



GPS Applications in United States Transit

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GPS Applications in United States Transit

In U.S., **Automatic Vehicle Location (AVL)** currently is synonymous with use of **Global Positioning System**

- Pre-1980's – Radio voice communication
- Up to early 1990's – Odometer & Signpost systems
- 1990's – GPS dominant AVL technology
- May 1, 2000 – U.S. Government stopped intentional degradation of GPS signals
- 2008 - GPS technology represents 80+% of all transit AVL systems deployed

GPS Applications in United States Transit

Transit seeks improvements to:

- Operations
- Communications
- Passenger Information

- Scheduling & Planning
- Safety & Security

BENEFITS from GPS Deployments

Operations

- Productivity gains (increased passenger trips / capital savings – reduced fleet demands)
- Improved schedule adherence
- Labor savings (fewer road supervisors, less manual data entry)

GPS Applications in United States Transit

BENEFITS from GPS Deployments (continued)

Communications

- Improved communications between transit operations staff
- Reduced voice radio traffic

Passenger Information

- Predict bus arrival times
- Reduces complaints about late vehicles

Scheduling & Planning

- More complete & accurate data
- Aids in effective bus stop placement

Safety & Security

- Enhances driver & traveler safety & security
- Better response to route detours

GPS Applications in United States Transit

AVL-GPS System Costs dependent on:

- System size
- Level of sophistication
- Components to be included/integrated

COSTS

- \$500-\$2000 per vehicle
- O&M cost = 2% capital

TOTAL Project Cost:

- \$15,000 maximum per vehicle
- \$8000 median per vehicle

LEVEL OF SOPHISTICATION & INTEGRATION

Standard:

- Computer Aided Dispatch
- Mobile Data Terminal
- Emergency Alarms
- Digital Communications

Sophisticated:

- Real-time Passenger Information
- Automatic Passenger Counters
- Automated Fare Payment Systems
- Automatic Stop Annunciation
- Automated Destination Signs
- Vehicle Component Monitoring
- Traffic Signal Priority

GPS Applications in United States Transit

U.S. TRANSIT MODES

2,000 Agencies



Fixed Route Bus

Rail Transit



65 Rail Systems



5,400 Agencies

Demand Response Service

3,600 Agencies



Human Services Transit

1,260 Agencies



Rural Transit



46 Agencies

Ferry Boat

GPS Applications in United States Transit

% of U.S. TRANSIT MODES that use GPS

2,000 Agencies



15%

Fixed Route Bus

Rail Transit



65 Rail Systems

40%



5,400 Agencies

Demand Response Service

25%



3,600 Agencies
Human Services Transit

10%



1,260 Agencies

20%

Rural Transit



>75%

46 Agencies
Ferry Boat

GPS Applications in United States Transit

Number of Public Transit Agencies Using GPS Technology:

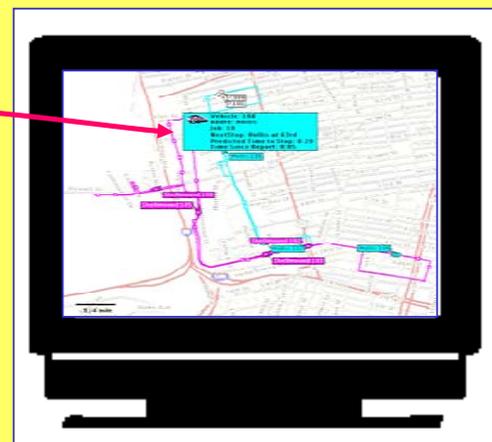
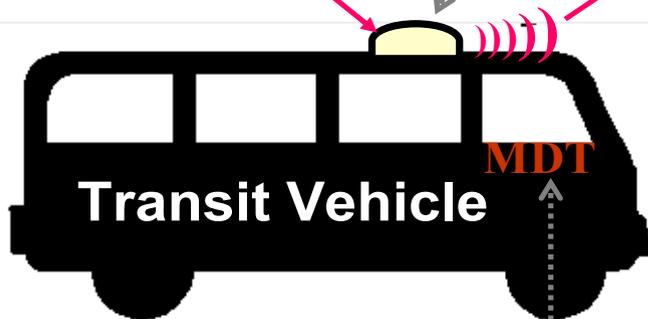
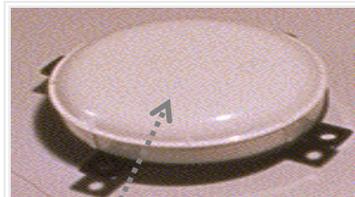
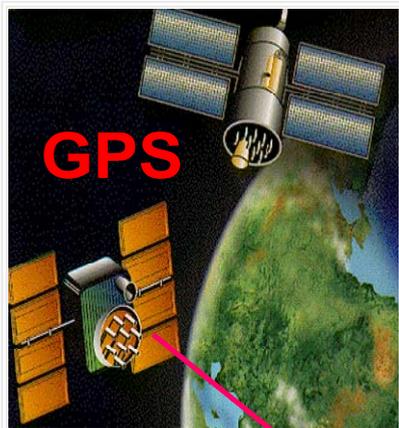
- Between **1,200** and **2,000**

