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Technology in Mobility Management:
Coordinating and Improving Services in Southwest Idaho

September 2009
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Contents

Abbreviations

APC	Automatic Passenger Counters
AVL	Automatic Vehicle Location
CUTR	Center for Urban Transportation Research
GIS	Geographic Information System
GPS	Global Positioning System
ITS	Intelligent Transportation Systems
MDT/MDC	Mobile Data Terminal / Mobile Data Computer
NTD	National Transit Database
RITA	Research and Innovative Technology Administration
VRT	Valley Regional Transit

Discussion of Findings

Summary
Different technologies have potential to improve mobility for rural residents and for targeted populations – disabled, elderly, and low-income – by enhancing transit and paratransit services and operations, as well as coordinating services among providers. This paper discusses assorted technologies and their potential role to improve mobility. General cost estimates are included where they were available, and direct links to vendors are provided.

The process of selecting new technologies for investment includes the following questions:
- What benefits or improvements will this provide?
- How does this fit within long-term plans, goals, and technology architecture?
- Which users will be directly benefited?
- Will it be easy to use/easy to learn for riders/users?
- What are the short-term vs. long-term costs?
  - What is the total cost of ownership, from purchase to maintenance?
- Will additional staff be required to use/maintain it?
  - Will it be easy to use/easy for staff to learn?
- Is this compatible with existing systems?
  - What are the needs/costs to make it compatible?
- Will it improve coordination with external systems/providers?

This report is intended to highlight possibilities and assist providers as they investigate technologies to improve mobility in their communities. The document cannot answer all of the questions listed above, but provides general information about technologies that benefit rural transit users and target populations. It should be used as a basis for discussion and a springboard for further investigation.

Observations
In the course of research for this report it became evident that implementation of these technologies was dependent not only on funding, but internal policy, external regulations, insurance, and cooperation and coordination among agencies and providers.

Technologies were grouped into ten categories, listed below. With each of the technologies explored there is a direct or indirect benefit to the target populations, and to rural and urban users. Benefits to rural transit riders and target user groups were generally consistent within groups of technologies – it was often found that the whole category of technologies would improve mobility for the users listed.

🔵 Automatic Passenger Counters	Application: mostly urban Target: non-specific • System-wide benefits in short-term (reporting) and long-term (system planning for target populations)
🔵 Automatic Vehicle Location	Application: rural and urban Target: paratransit users – elderly, disabled • System-wide benefits and capabilities
🔵 Bicycle Technologies and Practices	Application: rural and urban Target: low-income • Some benefits to disabled groups
🔵 Fare Collection	Application: rural and urban Target: low-income, elderly, disabled • System-wide/other user benefits also
🔵 Intelligent Transportation Systems	Application: urban, and some rural Target: system-wide benefits • Some direct benefits to paratransit – elderly, disabled
🔵 Paratransit Scheduling	Application: rural and urban Target: elderly, disabled
🔵 Rider Training and Assistance	Application: rural and urban Target: low-income, elderly, disabled • System-wide benefits
🔵 Service Coordination	Application: rural and urban Target: low-income, elderly, disabled • System-wide benefits also
🔵 Traveler Communication Systems	Application: rural and urban Target: system-wide benefits • Some direct applications with benefits to low-income, elderly, disabled
🔵 Users and Low-Tech Solutions	Application: rural and urban Target: low-income, elderly, disabled • System-wide benefits also

The key to successful implementation of most of these and other technologies is integration. On transit vehicles, an on-board computer or mobile data terminal (MDT) can be essential to link automatic passenger counter (APC) data with automatic vehicle location (AVL) position information and time to provide the most complete picture of passenger loads and demand. This document does not include a separate section on MDTs, as they are usually part of most technology systems provided by APC, AVL, and other technology vendors.

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Approach

Research on technologies for coordinating and improving services for mobility focused on three priority topics:

- Automatic passenger counters (APC)
- Automatic vehicle location (AVL)
- Paratransit scheduling

Research also revealed that analysis of various technologies and options should be analyzed across several transects:
- Technologies for providers vs. those for individual users
- High-tech vs. low-tech (mechanical) solutions
- All users vs. target populations (elderly, disabled, low-income)
- Urban solutions vs. rural solutions

Staff employed the following means/sources to gather information:
- Interviews and contacts
    - Snake River Transit, Treasure Valley Transit, and Valley Regional Transit (VRT)
    - Other agencies/providers
- Literature review, focusing on transit industry and technology
    - Recent periodicals
    - Government and private studies
- Internet research focusing on
    - Transit providers in the U.S. and abroad
    - Technology vendors

Costs and Vendors
The costs identified in the report, unless noted otherwise, were provided by the Research and Innovative Technology Administration (RITA) and are adjusted to 2007 dollars. RITA's website includes average costs[1] and links to studies and reports on ITS topics. The website includes other information, such as expected life of equipment and expected costs for operations and maintenance.

The American Public Transportation Association website provides an online catalog listing a number of other vendors for different products and services[2]. Additionally, the Transit Cooperative Research Program recently launched a new online source for information about emerging transit technology[3] which provides vendor information, news updates, and stories on policy, research, and other topics.

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[1] Intelligent Transportation Systems Applications Overview. 4 Apr. 2008. Research and Innovative Technology Administration. 5 June 2009 <http://www.itsoverview.its.dot.gov/>.
[2] Catalog of Member Products and Services. American Public Transportation Association. 9 June 2009 https://www.aptagateway.com/eweb/DynamicPage.aspx?Site=NoSections&Design=No&WebKey=1cf9 3f2b-9859-40ff-8d6f-3e29ff4726c3.
[3] See thetransitwire.com, sponsored by the Transit Cooperative Research Program.

Technology and Transit in Southwest Idaho

Most transit and paratransit providers in southwest Idaho have invested in a few technologies, such as radios or cell phones, wheelchair lifts, and the vehicles themselves. Still, a majority in the region are not yet taking advantage of technology that may be appropriate and helpful to them.

Some of the larger providers include Snake River Transit, Valley Regional Transit, Treasure Valley Transit (operating services in several counties), and Access and Dial-A-Ride paratransit. There is also Commuteride, a vanpool fleet offered by the Ada County Highway District (ACHD) for people commuting to/from or within Ada County. Vanpoolers contribute a monthly fee to participate, and Commuteride is exploring technologies to improve safety and rider matching.

Snake River Transit is based in Ontario, OR and extends services into Payette County. The agency uses Mobilitat software for scheduling and offers Dial-A-Ride paratransit services as far away as Vale and Nyssa. Snake River Transit is operated by Treasure Valley Transit. Treasure Valley Transit provides transit in Elmore and Valley Counties, and provides or assists with paratransit services in eight counties.

Valley Regional Transit (VRT), which provides ValleyRide transit and Access paratransit services in parts of Ada and Canyon Counties, is the largest provider in the state. VRT has invested in several technologies, including specialized software modules, magnetic fare cards, radios with data and voice capabilities, and automatic vehicle locators. Valley Regional Transit is also exploring additional technologies and better integration of existing technologies.

Existing VRT Capability

VRT currently uses Fleet-Net software, GFI Genfare products, and other technologies for a variety of functions. Newer Fleet-Net software modules are based on Microsoft Access software, and are compatible with other common applications. However, VRT has not yet been able to acquire all the newer versions of Fleet-Net modules, and Fleet-Net is still developing a module for paratransit scheduling.

