination maps
Detroit, MI
Malibu, CA
Malibu, CA
New York, NY
New York, NY
Raleigh, NC
Create new
Origin city
Albany, New York
Albuquerque, New Mexico
Atlanta, Georgia
Augusta, Maine
Destination city
Albany, New York
Albuquerque, New Mexico
Atlanta, Georgia
Augusta, Maine
Document: Done

0238



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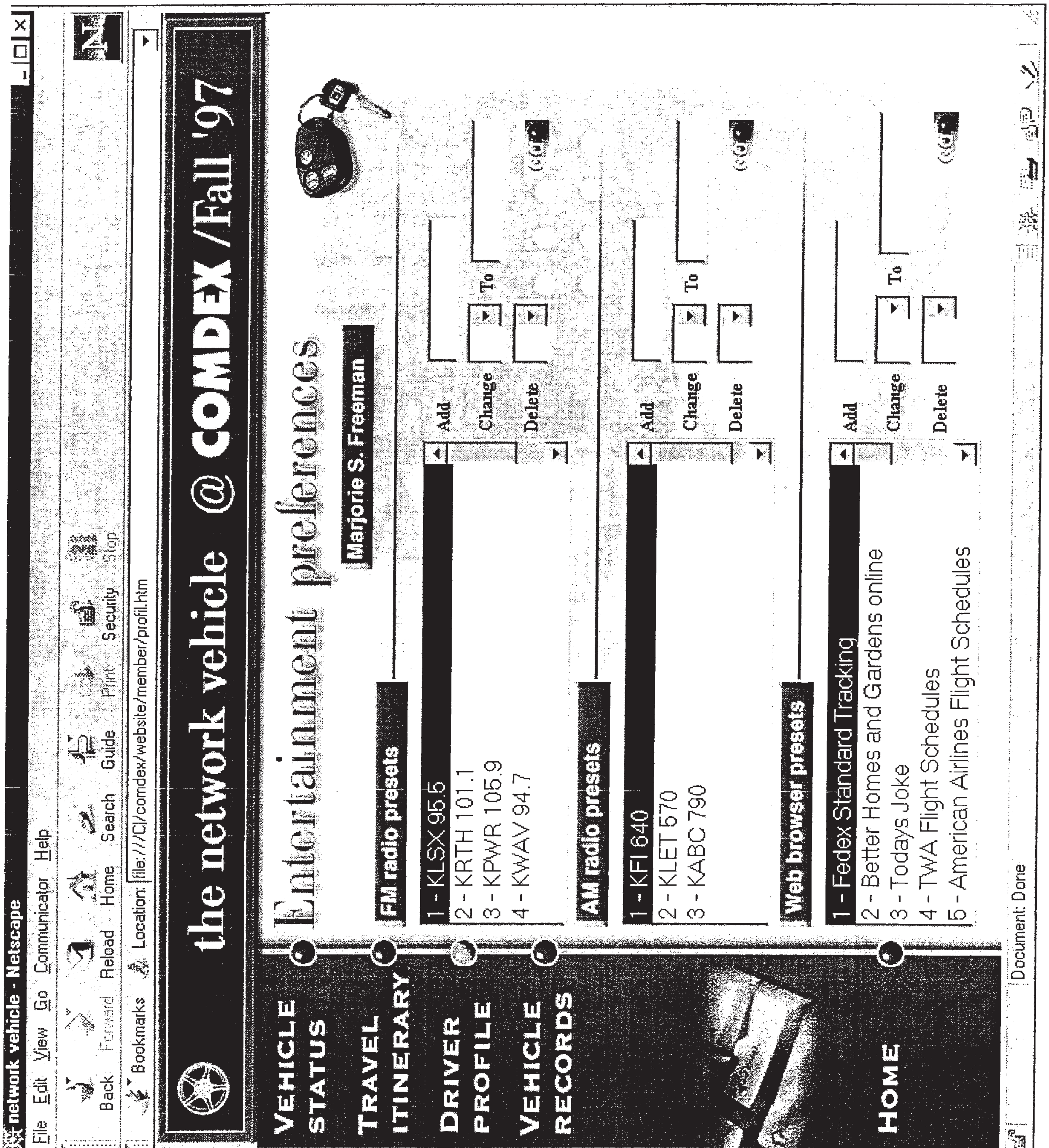
Back Forward Reload Home Search Guide Print Security Stop
Bookmarks Location: file:///C|/comdex/website/member/profil.htm
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Driver profile
Marjorie S. Freeman
Phone
Home: (111) 555-4985
Office: (111) 555-5973
Fax: (111) 555-5494
Address
123 Main Street
Anytown, USA 11111
Profile categories
Personal data
Personal data
Entertainment preferences
Information preferences
Vehicle preferences
Personal address book
Richard B. Freeman
Phone
Home: (111) 555-4985
Office: (111) 555-5298
Fax: (111) 555-5494
Address
123 Main Street
Anytown, USA 11111
Profile categories
Personal data
Document: Done

0239

0240


network vehicle - Netscape
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Back Forward Reload Home Search Guide Print Security Stop
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the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Entertainment preferences
Marjorie S. Freeman
FM radio presets
1 - KLSX 95.5
2 - KRTH 101.1
3 - KPWR 105.9
4 - KWAV 94.7
Add
Change
To
Delete
AM radio presets
1 - KFI 640
2 - KLET 570
3 - KABC 790
Add
Change
To
Delete
Web browser presets
1 - Fedex Standard Tracking
2 - Better Homes and Gardens online
3 - Todays Joke
4 - TWA Flight Schedules
5 - American Airlines Flight Schedules
Add
Change
To
Delete
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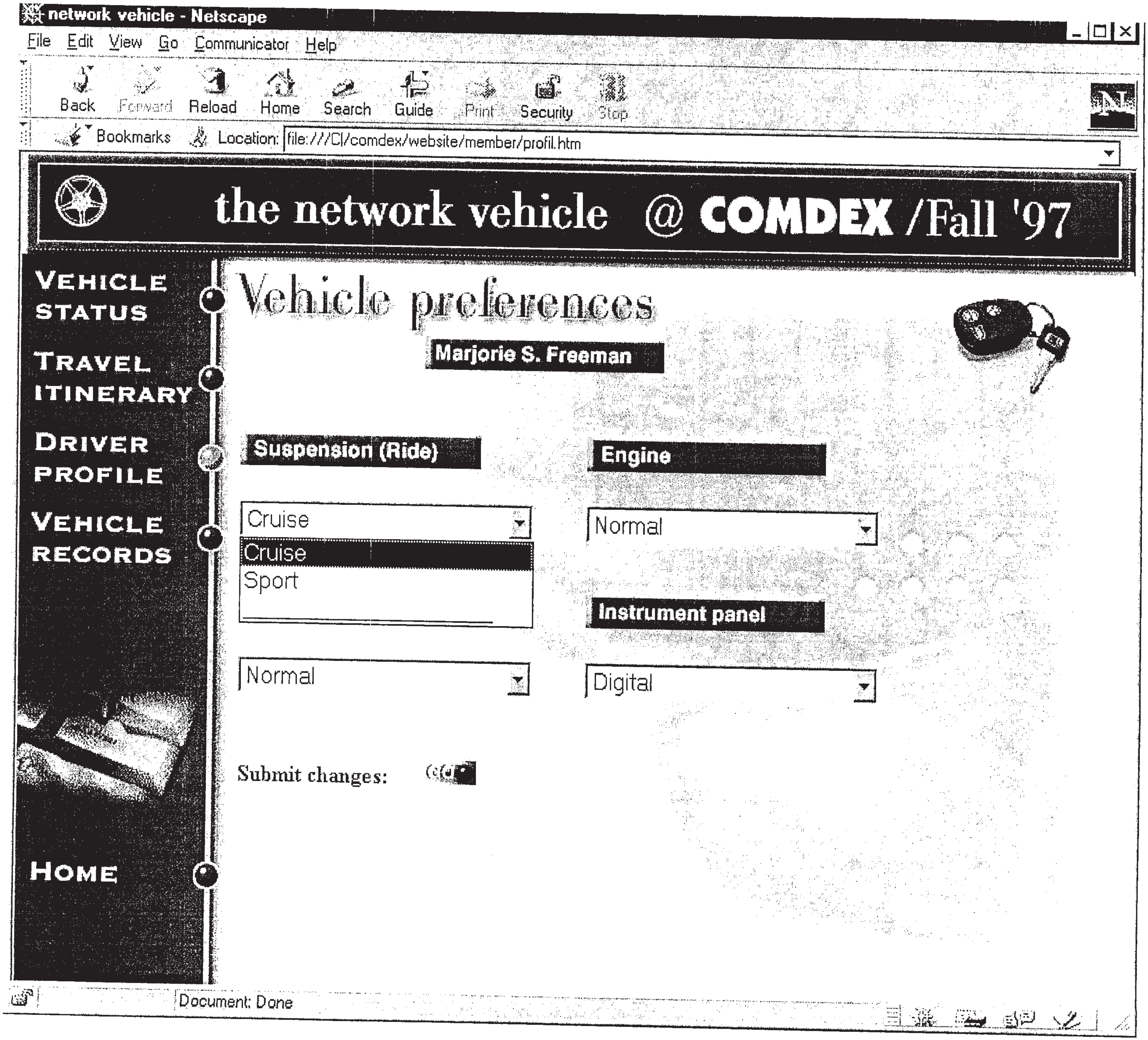

network vehicle - Netscape
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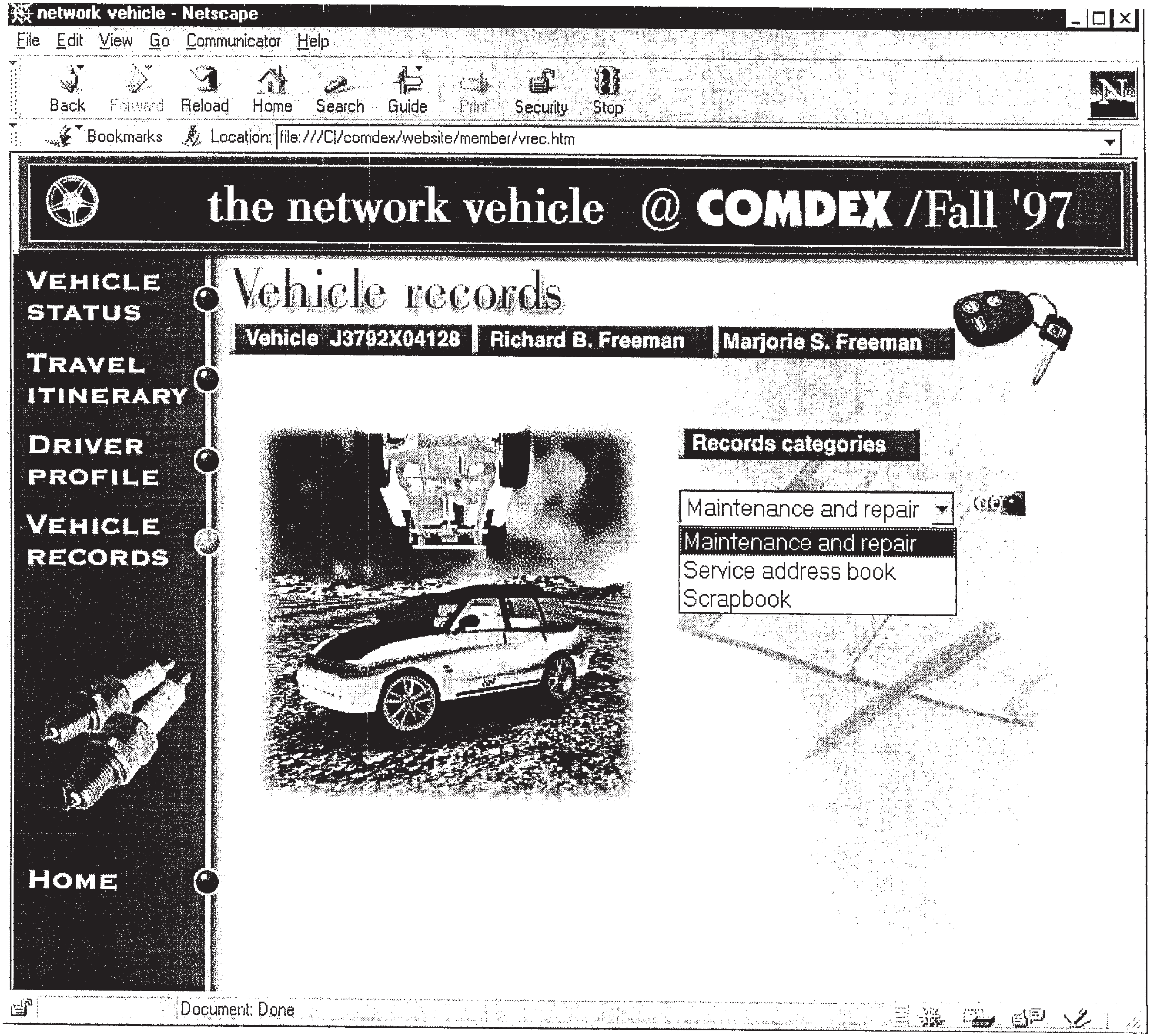
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Vehicle preferences
Marjorie S. Freeman
Suspension (Ride)
Cruise
Cruise
Sport
Normal
Engine
Normal
Instrument panel
Digital
Submit changes:
Document: Done

0241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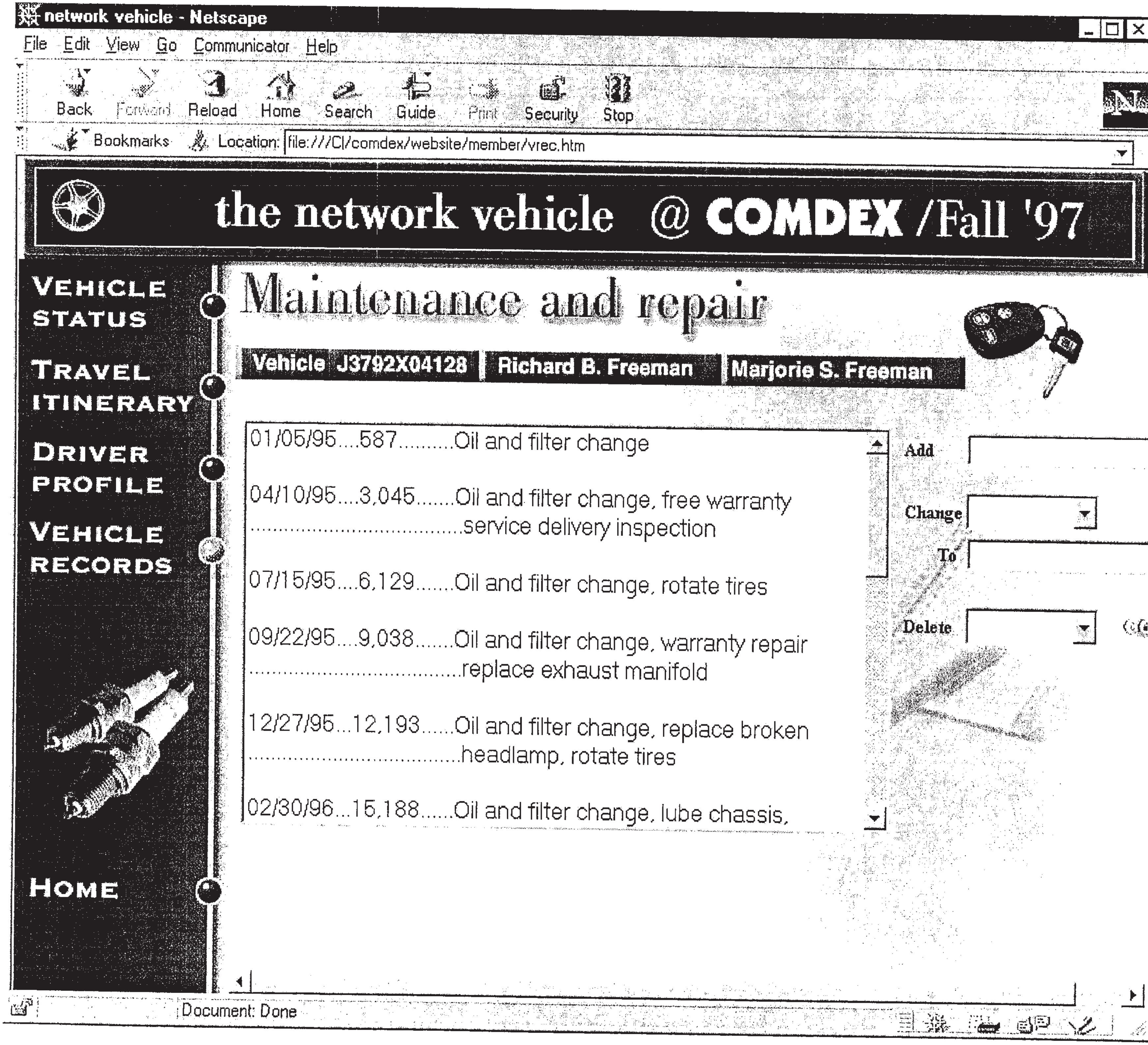
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Vehicle records
Vehicle J3792X04128
Richard B. Freeman
Marjorie S. Freeman
Records categories
Maintenance and repair
Maintenance and repair
Service address book
Scrapbook
Document: Done

0242



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Back Forward Reload Home Search Guide Print Security Stop
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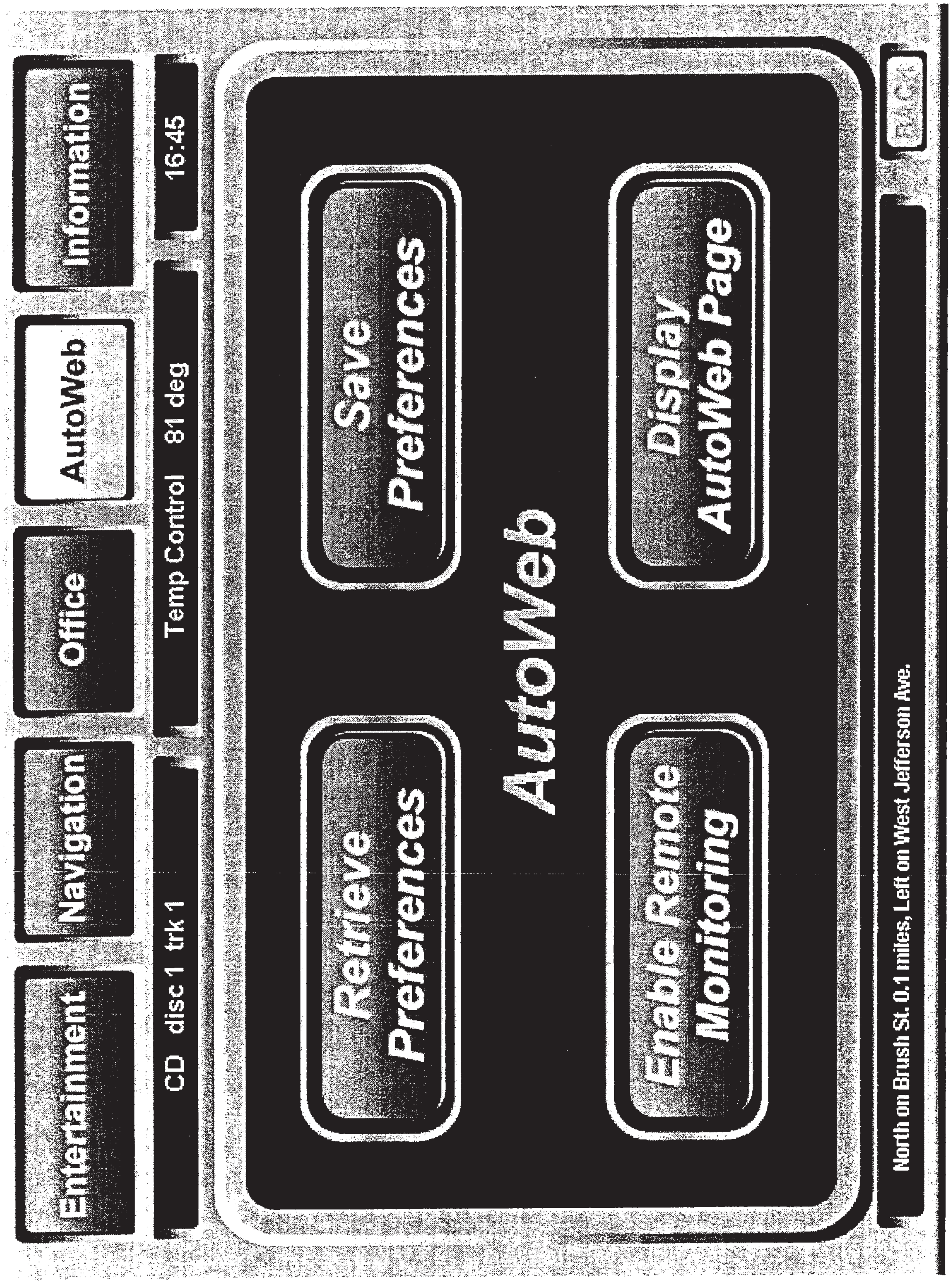
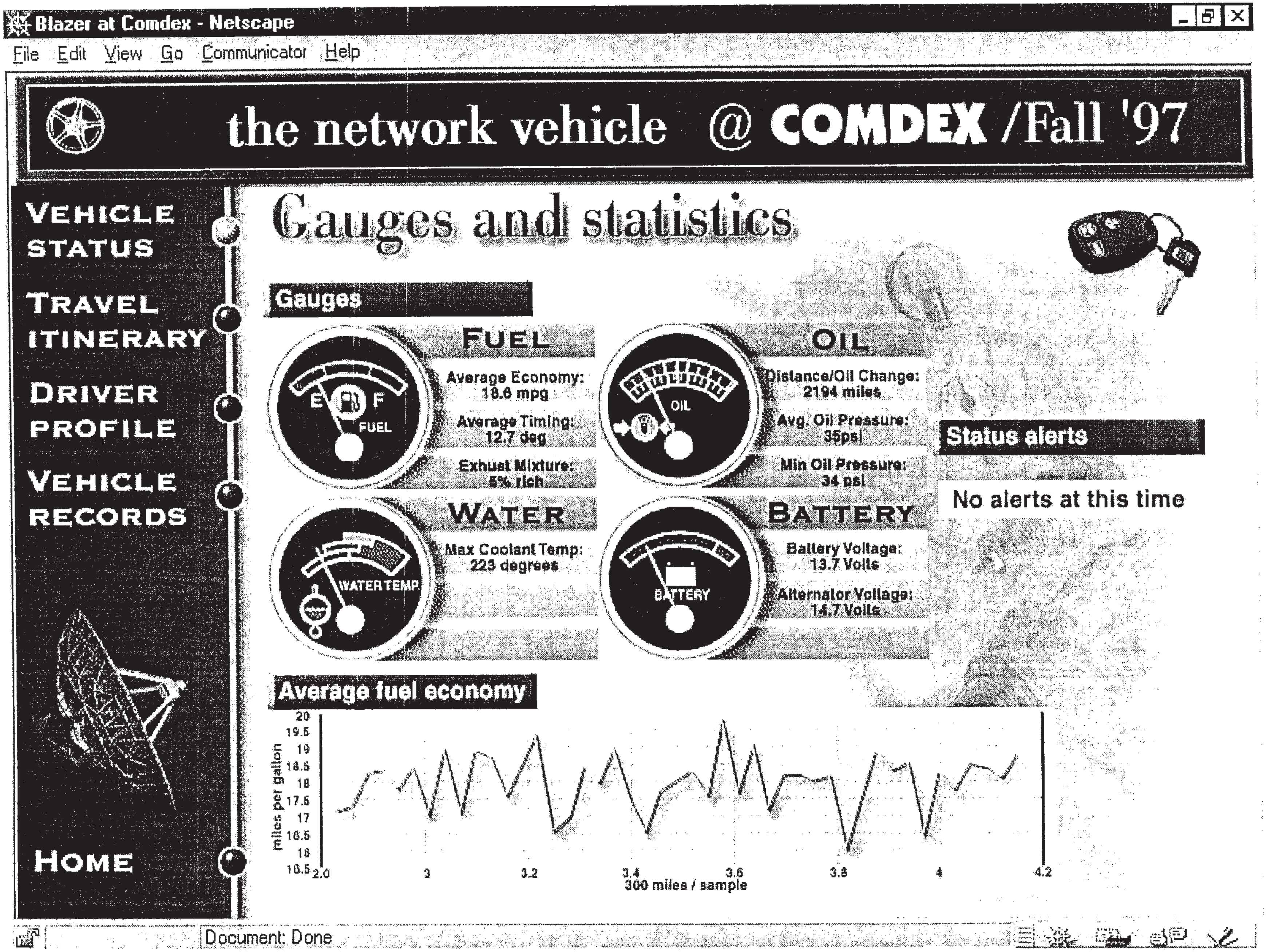
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Maintenance and repair
Vehicle J3792X04128
Richard B. Freeman
Marjorie S. Freeman
01/05/95....587..........Oil and filter change
04/10/95....3,045.......Oil and filter change, free warranty
....................................service delivery inspection
07/15/95....6,129.......Oil and filter change, rotate tires
09/22/95....9,038.......Oil and filter change, warranty repair
....................................replace exhaust manifold
12/27/95...12,193......Oil and filter change, replace broken
....................................headlamp, rotate tires
02/30/96...15,188......Oil and filter change, lube chassis,
Add
Change
To
Delete
Document: Done

0243

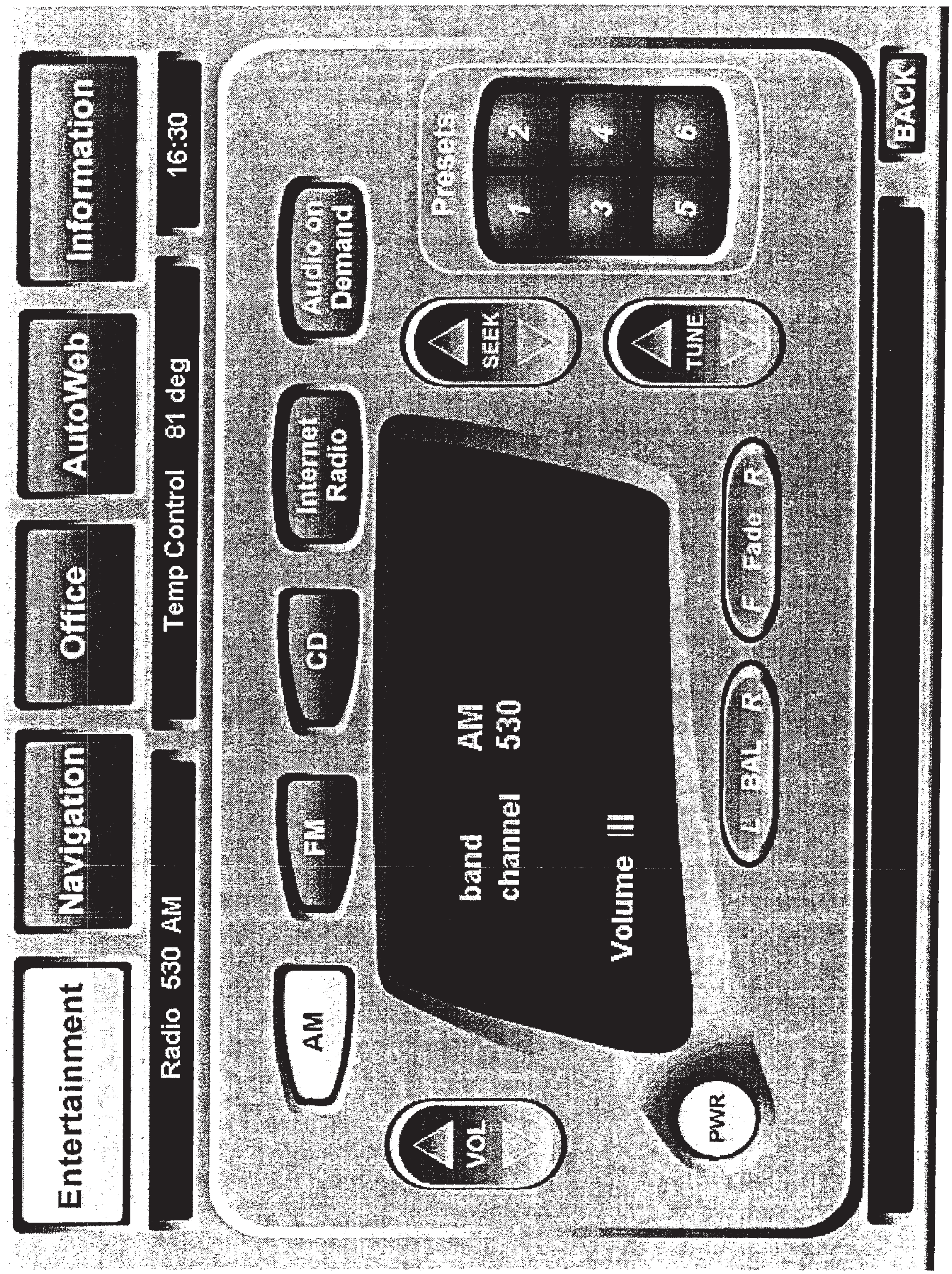

Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:45
AutoWeb
Retrieve Preferences
Save Preferences
Enable Remote Monitoring
Display AutoWeb Page
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

