Information Technology

and

Intelligent Transportation Systems

2003–2008

Technical Appendix A
Data and Application Architecture Detail

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1 DATA AND APPLICATION ARCHITECTURES

1.1 Introduction

Transit applications are acquired to support the major functions required by Transit staff. Some of MDT's major functions are supported by applications operated and maintained by Transit ITS Division staff, while others are supported by the county. The major functions and associated target applications may be mapped to Primary Processes to trace MDT goals and objectives to the technology that supports it. Table 1-1 maps the primary processes to the target applications. In some cases, like Internal Infrastructure, a majority of the required applications are county operated and maintained. Transit ITS Division staff provide technical support in building interfaces and local replicas of county data (e.g., risk management database extracted from the GSA).

Target (and existing) applications, whether county or MDT, require support of core data sets in the MDT technology infrastructure. Section 1.3 deals with Core and Archive Data, both to support internal primary processes as well as to meet Regional ITS Architecture requirements.

Table 1-1 Primary Processes and Target Applications

Primary Processes	Major Functions	Target Applications
Internal Infrastructure	• Financial management • Manage human resources* • Manage payroll • Manage revenue services • Manage smart card • Manage user technology	• Finance (interfaces to county) • Payroll (interfaces to county) • Revenue Services (coordinated with Fare Collection) • HR (interface to county), including Disciplinary Action • Training Tracking • Smart card management (coordinated with Fare Collection, HR, and Facilities Management/Security) • Capital Program Control • Call Center
Asset Management	• Manage assets	• EAMS
Service Implementation	• Manage passenger facilities • Plan service • Plan on-board configuration/performance data • Schedule fixed route service • Manage paratransit services* (certification, reservations, scheduling, dispatch, billing, and complaint/commendation)	• Planning Tools (for analyzing performance) • Scheduling (Fixed Route) • Paratransit tool suite • Loading and off-loading on-board data (includes preparation and dissemination)

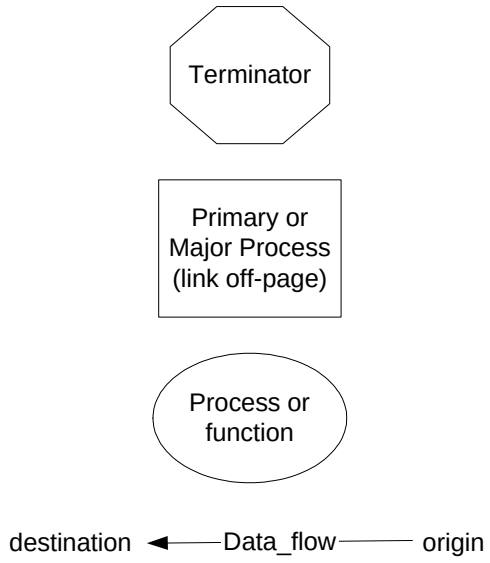
Service Management	• General
	  o Manage maintenance
	  o Manage operations workforce
	  o Field Supervisor management
	  o Manage communications
	  o Manage on-board vehicle systems
	• Bus
	  o Manage bus dispatch
	  o Manage bus operations
	  o Garage (parking) management
	• Rail and Mover
	  o Manage rail dispatch
	  o Manage rail operations
	  o Manage mover operations
	• Paratransit*
	  o Manage paratransit operations (contracted out)
		• Maintenance management (interface to EAMS)
		• Workforce management (for all mode operator and maintenance)
		• Supervisor management tools
		• Bus dispatch (with interface to workforce management data)
		• Bus operations (with interface to RT on-board, workforce, and dispatch data)
		• Rail dispatch (includes control, yard, and tower)
		• Rail operations
		• Mover operations (upgrade underway)
		• Garage parking tools (e.g., for managing APC-equipped vehicles)

Customer Information	• Provide customer information	• Trip planning (INFO), Complaints/Commendations (COM) with interface to CIN • Published material and special events • Fare media sales (e-commerce) • Real-time information (active stop signs/subscription services)
Safety and Security	• Manage incidents • Manage video surveillance*	• Incident tracking system • Video surveillance system (upgrade) • Risk management (interface to county)

1.1.1 Architecture Notation

The architecture notation used in the data flow and function diagrams in this section use the notation illustrated in Figure 1-1. Wherever possible, the notation of the National ITS Architecture is adopted. In some cases, the process diagram became so "busy" that it was decomposed to discrete major functions and the overall context diagram was not included in this document.