Primary GPS Transit Applications:

1. Automatic Vehicle Location (AVL)
2. Geographic Information System (GIS)
3. Traveler Information System
4. Transit Signal Priority
5. Automatic Passenger Counters (APC)
6. Electronic Fare Payment System

GPS Applications in United States Transit

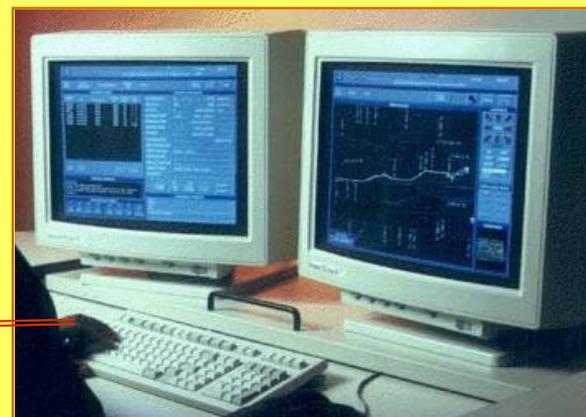
Automatic Vehicle Location



Dispatch Center

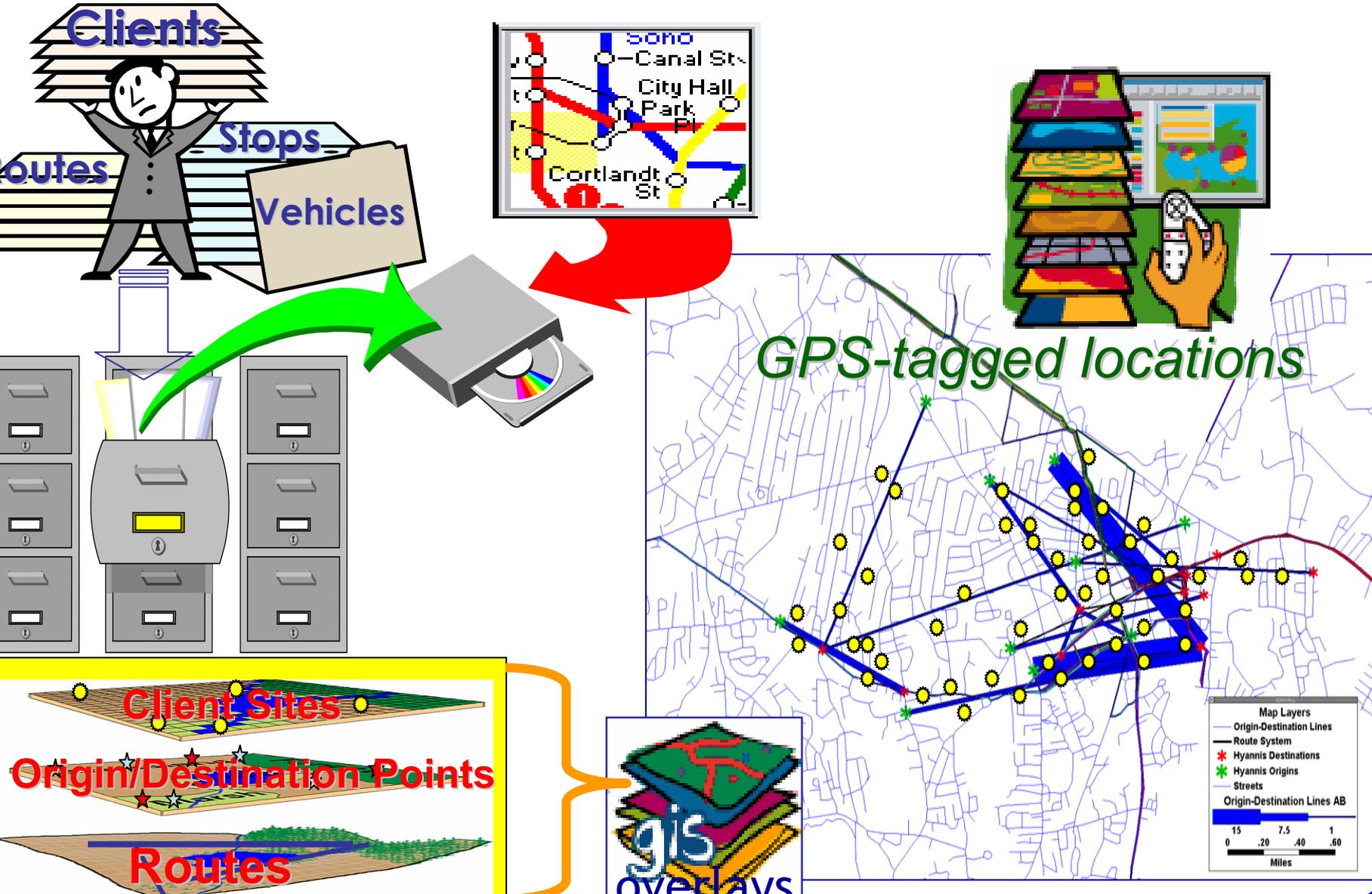


Mobile Data Terminal (MDT)