0244



Blazer at Comdex - Netscape
File Edit View Go Communicator Help
the network vehicle @ COMDEX /Fall '97
VEHICLE STATUS
TRAVEL ITINERARY
DRIVER PROFILE
VEHICLE RECORDS
HOME
Gauges and statistics
Gauges
FUEL
E F FUEL
Average Economy: 18.6 mpg
Average Timing: 12.7 deg
Exhust Mixture: 5% rich
OIL
OIL
Distance/Oil Change: 2194 miles
Avg. Oil Pressure: 35psi
Min Oil Pressure: 34 psi
WATER
WATER TEMP
Max Coolant Temp: 223 degrees
BATTERY
BATTERY
Battery Voltage: 13.7 Volts
Alternator Voltage: 14.7 Volts
Status alerts
No alerts at this time
Average fuel economy
miles per gallon
20
19.5
19
18.5
18
17.5
17
16.5
16
15.5
2.0
3
3.2
3.4
3.6
3.8
4
4.2
300 miles / sample
Document: Done

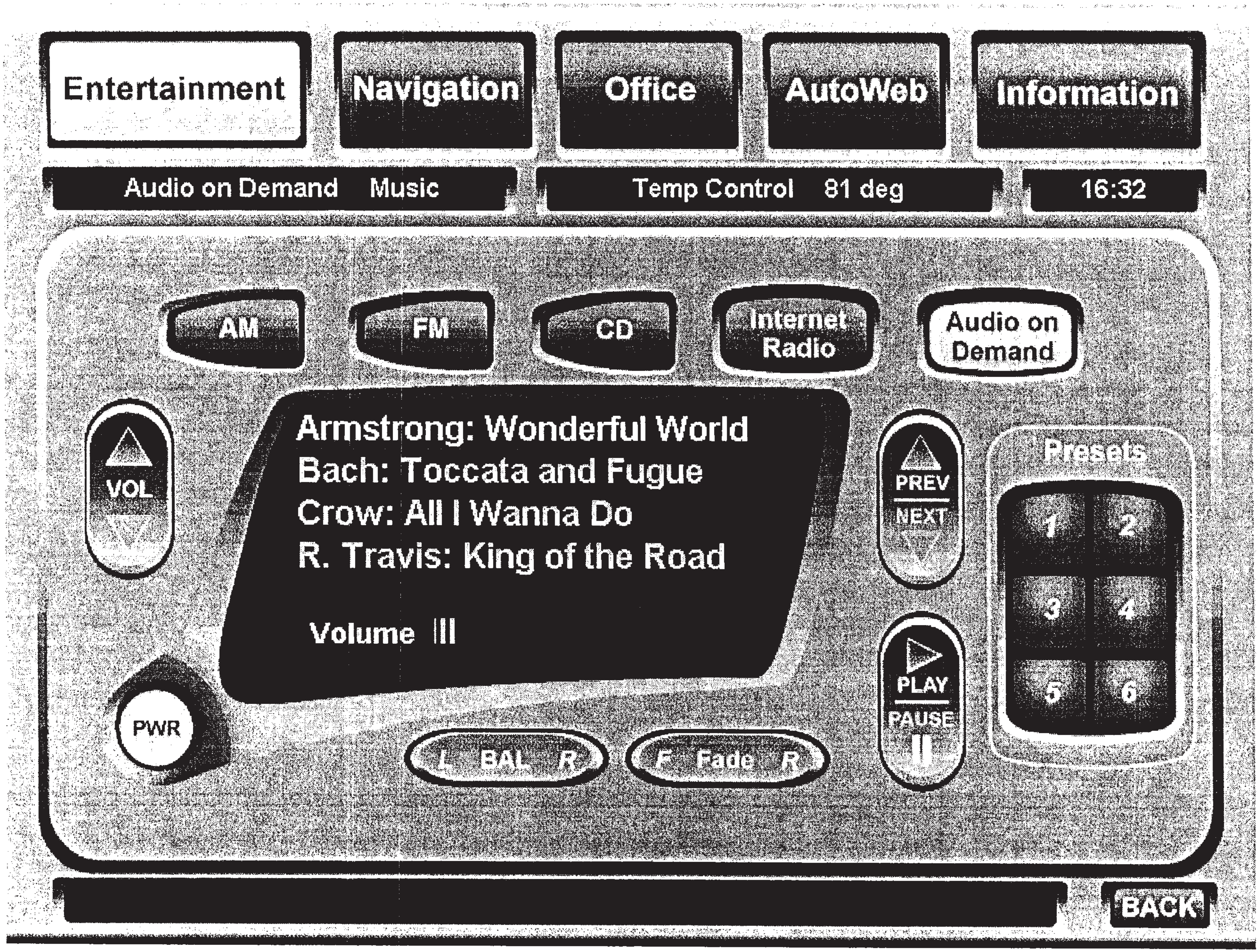
0245


Entertainment
Navigation
Office
AutoWeb
Information
Radio 530 AM
Temp Control 81 deg
16:30
AM
FM
CD
Internet Radio
Audio on Demand
band AM
channel 530
Volume III
VOL
PWR
SEEK
TUNE
Presets
1
2
3
4
5
6
L BAL R
F Fade R
BACK

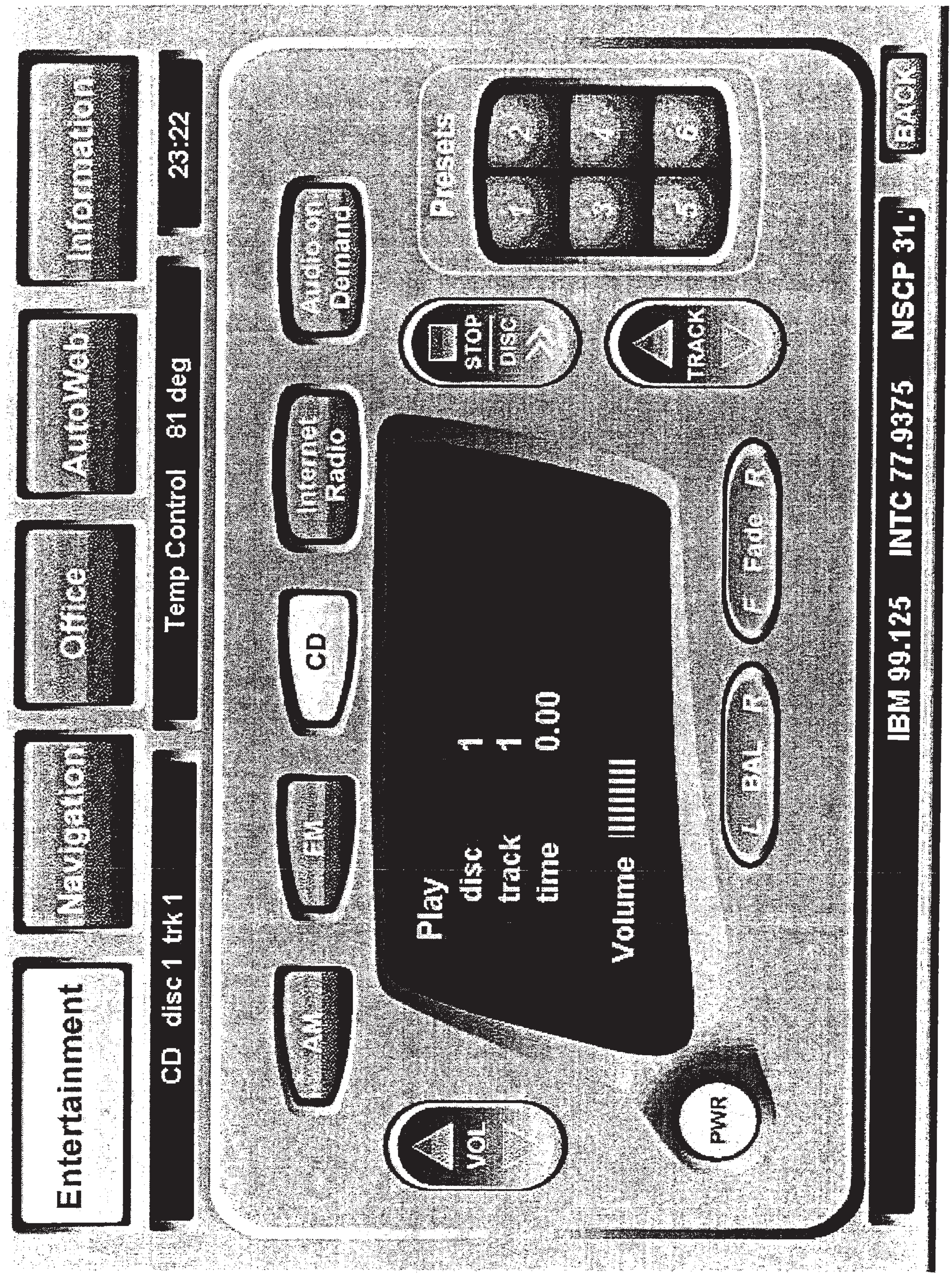
0246


Entertainment
Navigation
Office
AutoWeb
Information
Audio on Demand Music
Temp Control 81 deg
16:31
AM
FM
CD
Internet Radio
Audio on Demand
VOL
Music
Books
Children
Volume III
PREV
NEXT
SELECT
Presets
1
2
3
4
5
6
PWR
L BAL R
F Fade R
BACK

0247

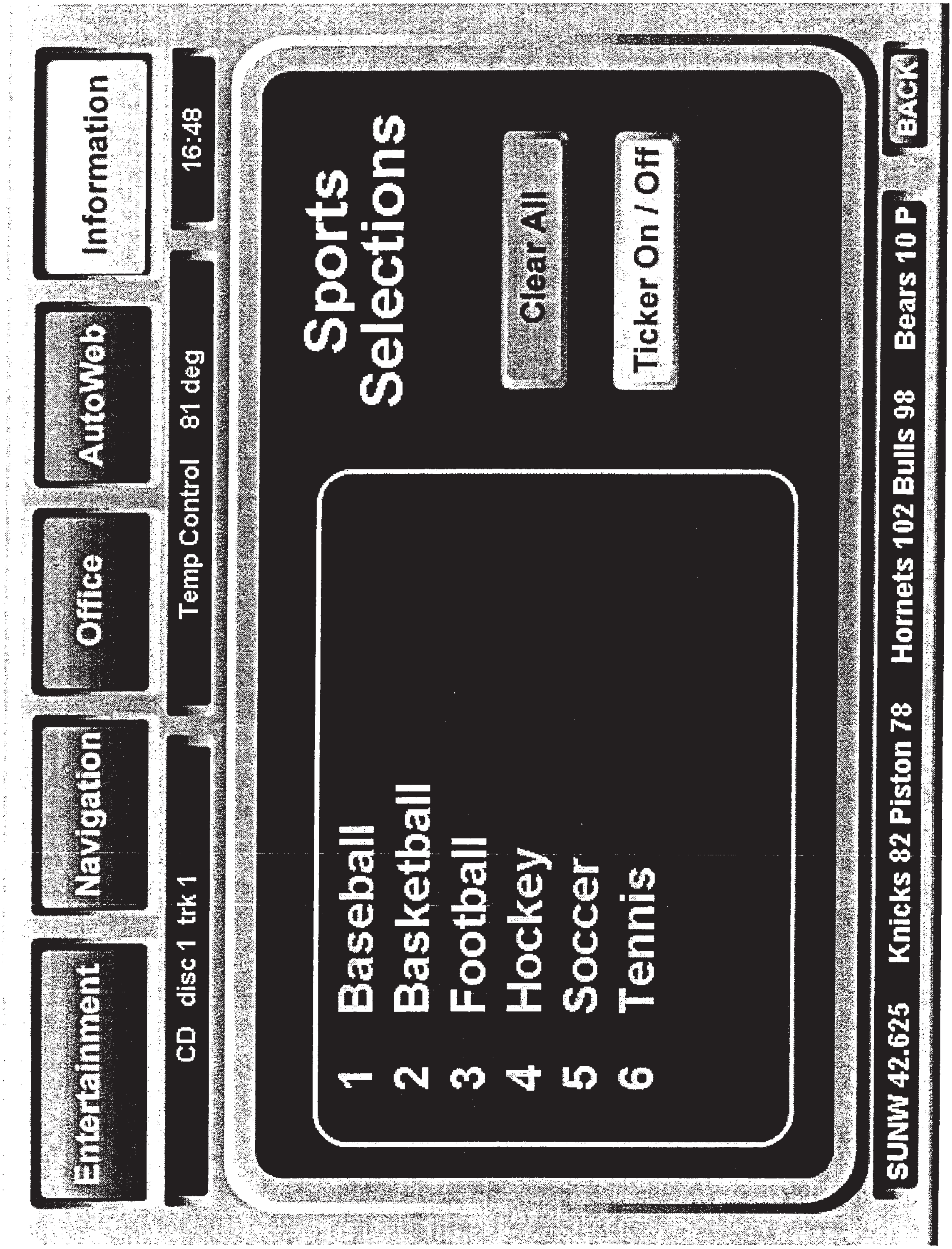

Entertainment
Navigation
Office
AutoWeb
Information
Audio on Demand Music
Temp Control 81 deg
16:32
AM
FM
CD
Internet Radio
Audio on Demand
VOL
Armstrong: Wonderful World
Bach: Toccata and Fugue
Crow: All I Wanna Do
R. Travis: King of the Road
Volume
PREV
NEXT
Presets
1
2
3
4
5
6
PLAY
PAUSE
PWR
L BAL R
F Fade R
BACK

0248



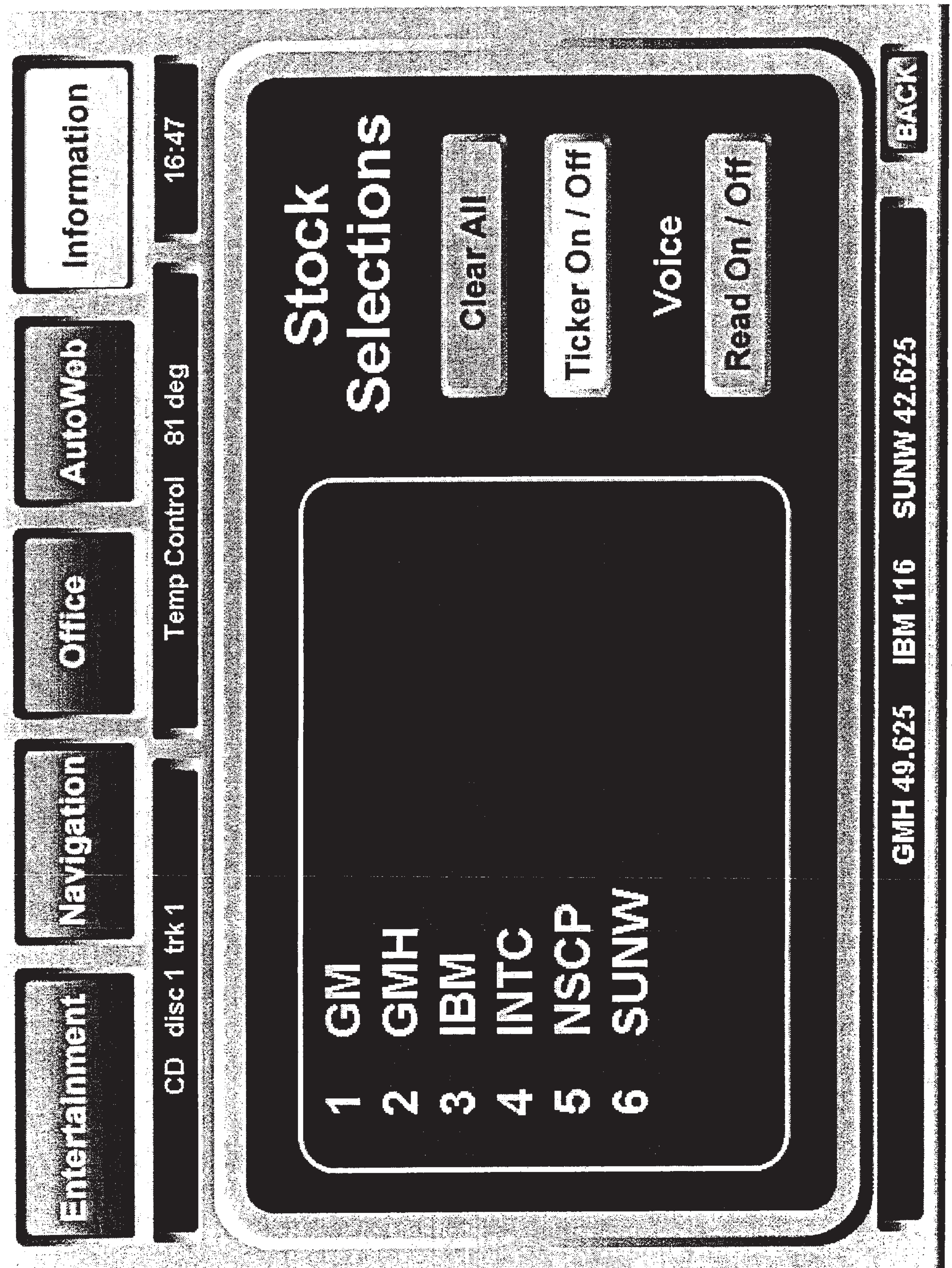
Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
23:22
AM
FM
CD
Internet Radio
Audio on Demand
Play
disc 1
track 1
time 0.00
Volume
VOL
PWR
STOP
DISC
TRACK
Presets
1
2
3
4
5
6
L BAL R
F Fade R
IBM 99.125 INTC 77.9375 NSCP 31.
BACK

0249

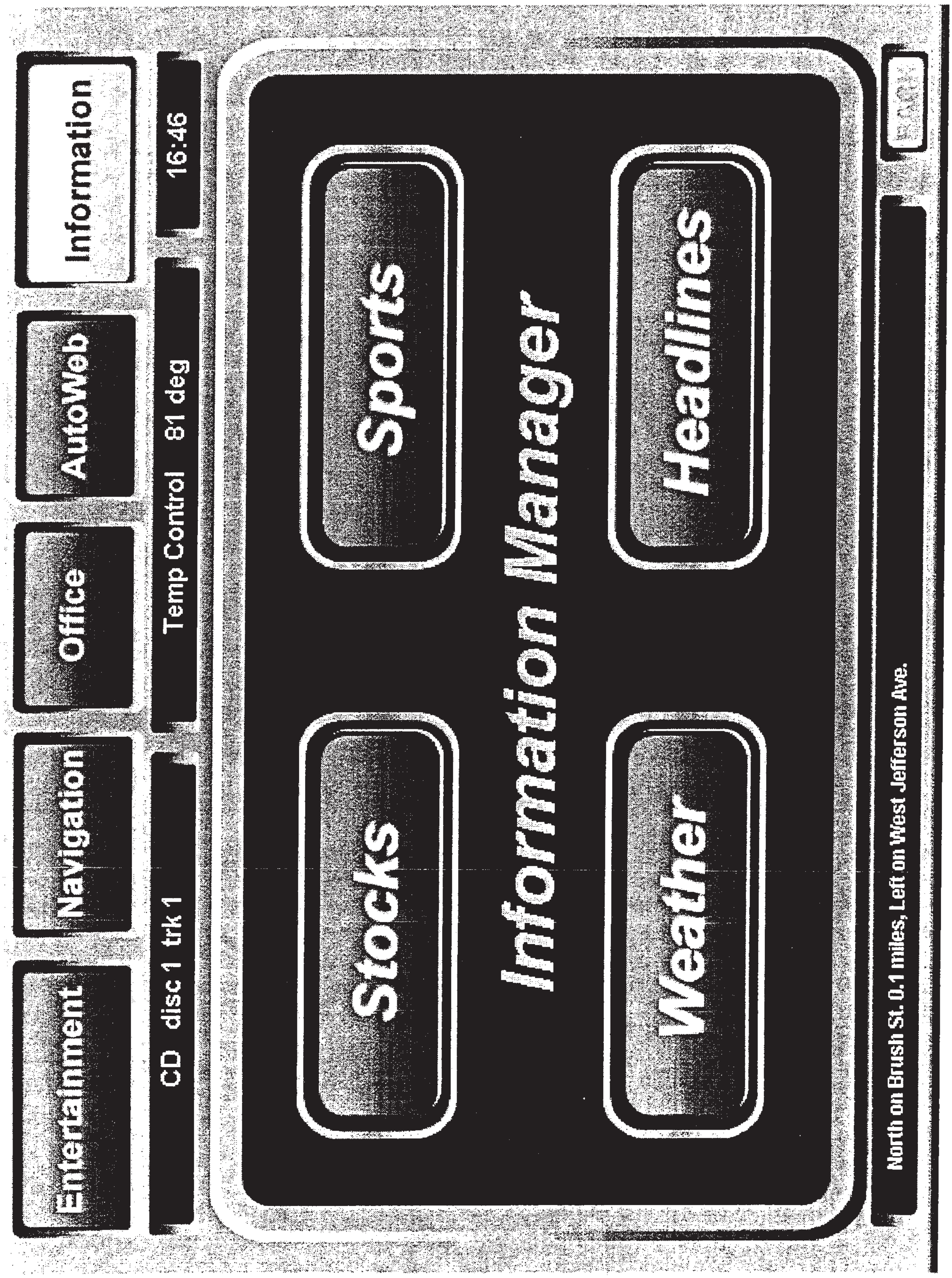


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:48
1 Baseball
2 Basketball
3 Football
4 Hockey
5 Soccer
6 Tennis
Sports Selections
Clear All
Ticker On / Off
SUNW 42.625 Knicks 82 Piston 78 Hornets 102 Bulls 98 Bears 10 P
BACK

0250


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:47
1 GM
2 GMH
3 IBM
4 INTC
5 NSCP
6 SUNW
Stock Selections
Clear All
Ticker On / Off
Voice
Read On / Off
GMH 49.625 IBM 116 SUNW 42.625
BACK

0251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Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
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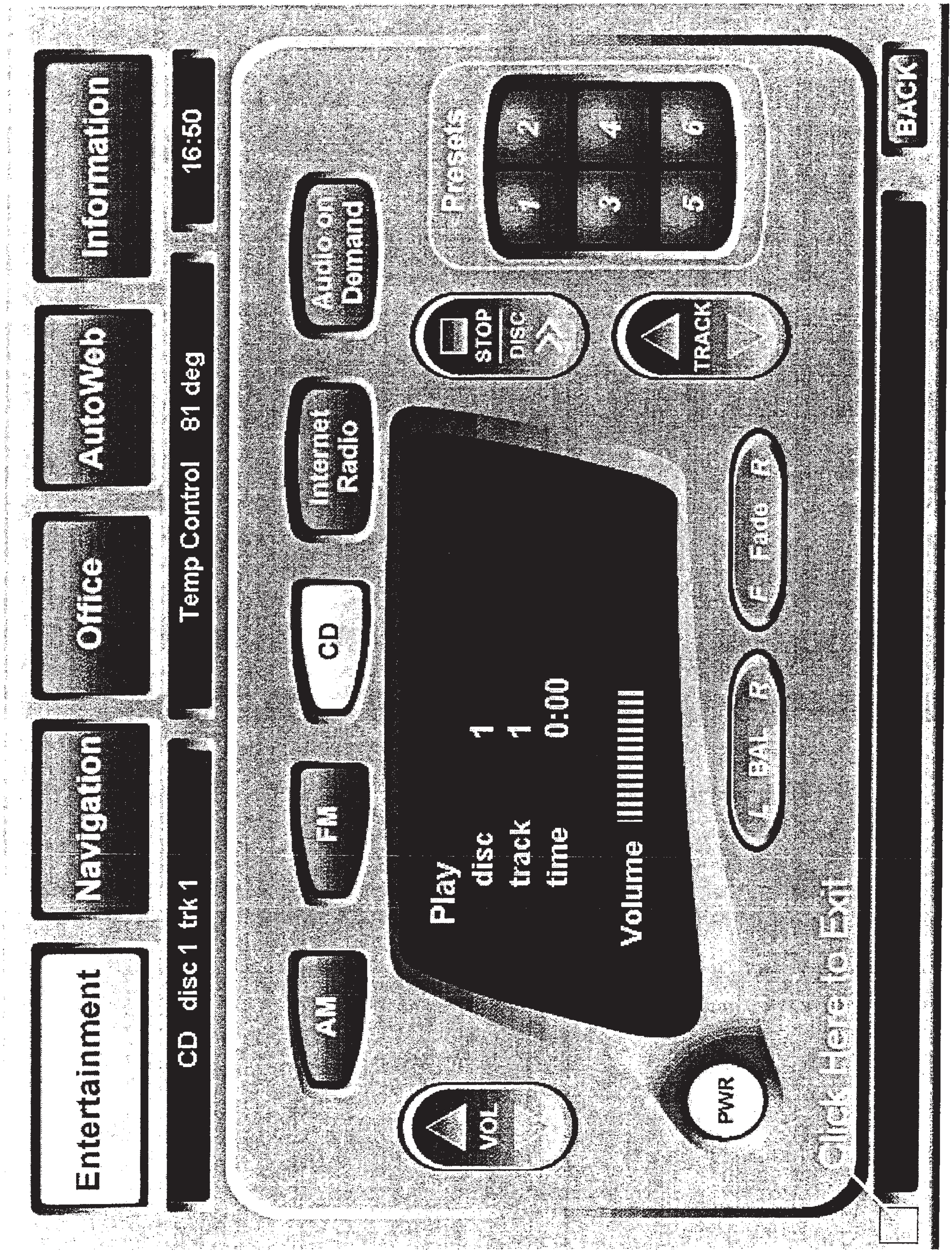
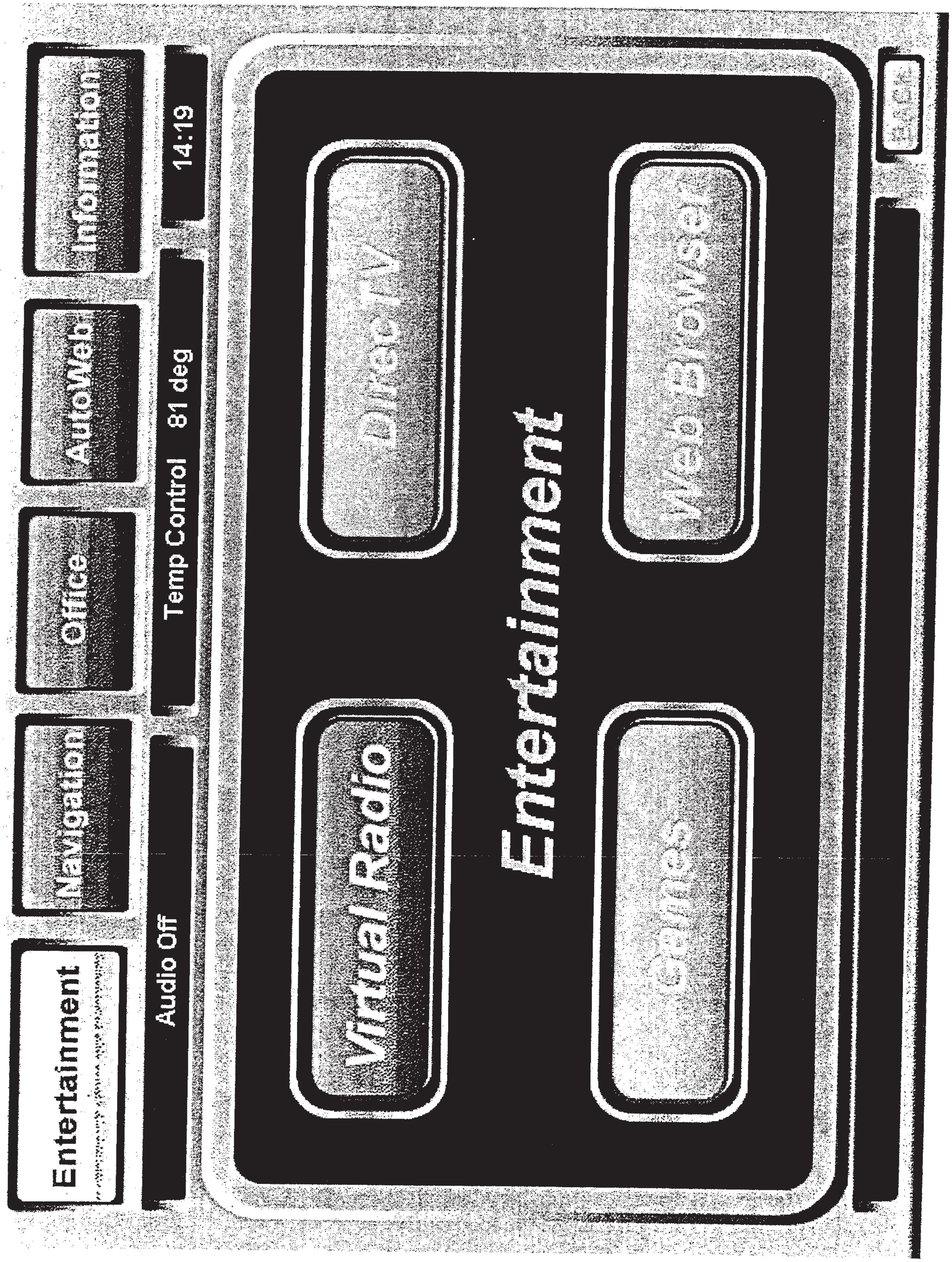
16:46
Information Manager
Stocks
Sports
Weather
Headlines
North on Brush St. 0.1 miles, Left on West Jefferson Ave.

