

CONF-980820--

RESERVE A SEAT!
INTELLIGENT TRANSPORTATION RESERVATION SYSTEM
FOR TOURISTS

Lorena F. Truett
 Oak Ridge National Laboratory
 P.O. Box 2008, MS-6207
 Oak Ridge, Tennessee 37831
 voice: 423-574-4225; E-mail: LFT@ornl.gov; fax: 423-574-3895

RECEIVED

JUL 29 1998

OSTI

Tim Conley
 GTE Wireless
 3100 West End Ave., Suite 700
 Nashville, Tennessee 37203
 voice: 615-386-5825; email: Tconley@mobilnet.gte.com; fax: 615-386-5115

Bruce Tonn
 Oak Ridge National Laboratory
 P.O. Box 2008, MS-6207
 Oak Ridge, Tennessee 37831
 voice: 423-574-4041; email: BET@ornl.gov; fax: 423-574-3895

Prepared for the
 Rural Advanced Technology & Transportation Systems
 1998 International Conference
 Penn State University
 University Park, Pennsylvania
 August 31-September 2, 1998

MASTER *JW*

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Oak Ridge National Laboratory
 managed by
 Lockheed Martin Energy Research Corporation
 for the U.S. Department of Energy under contract number
 DE-AC05-96OR22-464

The submitted manuscript has been authored by a contractor
 of the U.S. Government under contract No. DE-AC05-96OR22464.
 Accordingly, the U.S. Government retains a nonexclusive, royalty
 free license to publish or reproduce the published form of this contribution,
 or allow others to do so for U.S. Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

RESERVE A SEAT! INTELLIGENT TRANSPORTATION RESERVATION SYSTEM FOR TOURISTS

ABSTRACT

Providing safe, predictable, and efficient transportation for tourists to and from various venues presents a major challenge. Special-event transportation is notoriously unreliable and usually congested at peak times. The rural nature of certain tourist locations (e.g., the Grand Canyon) further complicates the problem.

The proposed Intelligent Transportation Reservation System will have three components, each of which performs different functions:

- on-vehicle component: This component has three purposes: (1) to keep a running count of the passengers on the bus in order to determine how many additional passengers can be accommodated based on the total capacity of the vehicle; (2) through use of Global Positioning Satellite (GPS) technology, to be able to determine the location of the bus at all times; and (3) to transmit information to a central data facility. Together, these three features provide location, available-space, and condition information to controllers at a central data facility and to prospective riders of the bus.
- kiosk component: Located at every loading/unloading point, the purpose is to allow passengers-to-be to determine when the next bus (or buses) will arrive and the availability of seating. Individuals can make a reservation for the next bus with sufficient seating and will know when that bus will arrive at the kiosk.
- information component: Located within hotels and at venue sites, this component will provide information on the buses in the system (e.g., route and current capacity) and loading/unloading locations throughout the network at any point in time.

The buses within the system and the entry/exit points of passengers with reservations will be monitored from a central control facility. By providing information to dispatchers on occupancy, vehicles can be rerouted according to demand, thus improving efficiency. The system will benefit tourists by increasing the likelihood that they will get seats in vehicles to and from venues and by decreasing waiting time for vehicles. The system will promote increased safety on vehicles by reducing the likelihood of overcrowded vehicles. The system will act to reduce emissions from vehicles as the transportation system is managed more efficiently and as people see the value of using public rather than private transport modes to get to and from the venues. The wireless communications capability between each bus and the central control facility ensures that accidents and other delays will be immediately known to the central facility. Based on this information flow, appropriate help can be dispatched. Because emergency vehicles can rapidly respond to accidents, breakdowns, or other delays, passenger comfort will be enhanced and safety greatly improved.

INTRODUCTION

After spending 50 weeks on a 9-to-5 job, a tourist wants to enjoy every minute of that much-anticipated two-week vacation. Standing in line for a bus (or van or similar vehicle) without accurate knowledge of the length of time before the bus's arrival is irritating. Partial information can also be frustrating; for example, the tourist could have a schedule indicating the bus's expected arrival time but not know that the bus is already filled or that it has had a mechanical breakdown and will not be on time. If, in addition to the seemingly interminable delay, the wait is compounded by bad weather (and in this year of El Niño unexpected weather disturbances seem to be fairly common), the tourist begins to look forward to the end of his/her vacation.