Figure 1-1 Architecture Notation



1.1.2 MDT Architecture within the Context of the Regional ITS Architecture

The Southeast Florida Regional ITS Architecture[1] was developed with input from MDT in 2000. According to FTA policy, MDT must be in compliance with the regional architecture. Information Technology Division managers and ITS engineering project managers should be aware of the regional architecture and what it means to their organization. The regional architecture should be a living document that is updated by its stakeholders as needed.

The regional architecture identifies eight subsystems and centers associated with MDT, including:

- Metrobus System
- Metrobuses
- MetroMover System
- Metrorail System
- STS[2]
- Station Security Monitoring System
- STS Paratransit Vehicle
- Transit Kiosk

[1] The contents of this section are taken directly from the Southeast Florida Regional ITS Architecture, and contain terms and references that may differ somewhat from those commonly used at MDT, such as "MetroMover" instead of "Metromover."
[2] Stakeholder name used in the regional architecture.

The regional architecture identifies STS only. Paratransit services, including Medicaid, are not included as an MDT subsystem. The IT Division staff liaison may wish to update the regional architecture accordingly.

The MDT Data/Application Architecture shows the flow to these external stakeholders at the level of detail described in the Regional Architecture.

1.1.3 Stakeholder Descriptions

1.1.3.1 Internal Stakeholders

The Southeastern Florida Regional ITS Architecture made assumptions about the internal units within MDT that are not relevant to an agency that builds enterprise information technology systems. For example, there is only one "Archive" versus one for each transit mode. Furthermore, the architecture only identifies internal stakeholders and subsystems that are needed to support regional architecture flows. All units, applications, and data sources may be considered an internal stakeholder.

Table 1-2 Major Regional ITS Subsystems and Associated Internal Primary Processes

Regional ITS Subsystem Names	Associated Internal Primary Processes
Metrobus System	All
Metrobuses	Asset Management, Service Management
MetroMover System	All
Metrorail System	All
STS	Service Implementation (Paratransit Services) and Paratransit Contractors [note: should include Medicaid]
Station Security Monitoring System	Safety and Security
STS Paratransit Vehicle	Paratransit Contractors
Transit Kiosk	Customer Information

1.1.3.2 External Stakeholders

Most of the external stakeholders were identified by the Southeastern Florida Regional ITS Architecture. They include both organizations and regional architecture subsystems (e.g., AA Arena Event Scheduling System).

There are some key stakeholders that are not included in the ITS architecture, such as maintenance contractors, STS and Medicaid contractors, etc. In addition, the most critical stakeholder for MDT is the county. They provide many services and applications to MDT, including Finance (FAMIS and ADPICS), procurement, human resources, incident reporting, GIS (base map), and more. The italicized stakeholders are those that were not identified in the Southeastern Florida Regional ITS Architecture.

External Stakeholders:

- AA Arena Event Scheduling System
- Contractors (AVL, Scheduling)
- County
- FDOT
- FDOT District Emergency Operations Centers
- FDOT Transit Database
- Florida DOT Traffic Information Web Page
- Florida State Emergency Operations Center
- Fort Lauderdale Downtown TMA Dispatch
- Local Police Dispatch
- Local Venue Event Scheduling System
- Maintenance Contractors
- Miami Arena Event Scheduling System
- Miami Intermodal Center
- Municipality Event Permit Systems
- National Hurricane Center Information System
- National Weather Service
- Other Southeast Florida Transit Management Centers (*regional transit systems)*
- *Paratransit Contractors*
- Port of Miami
- Press
- Private Sector Traveler Information Services
- Pro Player Event Scheduling System
- Regional Consumer Information Network
- SunGuide Advanced Traveler Information System
- Tri-Rail Commuter Rail System

1.2 Major Applications and Logical Functions

Target Applications and associated major functions are included in Table 1-1 above. The applications are segmented by primary process.