0252

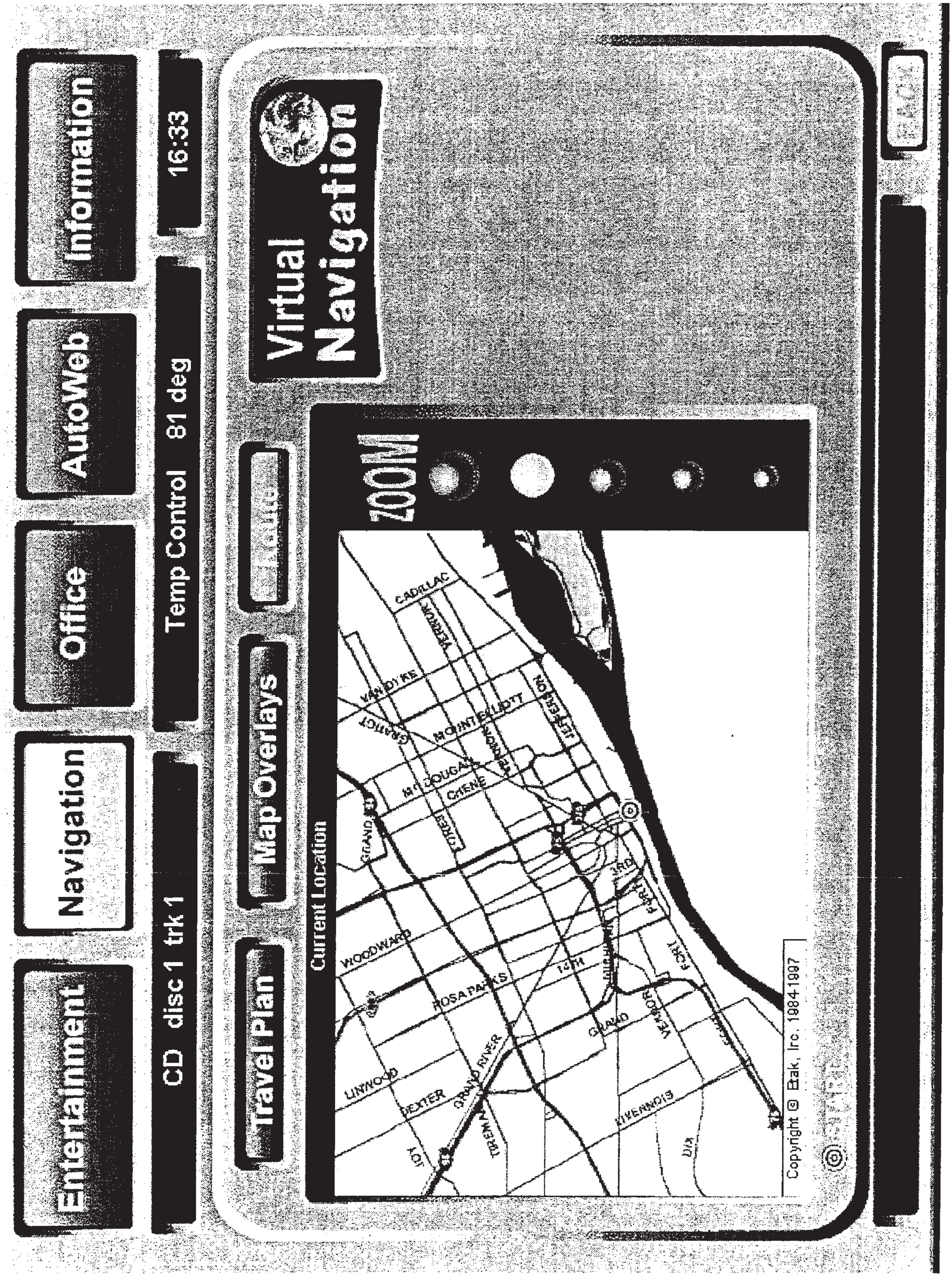


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:50
AM
FM
CD
Internet Radio
Audio on Demand
Play
disc 1
track 1
time 0:00
Volume
VOL
PWR
STOP
DISC
TRACK
Presets
1
2
3
4
5
6
L BAL R
F Fade R
Click Here to Exit
BACK

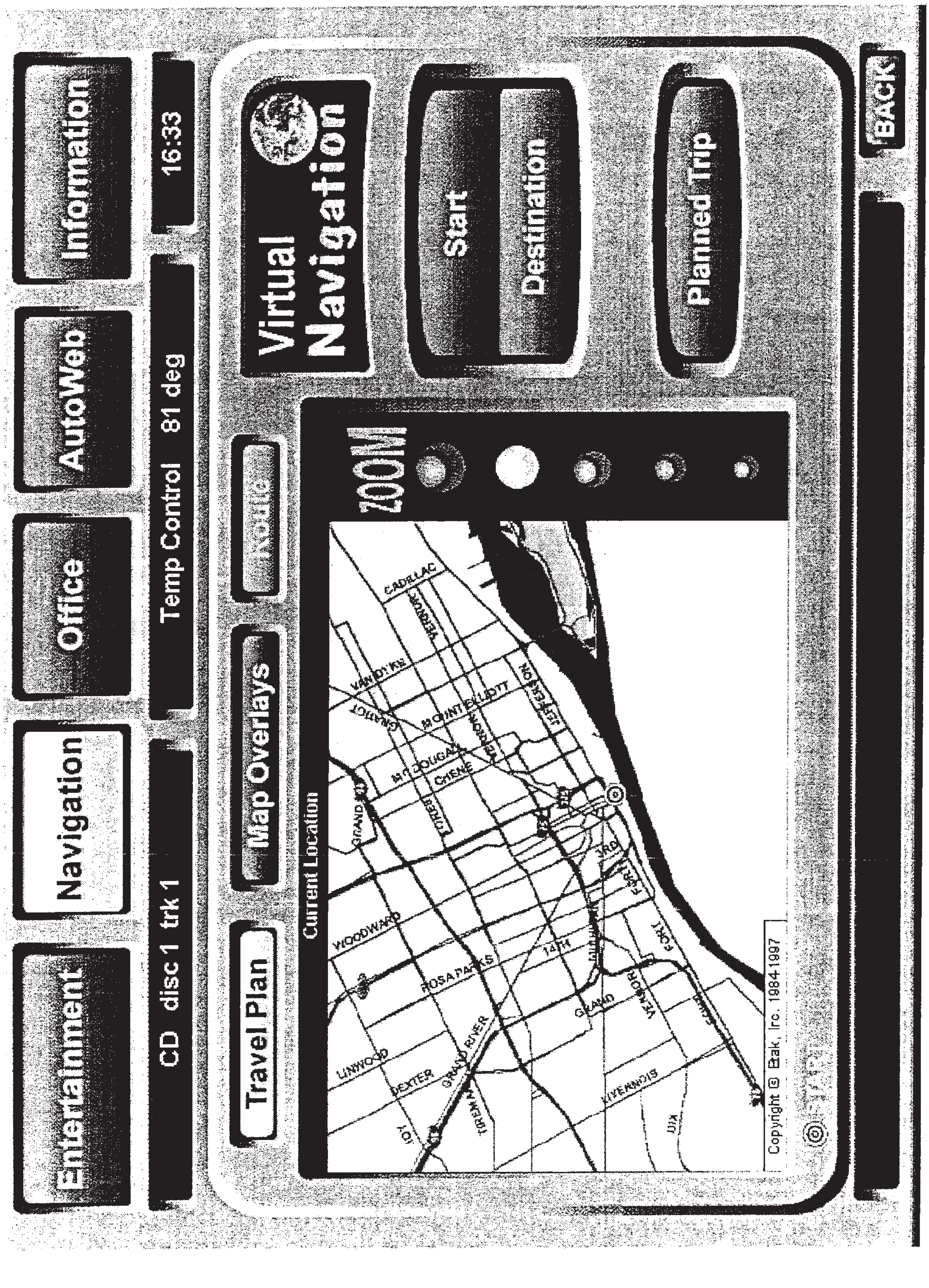
0253


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
14:19
Virtual Radio
DirecTV
Entertainment
Games
Web Browser
BACK

0254


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:33
Travel Plan
Map Overlays
Virtual Navigation
Current Location
ZOOM
WOODWARD
ROSA PARKS
GRAND RIVER
LINWOOD
DEXTER
CADILLAC
VAN DYKE
GRATIOT
JEFFERSON
CHENE
FORT
LIVERNOIS
14TH
3RD
GRAND
JOY
DIX
Copyright © Etak, Inc. 1984-1997

0255


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:33
Travel Plan
Map Overlays
Route
Current Location
Virtual Navigation
Start
Destination
Planned Trip
ZOOM
BACK
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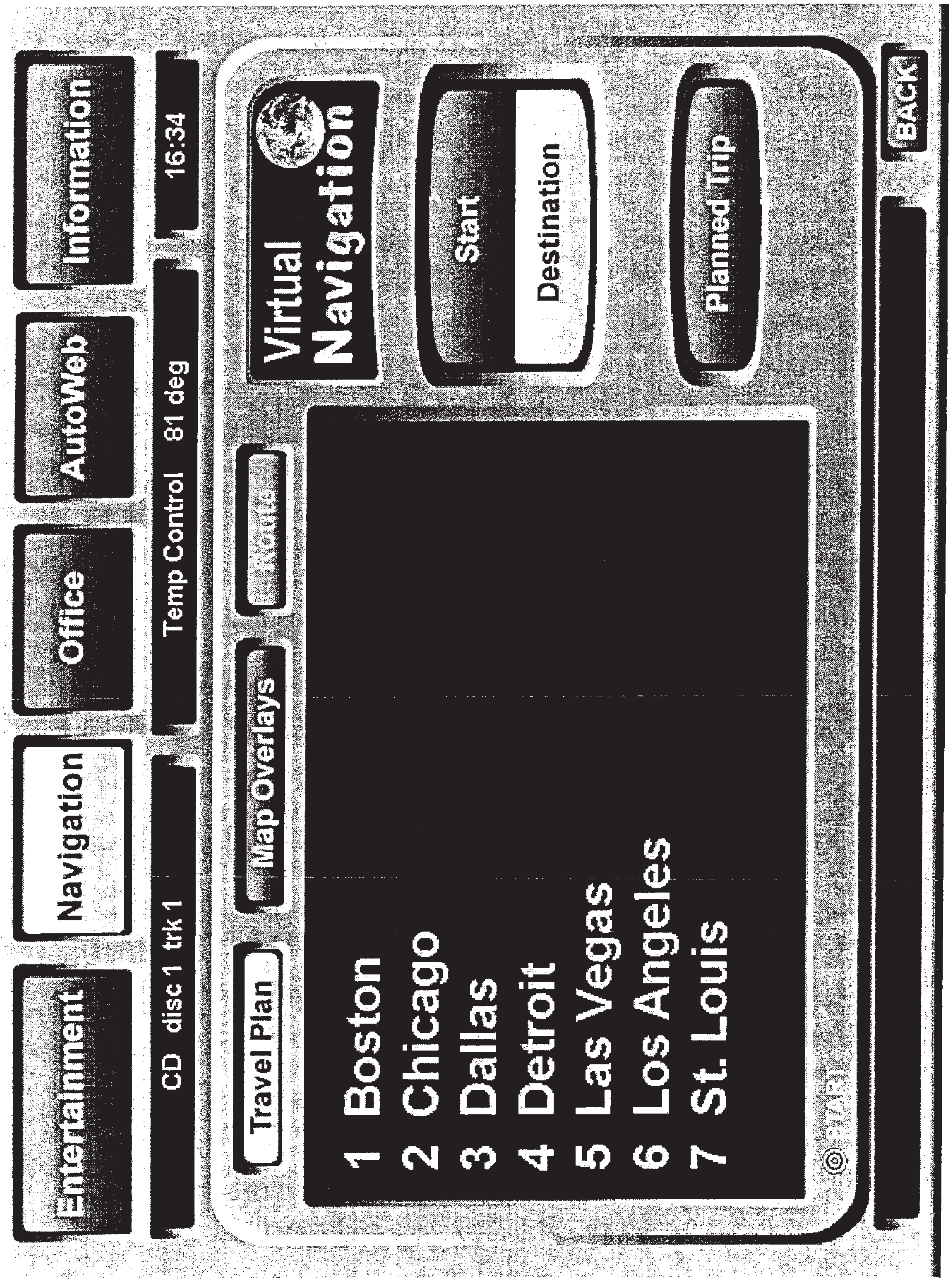
0256


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:34
Travel Plan
Map Overlays
Route
Virtual
Navigation
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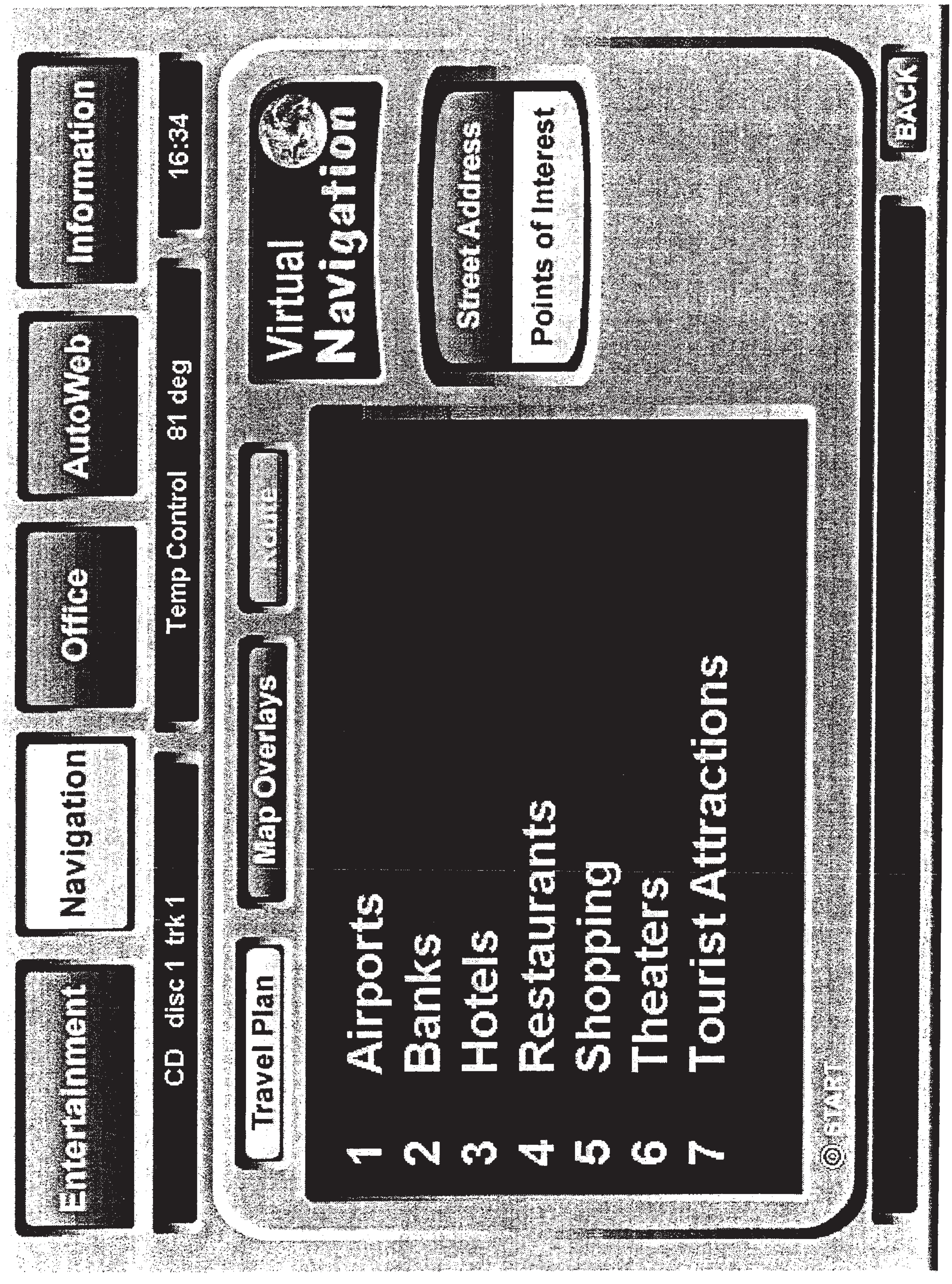
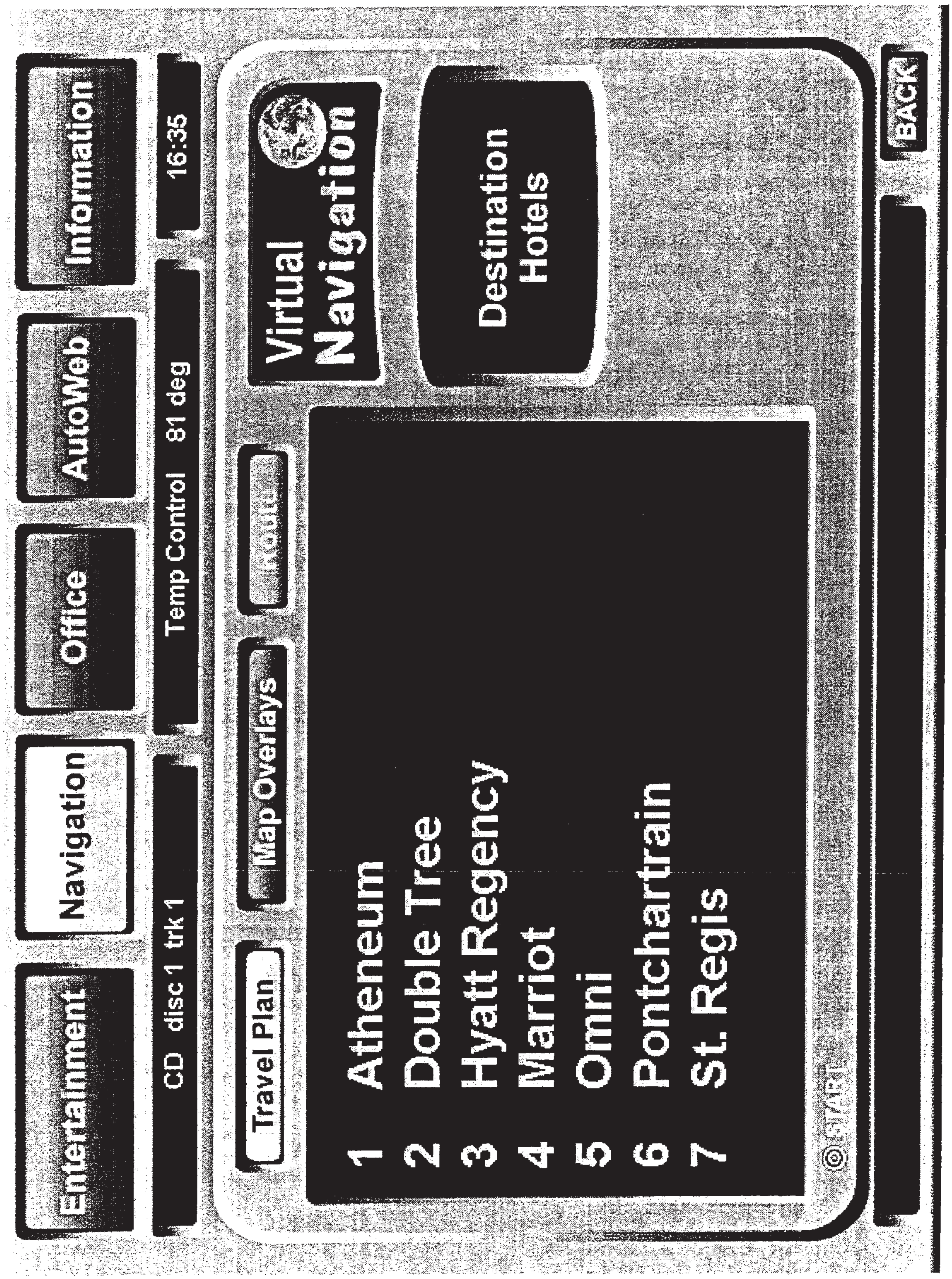
2 Chicago
3 Dallas
4 Detroit
5 Las Vegas
6 Los Angeles
7 St. Louis
Start
Destination
Planned Trip
START
BACK

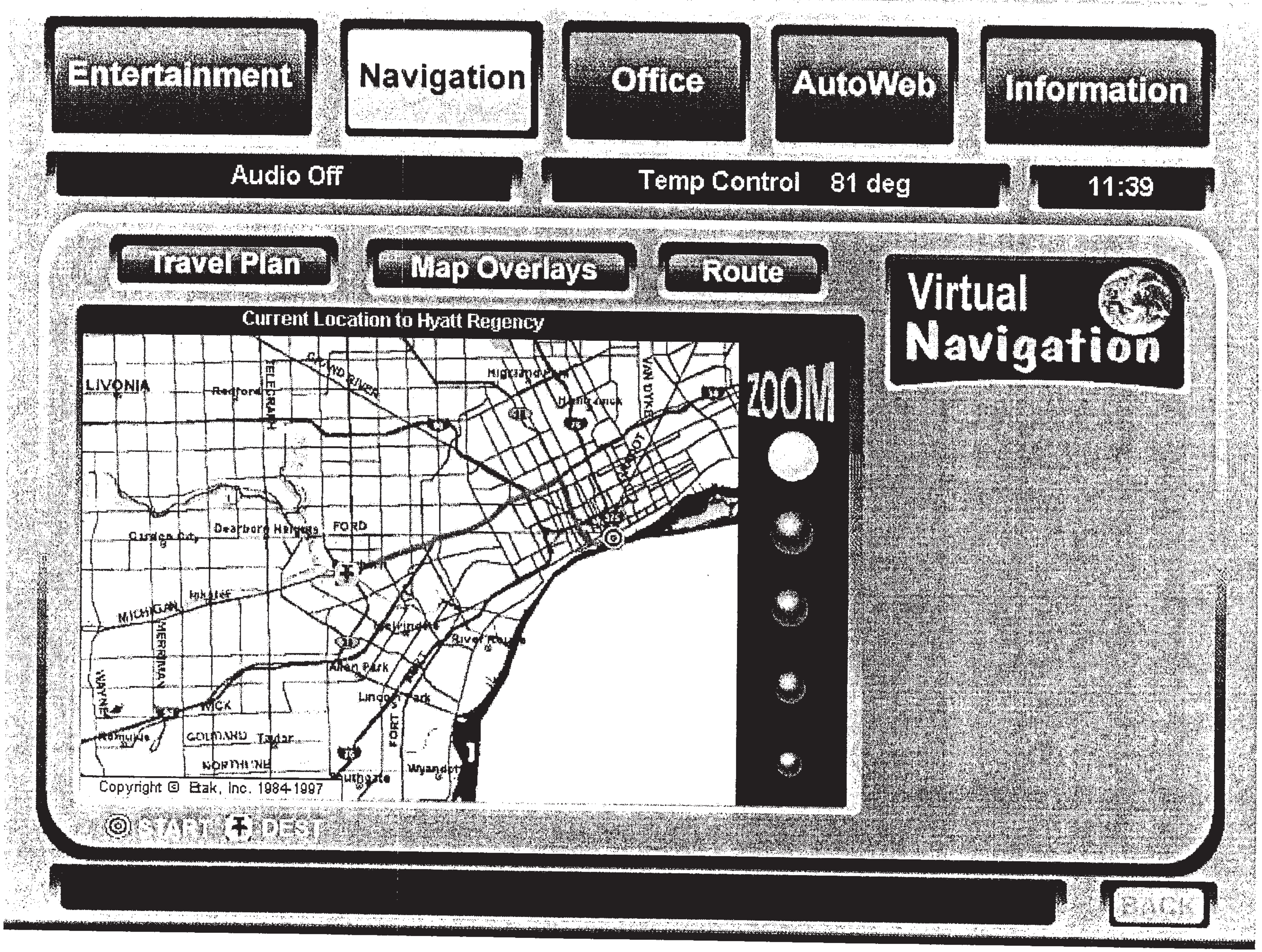
0257


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:34
Travel Plan
Map Overlays
Route
Virtual Navigation
Street Address
Points of Interest
1 Airports
2 Banks
3 Hotels
4 Restaurants
5 Shopping
6 Theaters
7 Tourist Attractions
START
BACK
0258