GPS Applications in United States Transit

Data Management & GIS



Top GPS Purposes for Geographic Information Systems

1. Bus Stops
2. Automatic Vehicle Location (AVL)
3. Bus Stop Amenities
4. Rail Stops
5. Rail Right-Of-Way
6. Transit Yards and other facilities
7. Transit Real Estate

GPS Applications in United States Transit

Traveler Information

Transit Information Center



Work / Home Transit Trip Planning

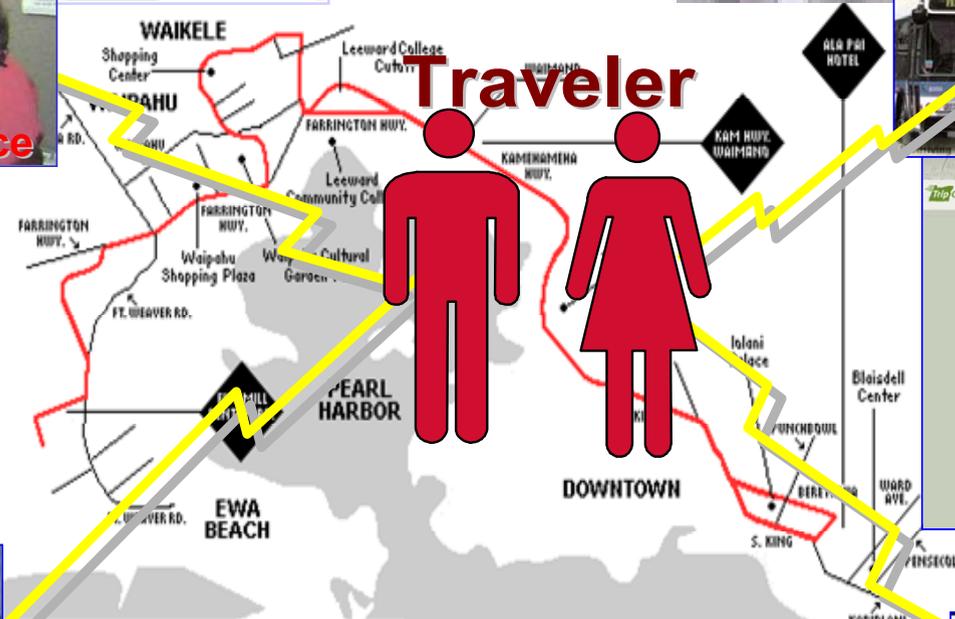


Starting Point & Destination

Starting From:
Street Address: [Address: (e.g. 1234 Wash Street)]
City: []

Going To:
Street Address: []
Landmark: []
Intersection: []

Estimated Time: 45 min PM am/pm



Route 48 Ewa Mill/Waikale/Honolulu

EASTBOUND: EWA MILL TO ALAPAI HOTEL
WESTBOUND: ALAPAI HOTEL TO EWA MILL

In-Station Information Kiosk



En-Route Real-time Transit and Multimodal Information

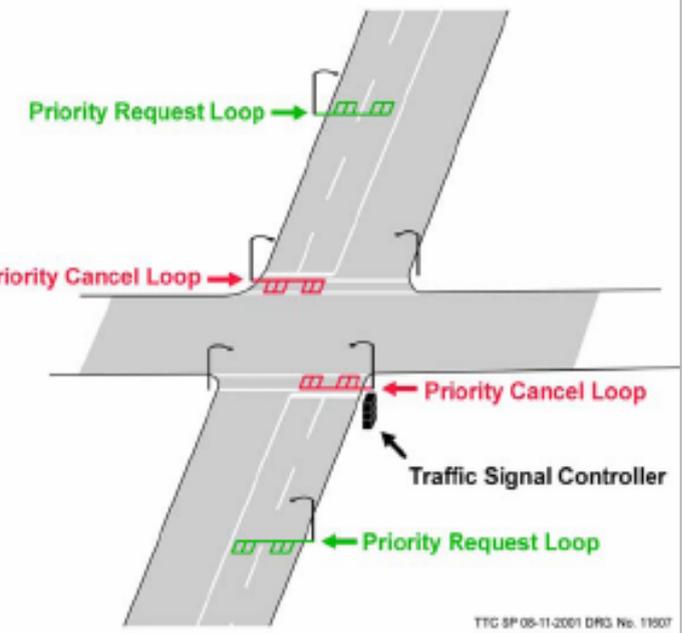
In-Station Travel Information

Transit Schedule enabled by GPS

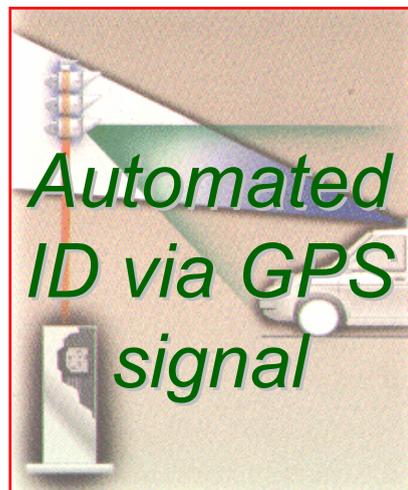
GPS Applications in United States Transit