The "Reserve a Seat!" system proposes taking the guesswork out of catching a bus to various venues. The system contains three major components — on the bus, at the waiting area, and at hotels. A central data controller functions to collect, process, and disseminate data to and from the three components. The communications system ensures a seamless information flow.

The proposed system needs to be flexible enough to be implemented in a wide range of tourist locations. A simple typology of locations would entail those locations associated with one-time, major tourist events versus continuous attractions. An example of the former is the Winter Olympics, which in the year 2002 will be held in the rural areas of Utah. Examples of the latter include Yellowstone National Park (multiple "viewing" sites with significant distances in between the sites) and the Grand Canyon (the South Rim is a significant distance from any urban area but has a limited number of sites where tourists congregate). With respect to the Olympics, system implementers would be especially concerned with security and traffic management issues, in addition to basic logistical issues. With respect to the national parks, system implementers would be especially concerned with tourist convenience and transportation system cost efficiencies. The design presented below is capable of handling these different priorities.

A DESCRIPTION OF THE THREE COMPONENTS

Descriptions of the three components used by tourists are given below. A drawing of the three components and the data that is communicated between each component and the central data controller is shown in Figure 1.

On the Bus

Devices on the bus are critical to the success of this system. The passenger count must be correct in order to know how many seats are available; location data must be constantly updated; and these data must be frequently conveyed to the central control facility for distribution to the reservation kiosk and information components.