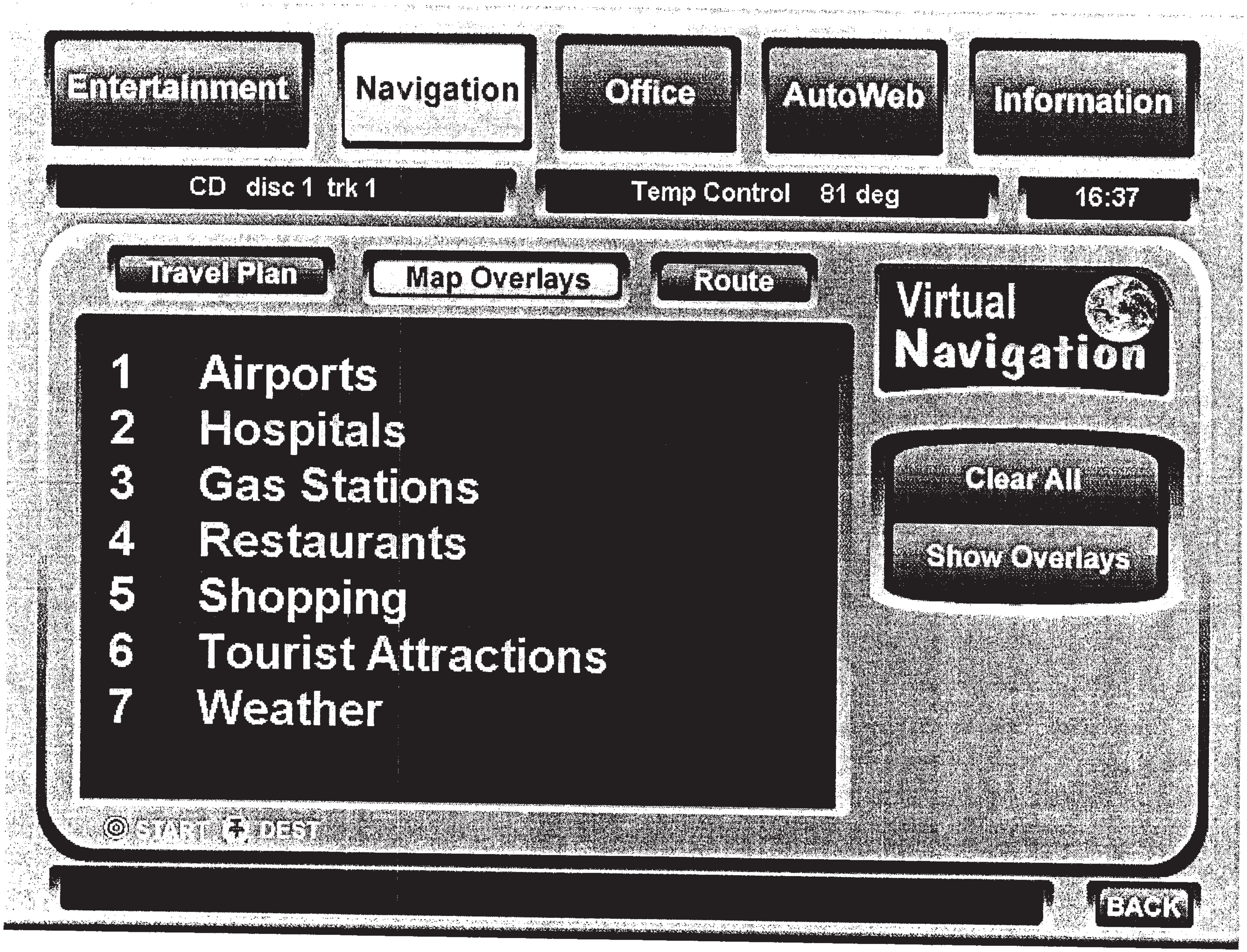


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:35
Travel Plan
Map Overlays
Route
Virtual Navigation
Destination Hotels
1 Atheneum
2 Double Tree
3 Hyatt Regency
4 Marriot
5 Omni
6 Pontchartrain
7 St. Regis
START
BACK

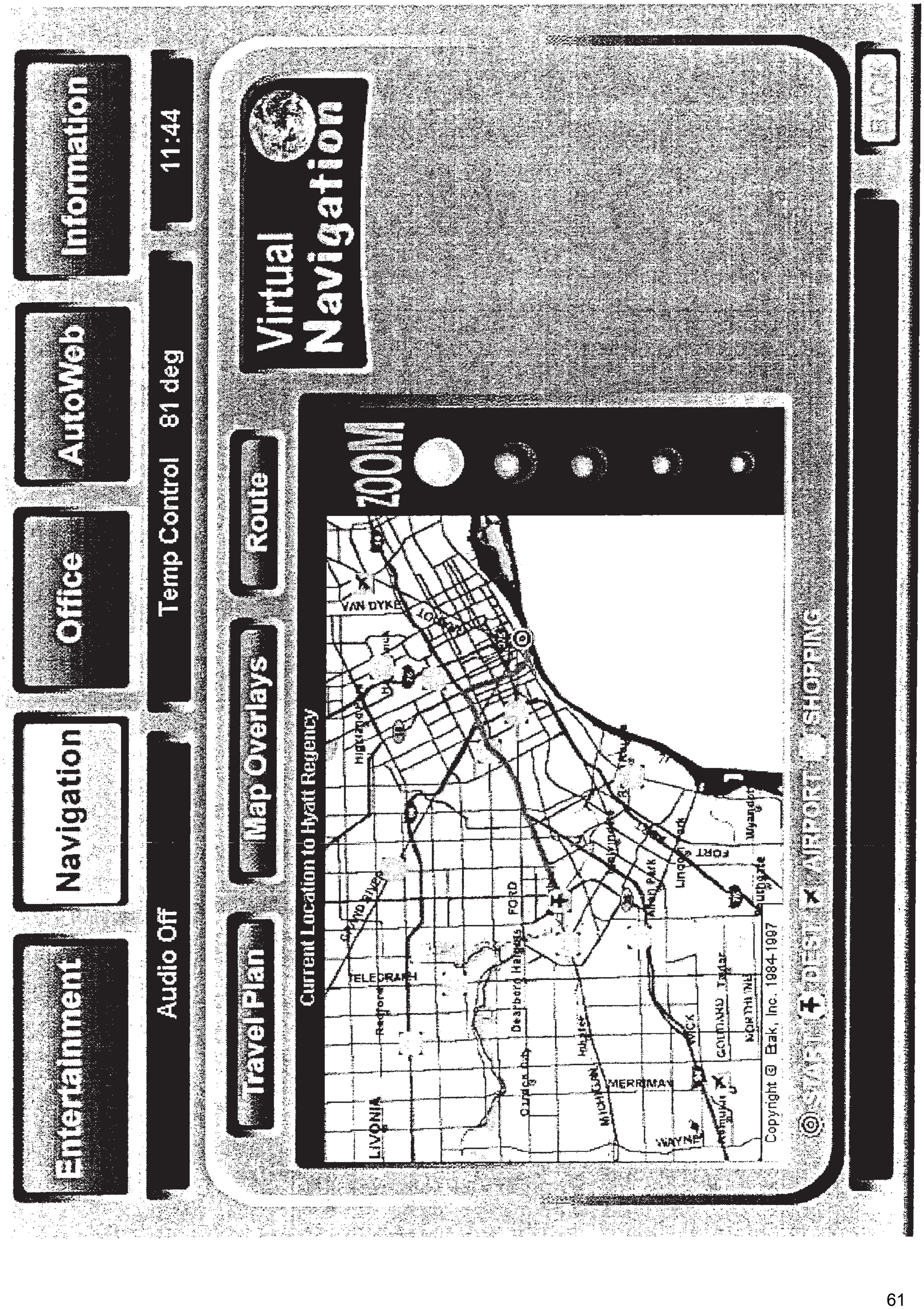
0259


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
11:39
Travel Plan
Map Overlays
Route
Virtual Navigation
Current Location to Hyatt Regency
ZOOM
LIVONIA
Redford
TELEGRAPH
GRAND RIVER
Dearborn Heights
FORD
MICHIGAN
MERRIMAN
WAYNE
Allen Park
Lincoln Park
River Rouge
VAN DYKE
Wyandotte
Copyright © Etak, Inc. 1984-1997
START
DEST
BACK

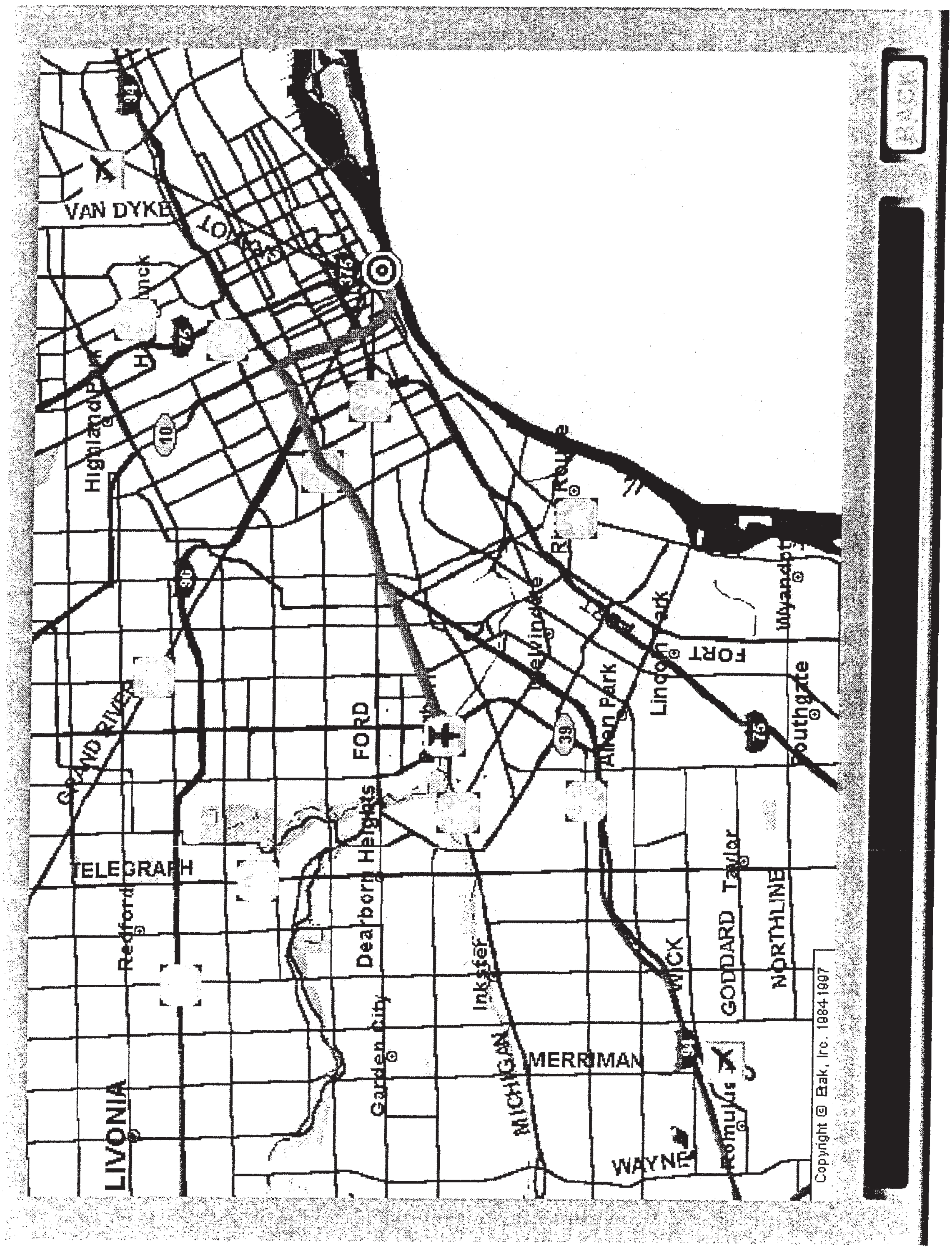
0260


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:37
Travel Plan
Map Overlays
Route
Virtual Navigation
Clear All
Show Overlays
1 Airports
2 Hospitals
3 Gas Stations
4 Restaurants
5 Shopping
6 Tourist Attractions
7 Weather
START
DEST
BACK

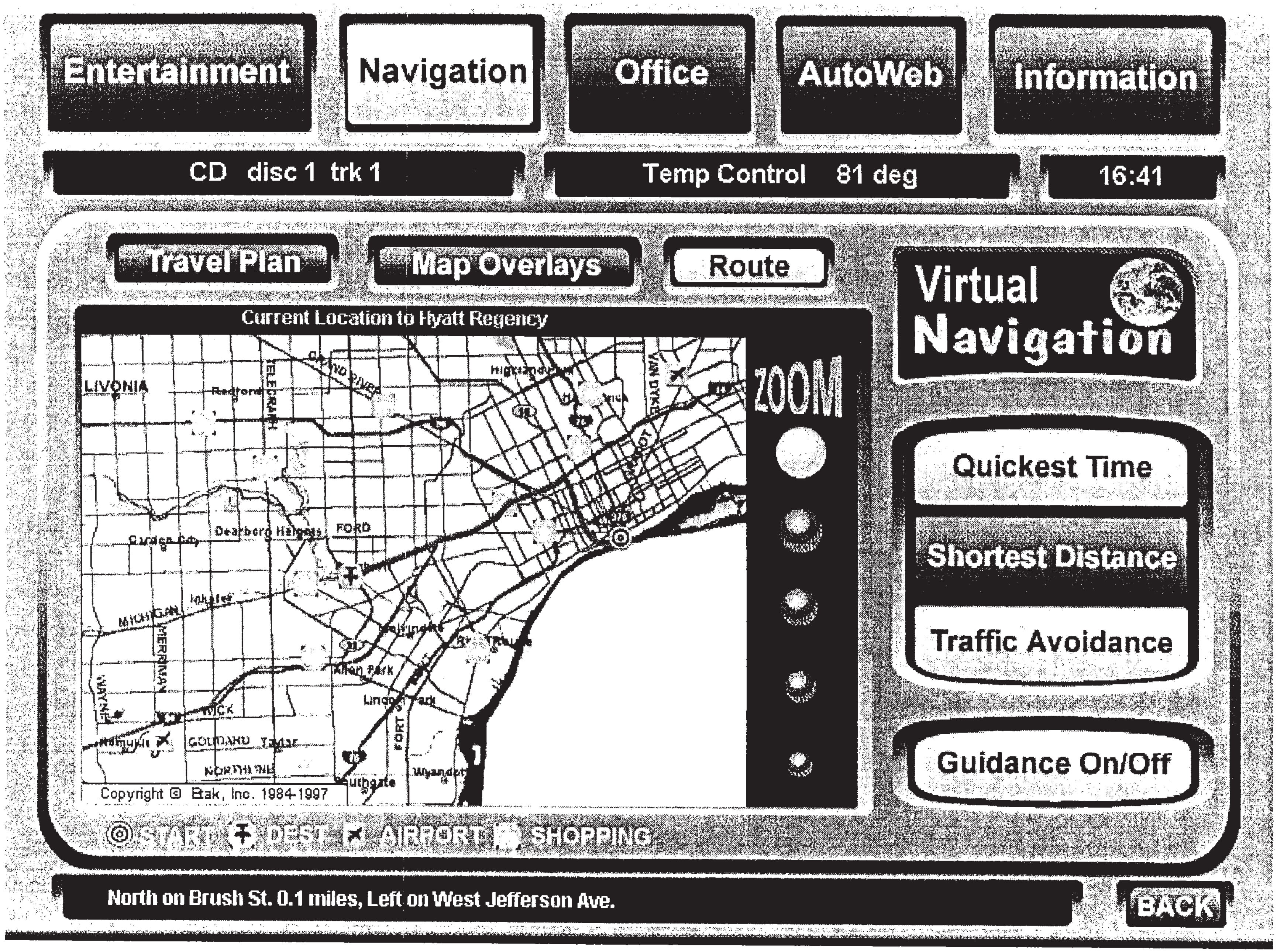
0261


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
11:44
Travel Plan
Map Overlays
Route
Virtual Navigation
Current Location to Hyatt Regency
ZOOM
Copyright © Etak, Inc. 1984-1997
START
DEST
AIRPORT
SHOPPING
BACK

0262


VAN DYKE
LIVONIA
Redford
TELEGRAPH
GRAND RIVER
FORD
Dearborn Heights
Garden City
Inkster
MICHIGAN
MERRIMAN
WAYNE
WICK
GODDARD
Taylor
NORTHLINE
Southgate
Allen Park
FORT
Wyandotte
Copyright © Etak, Inc. 1984 1997
BACK

0263


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:41
Travel Plan
Map Overlays
Route
Virtual Navigation
Current Location to Hyatt Regency
LIVONIA
Redford
TELEGRAPH
Garden City
Dearborn Heights
FORD
Inkster
MICHIGAN
MERRIMAN
WAYNE
VAN DYKE
Allen Park
Lincoln Park
Wyandotte
Southgate
NORTHLINE
Copyright © Etak, Inc. 1984-1997
ZOOM
Quickest Time
Shortest Distance
Traffic Avoidance
Guidance On/Off
START DEST AIRPORT SHOPPING
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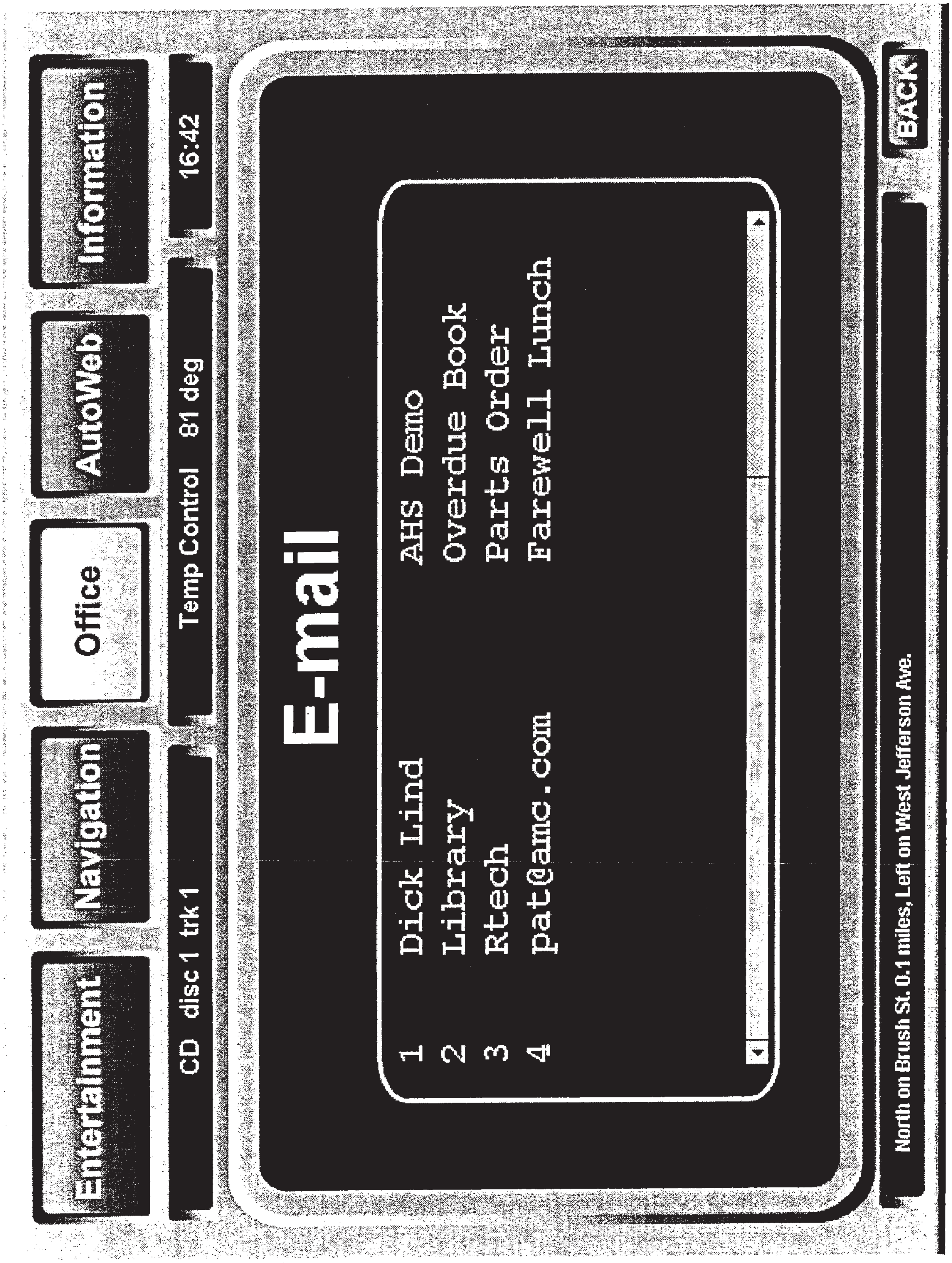
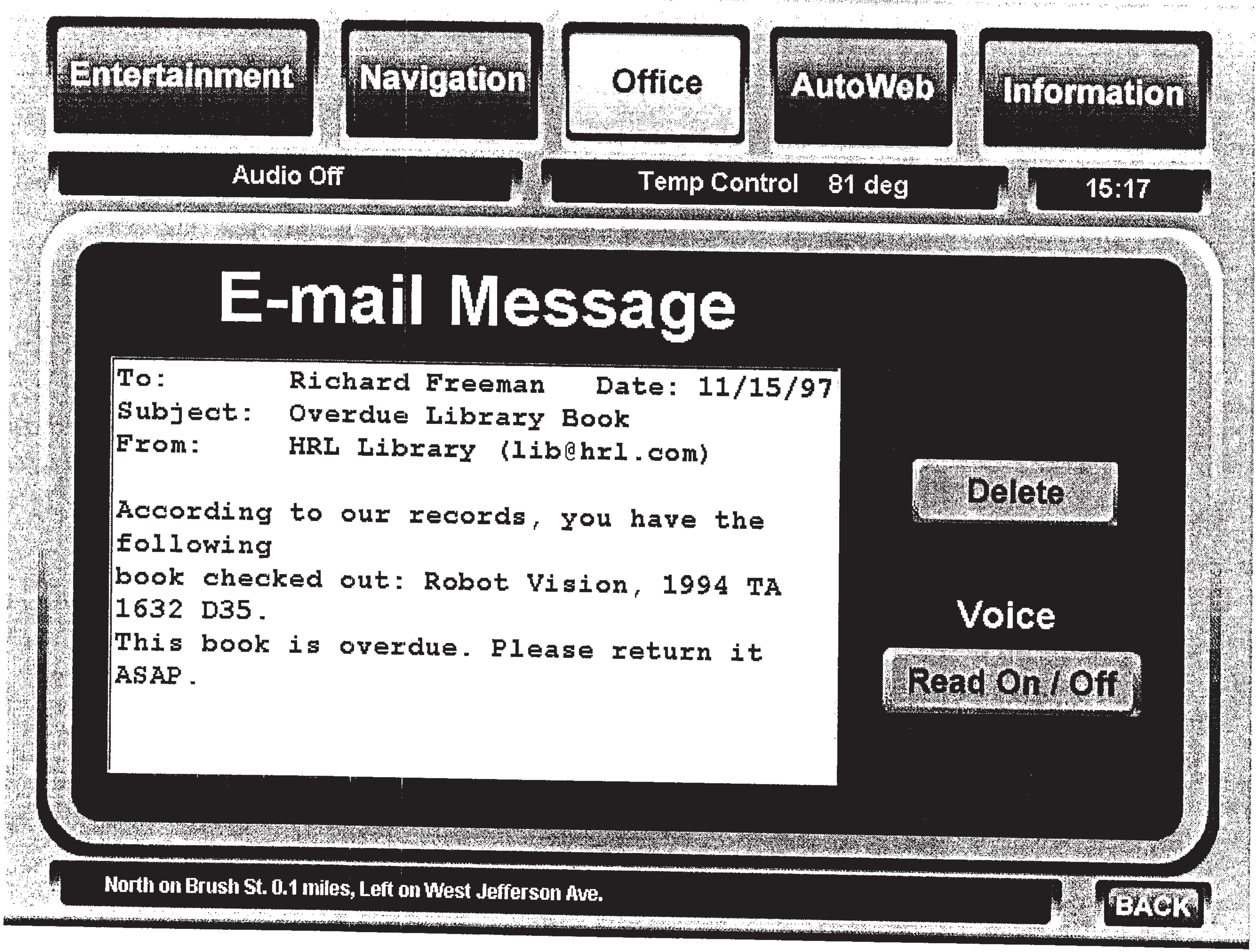
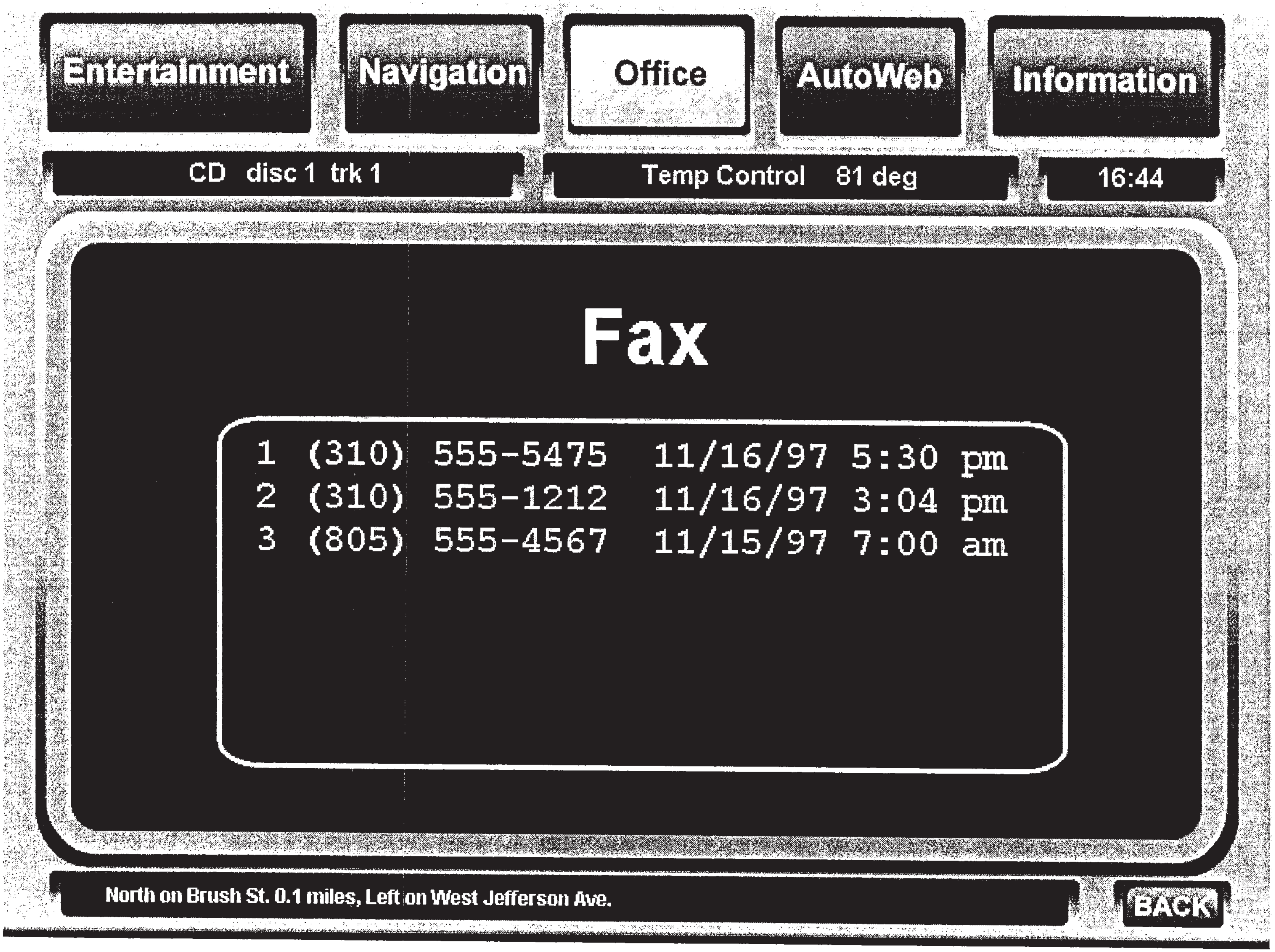
BACK