Traffic Signal Priority

Signalized Intersection

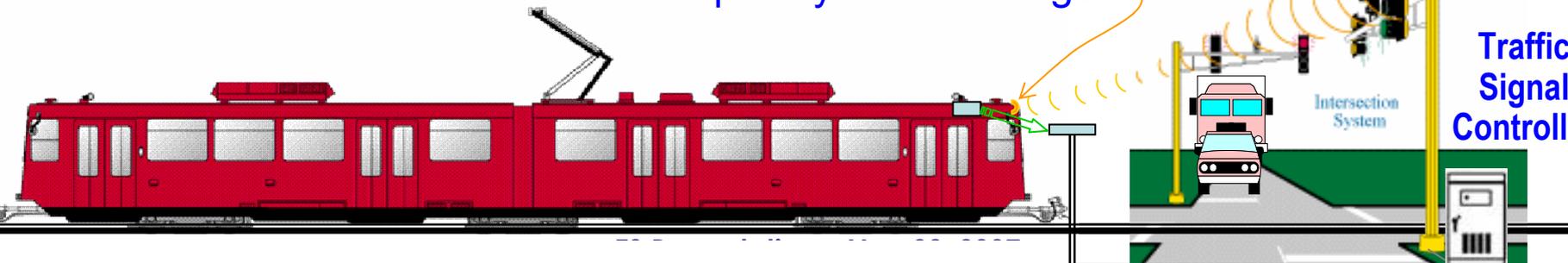


Traffic Signal Priority Emitter with Switch: Emitter initiates request for signal priority to be checked by Traffic Signal Controller against pre-determined desired condition



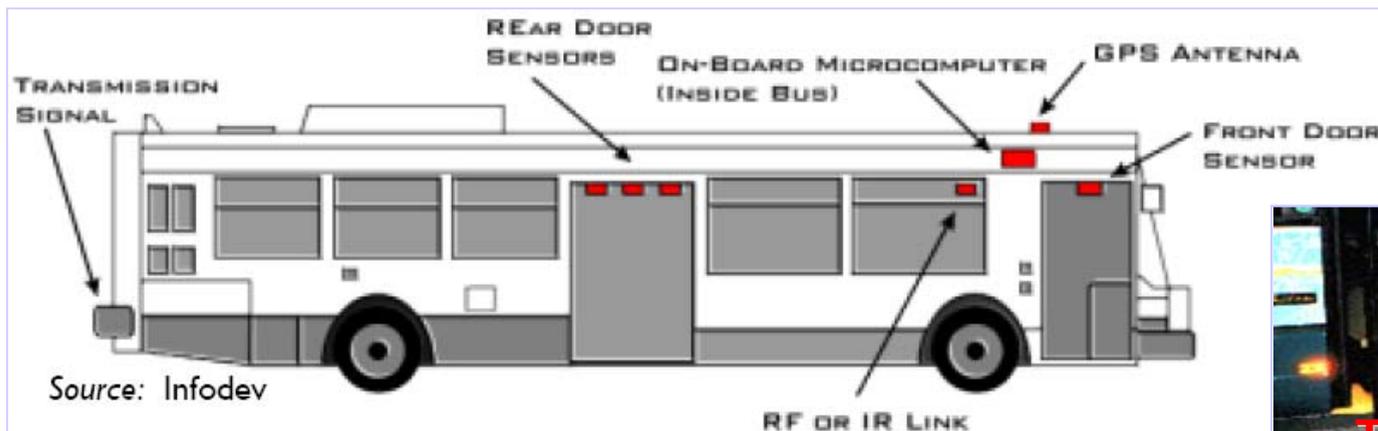
Detection System: Optical Strobe Light or Radio Frequency-Infrared Tags