1.2.1 Service Implementation

Basic Scope of Operations

Planners assess trends, demographics, and ridership, review comments, hold community forums, and perform surveys to determine how to allocate Transit services to the area it covers. From these studies, new services, including new, revised, and extended routes, altered frequencies, improved amenities, and stops are developed. These are documented, and other staff revise schedules and improve passenger facilities. Schedules, routes, and vehicle and operator assignments are developed and disseminated throughout the organization. Passenger facilities are added, moved, retired, or improved. Amenities are added to the passenger facilities, including signs, shelters, and benches.

In addition, configuration data is prepared to load onto the transit vehicles for the on-board services, and performance data is downloaded and disseminated to back-office systems.

Stakeholders

Internal Transit:
- Scheduling
- Planning
- Field maintenance
- Mobility planning
- Passenger facilities
- Field engineering
- Marketing communications
- GIS (IT and SS)

County:
- GIS (county)

External:
- Scheduling vendors
- Public/customers
- Public works (local)
- RTA (regional transit authorities)

Major Functions
- Plan service
- Schedule fixed-route service
- Manage passenger facilities
- Plan on-board configuration/performance data
- Manage Paratransit services

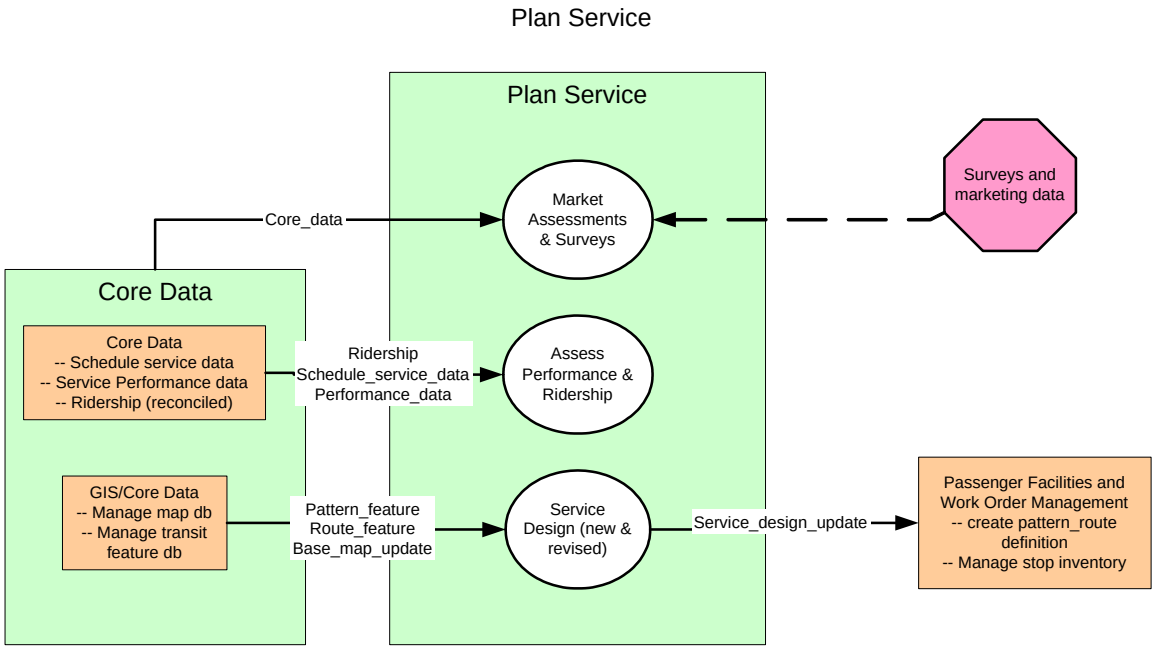
1.2.1.1 Plan Service

Market assessment and segmentation
A market assessment should be done using market surveys and demographic studies. The market assessment and segmentation will identify allocation of services and PTP budget segmentation to cities within Miami-Dade. These studies will impact how performance data storage (e.g., data warehouse) is organized and how the data is aggregated. The reporting and decision-making needs should drive the data collection requirements and relationships.