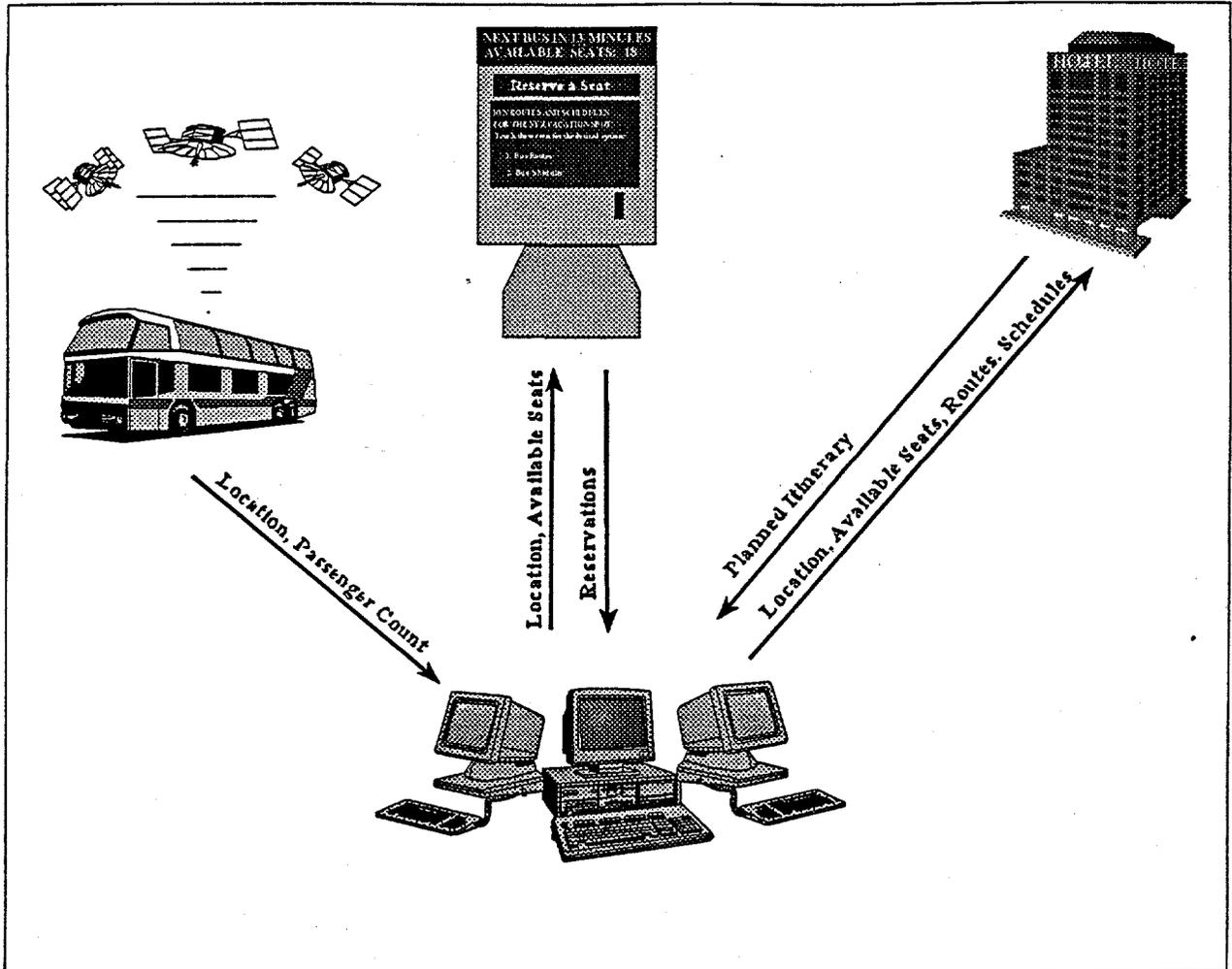


Figure 1. Data flows between the three physical components and the central data controller.

Using existing technology, a count of passengers entering and exiting each bus will be maintained and also transmitted to the central data controller. Thus, at all times, the number of unoccupied seats is known. When a reservation is made, the number of available seats is decremented at the central controller. When the bus actually arrives at the kiosk where the reservations were made, the database is updated based on the actual passenger counts.

Vehicle tracking is being done today by many vendors using an on-board computer and a Global Positioning Satellite (GPS) receiver mounted on the vehicle. Buses only need three GPS points to establish a location, and it is no more of a problem to "find" three satellites in a rural location than it is in an urban environment. This information is stored on board the bus and also transmitted to the central controller facility for processing and for distribution to the rest of the system components.

As an added feature, using the location information, verbal announcements of upcoming stops can be provided to passengers. The on-board computer is preset to make announcements of each stop at certain predetermined points, as indicated by the GPS location system. The bus driver is freed from any responsibilities to interact with the system.

The sites that could eventually employ this system are very different. In addition to the types of bus data described above, transit managers at a site might also choose to maintain on-board records of other types of information -- for example, length of time at a stop, vehicle speeds, whether the driver observed safety regulations, etc.

The technology of communication of the bus location and count information, as well as any pertinent information about the condition of the bus (mechanical problem, accident, illness of a passenger, etc.) is discussed in a later section of this paper.

At the Waiting Area

Each bus has a specific route, with established discharge/boarding sites. At each of these sites, a kiosk will inform those waiting how long it will be before the next bus will arrive and what is the available seating on that bus. Updated as often as appropriate for the specific tourist site (e.g., once a minute), this information will be provided in large type, readable by persons standing near the kiosk, and will be lighted at night to enhance readability.

Capabilities at each kiosk allow a tourist to reserve a seat (or seats) for that bus. In many locations, the transportation fees are included with the entrance price. In these cases, the seat reservation system will not generate additional revenue. The reservation provides the tourist with assurance that a seat will be available on a specific bus. If the closest available bus for that kiosk is already full and no passengers are to be discharged, then the tourist wishing to make a reservation can check on available seats for the next scheduled bus. The primary purpose is to inform the tourist of when he/she can expect to board a unit.

If the bus system is fare-based, this system could also be outfitted with a credit card validation and ticket-generating device. (GTE Wireless and US Wireless, using technologies described below, have partnered in this venture.) In this case, the ticket would be required for entry onto the bus. Restricting bus access to ticket holders would ensure that only ticketed passengers would be transported to the venues, which could be an important element in security plans associated with major one-time events such as the Olympics.

In addition, if special accommodations are required for a person with a disabling condition, that person will be able to inquire about the existence of such accommodations on each particular bus.

At Hotels and Other Public Places

The following text shows examples of the proposed design of the display that would be available at hotels and other public places at which a tourist might wish to plan the day's activities. These examples represent screens that the traveler would access via touch screen.