Optical Detector



WaveSide RF IR Tag Reader

Automatic Passenger Counter

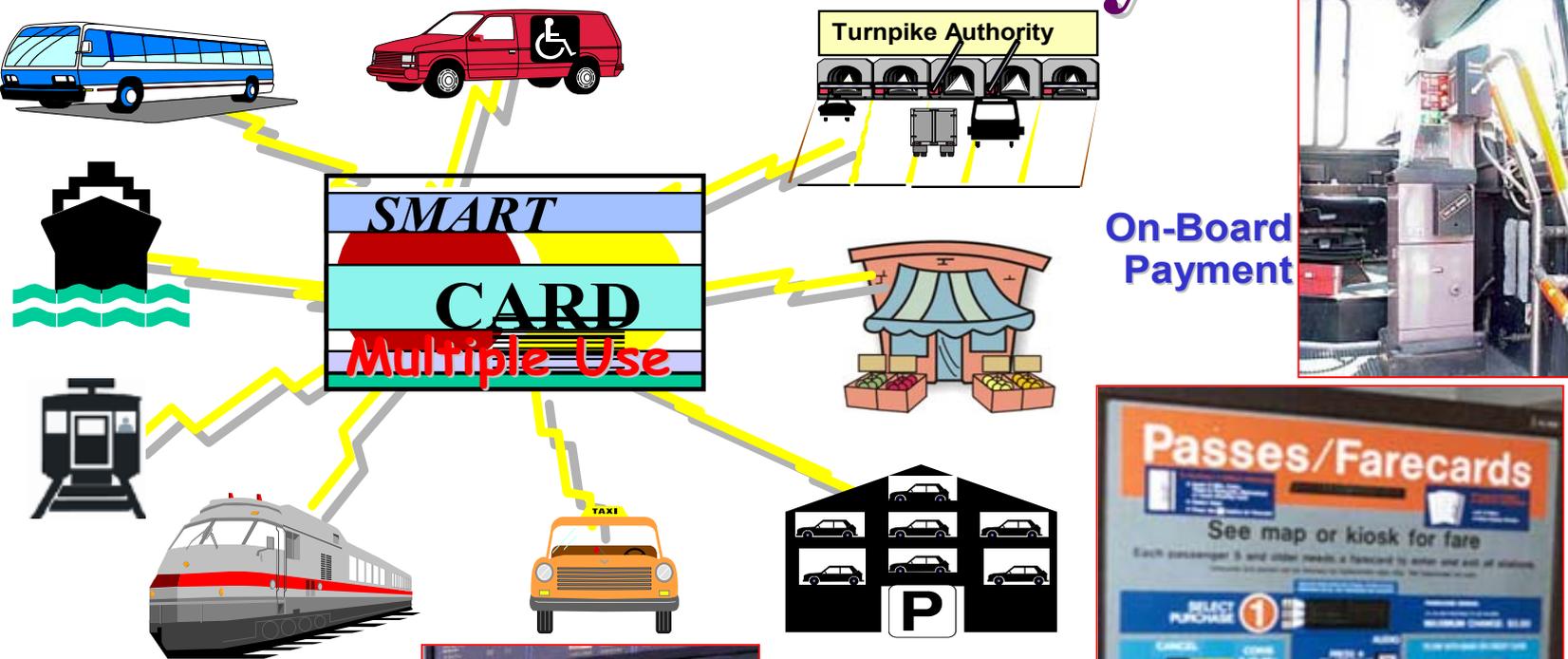


GPS-location stamped information



GPS Applications in United States Transit

Electronic Fare Payment



On-Board Validator



Ticket Vending Machine (TVM)



GPS systems can enable simplified collection of zonal fares

GPS Applications in United States Transit

Public Transit Agencies Using GPS Technology

Agency	Number of Vehicles	Context / Success of Deployment
Los Angeles County Metropolitan Transportation Authority (LAC MTA) Los Angeles, California	2,450 buses 127 light rail 104 heavy rail; 30 BRT	Integrated AVL-GPS system archives and automatically feeds run-time data to scheduling department.
Denver Regional Transportation District (RTD) Denver, Colorado	1,335 buses 70 light rail	Use of AVL-GPS, combined with an upgrade in the radio communications system and MDTs, improved on-time performance and increased ridership.
Metro Transit Minneapolis & St. Paul, Minnesota	922 buses 24 light rail	Integrated AVL & CAD along with APC and a new regional digital 800MHz radio system.
Metropolitan Atlanta Rapid Transit Authority (MARTA) Atlanta, Georgia	556 buses 336 heavy rail	Use of AVL & CAD resulted in operating savings and improved data collection, but also had high implementation costs.

GPS Applications in United States Transit

Public Transit Agencies Using GPS Technology

Agency	Number of Vehicles	Context / Success of Deployment
Milwaukee County Transit System (MCTS) Milwaukee, Wisconsin	484 buses	Use of an integrated AVL-GPS system improved on-time performance and adherence to schedules.
Ann Arbor Transportation Authority (AATA) Ann Arbor, Michigan	82 buses	Deployed integrated AVL-CAD, MDT, remote diagnostics, and silent alarms on fleet in stages. Improved on-time departures, but not arrivals. Initially, major errors in vehicle location data.
County of Lackawanna Transit Scranton, Pennsylvania	32 buses	Deployed basic AVL-GPS system in about 9 months
Montachusett Area Regional Transit Authority (MART) Fitchburg, Massachusetts	23 buses	Employs AVL-GPS and MDT for its fixed and demand-response buses.

GPS Applications in United States Transit

IMPLEMENTATION & OPERATIONAL CHALLENGES

Costs

- Capital funding sources
- Sustaining O&M funding

Implementation

- Lengthy procurement and installation process
- Institutional relationships
- Software or extensive customization
- Accurate GIS database
- National ITS Architecture consistency

Operations

- New technical expertise
- Reluctance of existing staff
- Schedule adherence design difficult
- GPS signal reception problems

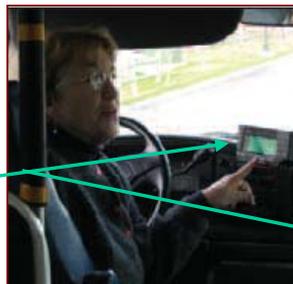
GPS Applications in United States Transit

Other GPS Transit Applications:

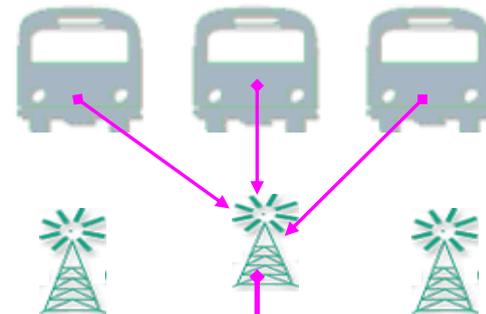
- Computer Aided Dispatch & Scheduling (CADS)
- Maintenance Management
- Transit Communications
- Security Cameras & Systems
- Weather Information Systems

GPS Applications in United States Transit

Computer Aided Dispatch & Scheduling



MDT Text Communications



Dispatch Run Detail

View **Active Items** Run **F06** Start Time **06:00** End Time **25:00** Reset

Vehicle Type **MV** Wheelchair Capacity 1 Seating Capacity 4 Seating w/ Max. wc 3

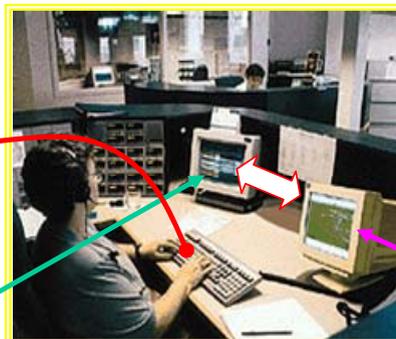
Open Dispatch Items:

23	ADD TRIP	401335	FOREST, JAMES	(508)877-4802
	(17:00) DO	13:50 (14:00P)	BRIGHAM & WOMEN'S - (45) CORE HOSPITALS	
	DO	14:25	40 NEWPORT RD	CAMBRIDGE (508)877-4802

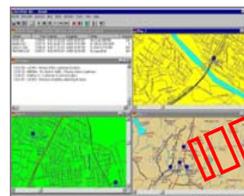
Computer Aided Dispatch Screen

Driver	Name	Veh Id	In	Out	--Time--	In	Out	--Odometer--	In	Out
								0		0
								0		0
								0		0
								0		0
								0		0

Map Time In HiLite Schedule Late Print NoShow Pick-Up
Message Time Out NoHiLite Dispatch Inquiry Pit Scr Close Drop-Off



AVL-GIS Vehicle Tracking



NE D-DON MARSHMAN

Street Address: 1290 EMPIRE CENTRAL DR

Close Next Van + - Rte Follow On Follow Off Turns

1:33 PM ETA 10:13 25370.25

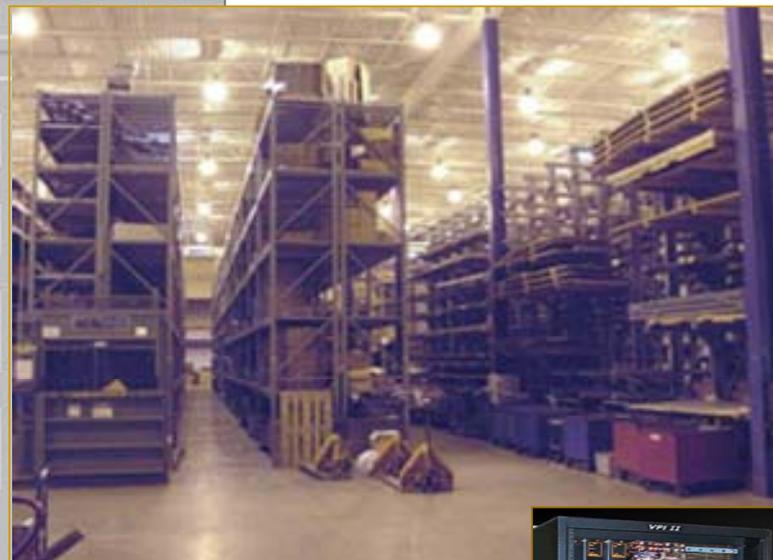
Maintenance Management

CFAWin96 - [Equipment Master]

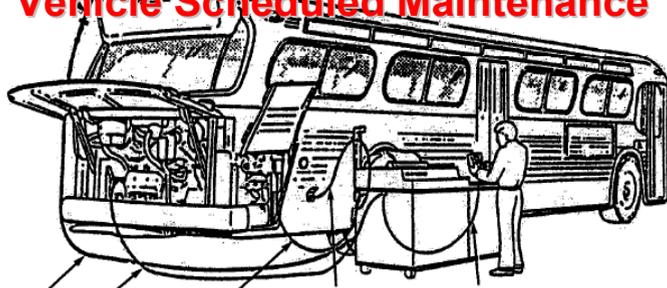
File Edit Lookup

NOTE PM VENDOR SCHEDULES REPORTS PRINT HELP

Identification	Description	Schedules
Lookup = Equipment# 605, 1992, FORD, MODEL V		
Equipment	License State / License# / Asset# / Miscellaneous: YTD / LTD:	
605	Illinois IL33567	SACKIS 4 4
<input checked="" type="radio"/> Active <input type="radio"/> Inactive <input type="radio"/> Down <input type="radio"/> Deleted	Chassis Year / Make / Model / Serial#:	
1992 FORD MODEL V	1FDYW90W5DVA19416	
Engine Make / Model / Serial#:		Transmission Make / Model / Serial#:
CUMMINS FORM300	FORD 5 SPEED	
Component01 Make / Model / Ser#:		Component02 Make / Model / Ser#:
IHC AIR		
Fleet / Class / Cost Ctr / Profit Ctr / EquipDef:		
001 01 0002 001		