The various technologies currently available or in use at VRT include:
- Global positioning system (GPS) tracking on buses (for AVL)
- Radio system on buses, voice and data capabilities
- Electronic fareboxes and fare media (magnetic stripe cards)
- Customer service call-tracking software
- Digital reader boards/headers on buses
- ValleyRide Internet website, including
  - Route maps and schedules

- How-to videos (for riders) via YouTube
- Printable forms for paratransit rider applications
- Additional website for VRT agency
- Fleet-Net software (for numerous transit functions and operations)
  - Financial management
  - Payroll and human resources
  - Asset and materials management
  - Fleet and equipment maintenance
  - Reporting and scheduling
    - National Transit Database (NTD) compatible reports
- Hand-held scanners
  - For inventory, work orders, etc. – data downloads into Fleet-Net
  - Scanners can also be used to perform Section 15[4] sampling and download data into Fleet-Net
- GFI software/farebox reporting, which imports into Fleet-Net
- FuelMaster fuel management system, which imports data into Fleet-Net

Future Technology for VRT

VRT is considering other technologies, several of which are compatible with existing technologies:
- Kiosks/ticket vending machines (GFI Genfare)
- Online ticket sales (GFI Genfare)
- Security cameras on buses
- Trip planner on website (Idaho 511, Google Transit, or Fleet-Net module)
- Interactive maps on websites, showing bus locations in real time (AVL)
- Automated messaging/alerts for delays, detours, etc.
  - Cell phones, pagers (Twitter, etc.)
  - Computers (e-mail, instant messaging)
- Call tracking for Customer Service representatives from remote locations

Other technologies would improve services both directly and indirectly to users. A few are listed here, and more are described in the *Inventory* section that follows:
- Drive cameras on buses (for safety training)
- WIFI on buses (rider/customer use, data communications, etc.)
- Digital monitors/screens in buses for advertising, news, route information
- Electronic passenger counters (record boarding/alighting at stops)
- Fleet-Net software upgrades, including new modules
  - Web-based trip planner (see above)

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[4] Section 15 of the Urban Mass Transportation Act requires transit agencies to have a uniform system of accounting and reporting. See Circular "UMTA C 2710.1A" from the Urban Mass Transit Administration for more information http://www.fta.dot.gov/documents/UMTA_C_2710.1A.pdf .

- o Paratransit scheduler
- o Wireless data capture (available July 2009)
- Bus Rapid Transit (BRT) route/system

Technology integration is also a key to maximizing existing technology. For instance, if the fare box collection data could be aligned with date/time information and with AVL data, more ridership information could be provided without additional equipment or staff time for manual counts.

Technology Inventory

Automatic Passenger Counters (APC)

Several technologies are in use to automatically count passengers entering and exiting vehicles, using infrared sensors, optical scanners, or treadle mats (step-pads). They can be very helpful in getting an accurate picture of ridership numbers for effective operational planning. They are also helpful in planning and resource allocation, including planning for low-income and other target populations.

However, the Federal Transit Administration (FTA) has very specific requirements for collecting passenger counts that will be reported to the NTD (per Section 15 of the Urban Mass Transportation Act). It requires a probability sampling process, either one that they specify or one that has been designed by a statistician and approved by the FTA. The Utah Transit Authority follows a process it specifies for buses and modifies it slightly for light rail because a train may consist of one, two, three or four cars. Providers cannot use automated passenger counters without first going through a statistical validation program with FTA.

Other passenger counter technologies use sound waves (sonar) and weight. IVS, inc. (AngelTrax) is improving systems to count passengers with sound waves, while the Budapest transit system estimates the number of passengers on a vehicle by measuring pressure in the vehicle's pneumatic springs (weight).[5]

Costs: Per vehicle costs range from about $900 as an add-on to an existing scheduling/tracking system to over $9,000 as a stand-alone installation. A study by the Center for Urban Transportation Research (CUTR) found the typical cost of adding an APC system to an AVL is "approximately $1,000 to $1,200 per bus. Since only a small percentage of vehicles need to be equipped with APCs to get a valid sample of data

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[5] Passenger Counting and Service Monitoring: A Worldwide Survey of Transportation Agency Practices. Rep. 2003. New York City Transit. 8 June 2009 <http://ntl.bts.gov/lib/23000/23600/23620/psgr_ ctg_svc_mon.pdf>.

(typically 10%), it could cost as little as $15,000 to equip a
system with a 150 vehicle fleet."[6]

Application: Urban (mostly applicable in areas with high ridership).

Target: System-wide benefits not directly focused on target
populations. Data used in planning and resource allocation for
target groups.

APC Vendors:

ACS/Orbital
http://www.orbitaltms.com
Orbital TMS "has integrated its technologies such as scheduling systems, passenger
information systems, and numerous vehicle systems for the public transit industry."

Orbital's SmartCount system uses a passive triple-sensor infrared APC mounted
above the bus doors (IRMA). As compared to other technologies, IRMA contains no
moving parts and supports both single and double wide door configurations. The
overhead mounting arrangement has the ability to detect and count simultaneous
passenger entry and exit.

Parvus/Eurotech
www.parvus.com www.eurotech-inc.com
Parvus created **RiderNet**, the world's first automatic passenger counter sensor
device to use vision technology for highly accurate passenger counting onboard
buses and trains. The technology can count people entering or leaving busses,
trams or trains with accuracy greater than 97%. They are mounted on the vehicle
ceiling near the door. RiderNet is now marketed, sold, and supported by Eurotech
Inc. as **PCN-1001**.

Hella Aglaia
www.hella.com APC
Based on 3D- Sense Technology Hella Aglaia's self contained Automatic Passenger
Counting System AVC 1 offers a counting accuracy greater than 98%. It is possible
to verify all results at any time, through the comparison with video recordings.

Periseo
http://www.periseo.com/
The CPC001 is one of the latest generation optical passenger counter units
available. The CPC001 is specifically designed for passenger counting in public
transport facilities. It is smaller than other products, but the company website does
not explain if it is compatible with AVL technologies or other fleet management
systems.

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[6] APTS Technologies: Fleet Management Systems. 2008. Center for Urban Transportation Research. 8
June 2009 <http://www.rapts.org/Technologies/08apc.htm>.

Infodev
www.infodev.ca
Infodev offers two infrared passenger counters – a directional counter and a multiple (direction) sensor bar, as well as AVL technology. Infodev also offers extensions for traffic signal control (see Priority Signal Control discussion in *ITS* section) and fleet maintenance.

Other[7] APC Vendors:
Urban Transportation Associates (recommended contact by Utah Transit Authority)
http://utatransit.net/#

acorel
http://www.acorel.com/en/onboard.asp

Clever Devices
http://www.cleverdevices.com/products.php

Tapeswitch
http://www.tapeswitch.com/
Sells treadle mats/switches.

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[7] In several sections of this report, additional or "other" vendors are identified. Details regarding these providers were not included in the report for a variety of reasons. Some had less information available on the internet, some were vendors focused on other products and services (not transit), and others had less applicability based on internet research. They may or may not have the ability to meet the specific needs of transit and paratransit providers in the Treasure Valley.

Automatic Vehicle Location (AVL)

There are two sides / components of AVL to be considered: in-vehicle equipment and the infrastructure to manage and measure its output. The specifics of each AVL network vary depending on the type of system deployed, but will generally include a transceiver installed in each bus that transmits information about the vehicle. At a minimum this will include:

- Location to within a few yards or feet
- Speed
- Direction

More comprehensive systems may include communication of other types of information, such as:

- Stops (planned and unplanned) and idle time
- Passengers embarking/disembarking and door openings/closings
- Swipe card data such as driver sign in or electronic bus passes and fares
- Emergency/panic button and remote surveillance
- Mechanical data regarding tires, brakes, engine, etc.

Using GPS satellites the transceiver on the vehicle notes its location and sends coordinates, along with any other vehicle data, to the base station. Data is transmitted at pre-set intervals, ranging from every ten seconds to every few minutes, by radio or cellular network.

Some AVL systems include stand-alone software that can show vehicle locations on a map, create alerts in case of emergency or safety violation, and generate reports for further analysis. While useful, these systems tend to be limited in terms of delivering maximum value from the data because they leave planned and actual data separate, thereby restricting the level of analysis that can be done.

Since most providers use some form of routing software, the ideal implementation feeds the AVL data directly into the routing application so that data about where the bus should be can be easily compared with information about where the bus actually is. This ability to produce comparative analyses very quickly is a key value of any AVL system. For more information on AVL applications, see the Trapeze website[8] for a white paper on real-time vehicle tracking.

> **Costs:** AVL units range from $400 to $2,000 to purchase and install GPS on vehicles.
>
> **Application**: Both rural and urban.
>
> **Target**: Some AVL applications are specifically designed for paratransit services and directly benefit elderly and disabled. System-

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[8] Real-Time School Bus Tracking: Building the Business Case. Rep. Dec. 2003. Trapeze Software Group. May 2009 <www.trapezegroup.com/PDFs/Trapeze%20White%20Paper%20Design%200312%20.pdf >

wide benefits include rural rider locations (on flex routes or paratransit), performance monitoring, emergency response, and service coordination.