0264

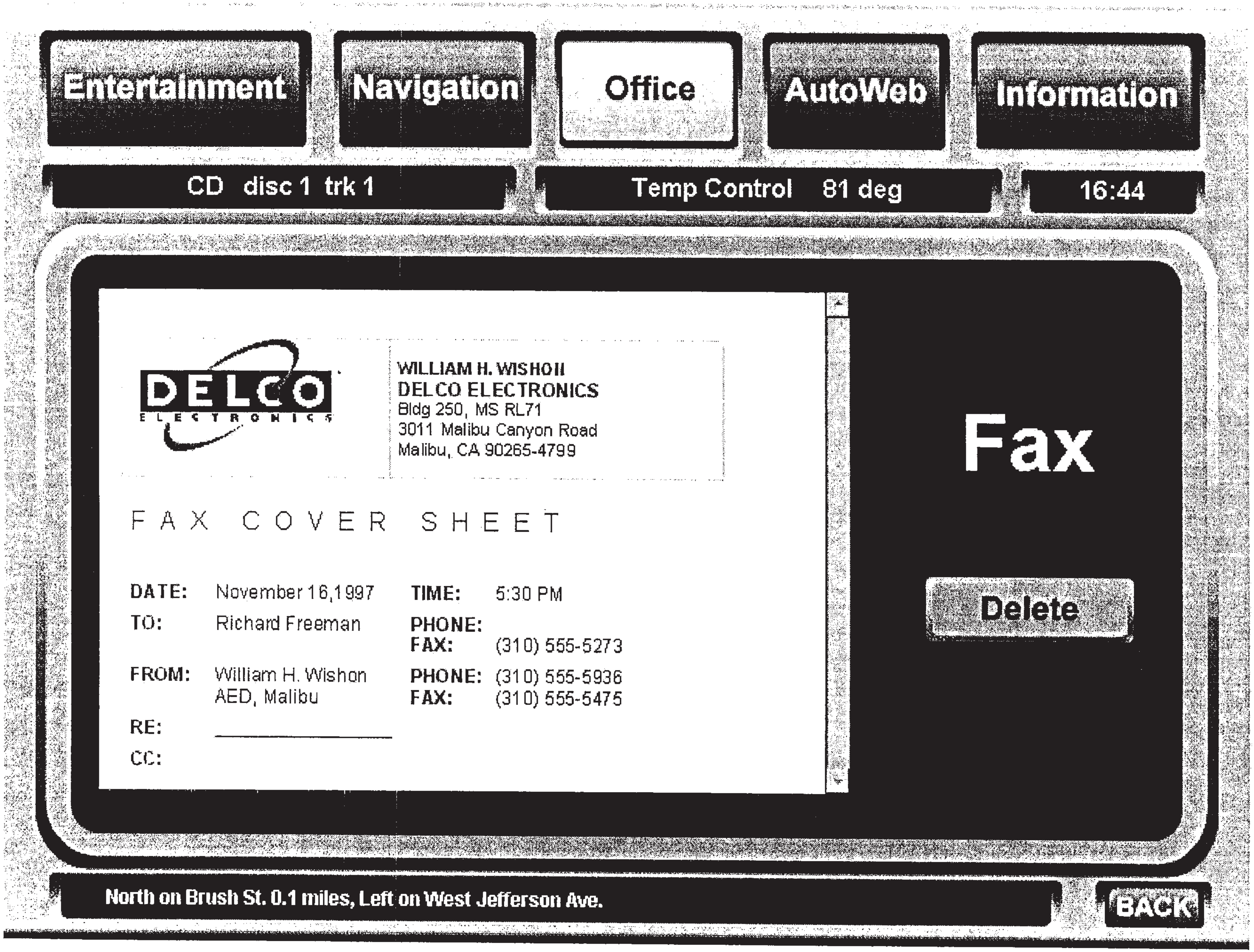

Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:42
E-mail
1 Dick Lind AHS Demo
2 Library Overdue Book
3 Rtech Parts Order
4 pat@amc.com Farewell Lunch
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK
0265


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
15:17
E-mail Message
To: Richard Freeman Date: 11/15/97
Subject: Overdue Library Book
From: HRL Library (lib@hrl.com)
According to our records, you have the following
book checked out: Robot Vision, 1994 TA 1632 D35.
This book is overdue. Please return it ASAP.
Delete
Voice
Read On / Off
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

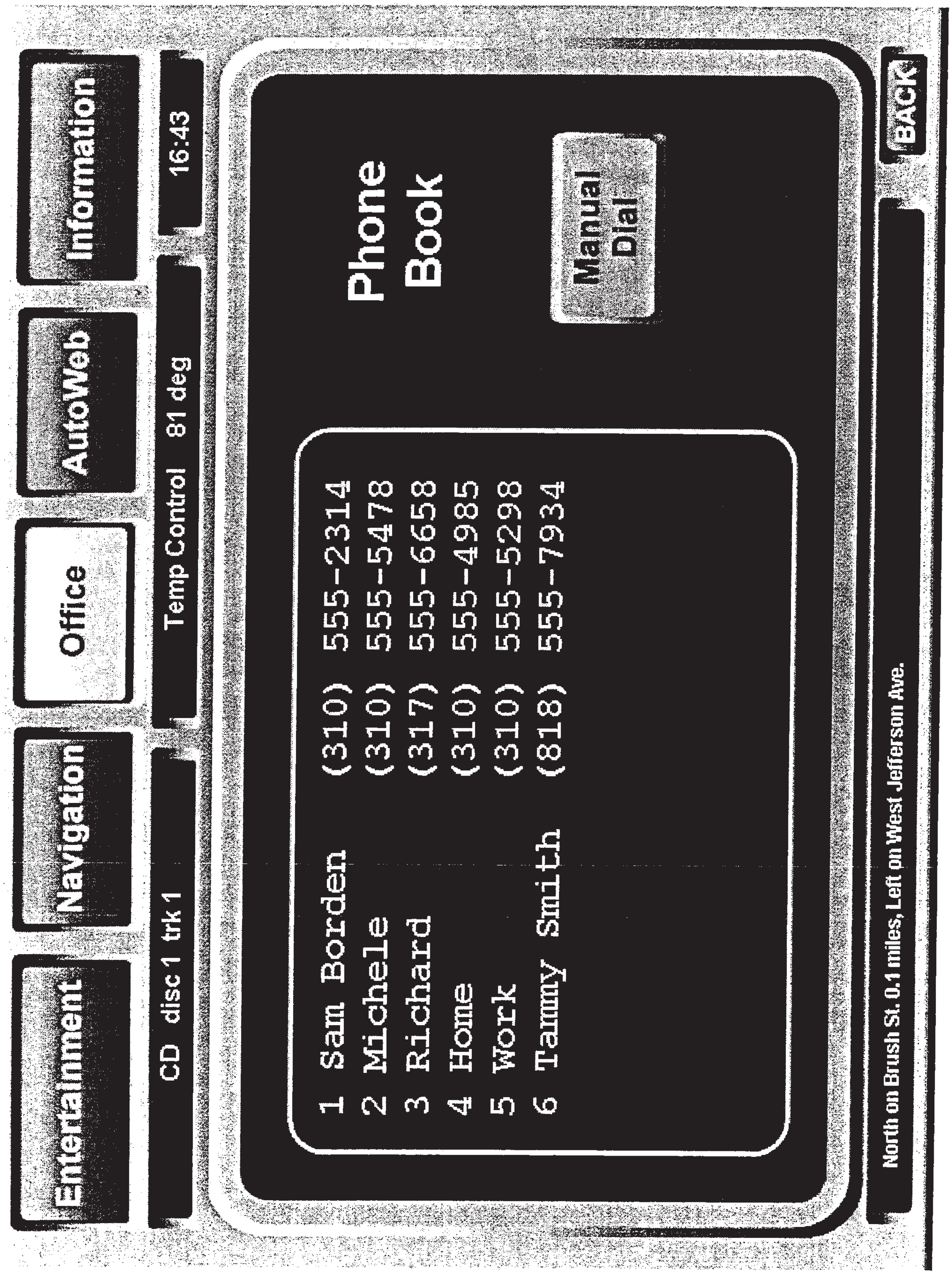
0266


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:44
Fax
1 (310) 555-5475 11/16/97 5:30 pm
2 (310) 555-1212 11/16/97 3:04 pm
3 (805) 555-4567 11/15/97 7:00 am
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

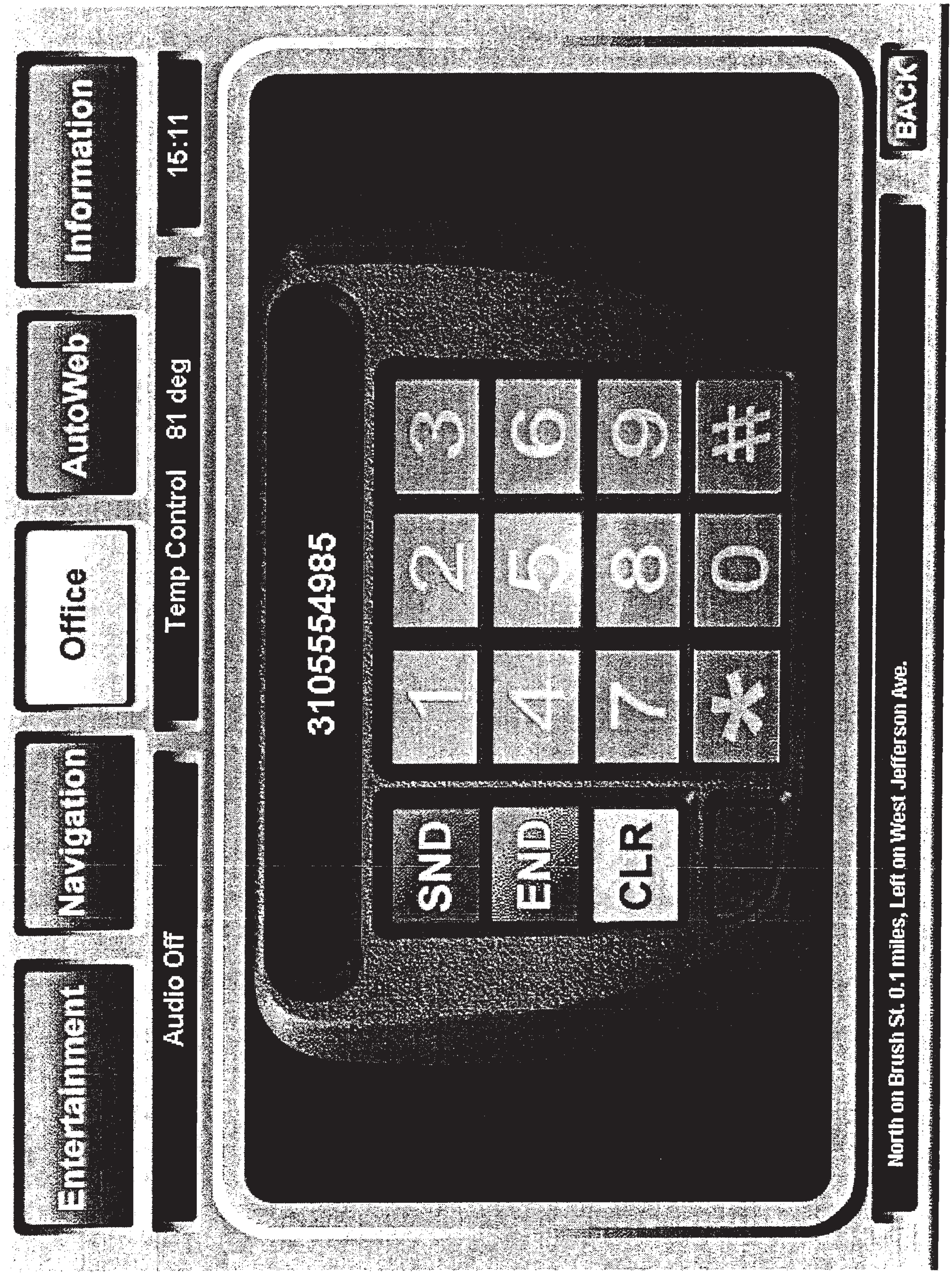
0267


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:44
DELCO ELECTRONICS
WILLIAM H. WISHOII
DELCO ELECTRONICS
Bldg 250, MS RL71
3011 Malibu Canyon Road
Malibu, CA 90265-4799
FAX COVER SHEET
DATE: November 16,1997
TIME: 5:30 PM
TO: Richard Freeman
PHONE:
FAX: (310) 555-5273
FROM: William H. Wishon
AED, Malibu
PHONE: (310) 555-5936
FAX: (310) 555-5475
RE:
CC:
Fax
Delete
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

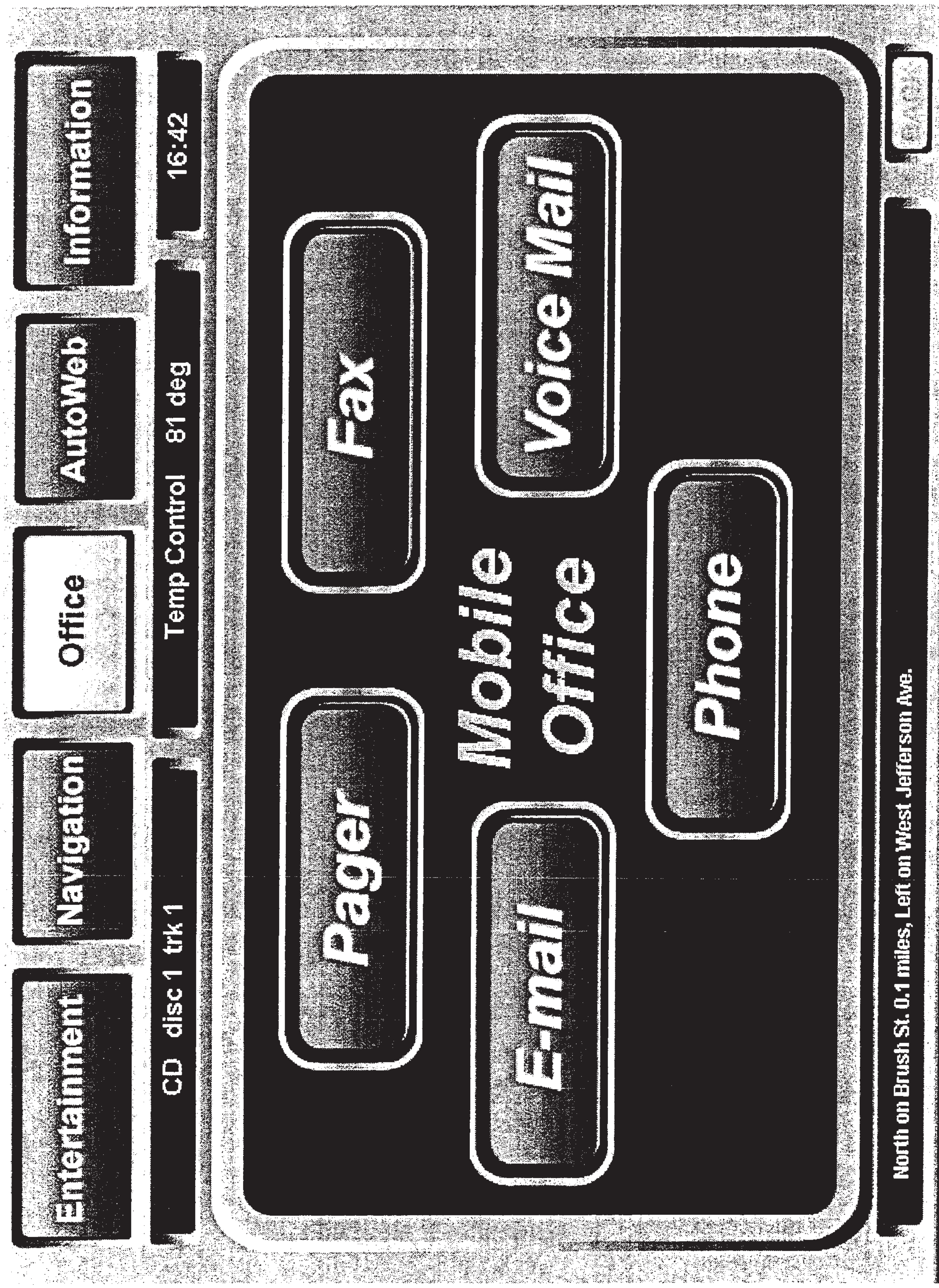
0268


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:43
1 Sam Borden (310) 555-2314
2 Michele (310) 555-5478
3 Richard (317) 555-6658
4 Home (310) 555-4985
5 Work (310) 555-5298
6 Tammy Smith (818) 555-7934
Phone Book
Manual Dial
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

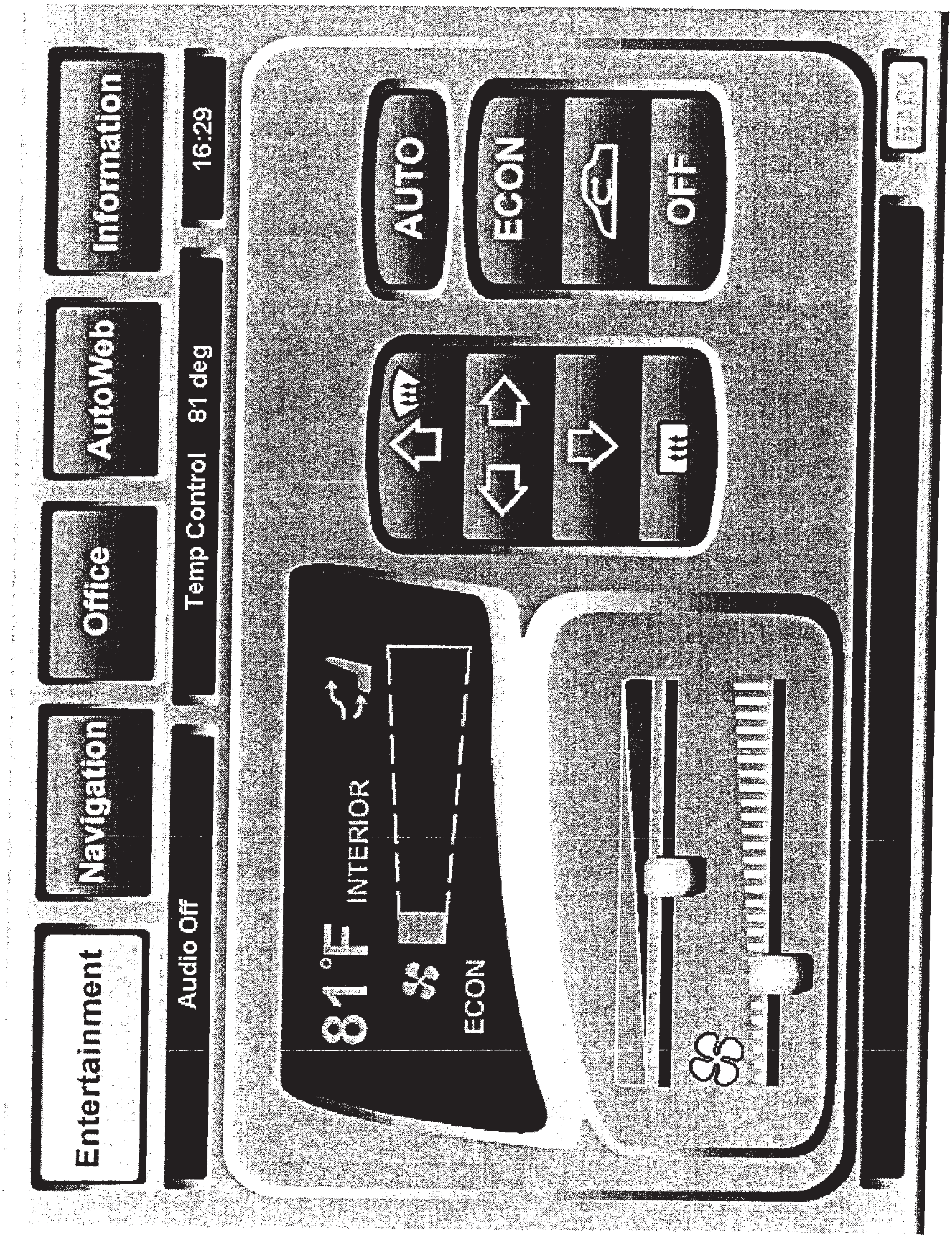
0269


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
15:11
3105554985
SND
END
CLR
1
2
3
4
5
6
7
8
9
*
0
#
North on Brush St. 0.1 miles, Left on West Jefferson Ave.
BACK

0270


Entertainment
Navigation
Office
AutoWeb
Information
CD disc 1 trk 1
Temp Control 81 deg
16:42
Mobile Office
Pager
Fax
E-mail
Voice Mail
Phone
North on Brush St. 0.1 miles, Left on West Jefferson Ave.

0271


Entertainment
Navigation
Office
AutoWeb
Information
Audio Off
Temp Control 81 deg
16:29
81°F INTERIOR
ECON
AUTO
ECON
OFF

0272

EXHIBIT C

REUTERS AG Monday, 22 April 1996 15:58:11

3:45 P.M. Apr 22 VW <VOWG.F> is working on a multimedia car

Hanover(Reuter) - Engineers of the Volkswagen company are working on a multimedia car. In addition to the traffic radio that today is considered standard equipment already, the vehicle, which is filled with high-tech components, will be fitted with CD player, video recorder, telephone, navigation system, a notebook computer, as well as external cameras, according to the manager of Electronic Research, Ralf Bergholz, speaking on Monday at the Hanover fair. The Wolfsburg company presented an “infotainment car” based on a “Sharan” at the trade show, which is equipped with monitors for the front seat passenger and the rear seats.

Each passenger was said to be able to select an individual program in the vehicle and listen to it with headphones. Available as image sources are a TV receiver, a video recorder, a CD player as well as a PC with Internet connection. Only the driver is prevented from watching TV, for reasons of safety. Instead, an on-board computer informs him about vehicle data such as the gas level, speed, or the engine's rotational speed. If desired, a navigation system may be displayed on the screen instead of the engine speed. Two cameras in each bumper also make it easier to park in small parking spaces.\

According to information from Bergholz, there are currently no specific plans for a market introduction of the multimedia car with the “feel of a living room”. However, VW is assuming that such a vehicle could exist in certain market areas.

sei/fgc

*For related news, double click:

[DE][AUT]

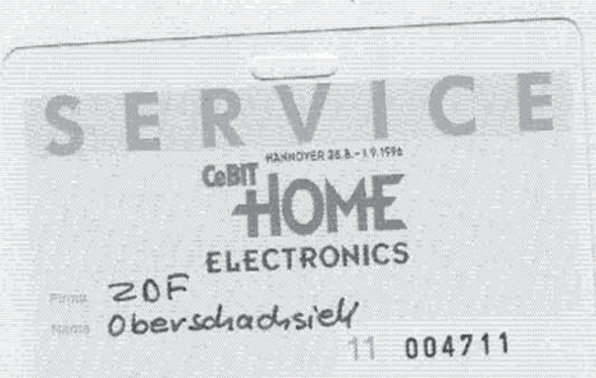
*For additional company news, double click:

[VOWG.F]

*For stock quotes and prices, double click:

<VOWG.F>

Monday, April 22 1996 3:45:28 P.M.
ENDS [nFJ2200797]



D E C L A R A T I O N

I, Judith E. Taddeo, declare that I am well qualified as a translator of German to English and that I have carefully prepared the attached English language translation from the original document:

VW arbeitet an Multimedia-Auto

[VW is Working on A Multimedia Car]

written in German and that the attached translation is an accurate English version of such original to the best of my knowledge and belief.

I certify under penalty of perjury that the foregoing is true and correct.

Date: 9/22/2015 Signature [signature]

Name Judith E. TADDEO

REUTERS AG Monday, 22 April 1996 15:58:11

15:45 22 Apr VW <VOWG.F> arbeitet an Multimedia-Auto

Hannover (Reuter) - Ingenieure des Volkswagen-Konzerns arbeiten an einem Multimedia-Auto. Das mit High-Tech vollgestopfte Gefährt solle über die bereits heute üblichen Verkehrsfunkradios hinaus mit CD-Player, Videorecorder, Telefon, Navigatonssystem, einem Notebook-Computer sowie Außenkameras ausgestattet sein, sagte der Leiter der VW-Elektronikforschung, Ralf Bergholz, am Montag auf der Hannover Messe. Die Wolfsburger präsentieren auf der Industrieschau ein "Infotainment Car" auf der Basis eines "Sharan", das mit Monitoren für den Beifahrer und die hinteren Sitzreihen ausgestattet ist.

In dem Fahrzeug könne jeder Passagier individuell ein Programm wählen und mit Kopfhörern abhören. Als Bildquellen stünden ein Fernsehempfänger, ein Videorecorder, ein CD-Player sowie ein PC mit Internetanschluß zur Verfügung. Nur dem Fahrer sei es aus Sicherheitsgründen verwehrt, dem Fernsehen zu frönen. Dafür werde er über einen Bordcomputer mit Fahrzeugdaten wie Tankinhalt, Geschwindigkeit oder Motordrehzahl informiert. Auf Wunsch könne statt der Drehzahl ein Navigationssystem eingeblendet werden. Jeweils zwei Kameras in den Stoßstangen erleichterten zudem das Einparken in engen Parklücken.

Nach Bergholz' Angaben gibt es bisher keine konkreten Pläne zur Markteinführung des multimedialen Autos mit dem "Ambiente eines Wohnzimmers". VW gehe allerdings davon aus, daß ein solches Gefährt in bestimmten Marktbereichen bestehen könne.

sei/fgc

* Für verwandte Nachrichten, Doppelklick auf:
[DE][AUT]
* Für weitere Firmenmeldungen, Doppelklick auf:
[VOWG.F]
* Für Kurse und Preise, Doppelklick auf:
<VOWG.F>

Monday, 22 April 1996 15:45:28
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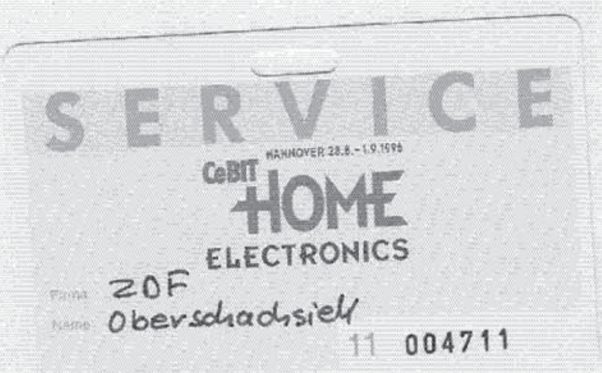

EXHIBIT D

Edited by:
Prof. Dr. Dieter Roller
Institut für Informatik Universität Stuttgart
Chairman,
ISATA Scientific Programme Committee.

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TRAFFIC INFORMATION MANAGEMENT

SPECIAL SESSION ON INTELLIGENT VEHICLES

DRIVER SAFETY ENHANCEMENT

ITS SAFETY SYSTEMS

COMMERCIAL OPERATIONS

ITS INTEGRATION

IN-CAR COMPUTING AND COMMUNICATION ENABLES ENTERTAINMENT, PRODUCTIVITY AND INFORMATION

Mr J Altnether,
Intel Corporation,
USA

97ATT073

Abstract: PC technology and applications continue to expand at an exponential rate. Many of these elements can be adapted to the automobile to provide new levels of entertainment, productivity and communication. In addition, new application requirements for the automobile such as navigation and real time traffic information are rapidly evolving. A system incorporating the Intel architecture provides the performance and flexibility to implement these functions. Examined in this paper are the architectural requirements and how they can be satisfied with the established Intel Architecture. Other factors, such as tools, and existing applications that can be utilised for quick development time and time-to-market will also be investigated.

Introduction: A number new applications and appliances are beginning to find their way into the automobile. Some of them are portable, allowing their use within the automobile. Each is a stand alone unit offering a dedicated service with little or no interaction with the other appliances. This not only limits the functionality but increases the cost because many of the functions are duplicated within each unit. For example, each usually has an embedded processor and a man-machine-interface such as a display.

The first is the cellular telephone. According to Datatquest, approximately 60 million cellular phones will be shipped in 1997 with a 22% CAGR. This is fueled by the decreasing costs of equipment and air time. In the beginning, standard personal cellular were used in the automobile. This provided both business and personal communication and is also used for emergency services. Currently cellular telephones are being integrated into the automobile with hands free operation. With services such as GSM, both voice and data can be transmitted, but few applications currently exist for digital data communication. This will change dramatically over the next few years.

Navigation systems are also beginning to be integrated into automobiles. Based on GPS technology many systems incorporate accelerometers or gyros to augment the accuracy of the GPS. In Europe alone this segment has grown at a 36% CAGR since 1993 (source: Dataquest). Navigation has two components: location and route planning. Location defines where the car is and establishes the beginning point for navigation. In addition, the location can be used as part of the safety component. Emergency road service would also require this information, as could the theft monitoring.