Vehicle Scheduled Maintenance



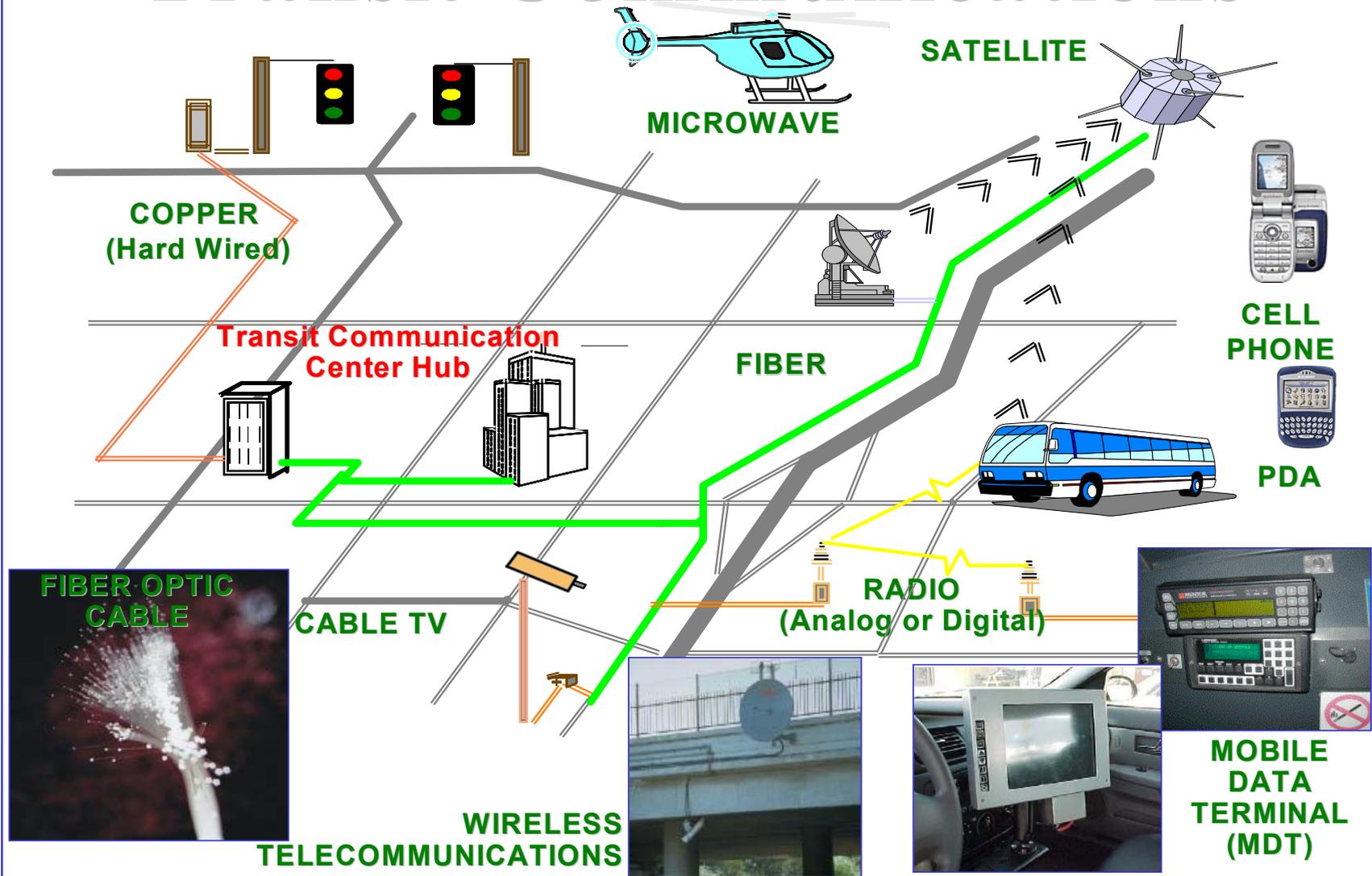
Maintenance Management System Processor

Maintenance Monitoring Equipment

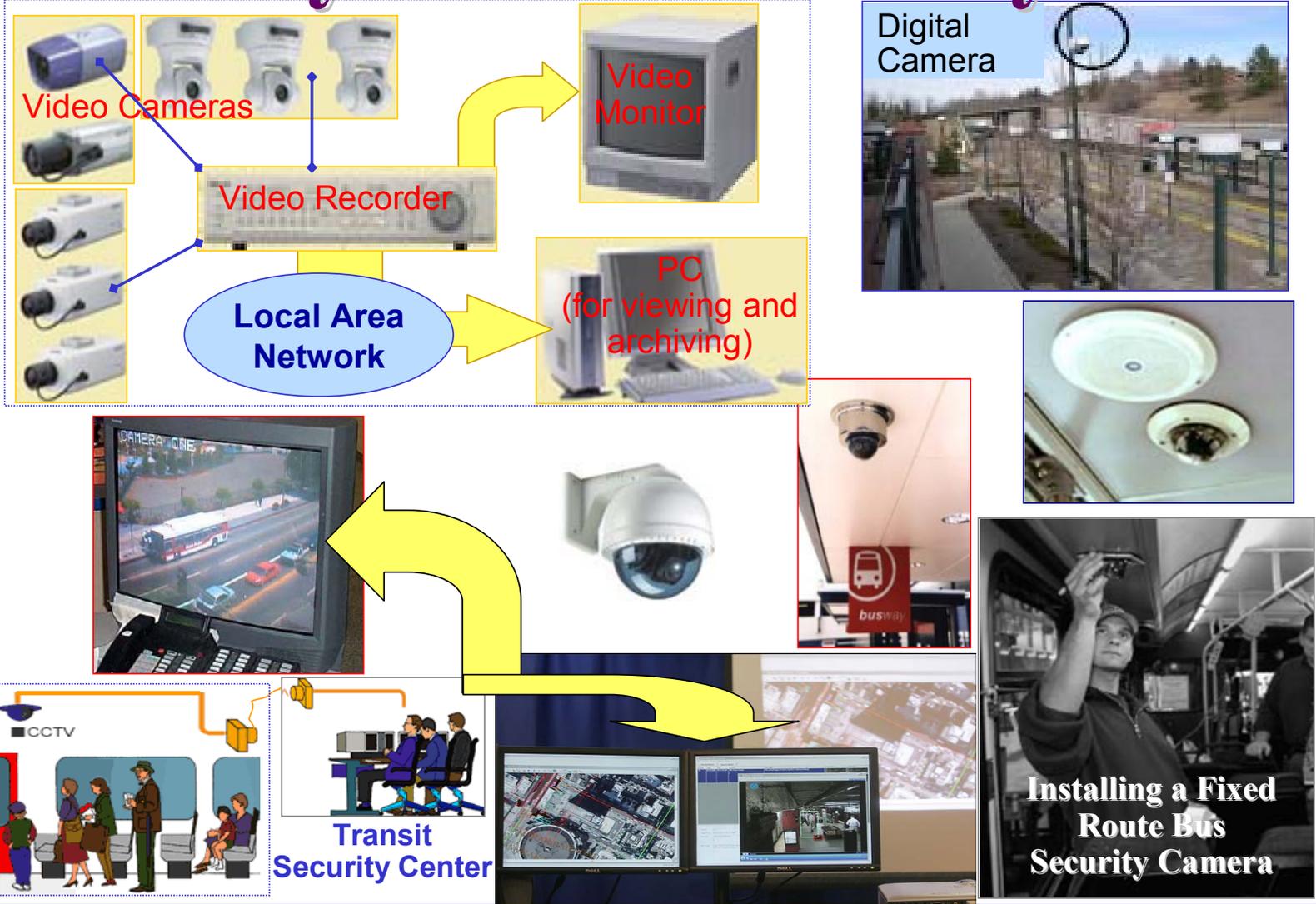


GPS Applications in United States Transit

Transit Communications



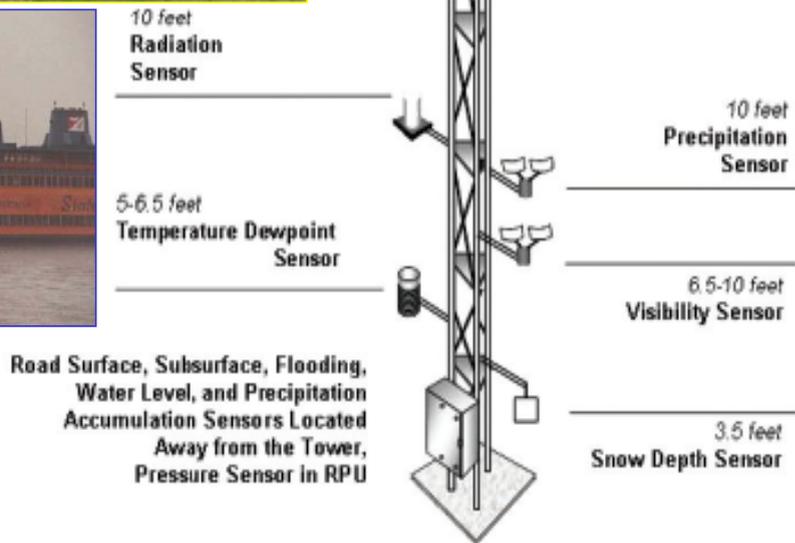
Security Cameras and Systems



Weather Information Systems



Environmental Sensor Station



GPS Applications in United States Transit

SUMMARY

GPS Transit Applications:

- Automatic Vehicle Location (AVL)
- Geographic Information System (GIS)
- Traveler Information System
- Transit Signal Priority
- Automatic Passenger Counters (APC)
- Electronic Fare Payment System Computer Aided Dispatch & Scheduling (CADS)
- Maintenance Management
- Transit Communications
- Security Cameras & Systems
- Weather Information Systems

Promote Increased Use

Address Implementation and Operational Challenges