AVL Vendors:

RouteMatch
www.routematch.com
Routematch provides scheduling software and other features, and offers different levels of paratransit scheduling software based on the level of computer assisted scheduling.

RouteMatch Software has developed additional AVL modules "that can seamlessly and easily be integrated into all of our RouteMatch Software products. By partnering with leading AVL/Mobile Data Computer (MDC) providers, the RouteMatch AVL/MDC modules can deliver an integrated, real-time messaging and vehicle tracking solution via the RouteMatch Mobile Data Communication and AVL modules. All messaging and tracking will be integrated into our transportation management system for easier use, more flexibility, and greater value to providers and their services."

Trapeze
www.trapezegroup.com
Trapeze Group is a software company and offers an AVL interface with its key scheduling and routing products (MapNet, PASS and PASS-MON). All three do comprehensive route planning and scheduling; MapNet targets school districts.

They also offer RidePro (vanpool finder) and a range of other products to the public transportation market.

NextBus
NextBus website
NextBus specializes in public/user interface with AVL data. They are partially owned by Grey Island/Interfleet (see below) and offer both hardware and software, including platform and other signs to display anticipated arrival times.

Their **Tracker Suite** includes a GPS unit (with cell phone technology communicator) and MDC. The NextBus website offers the public interface with the system to locate transit vehicles and plan trips. Their software can also be linked to third party AVL units – specifically Orbital and Siemens products.

Grey Island/Interfleet and FleetPoint
http://www.interfleet.com/

Grey Island's **Interfleet** product was originally design to track emergency vehicle/ambulance fleets, and offers hardware as well as software. ITS software can also work with other AVL systems. Interfleet focuses on fleet management rather than rider interaction. "The philosophy from its inception was to develop an open architecture that readily adapts to changing technology and an endless variety of business requirements."

In addition to NextBus, Grey Island also has acquired **FleetPoint**. FleetPoint's product is similar to Interfleet – it focuses on fleet management (non-transit) and the two appear to have been former competitors.

ACS/Orbital
http://www.orbitaltms.com
Orbital TMS "has integrated its CAD/AVL systems with numerous ITS technologies such as scheduling systems, passenger information systems, and numerous vehicle systems for the public transit industry." ACS can also provide passenger counters with the AVL fully integrated.

Radio Satellite Integrators
www.radsat.com
Radio Satellite Integrators, Inc. (RSI) designs, manufactures, and markets integrated tracking systems for AVL. RSI was founded to address the emerging needs of integrating GPS satellite positioning technology with wireless communication systems and Geographic Information System (GIS) digital mapping technology for AVL and other tracking systems.

RSI's V-Track system is a fully integrated Automatic Vehicle Location system comprised of multiple subsystems. The V-Track unit is capable of interfacing with a wide variety of external mobile data terminals, mobile computing devices, and in-vehicle peripherals. The RSI AVL mapping interface can be configured as a powerful ESRI based GIS software application in a client/server environment or as a Web-based tracking application. Customers include Dallas Area Rapid Transit and other transit and school systems.

Siemens VDO
http://www.vdo.com/home
Siemens was one of the first AVL system vendors. "The **VICOS-LIO** AVL system is perfectly suited to use with digital radio as all detailed specifications have been agreed with all leading digital radio suppliers. Within a VICOS-LIO AVL system, the moving vehicles communicate via the available communication media, irrespective of whether this is analogue data radio, digital radio…or future methods." VICOS-LIO has modules that are designed to communicate with major radio systems, including Motorola and Nokia.

Greyhawk Technologies

www.greyhawktech.com/

Greyhawk provides a variety of products ranging from AVL tracking systems for transit providers to GPS products for trucking companies. It provides an MDT touch-screen product that enable fixed-route drivers to deviate from their routes to pick up paratransit customers. They do not appear to offer an automated paratransit scheduling system. Most of their products appear to be tailored to real-time route adjustments.

IE Logistics

www.ielogistics.net/index.htm

IE Logistics offers AVL and GPS products based on ArcLogistics by ESRI such as fleet management, scheduling, routing, etc.

Other AVL Vendors

Telogis

http://www.telogis.com

iCCES

http://www.icces.com/fleet_management_automatic_Vehicle_location.htm

Air-Trak

http://www.vehiclelocationsystem.com

CompassCom Software

http://www.compasscom.com/

Bicycle Technologies and Practices

Bicycles are a common vehicle riders use to expand the reach of the transit system on one or both ends of a transit trip. However, there are limits to the number of bicycles that can be accommodated on a bus (or train), which impacts riders who need a bicycle for use on the far end the transit trip. On systems where bicycles are allowed to be stored in the passenger compartment, priority is always given to passengers, particularly those with disabilities, before bicycles.

Bicycles are not allowed in ValleyRide buses, but in some other cities' transit systems (e.g. Portland and San Francisco) bikes are allowed. A bicycle/no bicycle policy is usually based on insurance, cleanliness policy, rider/passenger volume, and equipment to strap bicycles into place within the transit vehicle.

To improve the transit network, and to strengthen the relationship between transit and bicycle riders, several items and practices have been explored. Some may be part the transit system; others require individual or business investment. Private investment in bicycles and related technology can be encouraged or promoted as a complement to transit. Potential items/practices that could be used include:

- Bicycle Sharing/Rental Systems
- Electric Bicycles and Folding Bicycles
- Lockers and Storage (at terminals/stations)
- Racks (on buses/vans)

Also see *Users and Low-Tech Solutions* section on page 34 for additional information.

Bicycle Options
Bicycle Sharing/Rental Systems are in place in cities and tourist destinations around the globe (e.g. Milan, Montreal, Paris, Portland, OR, and Washington, DC). Both standard and electric bicycles are good candidates for a sharing/rental system and can function as part of the transit network, particularly if reservations can be made in advance and/or online. Most systems are privately operated.

Alta Planning + Design developed a white paper on public bicycle systems[9] and posted it to the company's website. No vendor information is provided in this document. However, Intrago Mobility[10] is one known vendor that offers community rental systems for small electric vehicles - including electric bicycles.

       Role: Transit provider, public sponsor or local vendor.
       Application: Urban or rural.
       Target: Low-income and other transit dependent groups.
                     System-wide benefits for bike riders.

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[9] Bike Sharing/Public Bikes: An Overview of Programs, Vendors and Technologies. Rep. Alta Planning + Design. May 2009 <www.altaplanning.com/App_Content/files/pres_stud_docs/bike_sharing_whitepaper.pdf>
[10] <www.intragomobility.com>

Electric Bicycles provide power assistance to riders, adding support for inclines and speed. Because they can make difficult bike commutes easier and shorten the time for long-distance commutes, they have some potential, especially since they are less expensive than most automobiles. Since some electric bicycles are too heavy for some riders to lift onto a bus bicycle rack, an individually owned unit could generally be used on only one end of the transit trip. See *Appendix B: Electric Bicycles* for vendors and other information.

> **Role**: Individual rider.
> **Application**: Rural or urban.
> **Target**: Low-income and other transit dependent groups. Some elderly or impaired persons may choose electric bike because of the power assist.

Folding Bicycles include models that are designed to be carried safely onto a bus or train, and some include bags or covers for cleaner transport. Like electric bicycles, they offer a less expensive commute option than an automobile. See *Appendix C: Folding Bicycles* for vendors and other information.

> **Role**: Individual rider.
> **Application**: Both urban and rural.
> **Target**: Low-income and other transit dependent groups.
> System-wide benefits for bike riders.

Bicycle **Lockers** and improved **Storage** provide greater security and attraction for riders to complement their transit trips with bicycles. Lockers can be offered by a transit provider as a park-and-ride service, or private vendors may provide the service. Stackable lockers (with fold-out ramps in the upper locker) and upright lockers are offered by different vendors.

The City of Boise and Capitol City Development Corporation are currently exploring the idea of placing bike lockers in public parking garages in downtown Boise.

> **Role**: Transit provider, public sponsor or local vendor.
> **Application**: Both urban and rural.
> **Target**: Low-income and other transit dependent groups.
> System-wide benefits for bike riders.

Vehicle Racks limit the number of bicycles that can be carried with a bus or van at any one time. This is a concern for bicyclists who either don't want to leave a bicycle locked up at a bus stop, or need to use the bicycle at both ends of the transit trip. In some transit systems bikes are allowed in the passenger area and a few offer other storage/securing devices as well.