Today, route planning is static. This feature is available with a number of GPS system or navigation systems such as the "Never lost" system in Hertz rental automobiles. The assumption is that the stored information is current and no changes have occurred in the physical streets. If road construction closes a road and forces the automobile to deviate from the system's expected route, a new route will be recalculated usually through the same closed road. Real time information is required to eliminate this problem. Here is the beginning of integrating functionality. Information is received through the communication link. Real time traffic information is provided via one of the communication links. Information has a broader meaning than traffic information. Both voice and data information are required. Voice for the normal human communications and messaging and data for a variety of functions: traffic information, internet access to find hotels, restaurants, travel guides and electronic forms of communication such as faxes. At another level, the data communication channel can be used by the automobile to schedule maintenance, perform remote diagnostics and receive software updates for various components.

Another application that is being incorporated within the automobile is entertainment capability. This in the form of games, movies and television. Systems by Clarion and Fujitsu Ten are already on the market. These are proving indispensable on long trips or to occupy children.

In vehicle applications are comprised of four segments: information, safety, infotainment and productivity. Information includes trip guidance, route planning, points of interest and congestion avoidance. Safety comprehends: emergency location, vehicle immobilization, operator identification, and weather information. Infotainment for the driver provides user delectable news and music on demand; while for the passenger there are PC games, movies, news and internet surfing. Productivity is provided by hands free phone, FAX/modem, voice and email messaging and personal itinerary.

Discussion: All of these applications and functions can be satisfied with a PC. Several environmental trends are validating this. First there is a decreasing cost for communication and computing. PCs that one year ago cost $4000 now sell for $2000 with twice the performance. Secondly, there is a universal acceptance of portable computing. This segment is growing faster than the desktop. Next, there is a convergence of computing and communication. All new PCs sold now contain a modem, cellular phone interface or a wire connection. Finally, the information services available via internet continues to accelerate. The cost, mobility, communication and portability of PCs can be effectively used in the automobile to meet the emerging requirements. The PC technology offers a number of reasons to be migrated into the automobile: established base easy to integrate existing hardware and software, existing hardware and software standards, existing relationship between home and office PCs, ever expanding market that can be followed for low cost advantage, and existing tools and development environment.

The PC began as a tool to enhance productivity in the office and business environment. Many of the application suites were developed to provide word processing, document control, financial analysis and inventory control. Made possible by the PC was distributed processing, which made the PC a tool of individuals increasing their productivity. This individual productivity was carried into the home both as a spill-over from work and because the home is a small business and can take advantage of the office applications. Because the PC is not 100% utilised at home, entertainment's such as games were a natural filler for this free time. Today a link exists between the home and office computers and the natural extension is into the automobile.

The automobile did not participate in the PC revolution because the applications required were different that those of the office and home environment and required higher performance and functionality. Also, the simultaneous operation of two machines (the automobile and the personal computer) that each required attention was thought of as a safety hazard. Personal computers and their software have advanced to a stage where they can meet the automotive requirements.

The advent and enthusiastic acceptance of the personal computer has enabled information on demand, both processed or communicated information. The populace has accepted this, and is recognizing the necessity for this functionality in the automobile. The automobile has been the last bastion of unstructured time. The necessity for these functions is becoming apparent in four types of applications which are evolving: navigation, information, entertainment and safety.

A number of valid reasons have kept the PC from entering the automobile environment, but the primary reasons were limited technology capability and lack of application software. The technology and software exists today to implement such a system. There are a number of compelling reasons to draw from the PC and adapt technology and software to the automobile both from the stand point of technology and business.

By today's standards the first Personal Computers were primitive machines. They were 8-bit machines operating at 5 Mhz providing .33 MIPS. By contrast today's machines are 32- or 64-bit machines operating at 200+ Mhz and execute 220 MIPS. What the early systems did was to provide were platform standards. An open architecture fueled a plethora of applications and hardware peripherals enhancements. Standards emerged providing a number of advantages: low risk for the manufacturer, increased market size and market growth.

At this point in time there are no standards for the "computer platform" in the automobile. Several are being discussed in committees such as ITS but have not been ratified. In the meantime, the market is ripening and could be ready before the standards. One method to safeguard investment is to embrace existing popular standards. The Personal Computer offers such a standard. In addition, there is an existing infrastructure of hardware and software to be applied.

The size of the PC market continues to grow at an 18-20% per anum rate with no reasons to abate. As shown in Figure 1, as of 1996 there are over 250 million PCs installed. As of 1996 there are 250 million PCs installed and over 65% of those are Pentium® processor based.

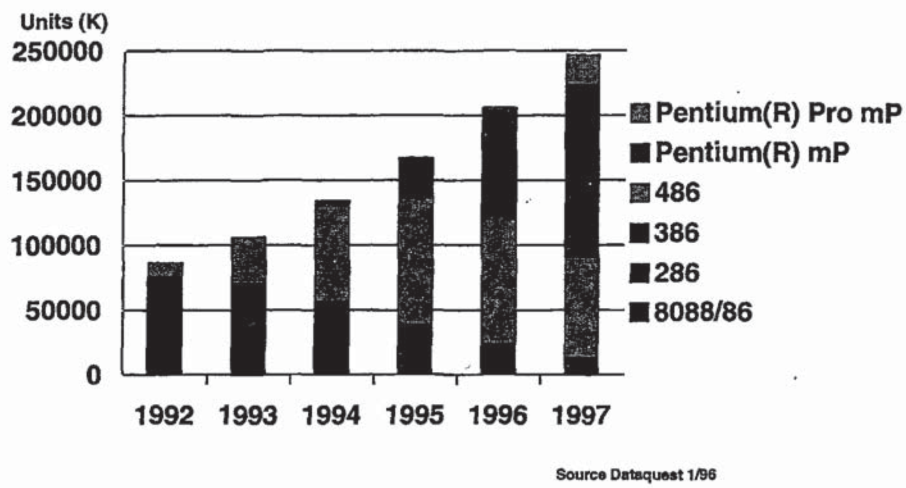
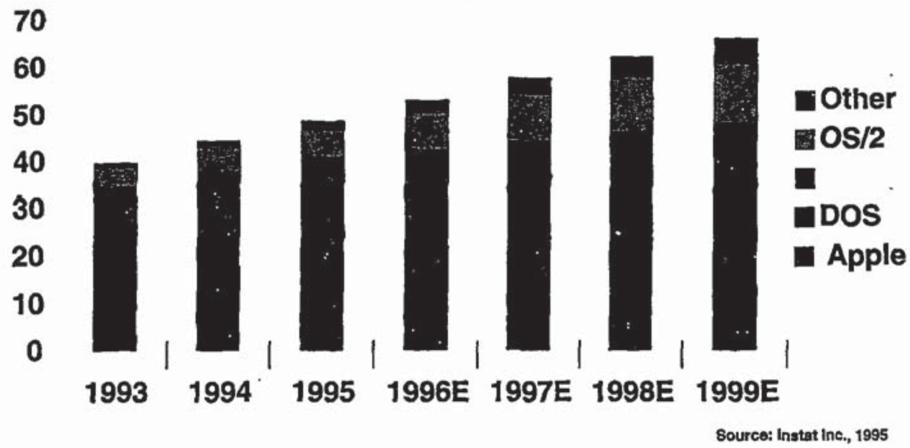


Figure 1. Installed PCs

Software too, advanced. The growth in personal computer performance is coupled to a correspondingly evolution in S/W and OS making them easy to use and efficient. The hardware and software exist in a constantly expanding upward spiral. Software pushes the hardware to its limits and new hardware is created to handle the increasing s/w requirements. Again, new s/w will stretch the limits of this new hardware on an ever upward spiral. In the beginning, what little software there was, had a clumsy man-machine interface (MMI). Often it required arcane commands to perform functions. Rather than requiring many hours to study manuals, hardware has become self-installing and programs are intuitive in their operation. Added to this is the capability to perform applications once thought of as exotic such as speech recognition, full motion video and high speed communications. As a result, the computers have moved from the domain of the highly skilled users to that of everyday unsophisticated users.

Here again, standards play an important role. Operating systems such as Microsoft Windows* 95 or NT are shipped with almost every PC. Any application that wants market acceptance or any peripheral expecting to be used, has the interface and drivers for this most popular operating system. As shown in Figure 2 this is the de facto standard and it runs on the Intel Architecture.



** Other brands and trademarks are the property of their respective owners
Includes Windows 3.1, Windows 95 and Windows NT

Figure 2 Operating systems

Because the PC has become a standard tool all development tools have been designed to run on the PC. This is true from Microsoft Developers Network to Psoft, to QNX to C and C++ compilers. Many of these tools have tracked the development of the PC and are very mature and stable. Another advantage of using the PC platform in the automobile is that the target is also the development platform, permitting native debugging.

The question then becomes, "How to integrate the PC to the automobile space?" To answer this, we must look at the automobile architecture. At present it is a multiprocessor distributed system on a bus such as CAN. To provide functions to the driver and the passengers, the PC functionality will be distributed also. The GPS, radio, wireless communication, displays, and all of the MMI will be distributed throughout the automobile. The PC bus will be a separate bus to avoid any interference with the functions on the CAN bus. On the CAN bus, many dedicated processors perform their local functions such as ABS, engine control, etc. and communicate to the other components via the bus. All of the information here should be considered mission critical and not disturbed. The system operates in real time and must be deterministic. This precludes using this bus for the PC system in the car. There is however information on this bus that is of interest and a gateway should be provided. Information such as wheel speed and engine performance can be monitored as well as sending information to the devices on the CAN bus

Attaching the peripherals to the PC platform and defining two bus structures, the system takes shape as in Figure 3. While the previous discussion mention two buses, this system provides for three: CAN/J1850, a USB for the PC peripherals and 1394 for high speed data transfers such as full motion video.

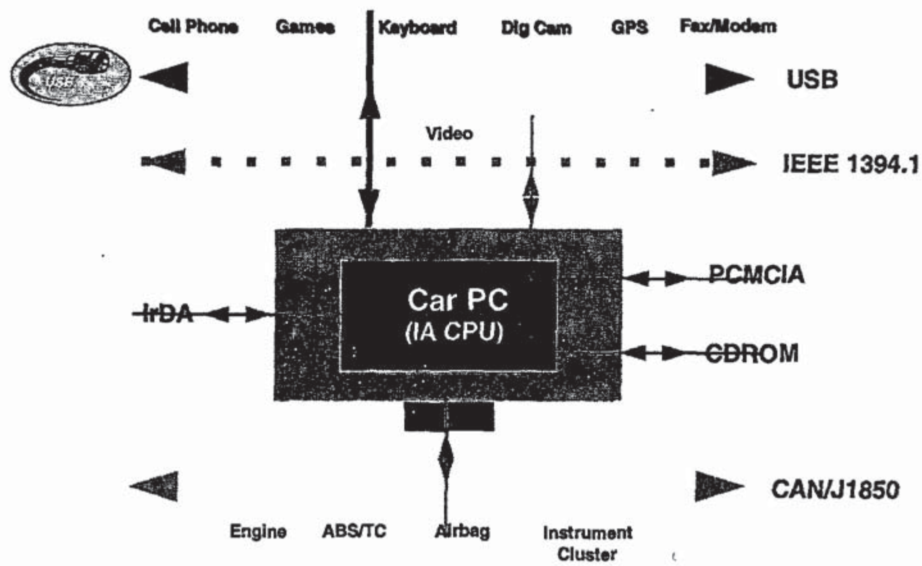


Figure 3. Connected CarPC Platform

USB is selected because it has become a standard on PCs. USB propagates a 12M/s differential data stream over a shielded twisted pair. Many peripherals are USB ready. Windows 95 supports hot plug-and-play of peripherals. This permits using existing peripherals in the automobile. For example, if one of the children has a favorite joystick, it can be used at any station without rebooting the system to recognise the peripheral. Because Windows 95 recognises USB, most if not all application programs can be used. USB is also used to interface to the car environment such as seat sensors, window and door controls. Slow data, level signals, switches and lamps are best interfaced to microcontroller rather than tying up valuable processor resources. Each element of the automobile should be thought of as a module, for example the driver's door. Intel offers the 8x930Ax microcontroller that has USB capability. Thus, the door locks, door ajar sensor, window controls and sensors and even the mirror can be interfaced to the microcontroller and it interfaces to the processor via USB. Up to 256 such modules can be incorporated. The 1394 bus is included to provide future high speed transmissions. This will permit full motion video (for movies) to be displayed at all passenger stations.

The PC platform is built around the Intel Architecture for technical reasons as well as the business reasons previously discussed. It provides continuous performance enhancements on a well defined road map. Each new generation offers greater that 2:1 performance enhancements. The product rich roadmap permits the platform architecture to be scaleable from low end price and performance to high end leading edge performance. Platforms can be scaled from i486® processor through Pentium processors up to the current generation Pentium Pro processor. This provides an order of magnitude range in the performance of systems. In addition, they bring with them complementary technology to further enhance the system performance. Two such examples are USB bus and MMX™ technology. MMX technology is a single instruction, multiple data operation. The latest version of the Pentium processor incorporated 57 new instructions to implement MMX technology. As a result, high performance digital signal processing is feasible on the Pentium processor. In the Connected CarPC environment, this could be used for image processing - MPEG2 decoding of movies, noise cancellation, soft communication devices to name a few uses.

This scalability of the architecture permits a range of systems for the automobile. As an example, three systems are shown: a navigation system, an internet system and a multimedia system. These systems are shown in Figures 4-6. The Navigation system is built around the Intel i486 processor and provides: position, navigation, vehicle control, audio entertainment. The Internet system uses a Pentium processor with MMX technology and provides: position, navigation, vehicle control and audio entertainment as does the navigation system but it also includes: speech recognition, communications. The Multimedia system provides all of the functionality of the Internet system but also adds: multimedia and games. This enhancement is due primarily to the salability of the processor that allows upgrading to a Pentium processor with MMX technology.

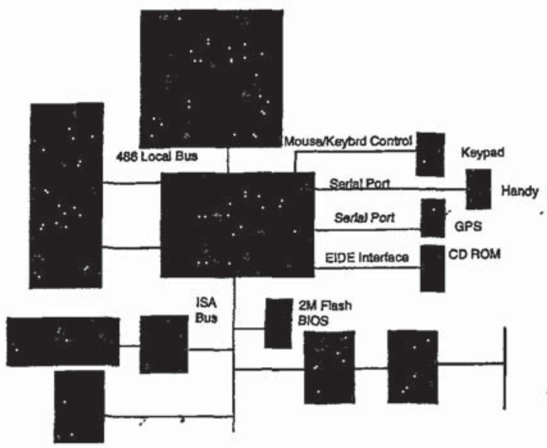


Figure 4 Navigation system

As can be seen in the two systems built around the Pentium processor, there is a large degree of commonality between the systems. The primary difference is in the performance and features of the Pentium processor. The Internet system uses a 133 MHz processor while the Multimedia system incorporates a 166 MHz Pentium Processor with MMX technology. Systems can easily be differentiated on performance and features while retaining commonality over a family of systems. This core platform can be expanded and extended in the future as more performance and features are required from the system. It is designed to follow the high volume PC components for upgradability and protection for legacy issues. The designer has the choice to incorporate higher speed Pentium processors as they become available or to incorporate the Pentium Pro processor.

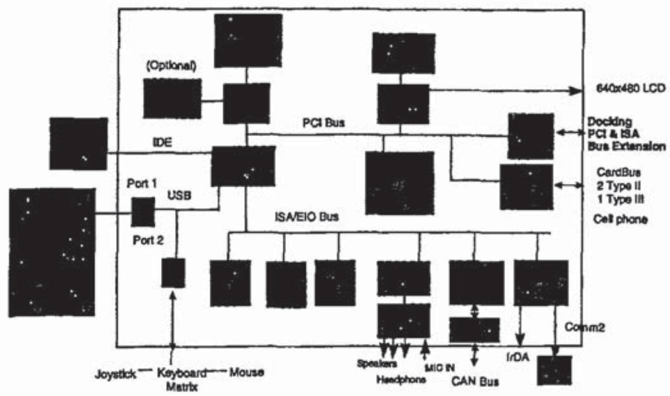


Figure 5 Internet system

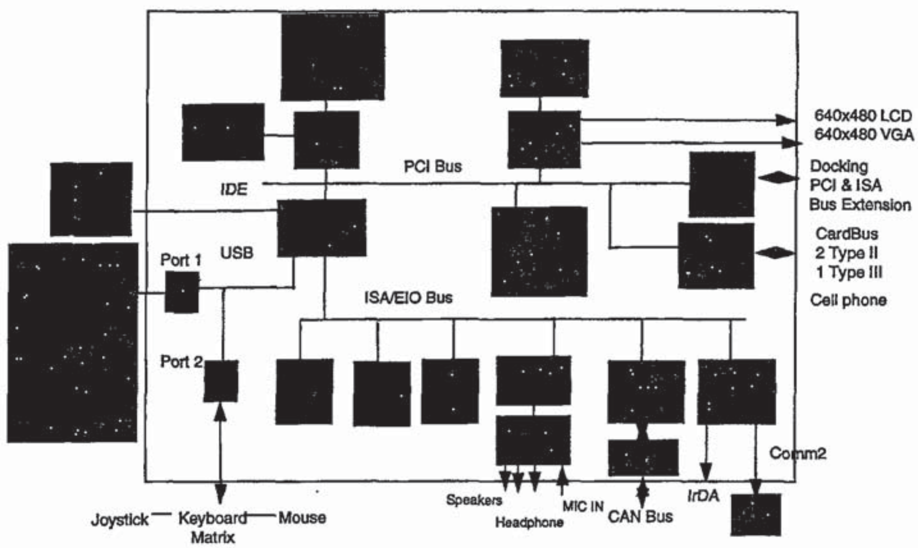


Figure 6 Multimedia System

Conclusion: In addition to the technical advantages, Intel Architecture provides a number of business advantages. These are quick time-to-market and low investment costs. Quick time to market is possible because the architecture is established and familiar. There are time proven, familiar, robust hardware and software packages available. Native debugging is accomplished on the PC. The solutions are low cost because they use the same high volume processors that are used in the desk top and laptop computers. PC peripheral components are widely available, eliminating the need to develop new peripherals. The tools are low cost and off-the shelf O/S and application software exist.

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EXHIBIT E

INTERNET MULTIMEDIA ON WHEELS: CONNECTING CARS TO CYBERSPACE

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Keywords: Mobile Communication, Road vehicles, Internet, and Multimedia systems

ABSTRACT

An integrated solution to seamless connectivity and innovative in-trip services is being researched at the Daimler-Benz Research and Technology Center in Palo Alto. The Internet Multimedia on Wheels Concept Car has an on-board, integrated wireless communication system and the computing infrastructure to provide Internet connectivity from the car to any specific server on the Internet while stationary or in motion. Essentially, the car is like any other node on the Internet with a unique Internet Protocol (IP) address such as the Vehicle Identification Number (VIN). Thus, an entirely new type of services can be delivered to cars in an efficient and secure way through increasingly less expensive wireless data connectivity over the Internet.

INTRODUCTION

With the advancement of the computing and communications revolution, the Internet is becoming more and more part of our daily life. We send e-mail, check our bank account, read newspapers, and "surf" the net just for fun. New multimedia applications even allow us to listen to "Internet-Radio," watch "Internet TV," make phone calls, and do video-conferencing over the Internet. By contrast, this communications revolution has yet to reach the automobile. Drivers and passengers in cars typically enjoy access only to radio broadcasts and occasionally television. To reduce the unproductive driving time, people use their cellphone for voice communication. Moreover, today information cannot be personalized or adapted to the driver's and passenger's needs. The challenge is to provide the Internet's multimedia capability in the automobile environment with varying and limited bandwidth, thereby, enable a whole new class of services to and from the car.

At the same time, there is a strong effort in the Intelligent Transportation Systems (ITS) community to stimulate research and industry to build an infrastructure which will lead to better traffic and transit resources management and enhanced safety. From cost and reusability perspectives, it is necessary that a single infrastructure provides most of the functionality instead of building a separate system infrastructure for each service. Internet has the potential to be such an infrastructure. The car is essentially a probe in this model collecting and sending data to service centers, which in case of future navigation systems will be used for building dynamic real-time traffic models that would be used for on-demand route guidance by individual vehicles.

VISION

First we define the term "Internet Car":

An Internet Car is one which is like any other node on the Internet. Although it is highly mobile, it uses standard TCP/IP protocols to communicate with the other nodes on the Internet. An Internet car can be an Internet client as well as an Internet server. The car in essence becomes an open platform for services to be delivered over the Internet .

Some scenarios where the Internet car would be useful for drivers and passengers are:

- Services from Internet service providers e.g. safety, security, news, stock, city guide, navigation, email, and movies.
- Seamless access to office or home computer from the car.
- Personal devices (smart cards, HPCs) can be used to personalize car seats, climate, phone numbers, Internet services bookmarks, and computing man machine interface.
- Interactive audio/video games over the Internet for passengers.
- Personalized Internet based services e.g. "my" commute traffic information.

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- Geo-specific information access on demand e.g. "nearest" Chinese restaurant.
- Internet based roadside assistance and remote diagnostics.

It is an open question what impact Internet content will have on the car, but it is our belief that ultimately it will be used to optimize the safety and security of the car along with comfort and convenience. Figure 1 illustrates a systems view of the Internet Multimedia on Wheels concept including a number of components that may be included in a full implementation.

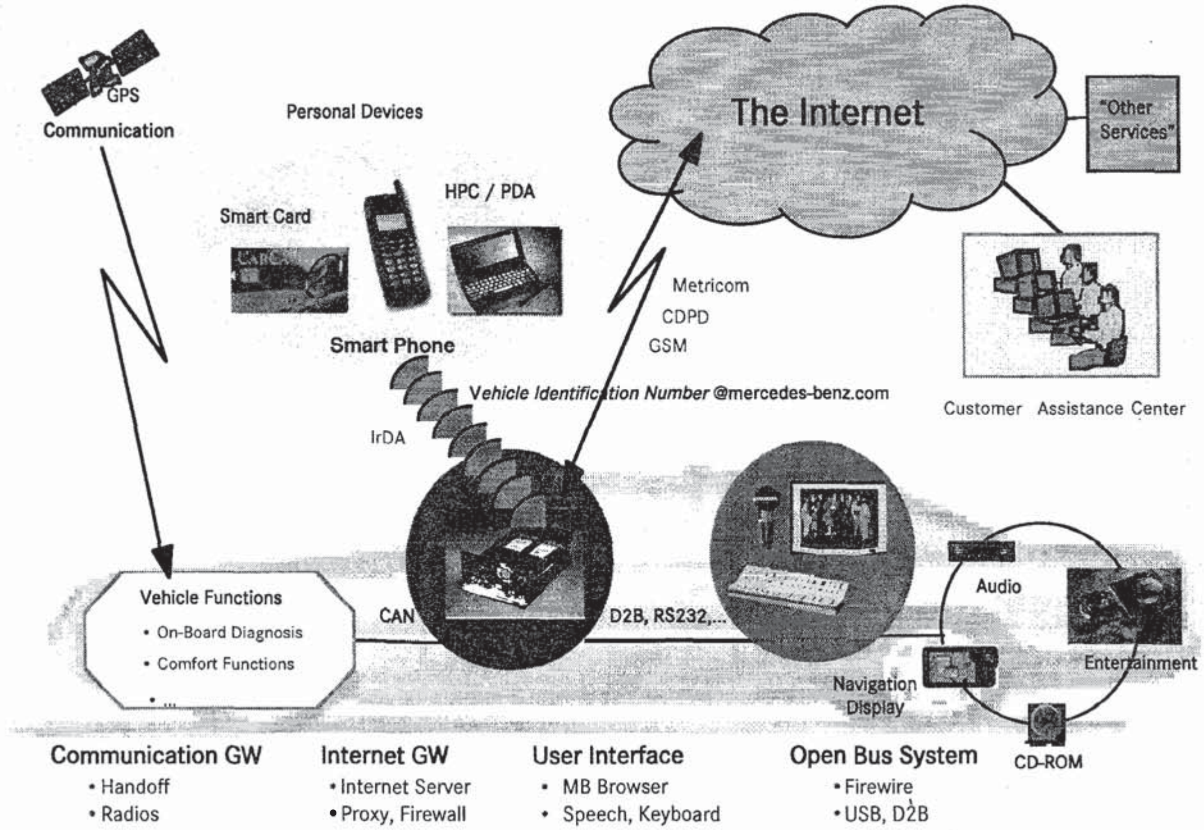

Figure 1: A systems view of the Internet Multimedia on Wheels concept.

There are a number of ways to bring the Internet connectivity and content into a car. These methods differ widely in terms of functionality, connectivity, in-car infrastructure and system requirements. The strength of connectivity to the Internet may range from a fully connected model where data and services are available all the time down to a disconnected model which requires the drivers/passengers to bring Internet data on a storage media with them.

MAJOR CHALLENGES

An overarching challenge for connecting cars to the Internet is to define a system architecture with flexible distribution of computing power and communication between the automobiles and the infrastructure. The answer may be as simple as the cost of wireless communication. At one end, the car may only have the input/output devices and a modem to request and receive information. On the other hand, the car may have state-of-the-art computing power with on-board storage media to receive raw data, and to process it. Clearly, the form of the final architecture will depend on costs and business models. In all cases it will always be necessary to maintain the integrity, security, reliability and speed of communication.

Wireless communication is expensive and the bandwidth is quite restrictive for applications requiring transfer of other than a few hundred bytes of text data. There are a number of wireless service providers using different flavors of communication protocols and bandwidth to support the Internet protocol e.g., the frequency hopping spread spectrum Ricochet network, Cellular Digital Packet Data (CDPD), and Personal Communication Services (PCS). The challenge is to provide the basic infrastructure that can provide national or global coverage without employing a whole array of modems.

The presence of multimedia information in a moving vehicle can be a potential hazard to safety of the car. It is essential that the software architecture is open for development of new services and benefits from being easily adaptable to new and evolving Internet technologies. At the same time a metric that will define what services are deliverable to drivers under what mobility conditions, and which services can be used by passengers should be established to optimize the safety in the car.

BENEFITS

Automobile access to the Internet opens up a wide range of new opportunities for drivers, passengers, and customer assistance centers. It also increases the security and safety of the car. The quality of travel can be improved by personalized route plans delivered to the car with up to the minute road and traffic information.

Drivers will be able to access their voice-mail, e-mail, and travel-related information such as restaurant guides and movie theater locations. The driver will have access to these services in a hands-free, eyes-free manner through voice commands and speech technology.

Passengers can additionally access richer interactive applications such as on-board or Internet games, audio-on-demand, and web surfing. They can access information about cities and historical places during a drive as they pass them.

Drivers and passengers can also use their personal devices like Smart Phones, Personal Digital Assistants (PDAs), Hand-held PCs (HPCs), etc., in an integrated fashion. Also, by integrating GPS and mapping technologies, the Internet car becomes "location aware" which will be used for a new class of services that will go well beyond classical navigation.

For the customer assistance centers that currently rely on a "telephony-based" service, the Internet car will provide a richer "datacentric" multimedia environment to deliver new services including operator's help manuals and intelligent roadside travel assistance. For these new services, user interfaces will be designed that allow easy and safe handling of the interactive media.

By grounding the concept and architecture of information technology for a car around the Internet and open standards, the Internet car can take full advantage of the tidal wave of Internet based services, technologies, and devices for many years to come, thereby transforming driving and riding into a completely new experience.

MOBILE SYSTEMS DESIGN

Inherently, the design of a system to provide access to Internet from cars must take into account the mobility aspect. Mobility in the system needs to be handled at two places. First, at the point of attachment (for example, at home or office), and secondly, during the time of travel. There are standardization efforts in this area already in the Internet community such as the Mobile IP proposal [1,2] along with the IPv6 proposal to Internet Engineering Task Force (IETF). In summary, Mobile IP assigns temporary care-off addresses to visiting hosts and directs Internet packets addressed to them at the home location to be forwarded to the point of attachment when a mobile (in this case the car) moves from one subnet to another.