Assess service performance and ridership
Assessing service performance involves getting data from existing systems to adjust current schedules. Data is collected in many forms, from current service usage such as schedule adherence, passenger counting, field surveys, and customer feedback, as well as market assessment and segmentation studies. The information is analyzed to determine how to improve service and where to allocate service (e.g., new and extended routes, additional bus stops, new rail stations and lines).

Identify improved and enhanced service
Identifying improved and enhanced service develops a new or extended route alignment with service frequencies and ridership goals. This function also evaluates existing routes and schedule adherence to adjust time points to better reflect actual running times. Descriptions and graphics of the new route alignments are developed as par of this function.

Figure 1-2 Plan Service



1.2.1.2 Schedule Fixed-Route Service

Generate schedules/trips

Route designs, including changes to frequency, capacity, stops, and route length, are updated, and new routes are added. Various types of parameters are input into the scheduling software to support implementation of operator work rules and better estimate actual running times, passenger loads, and other schedule adherence requirements (e.g., on-board performance data). Schedules and trips are generated for both rail and bus.

Generate vehicle assignments

Groups of trips are "blocked" into vehicle assignments and associated with a vehicle type (e.g., articulated, regular or mini buses).

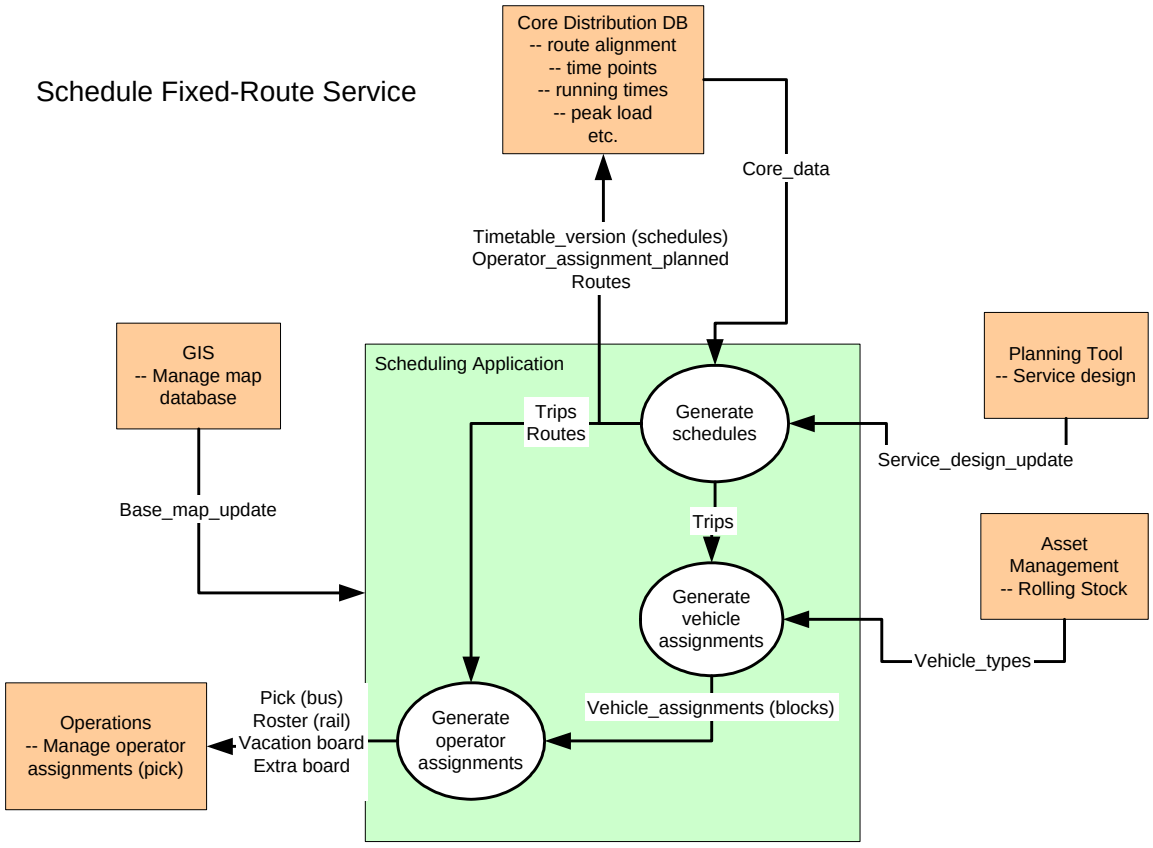
Generate operator assignments (pick list)