BUS ROUTES AND SCHEDULES FOR THE XYZ VACATION SPOT

Touch the screen for the desired option:

- 1. Bus Routes**
 - 2. Bus Schedules**
-

If the tourist chooses option 1, he/she will be shown a colorful map which shows all of the transportation routes with high-interest venues clearly marked. In addition, each route will display the loading sites and provide specific directions for how to find the closest loading area.

If the tourist chooses option 2, he/she will be shown a list of bus routes from which to choose in order to obtain a specific schedule.

BUS SCHEDULES FOR THE XYZ VACATION SPOT

Touch the screen for the desired option:

- 1. Loop A (Big View 1, Special Event 1)**
 - 2. Loop B (Big View 2, Activity 1)**
 - 3. Loop C (Special Event 2, Activity 2)**
-

After making a choice for a particular "loop," the tourist is shown the regular schedule for that loop as well as the current location of all buses running that loop. There will be an option for receiving location information on either a map or in text format. Below is an example of a text format.

BUS SCHEDULE
LOOP B: Big View 2, Activity 1

Loading areas (LA) and scheduled arrival times

LA1. Corner of M and N: 8am, 1pm, 6pm, 11pm (last delivery, no pickups!)

LA2. Green gazebo: 9am, 2pm, 7pm

LA3. Dancing fountain: 10:30am, 3:30pm, 8:30pm

LA4. Top of the mountain: 11:30am, 4:30pm, 9:30pm

The time is now 12:45pm

**The bus(s) on Loop B have the following arrival
schedule and seating availability:**

LA1: 12 minutes; 14 seats available

LA2: 3 hours and 15 minutes; 6 seats available

Viewers at the hotel sites will be able to view the information only and will not be able to reserve a ticket at these sites. Ticket reservations may only be made at the boarding kiosks and only for the bus(es) that stop at that particular kiosk. This helps to prevent individuals from getting tickets in advance and then failing to show up to actually board the bus.

It should be noted that, at any kiosk or hotel site, users will be able to submit a "planned itinerary" which can be printed for their own use during the day. The pre-planning by the tourist will also be helpful to the system in that, if a larger-than-normal influx of visitors plans to follow a particular path during the day, additional (or larger) buses can be assigned to that route. This pre-planning feature will not serve as a reservation for the bus, only as a tentative plan.

CENTRAL DATA PROCESSING

Using Automatic Vehicle Location (AVL) technology based on GPS, the location of each bus on its scheduled route can be accurately pinpointed. This location information will be maintained in a bus log and also transmitted to the central data processor on a regular basis (e.g., once each minute). The time between each transmission will vary depending on the application. When received by the central processor, the location data will be converted to a graphical display for each bus on every route. A time comparison of actual and scheduled (i.e., average or usual time to complete the route) information will compute the expected time of arrival for each bus at each kiosk. This information will then be transmitted to each kiosk as appropriate and to the hotels and other venues where the bus routes may be viewed.

In addition to location information, the passenger counts as determined by the counter on board each bus will be transmitted to the central data processor. Starting with this actual count of passengers, the central processor will decrement the actual count by the number of reservations by site and calculate an available number of seats based on the total capacity of the bus.

Based on the needs of each specific tourist site, the logic for making reservations will be determined. That is, for some tourist venues, allowing a visitor to make reservations for a bus which will not arrive for an hour or more may make sense while for others it may not.

The other piece of information that will be transmitted to the central controller is "bus condition," where "condition" is defined as any incident that needs to be reported, such as a mechanical breakdown, a passenger needing medical attention, a collision, etc. In this case, the bus driver could use a set of automated alert signals which will be embedded within the regular transmittal. A cellular phone might also be available to the bus driver if additional information needs to be sent.

COMMUNICATIONS CAPABILITIES

The information conveyed from the bus is crucial. The location of the bus and the number of available seats on the bus are used to determine the two constantly updated messages conveyed to the tourist wanting to reserve a seat at the reservation kiosks.

The bus's on-board computer communicates with the central data facility using a Cellular Digital Packet Data (CDPD) modem. CDPD uses TCP/IP, the standard protocol of the Internet to transmit these packets. At the central controller facility, the information is processed and distributed to the other system components.