Networking may be carried out using a variety of wireless technologies. Metricom, CDPD and Satellite based systems are the most attractive technologies in the US for connectivity to the Internet from the road. The 19.2 kbit/s bandwidth, CDPD wireless data service is already available in nearly 80 cities and may be used in conjunction with Circuit Switched CDPD to provide national coverage. Code Division Multiple Access (CDMA) is still being tested as a viable alternative for wireless Internet access. For short range data transaction, high bandwidth is typically the primary requirement. WaveLAN, IR or RF based solutions are most appropriate here. Finally, the new Java based smart card technologies will link personal information to cars. They will, in essence, provide a new way to communicate the identity of drivers/occupants to the car in an unobtrusive manner over the Internet. This information may then be used by the car to provide personalization of the seat position, climate, user interface in the car. The ramifications of such personalization features would include improved safety while driving, because mundane information for access to information services can be individually filtered out.

Internet communication is based on standard TCP/IP stack. However, TCP [3] does not have any special provisions to work over wireless connections. It's congestion control algorithm assumes that a time-out in transmission is due to congestion but not to the loss of a packet. So, when a timer goes off, TCP slows down and sends less packets to avoid the congestion. In wireless networks it is very likely that the timer went off because of the loss of the packet, so the proper way to deal with this problem would be to send the packet again as soon as possible. Currently there are two major ways to improve the performance of TCP over wireless [7]:

- Indirect TCP [4] splits the TCP connection into two separate connections. The first connection goes from the sender to the base station and the second from base to mobile station over the wireless link. The drawback of this scheme is that the semantics of TCP as an end-to-end protocol are hurt. The base station acknowledges (Ack) each received packet in the usual way but this is no guarantee for the sender that the packet has reached the receiver.

- Snooping Agents [5,6]. The basic idea behind this agent is that it observes and caches TCP segments going out to the mobile host and Acks coming back from it. Therefore, it sits in the link layer of the base station. When it sees a packet going out to the mobile host but sees no Ack coming back in a relatively short time, it just retransmits the packet without telling the source sender that it is doing so. When it sees a duplicate Ack from the mobile host going by, it also generates a retransmission meaning that the mobile host has missed something. The duplicate Acks are discarded to avoid a source of misinterpretation by the sender as being a sign of congestion. One drawback of this solution is that the system is implicitly aware that TCP is used as the transport protocol. Also, when the link is very lossy, it will run into the same problems as without the system. This can be fixed by a selective repeat mechanism which is applied when the base station notices a gap in the inbound sequence numbers. It requests a selective repeat of the missing bytes using a TCP option. The findings in [6] strongly suggest that such a TCP aware link layer algorithm improves the throughput and the goodput over wireless links substantially without compromising the end-to-end semantics of TCP.

Our research would focus on the questions, whether the snoop agent can be placed anywhere in the network and how this would change the performance of snooping.

IMPLEMENTATION

In the first implementation of the Internet Multimedia on Wheels concept, we have designed multimedia units for two different zones with the user interfaces as shown in the following figures. In these units, there is a color screen, channel select buttons, IrDA (Infrared) transceiver to support hand-held devices, and an audio outlet.

The access to applications is different in these two zones. The driver and the navigator have access to a single multimedia unit in the front (Figure 2), and the passengers in the back seat have access to individual multimedia units (Figure 3). The applications in the front zone are more traffic and navigation driven. In the rear zone, there is access to navigation, office applications, interactive games, and infotainment.

The driver has access to the navigation system and local or Internet based services. He will be able to use voice commands to access these services from the Internet.

The passengers in the rear can enjoy a richer multimedia environment on their multimedia sets for navigation, games, stereo, or Internet access. The built-in IrDA transceivers will allow HPCs/PDAs to interact with the systems in the car.

In addition, the hand-rest in the driver's zone has a slot for a personal device to enable the driver to bring in personal preferences to the car.

TODAY'S RESEARCH SCENARIOS

Drivers and passengers will use the Internet car for both fun and productivity. The Internet based navigation unit will plan a route which takes into account real-time traffic information and traffic history. Drivers will access news, voice mail, email, stock quotes, weather information all through a hands-free, eyes-free audio interface. Co-passengers will access rich multimedia information from various domains such as infotainment, office work, and entertainment. The car will empower the driver and passengers to choose the way they would like to spend their time from a large selection of options and services.

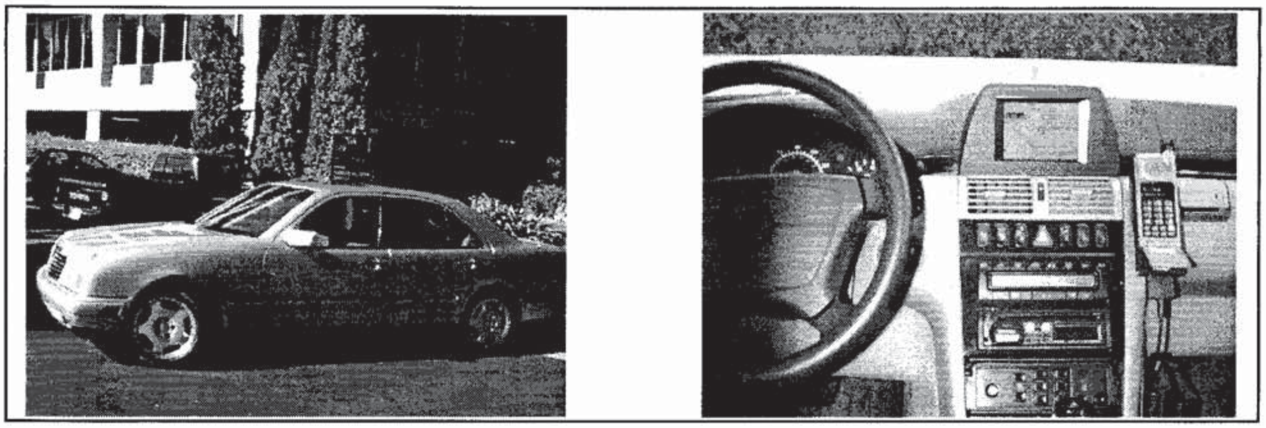

Figure 2: The E 420 Internet Multimedia on Wheels Concept Car and the front multimedia zone.

Figure 3: The rear passengers multimedia units with screens, channel selectors for games, computer, navigation, IrDA and Audio outlets

Furthermore, safety and security will be enhanced because Customer Assistance Centers will be always connected to the car. Services such as remote door unlocking, warning for bad road conditions, weather, accidents, and remote diagnostics, will add to the safety and security of cars.

THE FUTURE

Having an Internet address, the car becomes an integral part of cyberspace. Not only can passengers request information but also fleet owners and customer assistance centers can request information from the car or even modify the car's behavior. This ultimately leads to a network-centric solution where the car can be continuously monitored, and where in essence every Electronic Control Unit (ECU) will be addressable through the Internet protocols. In fact, the very concept turns every car into a probe with vast implications for traffic guidance and control.

It will be possible to analyze driving habits and optimize engine performance. Customer assistance technicians can download code to the vehicle to perform diagnostic tasks or upgrade the software version.

ECU's can use external data from the infrastructure to adapt in an optimal way to weather conditions, road conditions, and traffic to provide new safety services.

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EXHIBIT F

Web on Wheels: Toward Internet-Enabled Cars

An open system that conforms to standard Internet protocols for communication to and from automobiles could greatly enhance driving. Existing Internet resources can be leveraged to integrate a car into the Internet. Service providers will subsequently produce innovative services for drivers and passengers that will improve safety and security as well as provide infotainment.

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Matthias Stuempfle

Daniel Jiang

Axel Fuchs

Daimler-Benz Research and Technology, North America

The services provided to customers through the Internet can be extended to the automobile. Early versions of Internet-enabled cars might hit the road in five years or less. Portions of the technology could be available to customers in as little as two years as an after-sales solution. Indeed, such integration could become essential, given the constant access to information our just-in-time world seems to require. Integration could also be two-way: Your car might also provide information to the Internet for the purposes of remote diagnostics, among other things. Unlike the portable method of accessing the Internet with a laptop computer, an Internet-integrated vehicle is truly mobile. Mobility serves as both a challenge and a distinguishing factor in the design of our communication and service architecture.

With the advancement of the Global Positioning System (GPS) and other position-tracking technologies, *location awareness* emerges as a distinctive characteristic of combining mobile computing and automobiles. This knowledge will be used to build communication and service architectures. For example, a service could provide information about the nearest gas station or restaurant.

A safe and easy-to-use human interface for drivers and passengers must be designed to bring Internet-based services to moving vehicles. For example, an e-mail service must not require that drivers take their eyes off the road. We employ various alternatives, such as speech-based technologies, to address safety concerns.

SCENARIOS

Our overall goal is to provide "telematik" (telecommunications and computer science) services to drivers and passengers. What types of services are interesting to our customers and how we serve them are open questions. The Internet appears to be the most appropriate infrastructure through which to conduct car-based services.

Services range from the obvious to the innovative, and include the following:

- Integration of personal data to the car using personal devices such as smart cards and handheld personal computers.
- Interactive audio and video games for passengers.
- Personalized services on demand, for example, personalized commuting information.
- Location-based information on demand, for example, the nearest Chinese restaurant.
- Seamless access to office or home computers.
- Roadside assistance and remote diagnostics.

These services can be grouped as generic and location based. Generic services, for example, real-time stock quotes, are not directly car-related but are of interest to drivers and passengers. In general, the infrastructure for such services can be supported in the same way as a desktop environment.

Location-based services directly relate to the car-driving experience. Because the car moves, its location changes and thus brings new demands for services: Where is the nearest gas station? Location-based services are possible because a car's position can be known at all times with current GPS technology.

An Internet car is similar to any other node on the Internet. Although highly mobile, an Internet car can use the standard transmission-control protocol/Internet protocol (TCP/IP) to communicate with other nodes on the Internet. The Internet car can be a client and a server, and in essence becomes an open platform for services to be delivered over the Internet.

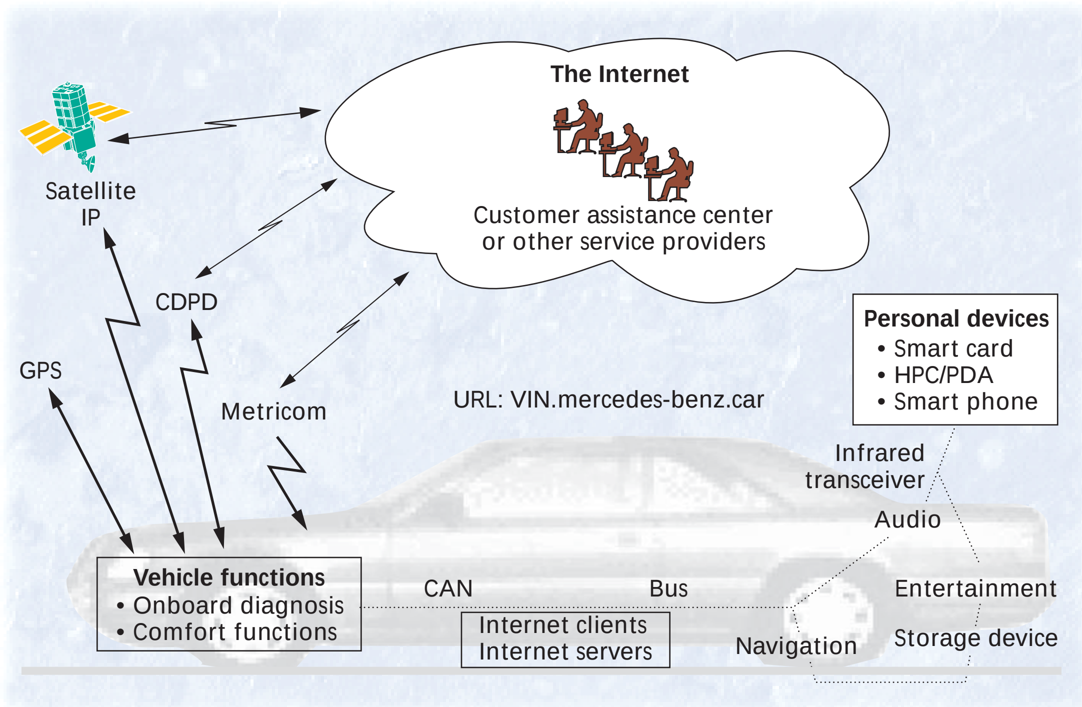

Figure 1. The Internet-on-wheels concept car integrates a mobile vehicle with services available on the Internet.

CHALLENGES

The design of Internet access for automobiles involves three major issues: mobile wireless communications, system architecture, and user interface design.

Mobile wireless communications

Networking requires a variety of wireless technologies.

In a local area, infrared (IR) and radio frequency (RF) technologies generally provide high-speed wireless access of several megabits per second at relatively small or no cost.

At the metropolitan level, technologies such as Metricom's Ricochet network are capable of access speeds of tens of kilobits per second with a flat monthly fee.

For a wide area, cellular digital packet data (CDPD) and emerging standards, such as the General Packet Radio System (GPRS), achieve speeds of about 10 kilobits per second at a higher cost. Furthermore, a plethora of new satellite-based systems are proposed. When realized, these satellite systems will deliver globally from a few kilobits per second up to one megabit per second at a premium. Of course, when all else fails, the wireless modem over the Advanced Mobile Phone System (AMPS) cellular system is still available.

These technologies provide the basic infrastructure for maintaining access to and from a vehicle. The main challenge lies in selecting the appropriate technology according to such factors as cost, performance, and availability.

System architecture

In connecting cars to the Internet, a system architecture must provide a flexible distribution of computing power and communication between the automobile and the infrastructure. Basically, a car could be treated as either a thin or thick client. Cars with only input/output devices and a modem to request and receive information are thin clients; cars with state-of-the-art computing power and onboard storage media to receive raw data and to process it are thick clients. The key factor influencing this overall architectural choice is the cost of wireless communication.

The form of the final architecture will be determined by technologies and business models. In any case, the integrity, security, reliability, and speed of communication must be maintained. The software architecture should also allow for the development of new services and benefits that adapt easily to new and evolving Internet technologies.

User interface

Introducing multimedia information in a moving vehicle creates a potential hazard. A human interface both safe and convenient while mobile at vehicular speeds significantly challenges the utility of services to be delivered over the Internet to drivers. The requirements for a safe human interface also have a drastic impact on the design of services for vehicles.

SYSTEM DESIGN

The initial intent of the project was to design a system to meet the challenges of wireless communication and the issues relating to a user interface in a car. At the same time, the growth of the Internet and the Web brought to the fore a new way of network computing. The design that emerged from these factors led to the concept of total integration of vehicle functions, personal data, position awareness, seamless access, and Internet-based services. Figure 1 shows this concept, which we call Internet-on-wheels.

Our system design has three major components: the communication layer, the service infrastructure, and the user interface. The reliability, security, performance, and scalability of the system are also essential aspects of our design but are beyond the scope of our discussion here.

Communication layer

The communication layer must be both open and convenient:

- *Openness.* In today's networking world, TCP/IP is the de facto standard for communication. Most applications use TCP/IP for communication, and many resources and services available on networks are accessible through TCP/IP, including the Web. It therefore must be used in any open networking solution. TCP/IP enables the use of many of today's existing applications, provides access to numerous resources, and encourages new service development. Furthermore, it does not make sense to require the current servers on the Internet to change their software or hardware.
- *Convenience.* Many wireless data communication technologies exist and more are coming. We need to support these technologies without additional burden. First, we need to work with the availability of a technology in a particular geographical region. Second, customers should not have to change the technology they currently use. For example, a user might be a Global Standard for Mobile Communications (GSM) subscriber, in which case the GSM handset should plug into the user's car to enable communication through the GSM network. To provide connectivity anywhere and to account for the coverage of different technologies, one wireless network should be able to hand off to another. We cannot expect a customer to have the technical understanding to manage the handoff, nor can we expect a driver to have the time or attention to deal with such details. Furthermore, a constant identity needs to be maintained. Therefore, the necessary handoff among various wireless networks must be seamless and transparent.

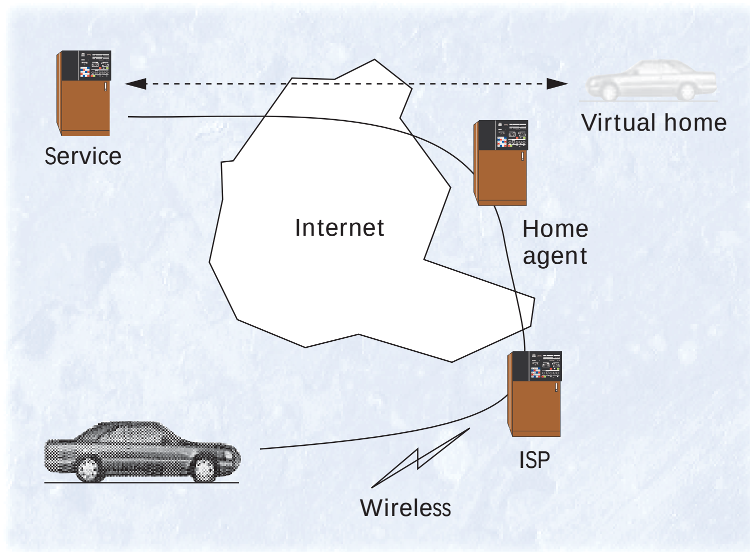

Figure 2. A typical Mobile IP communication network has a virtual home address.

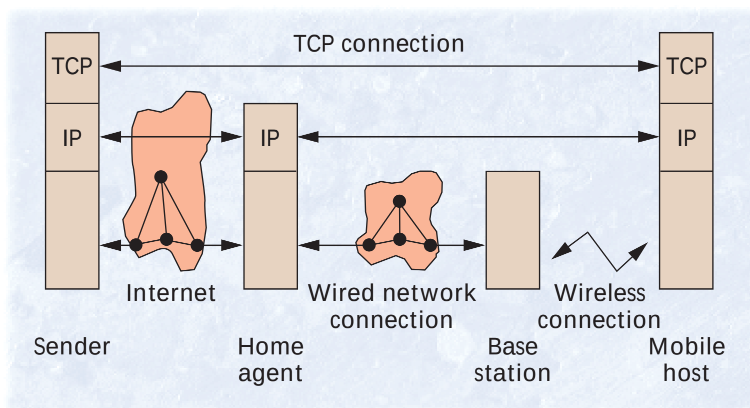

Figure 3. The basic Mobile IP architecture seamlessly hands off among interfaces.

We omit performance as a basic requirement of the communication layer. Although we want as much networking performance as possible, our ability to provide this in the communication layer is limited by available technologies and wireless service providers. So we try to provide an architecture that supports as many existing or emerging wireless technologies as possible, but we cannot dictate the performance of those wireless channels directly. Therefore, the application design should adapt to the communication layer's capabilities rather than the other way around. Of course, we will try to improve the networking performance as much as possible in our capacity.

Basic communication architecture. With augmented handoff support, the Mobile IP's capability of maintaining the same identity over various network access points provides a natural solution.[1,2] Mobile IP supports

Services for an Internet car are bidirectional. In the more common services, the car acts as a client and the service infrastructure supports such services.

a seamless handoff among multiple wireless interfaces in a manner that is transparent to the higher layers.

Figures 2 and 3 show the workings of the proposed Mobile IP. As Figure 2 shows, the vehicle has a virtual home IP address. Any service provider or corresponding host would always see the vehicle at that IP address, which is connected to the Internet at large via a home agent.

The vehicle connects through a particular wireless network and an Internet service provider (ISP) and uses an IP address issued by the ISP. The vehicle registers its current address with a stationary host known as its *home agent*. In communicating with a service provider, the incoming IP traffic from the service provider would be intercepted by the home agent and forwarded to the current address of the vehicle. Likewise, all traffic to the service provider would be sent to the home agent before being forwarded to the service provider.

In the event of a handoff from one wireless network or ISP to another, the actual IP address of the vehicle changes. Such a change would be reported to the home agent, and all subsequent IP traffic would be routed to the vehicle at the new address. None of these activities is visible from the applications that use the communication layer.

Communication performance. Two issues affect performance in this environment: TCP performance over wireless links and the handoff from one wireless network provider to another.

TCP[3] was designed to work for the wire-line-based Internet, which rarely creates errors in the transmission of IP packets. In such an environment, TCP assumes that failure to receive a packet results from congestion. In the event of a packet loss, TCP slows and sends fewer packets to lessen the congestion. Such an algorithm works well in the wire-line network, but not so well over the wireless link. However, when a TCP connection includes a wireless link, packet loss is far more likely to be caused by errors in a wireless channel. Consequently, TCP data should be sent faster, not slower.

The networking research community has done much to improve performance over lossy wireless links. In general, the proposed solutions fall into three groups:

- An end-to-end connection is intended to improve TCP performance relative to that of wireless communication.
- A split TCP connection divides a TCP connection into two end-to-end parts.
- The reliable link layer has some knowledge of the TCP.[4]

The end-to-end and link-layer solutions work comparatively well. However, any end-to-end solution requires changes at the TCP layers of both the sender and the receiver. All servers on the Internet that our customers might contact cannot be expected to upgrade their TCP software, leaving the link-layer solution as the most feasible measure for improving TCP performance.

One link-layer solution employs a *snooping agent*.[5] A snooping-agent observes and caches the TCP packets going out to the mobile host on the wireless link. When the agent senses that some packets are lost (by monitoring the acknowledgment packets coming back from the mobile host), it retransmits the cached TCP packets. In this way, the snooping agent effectively prevents the effect of packet loss on the wireless link from being propagated to the TCP sender and triggering a TCP slowdown.

The snooping-agent method works well in a wireless local area network (LAN), in which the snooping agent sits in the wireless base station. For wireless wide area networks (WANs), the snooping agent must be placed a little further away from the wireless link. The logical location would be that of the home agent through which all traffic goes. Our research will focus on the snooping agent's impact on performance relative to its distance from the vehicle.

The issues concerning handoffs and their effect on communication performance are twofold. First, handoffs exist among cells in a wireless network infrastructure. Although transparent to the mobile host, the handoff's impact on the communication layer performance is unclear. Second, the handoff from one wireless network provider to another has a much larger effect. During the change of an actual IP address, the registering of the change to the home agent, and finally the rerouting of traffic to reflect the change, some IP packets might be lost.

The impact of such a handoff could be lessened by holding onto the existing wireless connection and simultaneously routing the same packets to the new address as well as the existing one. With the new connection fully operational, the previous connection closes. The vehicle has the advantage of knowing where it is and where it is going to be and at what time.

Combining such information with the knowledge of where the coverage of a wireless network begins and ends, a new connection can be preestablished before the current connection runs out of coverage. Such information might be cached by the vehicle through the experience of driving in a familiar region, for example, a daily commute from home to work, or it could be provided by service providers that measure and collect the coverage of various wireless data networks.

In-car network. Most of the automotive industry supports some types of bus architectures for control

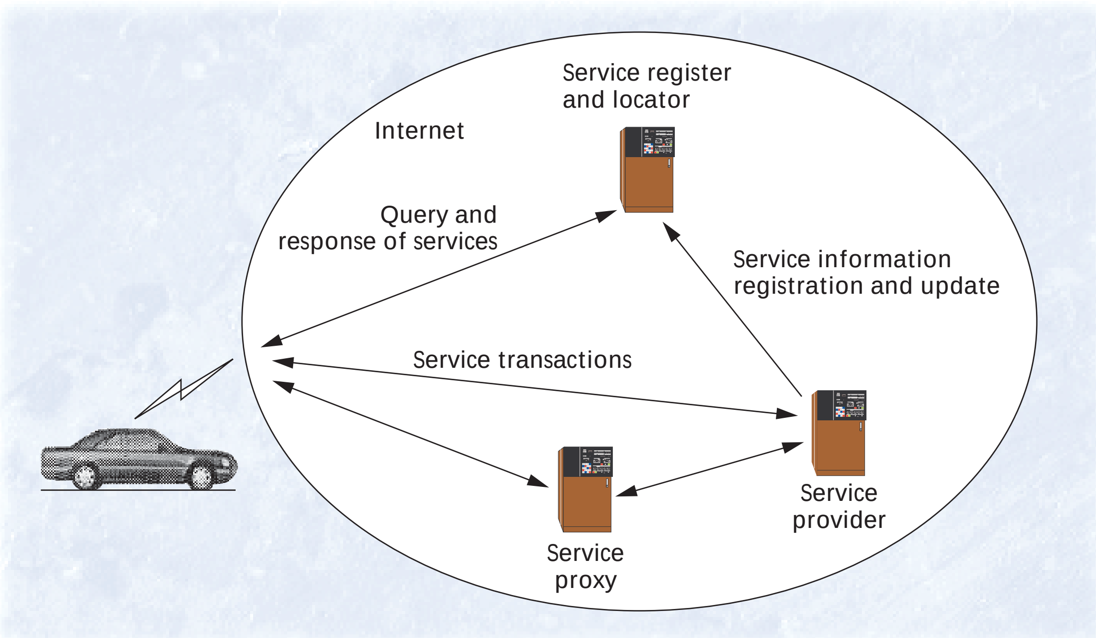

Figure 4. The service architecture design contains these high-level components.

and data transmission. A bus system with bandwidth large enough to support multiple video and audio channels is needed to support the Internet-based multimedia information in the car. The Universal Serial Bus (USB), the IEEE 1394 standard Firewire, or the Intelligent Transportation System Data Bus (IDB-I and IDB-II) could be considered for such a task.

Multiple inputs and outputs—such as screens, control units, and audio channels—must be available for use by all occupants in a car without any interference with each other. This flexibility is relatively easily achieved for screens and control units, but it is harder to separate audio sources without using headphones.

Merging the in-car network with Internet communication services will provide an integrated internal and external environment for the occupants. A multimedia infrastructure in a vehicular environment challenges the design. The storage media is an essential component of an Internet information-based multimedia environment in a car. At a basic level, the media might be just a cache or simply a readable media such as the minidisc or digital video disc, but the ultimate solution will be a hard-disk-like unit for storing large amounts of data that can be dynamically changed.

Docking of personal devices has wide acceptance in the personal computing arena. People will likely use devices such as smart phones, smart cards, and personal digital assistants (PDAs) to integrate with the car's multimedia system. These devices might also be a means through which to exchange personal information between the occupants and the car for seat adjustment, climate, and computer interface.

Service infrastructure

Services for an Internet car are bidirectional. In the more common services, the car acts as a client and the service infrastructure supports such services.

Service infrastructure functions. The service infrastructure has four main functions: It must search for service providers, manage the user profile, deliver the service, and use the service. Here we will not discuss issues like billing and so on.

A location-indexed database is necessary if the car occupants are to easily search geographical location-based services. The database must contain things like service providers, Web pages, and other information, indexed by the relevant geographical area. The vehicle's location determines the scope of the search.

A service profile specifies what and how services will be delivered to the customers in an Internet car. The service infrastructure provides storage and management of a customer's service profile.

After selecting a service provider, the communication layer offers data transport functions. However, the ability of the devices in the car to use the service content must be determined. For example, large images of a Web page cannot be displayed on a tiny PDA screen. Service delivery also needs to adapt to wireless link capabilities. A service proxy works well in such a situation.[6] By doing data transformation at the well-connected side of the Internet, the data load can be reduced and something easy to present can be created. By symmetry, a car-side proxy for the vehicle must act as a server in certain applications like remote diagnostics.[7]

The need to support ad hoc service types and service providers means that we need to support automated downloading, installation, and update of client software for future, unknown services.

Service architecture design. Figure 4 diagrams the high-level components in the service architecture.[8] The service register and locator is essentially the location-indexed database. This database accepts and responds to queries from the vehicle for services and service providers. Once a customer finds a service provider, services can be requested and transactions begun. Such service transactions might go through a proxy.

Figure 5. The front multimedia zone of the Internet car is accessible to both the driver and the navigator.

Figure 6. The rear passengers have access to multimedia units that contain screens, channel selectors for games, a computer, navigation tools, infrared transceivers, and audio outlets.

Placement of the user profile and determination of the component responsible for the profile management must be determined. This is essentially the issue of how to distribute the intelligence in the system.

User interface design

There is no precedent for the user interface of a Web car. Obviously, there are safety issues involved in the placement of screens, hand control units, hands-free phones, and buttons.

