Automatic Vehicle Location Fact Sheet: Transit Overview

September 2007

Technology Overview

An **Automatic Vehicle Location (AVL)** system is a computer-based vehicle tracking system that uses a specific location technology (usually **Global Positioning Satellites – GPS**) and a method of transmitting that real-time location of any receiver-equipped bus, van, train, or boat from the vehicle to a dispatch center. **GPS** satellites locate the bus, and the location data are then transmitted to the transit center through the communications system. The AVL-data can be used immediately for daily operations or archived for further analysis.

Use AVL to:

- Locate transit fleet
- Monitor schedule performance
- Assign appropriate vehicle for route deviation or demand response pickup
- Provide more efficient transit vehicle and modal connections
- Enhance on-board safety through quicker incident response

As a stand-alone technology, AVL does not serve many functional purposes. When combined with other technologies or processes, however, it can deliver many benefits in the areas of fleet management, systems planning, safety and security, traveler information, fare payment, and data collection. Introduction of an AVL system is often the first step in a more comprehensive **Intelligent Transportation Systems (ITS)** implementation.

Common Technology Combinations

Daily Operations

Combined with **Computer-Aided Dispatch (CAD)** and **Geographic Information Systems (GIS), AVL** optimizes dispatching and allows each vehicle to service more passengers. Agencies often realize reductions in nonrevenue miles, passenger wait times, and fleet size. AVL is utilized by **Transit Signal Priority (TSP)** systems through the detection of specific transit vehicles as they approach select intersections.

Safety and Security

AVL data displayed on a GIS map facilitates incident response.

Systems Planning and Fleet Management

AVL data can be used for systems planning and fleet management. When this data are combined with bus stop and facility inventory data, they can be mapped on GIS. These data can also be linked to **Automatic Passenger Counters (APC)** to gather ridership information by location and time. The data can be used for planning routes, schedules, and facility and fleet requirements.

Traveler Information

When linked to an electronic **traveler information infrastructure**, an AVL system will provide information on expected arrival times.

Electronic Fare Payment

An AVL system will collect fare information by location and trigger **electronic fare boxes** to accept different payment amounts across fare zones.

Is This Technology Right for My Agency?

AVL systems provide a number of benefits, including:

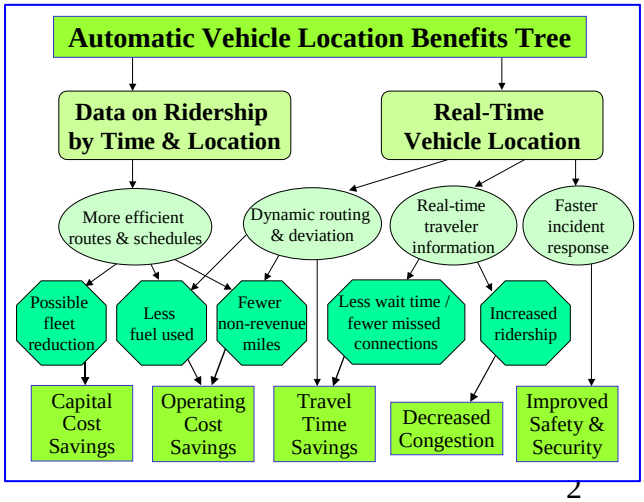
- Interoperability with existing and planned technologies
- Flexibility for changes in fleet size
- Capability for testing technology on a subset of vehicles
- Capacity for data storage and analysis
- System-sharing across modes and across agencies in a regional context

Automatic Vehicle Location
Core Technology By Mode

Agency Size	Transit Mode: Fixed Route Bus	Demand Response	Rural Transit	Human Service Transit	Rail Transit	Ferry Boat
Large	✓	✓	✓	✓	✓	✓
Medium	✓	✓	If AVL is desired, use low-cost, cell phone, internet-service option		Light Rail with ✓ Transit Signal Priority	✓
Small	✓	If AVL is desired, use low-cost, cellular phone, internet-based service option				✓

AVL systems are available at a wide range of costs and levels of sophistication to satisfy the budget constraints and needs of most agencies. Smaller agencies may wish to consider off-the-shelf, web-based systems, while larger agencies can contract with a vendor to install customized, integrated systems.

Agencies that have already implemented some of the technologies can extract more benefits by adding AVL. In general, AVL is a core technology for ***larger agencies***, especially bus and multimodal agencies, as they can spread the cost of the system over a larger fleet size. Larger agencies also require more complex analytical tools for systems planning and fleet management. Human services and demand-response agencies can capture the most benefits from an AVL-based communications and dispatching system that allows for dynamic rerouting and more efficient fleet utilization.



Benefits and Costs

Benefits

- Decreased passenger late arrivals by 21%.
- Improved on-time bus performance by 9%–23% in large cities.
- Reduced incident-response time by up to 50%.
- Possible savings include:
  - Reduced data-collection costs (Atlanta's MARTA reports saving $40,000 per year).
  - Decreased labor costs for schedule checkers.
  - Fleet reductions of 2%–5%, especially with CAD (Kansas City saved $1.6 million).