ValleyRide buses currently have a double bike rack on the front of each vehicle, and bikes are not allowed inside the bus. VRT is investigating racks with capacity for more than two bicycles.

No information for vendors of bike racks is provided in this document. However, Sportworks[11] is one private vendor that offers some rack options, including triple bike racks, vertical racks for use inside the vehicle, bike trailers, and under-carriage (luggage area) bike racks. Numerous other vendors supply bike racks that attach to smaller vehicles and could be employed in rural systems and others that don't use buses or large vans.

Role: Transit provider.
Application: Both urban and rural.
Target: Low-income and other transit dependent groups.
                     System-wide benefits for bike riders.

Bike Locker Vendors

Each of these vendors for bike lockers and storage offer electronic locking, payment, or reservation systems, as well as perforated "see-through" walls or doors for security.

American Bicycle Security Company

www.ameribike.com

Offers vertical/upright lockers and stackable units. Also sells lockers with solar cells for recharging electric bikes.

Creative Pipe, Inc.

www.creativepipe.com

Offers stackable units and other street furniture.

CycleSafe

www.cycle-safe.com

Products include solar or standard electric power options for recharging bikes, etc. and can accommodate Segways/personal transporters and other small electric vehicles.

Dero Bike Rack Company

www.dero.com

Stackable units available.

Huntco

www.huntco.com

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[11] <www.sportworks.com>

Aside from bike racks and lockers, offers unique bike storage pods – special bike racks with flip-up, rounded covers to protect bicycles.

Fare Collection

The amount of time required to collect fares on board can slow bus operations significantly. The more riders the service has, the greater the problem can be with longer delays at every stop. Some fare collection policies put a greater burden on customers, such as the requirement to have exact change, whereas others make transit use easy.

A fare system design should consider fare collection policy in terms of its impact on both the bus dwell time at stops and passenger convenience. A number of different technologies are now in use around the globe to make fare collection/payment easier and faster. Access to and the simplified sale of tickets and fares is also beneficial to target populations. For instance, just as postage stamps can be purchased at several banks' automated teller machines (ATM), in some places transit passes are also offered in ATMs.

On the ValleyRide system, the current fares of $1, $2, or $3 and magnetic stripe cards are relatively simple for riders to manage, and prepaid tickets (discounted stored value cards) are an incentive. However, the only place to purchase 3-month, 6-month, or 12-month passes, the VRT main office in Meridian, is not transit accessible. VRT cannot accept debit/credit card payments, although riders may use them to purchase 31-day passes and stored value cards at the retail outlets (Albertsons, etc.). VRT is also exploring online ticket sales.

ValleyRide uses simple cash boxes for fares and GFI Genfare' CardQuest machines to process magnetic stripe cards for prepaid fares and other passes.

Contactless Payment cards (SmartCards) and **Tap Cards** are now used in a number of systems, including the Utah Transit Authority. The new electronic fare collection (EFC) system for the agency is the first full-system rollout of a transit payment system based on an open payment network.[12] This means the new EFC system accepts major contactless credit and debit cards such as Visa *payWave*, MasterCard *PayPass* and American Express *expresspay* on buses and light rail and commuter rail lines. Payment authorization is initiated when a customer touches an electronic reader on a train platform or bus with a tap credit or debit card (or waves a contactless card near a contactless reader).

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[12] "Utah Transit Authority Showcases Open Payment System." Government Technology: State & Local Government News Articles. 23 Feb. 2009. 9 June 2009 <http://www.govtech.com/gt/621904>.

Unfortunately, most small transit agencies have not had the opportunity to take advantage of this technology because of its high cost. But as payment media have evolved from cash to magnetic fare media to contactless smart cards and tap cards, demand is on the rise.   This will result in more affordable system technology in coming years.[13] One example of a smart card reader designed specifically for use by small transit agencies is the contactless AcuFare 100TM Smart Card Reader System developed by Acumen Transit.

Other forms of contactless payment use cell phones to collect fares from riders, such as Near Field Communication (NFC) technology. These technologies are similar to creating a debit account that is connected to the user's cell phone, and the cell phone signals a farebox to deduct the fare from the account. While cell phone payment technologies are more common in Japan and some European countries, they do not yet have a foothold in the U.S.

Toronto-based Sirit Inc. is working with Microsoft to develop a platform for programming NFC and contactless technology into a number of mobile devices.

Costs: On-board flexible fare processor, fare box and smart card reader range from $600 - $1,100.
Smart Card Vending Machine - $27,000 - $29,000

Application: Both rural and urban. Some systems' costs are prohibitive for small/rural systems.

Target: Low-income, elderly and disabled can benefit with user-simplified fare collection. System-wide benefits for all riders.

Fare Collection/Smart Card Vendors:

Acumen Transit
www.acumentransit.com
Consulting firm that specializes in construction and infrastructure management and Intelligent Transportation Systems (ITS). Aside from the 100TM Smart Card Reader System, Acumen offers design, software development, equipment installation, and maintenance services. Also knows as Acumen Building Enterprises, Inc.

Cubic Transportation Systems
www.cubic.com/cts
Cubic provides automated fare collection systems for public transport including bus, light rail, ferries, parking, etc. Services include equipment design and manufacturing, device-level software, maintenance, call centre services, and card management and distribution services.

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[13] Halbritter, Tamara. "Affordable Smart Card Reader Technology.". Passenger Transport. 16 Feb. 2009. American Public Transportation Association. 3 Mar. 2009 <http://newsmanager.commpartners.com/aptapt/issues/2009-02-16/22.html>.

GFI Genfare

www.gfigenfare.com

GFI Genfare is a leading maker of fare collection systems with a variety of products, including multi-service kiosks, ticket vending and encoding machines, magnetic tickets and smart cards, data collection and reporting, and on-board audio communications systems.

init (innovation in traffic systems)

www.initusa.com

init offers MOBILE telematic systems - modularly structured to include on-board computers, passenger information displays, and electronic payment systems. Products include on-board ticket vending with credit/debit cards.

Telargo

www.telargo.com

Fare collection with Margento sPOS terminals can be accomplished by contactless, smart, or magnetic card, as well as mobile phones at remote points of sale (POS).

Advanced Card Systems

www.NFC-reader.com

ACS offers SmartCard readers and NFC card readers. ACS specializes in swipe card readers attached to computers for paying bills/invoices online (rather than entering a credit card number).

HID Global

www.hidglobal.com/ids/cashlessPayment.php

Provides secure identification/account access and other contactless applications.

Legic

www.legic.com/en/home.html

Legic platforms support SmartCard systems and other contactless applications.

Intelligent Transportation Systems (ITS)

ITS encompasses a large group of proven strategies and technologies for addressing the challenges of assuring safety, reducing congestion, and accommodating growth in transit ridership and freight movement. They include the use of sensors and information processing technologies encompassing a broad range of communications-based information and electronics. When integrated into the transportation system's infrastructure, and into vehicles themselves, these technologies relieve congestion, improve safety, and enhance productivity.[14]

For the purposes of this report, the strategies are limited within this section to a few actions and technologies that apply to transit and are not already included in this document (APC, AVL, traveler information systems, etc.). For more information about ITS applications, costs, benefits, etc., see the U.S. Department of Transportation's[15] ITS Applications Overview website.

ITS Options

Fleet Management Software has a variety of applications in planning and scheduling vehicle maintenance, resource allocation, etc. All of these can improve efficiency of the fleet, especially when combined with AVL. (See *AVL* section on page 10 for information on vendors, etc.)

> **Application**: Both rural and urban.
> **Target**:   System-wide benefits.

Surveillance — On Board cameras can be part of a system to record activities and provide remote monitoring of the passenger safety environment. In an ideal set-up, the video surveillance (cameras) would be augmented with wireless communications (for real-time/remote response), silent alarms, covert microphones, and/or intercoms.

> **Costs:**   A security package ranges from $3,000 per vehicle for a camera and hot button, up to $6,000 to include digital event recorder system.
> **Application**: Both rural and urban.
> **Target**:   System-wide benefits, increases safety for all target groups.

Surveillance — Wayside/at Park-and-Ride is also a key to passenger safety and comfort. Like an on-board system, cameras should be part of a remote monitoring system that includes passenger-activated emergency notification.