The trips are also grouped for operator assignments (runs for buses) or groups of operators (rosters for rail). Various operator assignment lists (including shakeup, vacation) are generated for operators to pick their assignments; a roster is generated from which rail operators pick their duty, and a run list is generated from which bus operators pick their work.

Generate Report

Finally, special types of reports are generated for customer information (e.g., timetables) and operations (trips, blocks, runs).

Figure 1-3 Schedule Fixed-Route Service



1.2.1.3 Manage Passenger Facilities

Create pattern definitions

Pattern definitions are received from Plan service and validated by Schedule fixed-route service. Passenger facilities will trace each pattern in a route to a base map. Bus stops are associated with the pattern based on the sequence of stops made along that pattern.

Manage stop, sign, bench, and shelter inventory

Manage stop, sign, bench, and shelter inventory oversees the process of organizing and validating the bus stop representation and its amenities (e.g., bench, sign, and shelter). The inventory is supported by a field survey of the real-world passenger facility.

Monitor work orders and field crews

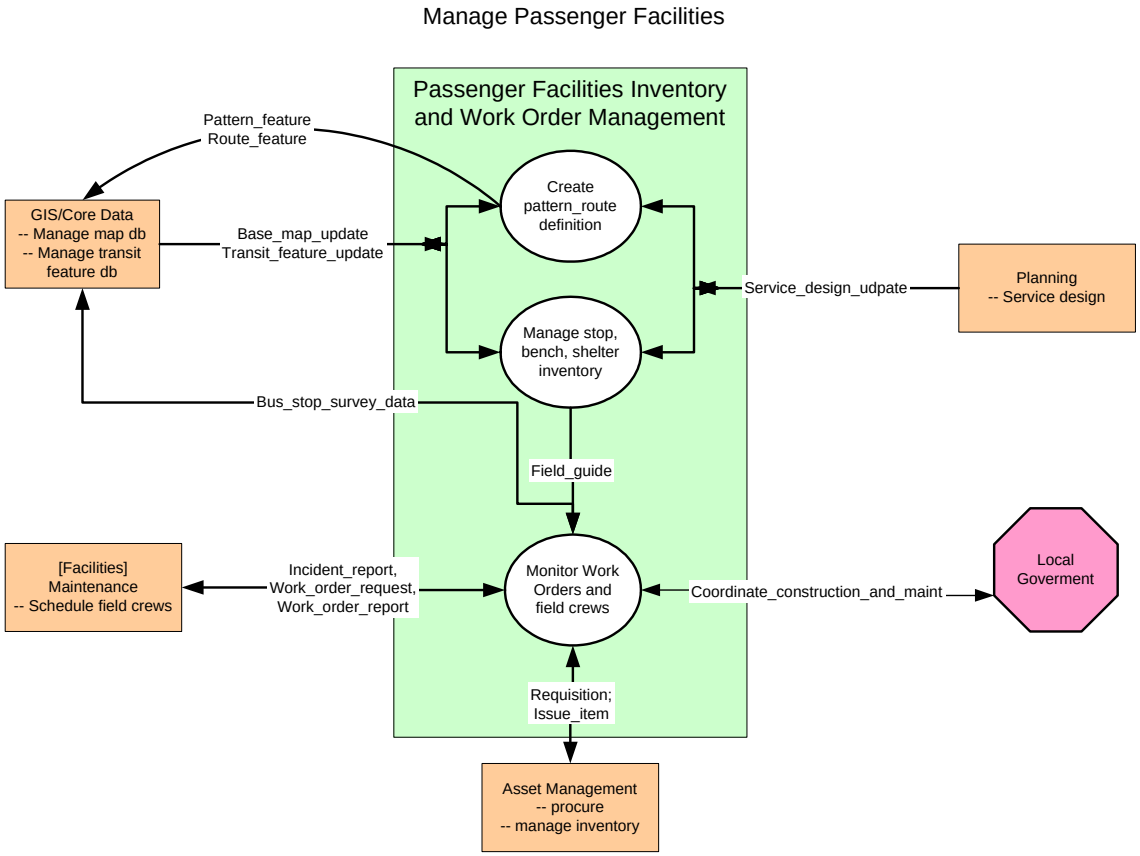
In the event that a new bus stop needs to be located, a bus stop needs to be moved, updated, or cleaned (based on a complaint or incident report [IR] from bus operators, bench enforcement officers, and citizens), Manage passenger facilities will issue and monitor a work order (WO) to facilities maintenance. A bench enforcement officer will be sent to locate and mark a bus stop and/or survey the location. Information on the location will be brought back and input into the bus stop inventory (manage stop, sign, bench, and shelter inventory). Facilities maintenance staff will register with Florida On-Call. (Florida One-Call will mark the utilities near the

selected bus stop location.) Posts and signs will be installed by the field crew. Finally, Passenger Facilities staff will sign off on the work order.

Manage stop sign development