Costs

Price

Costs for onboard GPS equipment ranges from $500 to $2,000 per vehicle. Total implementation costs per vehicle can reach $15,000, with median per vehicle cost estimated at $8,000. Atlanta paid $27,000 per vehicle with CAD integration.

A stand-alone AVL system cost a small rural agency in Iowa $80,000, whereas Baltimore paid close to $8 million for its implementation.

A small agency paid $60,000 for a 12-vehicle deployment of AVL linked to traveler information, while a large urban agency incurred a cost of $70 million to equip 5,700 buses. The median AVL system deployment cost is in the $200,000 range.

Commercial GPS can pinpoint a vehicle's location to within 3 to 4 feet.

Operations and Maintenance (O&M)

O&M costs for onboard equipment average 2% of the original capital cost.

- Recurring costs can include telecom service fees.
- Capital costs ranged from $10,000 to $50,000 per dispatch center in 1999.

Training

Expect an eight-hour day per driver and dispatcher for **AVL** and **Mobile Data Terminal (MDT)** implementation.

Transit Agency Deployments

Agency	Contact Information	Number of Vehicles	Context / Success of Deployment
Los Angeles County Metropolitan Transportation Authority (LAC MTA)	One Gateway Plaza Los Angeles, CA 1-800-COMMUTE (1-800-266-6883)	2,450 buses	Integrated AVL system archives and automatically feeds run-time data to scheduling department.
Denver Regional Transportation District (RTD)	1600 Blake St. Denver, CO 303-628-9000	1,335 buses	Use of AVL, combined with an upgrade in the radio communications system and MDTs, improved on-time performance and increased ridership.
Metro Transit (serving Minneapolis/St. Paul)	560 Sixth Ave. N. Minneapolis, MN 612-373-3333	922 buses	Integrated AVL and CAD along with APC and a new regional digital 800MHz radio system.

Metropolitan Atlanta Rapid Transit Authority (MARTA)	2424 Piedmont Rd. Atlanta, GA 404-848-5000	556 buses	Use of AVL and CAD resulted in operating savings and provided detailed cost information.
Milwaukee Country Transit System (MCTS)	1942 North 17th St. Milwaukee, WI 414-344-4550	484 buses	Use of an integrated AVL system improved on-time performance and adherence to schedules.
Montachusett Area Regional Transit Authority (MART)	R1427 Water St. Fitchburg, MA 978-345-7711	23 buses	Employs AVL and MDT for its fixed and demand-response buses.

Additional Resources

- Real-Time Bus Arrival Information Systems Return-on-Investment Study (August 2006), http://www.fta.dot.gov/documents/Final_Report_-_Real-Time_Systems_ROI_Study.doc
- ITS Applications for Coordinating and Improving Human Services Transportation – A Cross-Cutting Study (August 2006); http://www.itsdocs.fhwa.dot.gov/jpodocs/REPTS_TE/14140.htm
- Advanced Public Transportation Systems: State-Of-The-Art Update 2006 (March 2006), http://www.fta.dot.gov/documents/APTS_State_of_the_Art.pdf
- Best Practices for Using Geographic Data in Transit: A Location Referencing Guidebook - Defining Geographic Locations of Bus Stops, Routes and other Map Data for ITS, GIS and Operational Efficiencies (April 2005); Report No.: FTA-NJ-26-7044-2003.1; http://www.fta.dot.gov/assistance/research/research_4611.html
- Strategies to Expand and Improve Deployment of ITS in Rural Transit Systems – TRB Document 84 / Project J-09 (February 2005); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_84v6.pdf
- Handbook of Automated Data Collection Methods for the National Transit Database (October 2003), http://www.nctr.usf.edu/pdf/473-11.pdf
- Uses of Archived AVL-APC Data to Improve Transit Performance and Management: Review and Potential - TCRP Web Document 23 / Project H-28 (June 2003); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_23.pdf
- Guidance for Developing and Deploying Real-Time Information Systems for Transit (April 2003); http://ntl.bts.gov/lib/23000/23600/23663/RTTIS_Final.pdf
- Rural Transit ITS Best Practices (March 2003); Report No. FHWA-OP-03-77 / EDL No. 13784; http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13784.html
- Guidebook for Selecting Appropriate Technology Systems for Small Urban and Rural Public Transportation Operators - TCRP Report 76 / Project B-17 (2002); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_76.pdf
- Bus Rapid Transit and the use of AVL Technology: A Survey of Integrating Change (2002); California PATH Research Report No. UCB-ITS-PRR-2002-17; http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1559&context=its/path
- Advanced Public Transportation Systems for Rural Areas: Where Do We Start? How Far Should We Go? - TCRP Web Document 20 / Project B-17 (June 2001); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_20.pdf
- ITS Decision Website: Automatic Vehicle Location (Last updated: February 2001); Caltrans and California Center for Innovative Transportation at the University of California at Berkeley; http://www.calccit.org/itsdecision/serv_and_tech/Automatic_vehicle_location/automatic_vehicle_location_summary.html
- Automatic Vehicle Location Successful Transit Applications: A Cross-Cutting Study (August 2000); Report No. FHWA-OP-99-022/ FTA-TRI-11-99-12 / EDL No. 11487; http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//11487.pdf