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[14] U.S. Department of Transportation, Research and Innovative Technology Administration. Intelligent Transportation Systems Joint Program Office. Report No. FHWA-JPO-08-032. Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned. By Robert P. Maccubbin et al. Washington: 2008.

[15] < www.itsoverview.its.dot.gov >

Costs: Surveillance cameras and mounts – $2,000 - $5,000 (includes pan/tilt/zoom; higher costs are for color)

Application: Both rural and urban.

Target: System-wide benefits, increases safety for all target groups.

Transit Signal Priority is similar to the method used to change traffic signals in favor of fire engines. Transit priority however, does not usually change a signal to accommodate transit, but will make minor adjustments to a signal cycle. For instance, in some communities sensors at intersections will modify a signal cycle as a bus approaches it, normally to maintain a green light phase longer to allow the bus to pass through. The overall cycle (which is timed with upstream and downstream intersection signals) does not change.

Costs: Signal Preemption Receiver (at intersection) – $2,000 - $6,000
Signal Controller Upgrade for Preemption – $2,000 - $4,000
Signal Preemption Processor (on board) – $200 - $400
Signal Preemption/Priority Emitter – $500 - $2,000

Application: Mostly urban.

Target: System-wide benefits; paratransit vehicles also.

Transportation Management Centers allow the operations of several agencies to be managed in the same facility, not unlike a joint dispatch center for police and fire protection services. Such facilities can greatly improve operational performance and enhance coordination in special events, severe weather conditions, and emergency response.

Some interagency management already takes place in southwest Idaho, such as intersection surveillance cameras in the Boise and Nampa areas and combined traffic signal coordination on local and state roads in Ada County. Additionally, an Interagency Regional Operations Center has been proposed for the Treasure Valley.

Costs: Management center costs vary greatly according to the number of operations and size of agencies involved, and if space is not available with one of the participating agencies.

Application: Mostly urban.

Target: System-wide benefits reach beyond transit.

Paratransit Scheduling

In an effort to reduce cost through increased productivity, and improve service quality through enhanced reporting and analysis of data, paratransit providers are investing in paratransit scheduling software and systems. Some common scheduling software features include: (1) automated scheduling, (2) automated dispatching, (3) advanced reporting, (4) AVL integration, and (5) customer self-service. Features such as these can help improve a provider's ability to meet the needs of elderly and disabled customers.

In addition to the out-of-the-box features of scheduling systems, paratransit providers need to consider how well the software will integrate with existing systems and what type of training a potential vendor offers. The California Association for Coordinated Transportation has an online guide[16] for providers seeking to acquire demand responsive software and technologies.

Dynamic routing/scheduling can be employed to enhance a paratransit or a fixed-route system, allowing pickups/drop-offs to be added to a trip while en route. Recent and ongoing research has focused on the use of personal GPS devices for paratransit users for two applications – dynamic routing and improving pickup rates. Success in either of these activities can make a paratransit provider more efficient and increase ridership.[17]

> **Application**: Both rural and urban.
> **Target**:   Paratransit riders - elderly and disabled.
>   System-wide benefits also possible for flex routes.

Paratransit Scheduling Vendors:

RouteMatch
www.routematch.com
Routematch provides fixed-route, paratransit, billing, AVL, MDC, and other solutions for the transit industry. The company offers different levels of paratransit scheduling software based on the level of computer assisted scheduling. The product line ranges from completely manual to completely automated scheduling.

Mobilitat
www.mobilitatsoftware.com
Mobilitat, based in Wyoming, offers the Easy Rides dispatching and scheduling service packages. Easy Rides comes in three editions, designed for small to large

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[16] <http://www2.calact.org/assets/pdf/toolbox/penn-software-guide.pdf>
[17] U.S. Department of Transportation, Federal Transit Authority. Office of Mobility Innovation / Lehman Center for Transportation Research. Feasibility Study on the Use of Personal GPS Devices in Paratransit. By Fabian Cevallos et al. Washington: 2009.

providers, and includes GIS and AVL capabilities. Snake River Transit uses Mobilitat products for scheduling.

Trapeze
www.trapezegroup.com
The Trapeze Group offers a range of products and services to the public transportation market such as ITS, ridesharing, school transportation, and community transportation. It also offers automated scheduling, dispatching and reporting solutions. Trapeze does not specifically sell a product for paratransit use; however, it does have community transportation and medical transportation solutions.

Ridexpress
www.rideexpress.com
Rideexpress offers a scheduling software package that enables users to keep track of riders, routes, trips, etc. It also offers scheduling solutions. It doesn't appear to have automation abilities. They do publish the price on their website. A single-user version is $3,495 and a 5-user network system is $3,995. This company appears to market to senior citizen centers and other small-scale providers.

RouteLogic
www.routelogic.com/ProductsParaRoute.html
Routelogic offers five software products for transit providers. Their ParaRoute product contains the most features. It has order taking, scheduling, dispatching, mapping, reporting, and other features. Their website is informative because it provides a table that compares features between the five products.

Ontira
www.ontira.com/solutions/paratransit-demand_response.htm
Most of Ontira's product suite is geared toward improving transit and paratransit call center efficiency through online trip planners and real reporting solutions that integrate with other providers' solutions.

Mentor Engineering
www.mentoreng.com/solutions/index.html
Mentor Engineering offers solutions for transit, taxi, and other businesses. It offers transit ITS solutions for both fixed-route and paratransit providers. Its paratransit solutions have features designed to meet the needs of different users, such as managers, drivers, maintenance personnel, dispatchers, and passengers.

Logic Tree
www.logictree.com/content/solutions.htm
The main thrust of Logictree's product suite is geared toward communication technologies between a transit provider and their customers (including paratransit

providers and customers). One of their products enables paratransit customers to call and find out when their next scheduled trip is through voice recognition software instead of speaking with a customer service agent.

Logic Transport
www.logicaltransport.com/index.html
Logic Transport offers an integrated scheduling solution that enables multiple providers to schedule and collaborate together. It offers live scheduling, demand response transit, and taxi scheduling/dispatch. It also provides fixed, semi-fixed, and fully flexible scheduling solutions. It also offers real time tracking of vehicles.

IE Logistics
www.ielogistics.net/index.htm
IE Logistics offers solutions based on ArcLogistics by ESRI such as fleet management, scheduling, routing, etc. They also offer AVL and GPS solutions but they don't appear to specifically market a "paratransit" solution.

Ecolane
www.ecolane.com/index.html
Ecolane specializes in paratransit and demand responsive transportation (DRT) services. Their Ecolane DRT software fully automates the reservation, scheduling, and dispatching of paratransit services. They advertise that with their software users will not need scheduling or dispatching personnel.

CTS Software
www.cts-software.com
CTS has been in the paratransit software industry for 25 years. Their main software product is called TripMaster. The product provides scheduling, dispatching, mapping, billing, and reporting solutions. It also offers a brokering solution that enables collaboration among different providers.

Rider Training and Assistance

Many potential transit users are simply unfamiliar or uncomfortable with the system and therefore avoid it. Some people are new to the region or are temporarily or permanently unable to drive. Training can help all groups of riders, and can help paratransit users make the transition to fixed-route services. If paratransit riders are able to use regular transit, great cost savings can be realized if they can become comfortable using the public system.

Rider training can be static (printed material), automated (web-based videos, maps, updates), interactive (web-based applications), or in-person.

In-Person training programs are effective in a variety of communities – see discussion in *Users and Low-Tech Solutions* section on page X.

Rider assistance can be done with electronic devices as well as in-person by a caregiver, for example. Only technology-based methods of training and assistance are discussed here.

Rider Training and Assistance Options

Automated Rider Training is growing with the proliferation of video clips and online media. These and other emerging instructional media can assist the general public as well as target populations in getting acquainted and comfortable with a transit system. Other media to be employed may include public service announcements, demonstrations, and translations into the spoken languages of refugee groups and other non-English speaking populations.

Automated training is currently offered by VRT on the internet with video clips (through a YouTube page) that offer basic rider instructions. The videos include procedures for wheelchairs on various vehicles, and how to use various magnetic and smart cards with the fare boxes.
> **Role**: Transit provider, also volunteer/non-profit organizations.
> **Application**: Both rural and urban.
> **Target**: System-wide benefits including all target groups.