User interfaces can range from a simple one-touch operation to a fully interactive audio and video experience. Clearly, the driver, navigator, and passengers have differing circumstances when the vehicle is parked or in motion. A taxonomy of the driver, navigator, and passengers with different human interface needs is a good starting point to understand the basic differences in the design of interfaces for these positions.[9]

Drivers might find a primarily speech-driven interface most suitable, whereas passengers and navigators can use a richer and more interactive interface. We expect that a conversational, dialogue-based speech system will be used in the future.

Large speech-recognition systems, especially those that support natural-language processing, are expensive and difficult to support in cars. Therefore, a network-based solution makes sense. Such a solution is well suited to a dynamic, on-the-fly vocabulary, and conversational natural-language processing approach, and it is cheaper to maintain and upgrade. A hybrid between in-car recognition for the car controls and a network-based approach for external information-based services would be ideal.

The type of user interface chosen will be closely tied with the nature and type of services that can be delivered to drivers and passengers. Mobility is no longer only driving the car but incorporates also the states of being at home, in the garage, on the road, and at the destination. A driver's *safety* depends on the state of *mobility*, the *time* available, and the driver's *goals*. We intend to define a metric on the basis of the relationship between these four human factors and the services that can be delivered to car drivers and passengers.[9] This metric will be used to define user interfaces that are safe and match the measures used by Mercedes-Benz, the Society of Automotive Engineers, or similar established safety standards. See Figures 5 and 6.

The presentation and user interface architecture shown in Figure 7 assumes that content providers supply the data and the semantics to describe the architecture's structure. The presenter uses this information along with the user input and status information (vehicle speed, user being the driver or passenger) to render and deliver content to appropriate output devices.

CONCEPT DEMONSTRATION

In the first implementation of the Internet-on-wheels concept car,[10] we designed multimedia units for two different zones (*drivers* and *passengers*) with the user interfaces as shown in Figures 5 and 6. Each of these has a color screen, channel select buttons, an infrared transceiver to support handheld devices, and an audio outlet.

Access to applications differs in these two zones. The driver and the navigator have access to a single multimedia unit in the front (Figure 5), and the passengers in the back seat have access to individual multimedia units (Figure 6). The demonstrative applications in the front zone access information related to traffic and navigation. In the rear zone, access expands to include navigation tools, office applications, interactive games, and infotainment.

Drivers can access voice-mail, e-mail, and travel-related information such as restaurant guides and movie theater locations. By integrating the GPS and mapping technologies, the Internet car becomes location-aware, which allows for a new class of services that go well beyond classical navigation. The driver will have access to these services in a hands-free, eyes-free manner through voice commands and speech technology. In addition, the armrest in the driver's zone has a slot for a personal device to enable the driver to bring in personal preferences.

Passengers can access richer interactive applications such as onboard or Internet games, audio-on-demand, and the Web. They can access information about cities

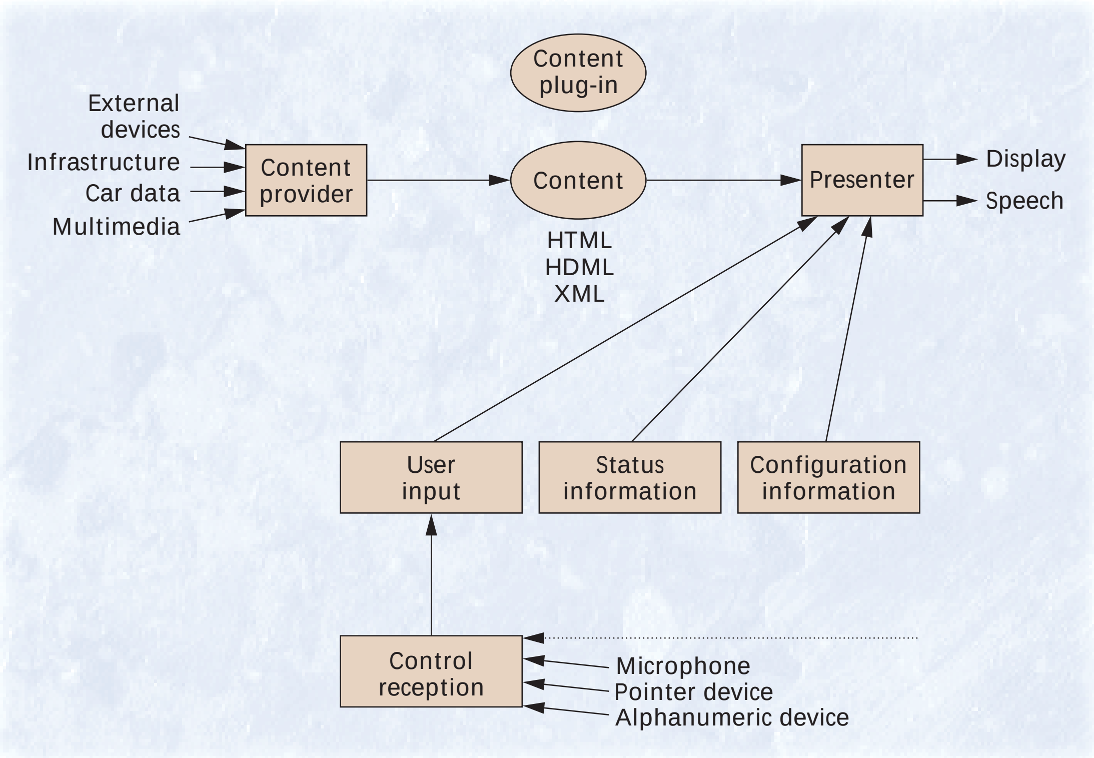

Figure 7. Content providers define the data and semantics for the presentation and user interface architecture.

and historical places during a drive as they pass them. Passengers can also enjoy an enhanced multimedia environment for navigation, stereo, or streaming audio and video. The built-in infrared transceivers will allow PDAs, handheld PCs (HPCs), and smart phones to interact with the systems in the car and the Internet. For these new services, user interfaces will allow easy and safe handling of the interactive media.

For the customer assistance centers that currently rely on telephony-based service, the Internet car provides an expanded datacentric multimedia environment to deliver new services, including operator's help manuals, intelligent roadside travel assistance, and remote diagnostics.

The intelligent transportation systems community intends to stimulate research and industry to build an infrastructure that will lead to better traffic and transit resource management and enhanced safety. From the perspectives of cost and reusability, a single infrastructure must provide most of the functionality as opposed to a separate infrastructure for each service. The Internet has the potential to be such an infrastructure. The car acts essentially as a probe in this model, collecting and sending data to service centers, which in future navigation systems will be used to build dynamic real-time traffic models for on-demand route guidance for individual vehicles.

The spectrum of service possibilities ranges from a highly integrated, PC-like environment to a fully autonomous network computer-like system. A safe and convenient human interface design will leverage the vast pool of potential services from the Internet for drivers and passengers.

Our research aims to investigate and prototype future Internet-based services for cars. By grounding the concept and architecture of information technology for a car around the Internet and open standards, the Internet car can take full advantage of the tidal wave of Internet-based services, technologies, and devices for many years to come. ❖

Acknowledgments

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EXHIBIT G

The car as a mobile-media platform

by Kevin Jost, Associate Editor

Vehicle and computer technologies are merging as the automotive industry scrambles to provide consumers with PC functionality in their vehicles.

The average automobile user spends about seven hours per week of largely unproductive time behind the wheel. Automakers are looking at this as an opportunity, anticipating driver needs by providing information technology to extend the electronic environment of the home and office to the automobile. Industry engineers are designing systems that provide safe, affordable, and valuable information, communication, entertainment, and security features. However, their ability to do this is dependent on building the right hardware and software infrastructure.

One of the chief proponents of such offerings is Microsoft. In January, the company announced the Auto PC, the latest member of its PC Companion line of products powered by the Windows CE operating system. It brings the benefits of interactive speech technology, connectivity, information on demand, and enhanced entertainment to the automobile.

Microsoft's interactive-speech technology user interface enables the Auto PC to respond to oral commands and communicate information to drivers, allowing them to keep their hands on the wheel and eyes on the road. Microsoft expects the technology to become widely accepted as the primary way of interacting with automotive computing devices.

The Auto PC displayed by Microsoft is the size of a car stereo system, so it can be easily installed in the instrument panel. It provides drivers access to personal information and driving directions as well as wireless services such as e-mail, paging, and traffic alerts; a digital audio system; an AM/FM radio; and a CD player. PC Companion devices are designed to work together, so users can share information between their Auto PC and Handheld and Palm PCs.

The Auto PC platform is expandable and upgradeable. The latest example, version 2.0, allows a variety of third-party applications such as enhanced navigation, wireless data capabilities, cellular telephone integration, and vehicle diagnostics.

The list of automotive manufacturers, suppliers, and aftermarket electronics vendors supporting the Auto PC platform includes Alpine, Clarion Corp., Daewoo Telecom, Hyundai Electronics Industries Company, IAV GmbH, Infinity Systems, JBL, Magneti Marelli, MD-Co., Nissan Motor Corp. U.S.A., PSA Peugeot Citroen, Samsung Electronics Company, United Technologies Automotive, Visteon, and Volkswagen AG. The first units on the market are expected to be from electronic aftermarket companies in the second quarter of 1998.

Clarion to market first unit

Clarion Corp. of America is expected to be the first car audio manufacturer to bring the Auto PC platform to market this spring or summer (see sidebar). In early February, the Clarion AutoPC was showcased in an Infiniti concept car called the I30 Executive Luxury Special Edition (ELSE). The concept-car unit takes the core Windows CE 2.0 operating system and adds speech recognition, a car-stereo-sized visual interface, and other car-oriented features to create an information and entertainment device for the car.

The Clarion AutoPC fits within a car's instrument panel. It allows drivers to keep their eyes on the road and their hands on the wheel while receiving e-mail alerts, dialing a cell phone, navigating to a specific destination, locating a restaurant or hotel, accessing traffic and weather conditions, or changing the musical selection on the stereo.

"Microsoft's open, expandable Auto PC platform will bring a new level of excitement and opportunity to the in-vehicle systems market," said James Minarik, president, Clarion Sales Corp. "Clarion is bringing to market the first product in this category, the Clarion AutoPC, demonstrating our commitment to developing mobile multimedia products that converge car audio and personal computing — allowing consumers to drive smarter and safer."

OEM suppliers develop production Auto PCs

A number of automotive original equipment suppliers have announced plans for development of Auto PCs, including UT Automotive, Visteon, and Delphi.

UT Automotive announced in November that it would use the Windows CE operating system to develop an architecture for in-vehicle use, starting with multimedia, information, communication, and entertainment (MICE) applications. The development agreement with Microsoft will help UT Automotive influence and pioneer product development, expand its product lines, and position the company to be the preferred supplier in the future for in-vehicle operating platforms, according to Roch Basson, UT Automotive's vice president of electrical and electronic products. Development of a computer operating system is being driven by the number of comfort and convenience functions being offered in automobiles, Basson said.

In January, Visteon Automotive Systems announced it was joining forces with Microsoft and Intel to develop a computing platform for vehicles designed to "keep drivers safely connected to the information they need and want on the road." The platform is based on the Microsoft Windows CE operating system and Intel Architecture microprocessors. Visteon expects to be first-to-market with its version of Auto PC technology in a production vehicle and will pilot a dealer-installed version of the system this summer.

At the 1998 SAE International Congress and Exposition, Visteon unveiled its Auto PC-based multimedia system. Called ICES, the electronics infrastructure hardware and software architecture supports information, communication, entertainment, safety, and security features. Visteon says that ICES extends the electronic environment of the home and office to the vehicle, delivering Internet access, an emergency service, and other features such as a cell phone, climate control, high-quality audio, and even movies for rear-seat passengers.

By using state-of-the-art voice and navigation technology, ICES can tell a driver about traffic snarls as they occur and suggest time-saving alternate routes. More importantly, the system can also listen to and understand the driver's requests to map new routes.

"Our research shows that customers want the time in their vehicles to be productive, entertaining, and, most of all, safe," says Charles W. Szuluk, President, Visteon. "With ICES we've answered the customer's call. Drive time will never be downtime again."

Safety was an important consideration for the ICES development team. For instance, drivers will be able to retrieve and respond to e-mail, voice mail, and pages using simple voice commands.

Visteon's Windows CE-based ICES multimedia system has information, communication, entertainment, safety, and security features.

ICES is powered by Intel Architecture microprocessors and the Microsoft Windows CE operating system. By maximizing integration, Visteon engineers developed a system that is said to offer automotive manufacturers significant cost savings and a compact, lightweight package that is easy to install.

Drivers will be able to tailor ICES to the features they want and add more features by installing new software — as they do with their home and office PCs. Key technologies of Visteon's system include a voice-activated control system and a Remote Emergency Satellite Cellular Unit (RESCU).

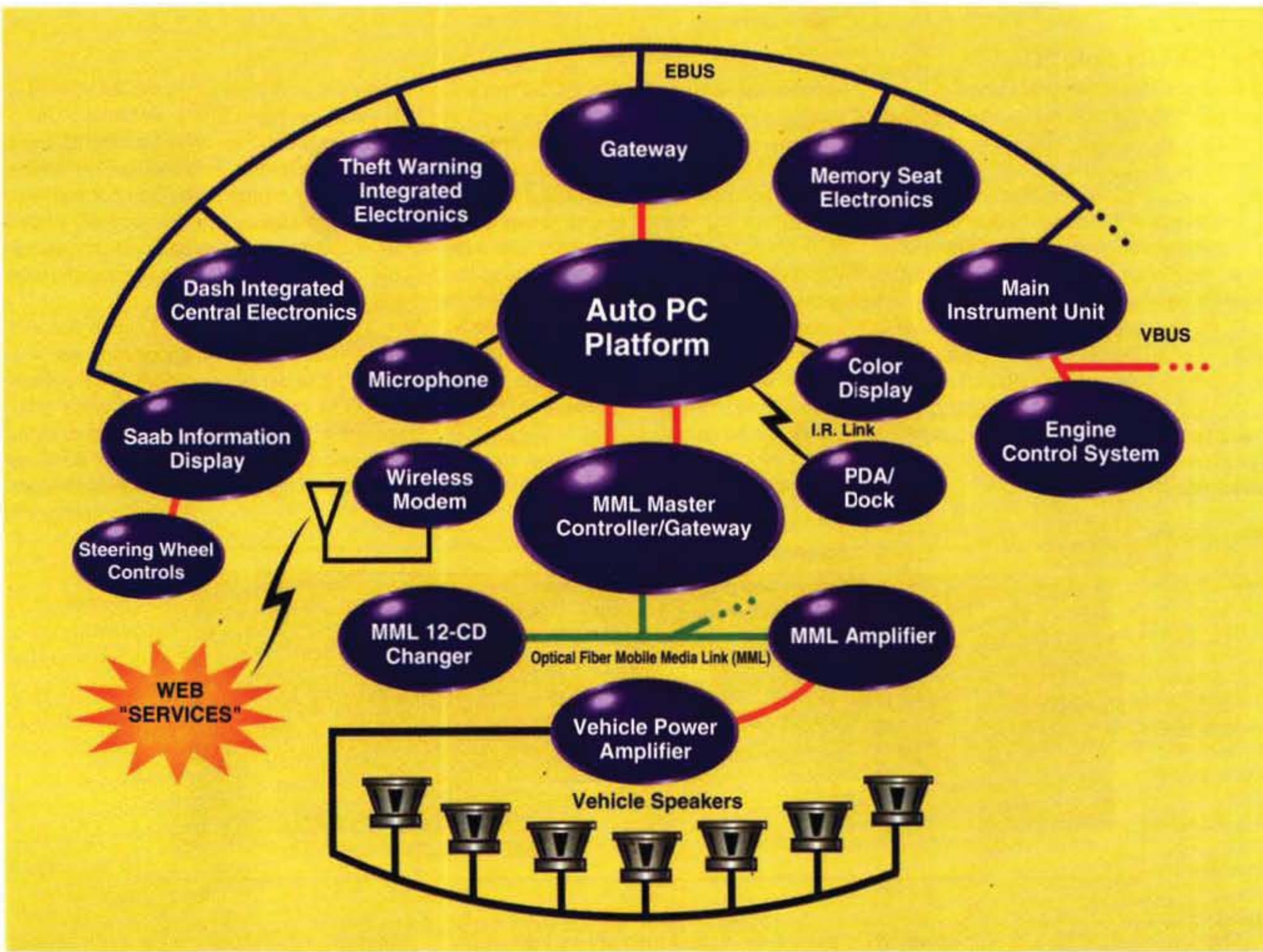
The voice-activated system allows drivers to control vehicle functions that are usually operated manually — such as climate control and audio — with simple voice commands to help alleviate distractions while driving. The voice system recognizes natural language commands, including a wide range of voices, languages, and dialects.

Visteon's RESCU is a factory-installed system that combines Global Positioning System (GPS) technology and the cellular telephone network to aid drivers in distress. It activates automatically upon air bag deployment and includes new convenience features such as route assistance and concierge services.

Also at SAE '98, Delphi and Saab introduced a Saab 9-5 concept called the Personal Productivity Vehicle said to feature the most advanced mobile office technology — including communication, entertainment, and computer desktop functions. Developed at Delphi Delco Electronics System's Mecel AB subsidiary in Goteburg, Sweden, the Personal Productivity Vehicle uses the Microsoft Windows CE-based Auto PC platform. It integrates an AM/FM receiver, CD-ROM, IrDA, serial port interface, universal serial bus, COMPACTFLASH expansion slot, and a high-resolution display.

The vehicle features steering wheel controls, interactive speech technology to respond to driver commands, and speech synthesis to communicate text information — again "allowing drivers to keep their hands on the wheel and eyes on the road." Through speech recognition, the driver can send e-mail, obtain turn-by-turn Global Positioning Satellite (GPS)-based navigation to a specific destination, ask for traffic and weather conditions, locate a restaurant or hotel, or change the musical selection on the stereo. The concept vehicle also offers wireless features in which a cellular modem connection can be used for vehicle-to-roadside assistance or to receive e-mail and Internet information. An infrared data link connects to Windows CE-based devices, such as Handheld and Palm PCs or another personal handheld Data Assistant, for transferring data to and from the vehicle.

High-bandwidth connectivity is achieved in the vehicle with a unique, ultra-high-speed, fiber-optic serial data link called Mobile Media Link (MML), which



The Delphi/Saab Personal Productivity Vehicle uses the Microsoft Windows CE-based Auto PC platform.

is capable of providing multiple-channel digital audio and video. MML also can connect and control inputs and outputs to facilitate a variety of consumer electronic products such as head-up display, television antenna and tuner, DVD player, compact disc player, digital stereo audio, and digital speaker amplifiers.

Data are transmitted and distributed from network nodes via a plastic-optical-fiber physical layer, passive star, and optoelectronic devices developed by Delphi Packard Electric Systems. Delphi Delco Electronics Systems provided the hardware, standard link protocol, and integrated circuit design. The MML fiber-optic bus is capable of signal transmissions rates of up to 110 Mb/s and can support up to 50 channels of audio and 20 channels of TV-quality compressed video.

"Because the fiber-optic cable is immune to electromagnetic interference (EMI) and generates no emissions, MML provides vehicle occupants with crystal-clear audio and video without negatively affecting other vehicle systems increasing functional reliability," said Jim Crouse, director of engineering at Delphi Packard Electric Systems. Compared with other systems, MML also can provide higher performance. While other fiber-optic systems currently feature only audio capability, MML offers both audio and video.

Delphi and others offer alternative

In addition to the Windows CE-based Personal Productivity Vehicle, at SAE '98 Delphi introduced another technology initiative concept called a Network Vehicle that it is working on with IBM, Sun Microsystems, and Netscape. With the concept, the four companies demonstrated how existing hardware and software technology — including wireless communications, global positioning via satellite, head-up displays, voice recognition, Java technology, microprocessors, Web access and collaboration, and other Internet/intranet features — can be integrated.

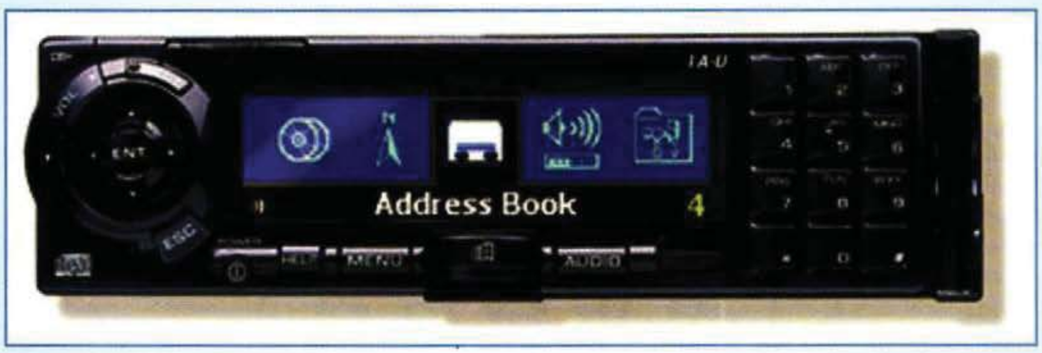
"Much of the technology to do this, including our head-up displays, steering wheel-mounted controls, and man-machine interface in the passenger compartment, exists today," said Dave Wohleen, general director of engineering for Delphi Delco Electronics Systems. "Working with vehicle manufacturers, these technologies could be integrated into all types of vehicles."

The Network Vehicle receives direct broadcast reception from Hughes DirecTV and DirecPC satellites by use of an innovative flat antenna embedded in its roof, which provides the driver and passengers with route and travel information, to movies and real-time stock quotes. Existing services that could be integrated in the future include theft-deterrent technologies and the ability to contact emergency services. Future features include dictating and electronic distribution of memos; setting work schedules; listening to, and dictating a response to, faxes; and viewing videos.

The Clarion AutoPC

At the Consumer Electronics Show in January, Clarion Corp. of America introduced the first Auto PC. The 1-DIN unit fits in an automobile's instrument panel and is built on an open architecture platform powered by the Microsoft Windows CE operating system. It integrates car audio, computing functions, navigation, and wireless communications via hands-free voice activation.

A key innovation of the Clarion AutoPC is its use of Universal Serial Bus (USB) architecture, allowing for compatibility with other USB products. This provides numerous opportunities for hardware and software developers to create and market customized products for consumers.



The Clarion AutoPC is a high-powered AM/FM stereo with integrated digital signal processing (DSP) equalization and a built-in 35 W x 4-channel amplifier. It comes with a Hitachi SH3 processor, 8 MB DRAM/8 MB ROM, and the first in-dash Clarion quality USB CD audio and CD-ROM drive, which supports an optional six-disc CD/CD-ROM changer. The backlit, 8-color LCD screen provides consumers with an easy-to-read, icon-driven user interface.

The AutoPC unit recognizes over 200 simple voice commands, allowing consumers to interact with the unit without taking their eyes from the road. With its text-to-speech application, the AutoPC can provide status information and assistance, such as turn-by-turn directions or e-mail alerts, through speech synthesis and text information presented on the unit's display. To make finding destinations easier, the Clarion AutoPC comes standard with a basic point-to-point navigation system that provides route calculation from a user-specified starting location and destination, as well as accurate turn-by-turn directions. Other built-in applications include an address book, mileage log, and a hands-free voice memo feature.

The unit supports an optional compact flash memory card that can be used to expand the onboard memory as well as provide an interface for other products such as paging and hardware accessories. Also included is an infrared data port, enabling easy exchange of data to and from a handheld PC.

A number of hardware accessories will also be available. The optional Global Positioning System (GPS) receiver works in conjunction with the built-in navigation system to provide automatic starting point identification and location updates. The GPS accessory, coupled with the cellular phone interface, enables access to roadside emergency services, such as providing directions when lost and pinpointing the location of a 911 call for immediate assistance. Using wireless "push" technology, the Clarion AutoPC's wireless receiver option allows consumers to receive an array of customized information, such as real-time traffic, news updates, numeric paging, voice and e-mail alerts — all using text-to-speech technology.

To protect the car and Clarion AutoPC inside it, an optional Clarion/Ungo security system is under development. This system has USB connectivity and provides consumers with all the features found in other high-end Ungo security products such as Electronic Logicsensor and Motion/Impact detector. When combined with the cellular telephone interface and GPS, this system also provides easy tracking of stolen vehicles.

The Clarion AutoPC will be shipping in limited quantities in spring 1998, with mass production beginning in June 1998. Suggested retail price for the base unit is $1299. Clarion also announced at the Consumer Electronics Show that it would supply the new mobile-media product to Citroen, which will be the first in Europe to offer the Clarion AutoPC.

For more information, circle 103

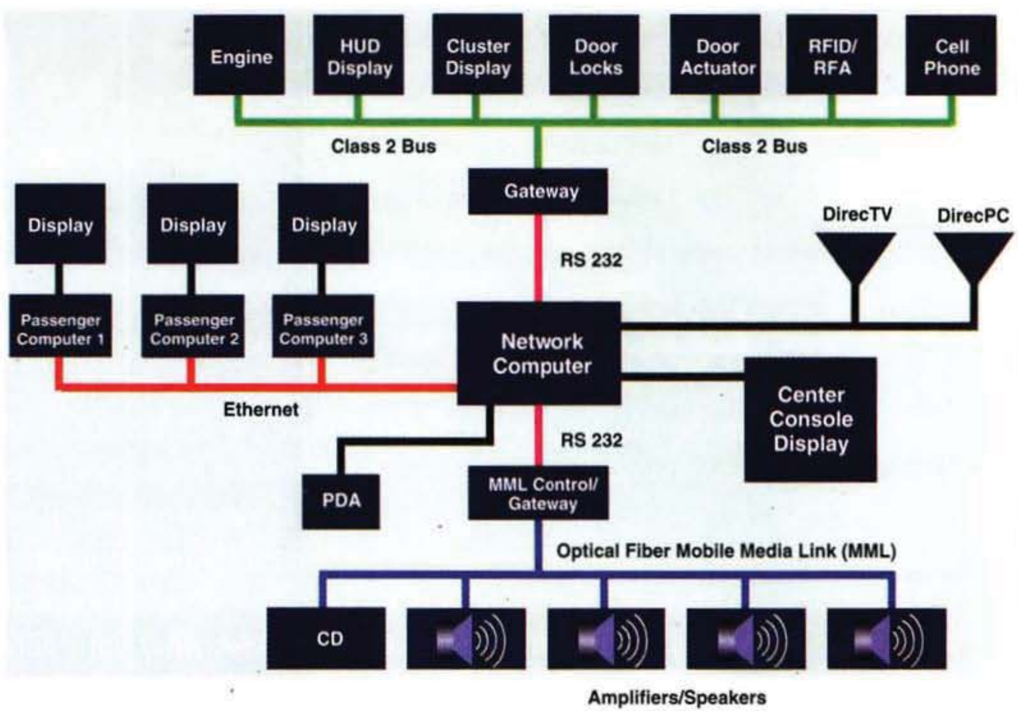
These "smart" features are enabled in large measure by the real-time data-streaming capabilities over a wireless network made possible through IBM's Java-based technology. Java enables the rapid development and prototyping of applications that run within the vehicle. With the technology, automakers also have the flexibility to create a Network Vehicle using a variety of hardware and operating system platforms.

The Network Vehicle has voice-recognition technology for drivers and passengers to request and listen to e-mail messages, locate a restaurant or hotel, receive navigation help or specific music and sports scores, and use voice-activated telephone services — all without interfering with driving. Drivers can use a Delphi head-up display projected onto the windshield to navigate while keeping their eyes on the road. Passengers using individual terminals next to their seats can use the Internet, watch high-resolution television, or play computer games.

The use of Java allows for an open, scalable platform to deploy cutting-edge content and applications in vehicles, according to Jim Mitchell, vice president of technology and architecture at JavaSoft, a business unit of Sun Microsystems, Inc.

"As Internet-based services add new dimensions to the daily lives and work of millions of people, we see great value in extending network access beyond the home, classroom, or office by making it easily accessible from anywhere," said Netscape's vice president of technology, Mike McCue. "Our participation in this technology initiative underscores our vision of a network world where our products run across computing platforms and the new portable devices that serve a mobile lifestyle. Access will be from anywhere — including vehicles."

On-Board Architecture



Delphi collaborated with IBM, Sun Microsystems, and Netscape on the Network Vehicle, which uses Java-based technology.

Interesting? Circle 17
Not interesting? Circle 18