CDPD is a transmission technology which splits messages up into "packets" that are sent on existing analog cellular networks [Advanced Mobile Phone Service (AMPS)] at a rate up to 19,200 bits per second. This allows a fast, flexible method for sending and receiving data to and from the mobile devices.

CDPD is very secure. It uses the Diffie-Hellman encryption key, and also RC4 security (stream ciphering). Therefore, it is virtually impossible for someone to steal or alter the data.

CDPD works best for short bursts of data transmissions. This does not mean that transferring large data files is impossible; however, the pricing is geared for small amounts of data to be transmitted. Examples of current CDPD applications include E-mail, credit card verification, telemetry (meter readings, temperature sensors, alarms), messaging (mobile dispatch, field service), ATM machines, query/response applications, file transfers, and web browsing.

Today, at least fifty major metropolitan areas have access to CDPD. Many tourist spots that would use the reservation system described in this paper, however, would not be located in major metropolitan cities. Therefore, the limited range of CDPD must be considered.

Circuit Switched CDPD (CS-CDPD) addresses the problem of those locations across the U.S. that do not have CDPD coverage but do have analog cellular coverage. CS-CDPD is a technology that seamlessly connects to CDPD. For example, if the moving vehicle leaves the CDPD coverage area, the modem senses it has no coverage and dials an 800 number to connect back into the CDPD network. Thus, as long as there is analog cellular coverage, there is a possible connection to the CDPD network via circuit switching. Although this technology is very new in its implementation, it is a viable solution for rural areas.

The use of CS-CDPD still applies to short bursts of data in that the modem will connect when packets need to be transmitted and will disconnect after a time-out period. The information to be transmitted for the Reserve a Seat! System will include the time of transmittal, bus number/identifier, location, and passenger count. It is possible, depending on the needs of a particular application, that passenger count would not need to be included with every transmission.

If there is a delay, its cause (e.g., an accident, mechanical failure, etc.) and the exact location of the bus can be relayed to the central control facility via the wireless on-board communication link. This incident communication may be an automated message based on some time outage (e.g., the bus hasn't moved for xx minutes) or a pre-programmed message the transmission of which is instigated by the bus driver, or there could be some other methodology programmed into the system.

CONCLUSIONS

All of the technology described in this paper currently exists, although not in the configuration described. The proposed tourist reservation system is feasible and would provide tourists with an efficient method for scheduling their activities during their dream vacations.

In addition to providing an efficient method of transportation for tourists, some other benefits include the following:

- When tourists realize the convenience of using the reservation system, fewer personal cars will be used, which implies less congestion and less pollution. Pollution from automobile exhaust is a very important issue for many of our national parks.
- Because of customer convenience, especially for persons with disabling conditions, people will want to visit and revisit sites with the efficient transportation system.
- Use of a reservation system will reduce the operating expenses for any existing transit system on the site because of the more efficient use of buses.
- After a few weeks of operation, the log books and other records maintained by the system will help site operators with planning and scheduling. In addition, on a daily basis, if it is known how many passengers are dropped off at a particular venue, then how many must be brought back from that venue is also known. This could be a useful security measure.

The "Reserve a Seat!" system has multiple benefits. Greater comfort (less frustration), greater safety (because of the rapidity of dispatching emergency vehicles), and better information exchange lead to happier travelers. Satisfied travelers spend more money on mementoes at the

tourist sites. Finally, the environment benefits when buses replace personal cars as a mode of transit with the attraction. The traveler, the tourist site, the environment — the “Reserve a Seat!” system has a special attraction for them all!

ACRONYMS

AMPS	Advanced Mobile Phone Service
AVL	Automatic Vehicle Location
CDPD	Cellular Digital Packet Data
CS-CDPD	Circuit-Switched Cellular Digital Packet Data
GPS	Global Positioning Satellite
TCP/IP	Transmission Control Protocol/Internet Protocol

REFERENCES

Quantum Sky, Inc., Information Packet on “Data Guide, a Fleet Intelligence System,”
P.O. Box 158, Tecumseh, Michigan. [contact Mr. Ray Peabody, Director of
Marketing, 517-424-8000]

Web sites with information on technologies described in this paper include the following:
<http://www2.wirelessdata.org/public/whatis/index.html>, <http://www.trimble.com>,
<http://www.miras.com>