Interactive Rider Training is similar to interactive (online) trip planning, but offers more instruction based on the riders needs. (See *Traveler Communication Systems* section on page 30.)
> **Role**: Transit provider, some non-profit organizations.
> **Application**: Both rural and urban.
> **Target**: System-wide benefits; can be focused on target groups.

Travel Assistance Devices (TAD) help disabled riders navigate public transportation to become more independent. The TAD developed with the CUTR at the University of South Florida uses software, added to a rider's cell phone, with GPS to notify the rider when to "get ready" to get off soon – usually a few stops before his/her destination – and another prompt to "pull the cord now" to ask the driver to stop.[18]

Each trip must also be planned with the TAD's online trip planner (similar to Google Transit), which automatically downloads into the cell phone. Developers of the CUTR software hope to be able to offer the package for free. It is unclear what preparations or compatibility are required for the transit system schedule to work with the TAD network.

      Role: Transit provider, public assistance agency, non-profit organizations.

      Application: Both rural and urban.

      Target: Elderly and disabled.

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[18] "Travel Software to Aid Disabled Riders." Metro Magazine. Feb 2009. Metro Magazine. 16 Apr 2009 <http://www.metro-magazine.com/Article/Story/2009/02/Travel-Software-to-Aid-Disabled-Riders.aspx>.

Service Coordination

Coordinating transit and paratransit services, whenever possible, creates economies of scale and operating efficiencies, and can improve efficiency for providers while increasing mobility for users. It involves not only improving rider connections between provider systems, but sharing information and resources, including vehicles, can reduce costs.

In many areas there are several agencies that provide transportation for their clients and it is quite possible that services are redundant or overlap. In some states regional coordination is directed by law and there can be formal arrangements and roles for certain agencies. Other states help facilitate informal coordination and communication among providers.

There are also a number of vendors that offer software and other systems to help coordinate services among providers.

VRT has adopted a Transportation Service Coordination Plan[19] which includes an analysis for organizational models of coordination and recommendations for a lead agency role for the Treasure Valley. The key goals of the plan are to maximize existing public transit services, increase the efficiency of those services, and secure additional funding for those services.

Treasure Valley Transit provides paratransit services in Canyon County, and it loans vehicles to senior centers in the region to operate and schedule paratransit vehicles independently. Discussions are underway for the senior centers to consider coordination alternatives that can enhance their current transportation programs.

> **Application**: Both rural and urban.
> **Target**:   Elderly and disabled paratransit users, system-wide benefits also.

Service Coordination Examples and Resources

California Association for Coordinated Transportation
www.calact.org
Calact represents small, rural and specialized transportation providers in California, and offers a rural technical assistance program, training and certification, and links to appropriate insurance resources.

Texas Regional Planning Coordination Program
www.regionalserviceplanning.org

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[19] Transportation Serviced Coordination Plan. 29 Nov. 2007. Nelson/Nygaard Consulting Associates, Valley Regional Transit. 9 June 2009 <http://www.valleyregionaltransit.org/Portals/0/Studies/TSCP/FinalTSCP.pdf>.

The Texas RSP program focuses on interagency coordination and maintenance. They also connect providers in online communities for discussions and networking, and have an online transit coordination guidebook.

Service Coordination System Vendors

Trapeze
http://www.trapezegroup.com/
Trapeze offers a number of transit system products, and is well known for scheduling software. It also offers service planning and coordination.

CTS Software
www.cts-software.com
CTS' main software product is called TripMaster and offers a brokering solution that enables collaboration among different providers. The product also provides scheduling, dispatching, mapping, billing, and reporting features.

Route Match Software
www.routematch.com
RouteMatch offers a number of transit products, including packages for interagency coordination. The company's website includes a white paper[20] on the role of technology in coordination.

Logic Transport
www.logicaltransport.com/index.html
Logic Transport offers an integrated scheduling solution that enables multiple providers to schedule and collaborate together.

Additional information about these vendors can be found in the *AVL* and *Paratransit Scheduling* sections of this document (pages 10 and 23).

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[20] http://routematch.com/_documents/CoordinatedTransportationWhitePaper.pdf

Traveler Communication Systems

Transit providers can communicate both schedules and system updates to riders through a number of applications, including wireless devices, the internet and electronic message signs in transit vehicles, at bus stops (wayside), or in terminals.

Traveler Communication Options

In-Terminal Communication, or **Wayside Communication**, provides arrival/departure information of buses (or trains, etc.) at bus stops, terminals, stations, or platforms. Information is displayed on monitors, variable message signs, sign boards, passenger information displays, and/or electronic kiosks. They are best if interactive and offer real-time information. They are most applicable in larger systems and/or in areas with high foot traffic or high passenger volumes. (See also Multi-Modal Traveler Information Systems discussion, below.)

> **Costs**   Informational Kiosk – $10,000 - $22,000
>   (includes hardware/software, server, enclosure, install)
>   Kiosk Upgrade for Interactive Use – $5,000 - $8,000
>   LED Transit Status Information Sign – $4,000 - $8,000
>   Smart Card Vending Machine – $27,000 - $29,000
> **Application**: Mostly urban, some costs prohibitive for smaller systems.
> **Target**:   System-wide benefits including all target groups.

In-Vehicle Communications can automatically provide visual and/or audio announcements on transit vehicles. Typically, announcements include next stop, major cross road, transfer point, landmark, and/or destination information. Additional information, such as public service announcements, can be included. These can reduce distractions to the driver (fewer questions from riders) as well as raise funds from advertizing. With on-board computers, in-vehicle communication devices can also be interactive and provide multi-modal information.

> **Application**: Both rural and urban.
> **Target**:   System-wide benefits including all target groups.

Multi-Modal Information systems employ electronic media (monitors, kiosks, internet, instant/text messaging, etc.) to provide real-time and/or static information on transit schedules to enable travelers to make fully-informed mode choice decisions, both pre-trip and en-route. Location of devices is most effective at high-volume transit stops, and can also be part of an on-board information and communication system.

> **Application**: Both rural and urban.
> **Target**:   System-wide benefits including all target groups.

Online Trip Planners are becoming more common throughout the country, and may also be called web-based or route planners. While most Americans are

familiar with online airline bookings/procedures, online transit trip planners are just catching on. They are available via several vendors and software packages now, and VRT has explored the possibility of using Idaho 511 or Google Transit for an online service. Fleet-Net offers an online trip planning module.

Trip planners can be static and/or real time, and may include transit routes, maps, schedules, fares, park-and-ride lot locations, transit trip itineraries, etc. Media supporting pre-trip information may be static or real-time, but must be up-to-date. Trip planners are more valuable with real-time bus/train status (possibly via AVL), and can relieve some burden on customer service agents – unless the system isn't functioning properly.

Over time, data collected from planned trips may help providers identify new rider needs and achieve more efficiency in routing and scheduling.
> **Application**: Both rural and urban.
> **Target**:   System-wide benefits; potentially helpful to all target groups.

Personalized information systems are either tailored to meet an individual's needs (e.g., a travel profile) or subscriptions for notices (also called a push-based system). They may include incident notification, transit vehicle arrival alerts, or other information. Messages are received via e-mail, personal digital assistants (PDA), or text message. Twitter is one mode that could be used as part of a personalized information system for transit. Personalized information has great potential to enhance ridership in a transit system.
> **Application**: Both rural and urban.
> **Target**:   System-wide benefits; potentially helpful to all target groups.

Web-Based Traveler Information is closely associated with trip planning technology, and it can be the base for personalized information systems. Users have access to a combination of static and real-time information to aid them in trip planning or making other decisions.
> **Application**: Both rural and urban.
> **Target**:   System-wide benefits; potentially helpful to all target groups.

Communication System Partners and Vendors

innovation in traffic systems (init)
www.initusa.com
Init offers MOBILE telematic systems - modularly structured to include on-board computers, passenger information displays, and electronic payment systems. They also offer passenger information systems for wayside or on-board vehicles.

Google Maps/Google Transit

http://maps.google.com/help/maps/transit/partners/
Transit in Google Maps is a "public transportation planning tool that combines the latest agency data with the power of Google Maps. It integrates transit stop, route, schedule, and fare information to make trip planning quick and easy for everyone. For agencies around the world, Google Maps is a cost-effective solution targeted at transit novices and seasoned travelers alike." There is no charge to providers, although there are technical requirements. Demand is currently very high and they are currently not accepting new agency applications.

It is available in 12 different languages, and is "compatible with screen readers for the visually impaired. Transit information is also available in Google Earth and Google Maps for Mobile."

Idaho 511
http://511.idaho.gov/
The Idaho Transportation Department sponsors Idaho 511 and offers regularly updated highway information. VRT has explored the possibility of a relationship with Idaho 511 for trip planning and traveler information.

NextBus
http://www.nextbus.com/corporate/index.htm
NextBus uses AVL technology to communicate arrival and travel times to assist users in making decisions with real-time information. See also NextBus information in the *AVL* technology section on page 10. "NextBus information is not a static schedule listing — it is actual arrival information, updated at regular intervals. Because traffic variations, breakdowns, and day-to-day problems faced by any transit provider can interrupt service, NextBus was designed to keep you on schedule even if your bus or train isn't."

Trapeze
www.trapezegroup.com
Trapeze Group offers RidePro (a vanpool finder) and other software. They provide a range of other products, including scheduling software and AVL technology.

Location-Efficient Housing/Transit Information assists target populations and other riders in making housing choices that are compatible with their transportation needs – and vice-versa. Businesses can also employ housing/transit efficiency data in marketing or location decisions. Although geographic information about transit lines and stops, bike lanes, and paratransit services are usually available online, it is not usually presented in a coordinated fashion. If presented together, riders and businesses can use the data make more efficient choices.

In communities with fixed-route transit many people and businesses include proximity to transit in decision making – where to live/locate a business and where to seek employment/employees. In communities without fixed-route transit it appears that fewer people and businesses (or public agencies) include transit/paratransit services in their choices for location.

An ideal location-efficient database, using online GIS programs or mapping applications, provides consumers with information about potential housing and business choices. For instance, before an elderly or disabled person rents an apartment, he/she should be able to easily determine all the transit and paratransit options available for that address. Ability (walking distance, sidewalks, etc.) and eligibility information should also be available. Further, he/she should be able to easily determine if his/her doctor, church, or community center is accessible from that location, or which doctors, churches, etc. are accessible. Low-income and other riders, especially bike riders, can also benefit by matching bus routes and similar data with bike lanes/trails.

        Application: Mostly urban.
        Target: Paratransit users and transit-dependent groups; system-wide benefit also.

Users and Low-Tech Solutions

In analyzing technologies for transit, the potential for low-tech (non-electronic) or even non-technical solutions should also be considered in improving mobility. These range from rider training to on-board storage compartments. Some are applicable for users to invest in individually, and can be promoted as complements to a transit system.

Low-Tech Options and Applications

Electric and **Folding Bicycles** are discussed in the Bicycle Technologies and Practices section (page 14). Folding bicycles and electric bicycles, or e-bikes, are possible user investments that can expand the functional service area of a transit system.

> **Role**: Individual investment, can be promoted/encouraged by transit provider.
>
> **Application**: Both rural and urban.
>
> **Target**: Low-income and other transit dependent groups. Some elderly or impaired persons may choose electric bikes because of the power assist. Folding bikes add overall benefits to cyclists using the system.

Bike Sharing/Rental Systems and bike **Lockers** are discussed in the Bicycle Technologies and Practices section (page 14). Both are solutions to encourage greater use of bicycles and transit, and can be privately funded with support from or lease agreements with transit providers and local governments.

> **Role**: Public or private investment, can be sponsored by transit provider or local government.
>
> **Application**: Both rural and urban.
>
> **Target**: Low income and other transit-dependent groups. System-wide benefit to bike riders.

Rider Training programs (in-person) can be personal or group-focused, and are effective in numerous communities. In some metropolitan areas transit providers are collaborating with each other or with outside partners to provide targeted training programs to educate and encourage the use of transit.

As featured in one *Metro Magazine* article,[21] field trips and other demonstrations are being created to focus on specific groups. For children this includes a cooperative program with a children's museum, or field trips to transit stations and bus

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[21] "Tailored Programs Educate Public on Transit Options." Metro Magazine Dec 2008. Metro Magazine. 23 Feb 2009. <http://www.metro-magazine.com/Article/Story/2008/12/Tailored-Programs-Educate-Public-on-Transit-Options.aspx>.

maintenance facilities. The author noted that creativity and the use of technology in the training is vital.

For seniors, the focus can be to increase comfort levels – and use – of fixed-route transit to ease the burden on the paratransit system, and to encourage aging drivers to leave their cars behind. Additionally, Easter Seals' Project ACTION "trains the trainers" who work with disabled riders.

        Role: Transit/Paratransit providers offer training.
                                   Also offered by non-profits or special interest groups.
        Application: Both rural and urban
        Target: Elderly, disabled, and children; system-wide benefits.

Loading Platforms are higher than a sidewalk or street and provide floor-level access to transit vehicles without requiring riders to climb up or be lifted into a bus, van, or train. The use of loading platforms greatly reduces the amount of time to load wheelchairs and makes boarding and alighting much easier to all users, including elderly or mobility-impaired passengers. They are an integral part of many BRT and rail transit systems. In some places ramps are used for the same purpose.

However, transit and paratransit vehicles must be compatible with platforms – they must be able to pull alongside the platform and have the floor level with it. For instance, a bus with fixed steps is incompatible with most platforms. Platforms are also difficult to implement in a system with several vehicle types, and if a platform will be used by more than one provider with different vehicles.

        Role: Transit provider or host/destination.
        Application: Both rural and urban
        Target: Disabled, elderly riders; system-wide benefits.

Kneeling Buses have the capability to release air from their suspension systems and lower the carriage. They make loading of all passengers easier and are becoming common in the U.S. All VRT buses are kneeling buses.

        Role: Transit provider.
        Application: Both rural and urban.
        Target: Disabled, elderly riders; system-wide benefits.

Low-Floor Buses have similar advantages kneeling buses, since they are closer to the ground than a standard bus. A low-floor bus also has no steps between the entrance and all or part of the bus. Because there are no steps on low-floor buses, some are compatible with platforms for loading.

        Role: Transit provider.
        Application: Both rural and urban.
        Target: Disabled, elderly riders; system-wide benefits.

On-Board Storage is important to passengers who are transit-dependent and use the system for shopping trips, including rural customers who travel into urban centers for shopping. However, most transit vehicles are not equipped for riders to transport anything besides what can be held on their laps. Luggage compartments are more common on airport shuttles and overhead storage racks are seen on long-distance buses. This is a low-tech solution that providers can implement to better accommodate these passengers while securing their belongings in order and out of the way. On-board storage can be either factory-installed or retrofitted. Under-carriage storage areas can also be used – for bicycles as well as other belongings.

Role: Provided by transit/paratransit agency on vehicle.
Application: Both rural and urban.
Target: Low-income and other transit dependent users.

Appendices

Appendix A: Glossary of Terms

Automatic Passenger Counter (APC)
A technology installed on transit vehicles that counts the number of boarding and alighting passengers at each stop while also noting the time. Passengers are counted using various technologies, such as pulse beams, video, etc. Stop location is generally identified through use of either GPS or signpost transmitters in combination with vehicle odometers.

Automatic Vehicle Location (AVL)
A system that detects and monitors the real-time location of transit vehicles carrying special electronic equipment that communicates a signal back to a central control facility, locating the vehicle and providing other information about its operations or about its mechanical condition.

Bus Rapid Transit (BRT)
A public transit service that uses buses and dedicated right-of-way or dedicated bus lanes, often with signal priority.

Digital Radio
Radio technologies that carry information as a digital signal instead of analog.

Fare Box
A device that accepts the coins, bills, tickets and tokens, or electronic payment given by passengers as payment for rides.

Fixed Route
A transit service provided on a repetitive, fixed-schedule basis along a specific route, with vehicles stopping to pick up passengers at, and deliver passengers to, specific locations.

Flex-Route
A point-deviation service in which transit vehicles stop at designated bus stops (points) at scheduled times, but during the time between two scheduled stops, drivers pick up and drop off passengers with advance reservations over a dispersed area.

Geographic Information System (GIS)
A computer system that captures, stores, analyzes, manages, and presents data as well as geographic information.

Global Positioning System (GPS)

A navigation system using satellite signals to fix the location of a radio receiver on or above the earth's surface. OR – A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on earth by calculating the time difference for signals from different satellites to reach the receiver.

Magnetic Card/Magnetic Stripe Card

A type of card (paper or plastic) capable of storing data by modifying the magnetism of tiny particles on a band of magnetic material on the card. The magnetic stripe is read by physical contact and swiping past a reading head. The technology is most commonly used in credit cards, identity cards, and transportation tickets.

Mobile Data Terminal/Mobile Data Computer (MDT/MDC)

A computerized device used in public transit vehicles, taxicabs, courier vehicles, service trucks, trucking fleets, military logistics, fishing fleets, warehouse inventory control, and emergency vehicles to communicate with a central dispatch office.

National Transit Database

Established by Congress to be the nation's primary source of information and statistics on the transit system of the United States.

Near Field Communication (NFC) Technology

A short-range wireless technology that embeds chips and antennas in phones and other devices enabling them to act like contactless cards (SmartCards) and also the technology for receivers to read data from contactless chips.

Open Payment System

The acceptance of payments for fares from a variety of sources, such as debit and credit cards or other electronic payment. A closed payment system (for a transit provider) would limit riders to using cash, tokens, or tickets sold only by the provider.

Paratransit

Type of passenger transportation that is more flexible than conventional fixed-route transit but more structured than the use of private automobiles or taxis. Paratransit includes demand response transportation services, shared-ride taxis, carpooling, and vanpooling. Most often refers to wheelchair-accessible, demand response service.

Research and Innovative Technology Administration (RITA)

A division of the U.S. Department of Transportation that coordinates research programs and is charged with advancing the deployment of cross-cutting technologies to improve the nation's transportation system.

SmartCard

A plastic card containing a computer chip that enables the holder to purchase goods and services (such as a transit ticket), enter restricted areas, access medical, financial and other records, etc. SmartCards are contactless – they need only to be held near the receiver to be activated.

Tap Cards/Tap Tags

An embedded technology similar to SmartCards but is activated by a tap vs. being contactless. Users tap their phone or other device against the tag, which automatically opens an application on the phone/device or secure chip inside it to allow riders to easily pay fares or buy/reserve tickets.

WIFI

A local area network that uses high frequency radio signals to transmit and receive data over distances of a few hundred feet.

Appendix B: Electric Bicycles

<u>Overview</u>

Electric bikes (e-bikes) and motors, when combined with other bicycle options, add utility and distance to bicycles. They also complement bus and train systems for long-range point-to-point transportation. For more information on e-bikes, electric scooters, and other options, visit <u>Electric-Bikes.Com</u>.

Company	Website	Order Process	Pricing*	Note
Amped Bikes	www.ampedbikes.com	Dealer / Online	$360	Offers kits to convert bikes to electric
Currie Technologies	www.izipusa.com www.currietech.com	Dealer / Online	$799 to $3000	Multiple models, Lithium Ion batteries, ezip / izip product lines, incl scooters
Electric Motion Sys.	www.e-ms.us	Direct Online	Ave $3000	New company with new product
eZee	www.ezeebike.com	Dealer		Lithium polymer batter, 350 W motor
Giant Manufacturing	www.giant-bicycles.com/en-us	Dealer	$2,255	
Intnl. Ecological Sys.	www.cycleies.com	Direct Online	$595 to $895	Offers two bikes, 250W motor
OHM Cycles	www.ohmcycles.com	Dealer		Offers a few models. Motor ranges from 250 to 450 W
Powabyke LTD	www.powabyke.com	Dealer / Online	$900-1200	Offers different bikes for different purposes - shopping, commuting, etc.
Prima Power	www.powerbikes.com	Dealer		Offers multiple models
Schwinn	www.schwinnelectricbikes.com	Dealer		3 models
Ultra Motor	www.ultramotor.com	Dealer		3 electric bike models, scooters also

Prices from individual vendor websites.

E-Bike Images

Currie	Electric Motion Sys.	Ezee	OHM	Schwinn

Appendix C: Folding Bicycles

Overview

Using public transportation can help improve the mobility options for many low income households. However, not every low income household is close to a bus stop. Also, the destinations for low income households may not be close to bus stops either. To solve this particular road block to using public transit as a mobility option, individuals can purchase bikes to ride to and from a bus stop that may be too far for walking. However, a potential problem to combining these two modal options is bicycle storage. Many buses only have room for two bikes on the bus bike rack.

A potential solution to this problem is the use of folding bikes. Folding bikes can be used on the first and last legs of a bicycle/transit/bicycle trip without the need of bike storage capacity on buses.

Industry and Pricing

There are approximately 100 different folding bike manufacturers across the world with about 17-20 manufacturers located in the U.S. Many foreign-based manufacturers have distributors and retailers in the U.S. The price for a folding bike ranges from $179 to $7,000, depending the size and purpose of the bike. The higher prices are typically for racing and mountain bikes that can be easily folded to transport the bike long distances. The price for typical city commuter folding bikes ranges between $199 and $700. The average weight for a city folding bikes is about 25 lbs. Many of the bike manufacturers offer bags for the bikes once they are folded down and some manufacturers have chainless models to avoid the dirt and grease associated with regular chain bikes.

Examples
The two pictures

Contents

 below illustrate the typical folding bike. The picture on the left is an un-folded bike and the picture on the right is the same bike that is folded down. Most bikes can be folded and unfolded within a couple of minutes (see additional photos below).

(Dahon)

Availability

Most manufacturers sell through retailers.   However, some also sell directly to the consumer via the internet.   Out of 18 local bicycle retailers that were contacted, only two had a folding bike currently in stock. Two other retailers occasionally carry folding bikes and anticipate ordering/receiving new shipments within a month. Walmart's online store also carries a folding bike for $179. The local stores who currently carried a folding bike were A1 Bicyles and REI. Capital Schwinn Sports and Bicycle Mania did not carry any when contacted but expected to order/receive more within one to two months.

Company	Website	Order Process	Pricing*	Weight	Note
Abio	www.abiobikes.com	Through Dealers	$790	29-30 lbs	Chainless drive, 220 lb capacity
Bike Friday	www.bikefriday.com	Dealer / Direct Online	$895 to $7000	18 to 55 lbs	Offers multiple models, a folding tandem bike, customized bikes
Breezer	www.breezerbikes.com	Through Dealers		19 to 32 lbs	Has different models. Capacity up to 230 lbs for larger bike.
Citizen Bike	www.citizenbike.com	Direct Online	$649		20", 6-speed, alloy frame, can also purchase storage bag
Dahon	www.dahon.com	Dealer / Direct Online	$199 to $2300	ave 25 lbs	Been in business for 25 years. Max weight around 230lbs.
Downtube	www.downtube.com	Dealer / Direct Online	$399 to $559	ave 25 lbs	Various models. Some come with full suspension.
Dynamic Bicycles	www.dynamicbicycles.com	Dealer / Direct Online		28 lbs	Offers chainless bikes. Offers one folding bike model that is sold out.
ixi	www.ixibike.com	Direct Online	$799 to $999	26 lbs	Customized. Rubber belt instead of chain. Recently featured in Statesman.
KHS	www.khsbicycles.com	Dealer			Offers various types of bikes including folding bikes.
Kinn-Ovations	www.kinn-ovations.com	Dealer / Direct	$399		Chainless bike - uses a drive shaft. Offers one model that folds and is chainless.
LucaBike	www.lucabike.com				Appears to be a new company. Little info on pricing, etc.
Montague	www.montagueco.com	Dealer / Direct Online	$499 to $699	29 to 31 lbs	Folding mountain bikes. Not geared toward urban uses.

Company	Website	Order Process	Pricing*	Weight	Note
Schwinn	www.schwinnbike.com/us/eng	Dealer			Offers multiple bikes in addition to one folding bike model.
Slingshot	www.slingshotbikes.com	Direct Online	$599 (frame)		Offers a folding frame - geared toward transporting mountain bikes, not commuting.
Sun Bicycles	www.sunbicycles.com	Dealer			Offers multiple bikes, e.g., tandem, recumbent, and folding bikes.
Swift	www.swiftfolders.com	Dealer	$920	28 lbs	Offers only one bike – folding.
Xootr	www.xootr.com	Dealer / Direct Online	$699		Offers small folding scooters and bikes.

Prices from individual vendor websites.

Folding Bike Images

Abio	Bike Friday	Breezer Bikes	Downtube