Signs for bus stops and other passenger facilities are designed by Marketing (Signage and Information); Passenger Facilities identifies the maximum/minimum number needed for the service route. Marketing completes a procurement request to Asset Management (see Section 1.2.6). When the signs arrive, Facilities Maintenance may request the signs according to their work order needs. Signs are managed by size.

Figure 1-4 Manage Passenger Facilities



1.2.1.4 Manage On-Board Configuration/Performance Data

Prepare on-board event triggers

Many on-board functions are required to trigger events based on location, time, or another event. For example, announcements are triggered when the transit vehicle approaches a bus stop at which it is designated to stop; a headsign is changed at the end of a trip. Most trigger events that are loaded onto the revenue vehicle are associated with the vehicle assignment, including all the trip instances of related patterns. Revenue and non-revenue patterns compose the basic building blocks for ordering the trigger events. Descriptions of the existing Trigger

Locations are listed in Table 1-3 (this table should be updated as new applications that need trigger events are deployed).

Table 1-3 Trigger Location Descriptions

Type of Function	Trigger Location Description
Annunciator	offset from bus stop along each pattern
AVL/Schedule Adherence	the time point area (30 meters) from pull-out to pull-in (block) (revenue and non-revenue)
APC/Schedule Adherence	stop point zones and time point areas (30 meters) from pull-out to pull-in (revenue and non-revenue)
Fare Collection (zone)	zones associated with bus stops, location, and zone number of bus stops
TSP	location of signal controllers that support TSP
Rail/Mover Annunciator	track circuit identifiers

Manage on-board equipment component configuration
Because each vehicle will have different equipment installed, a description of the asset hierarchies, including hardware configuration and data load and software versions, are key to ensuring the right configuration data (including AVM) is downloaded onto the correct vehicle.

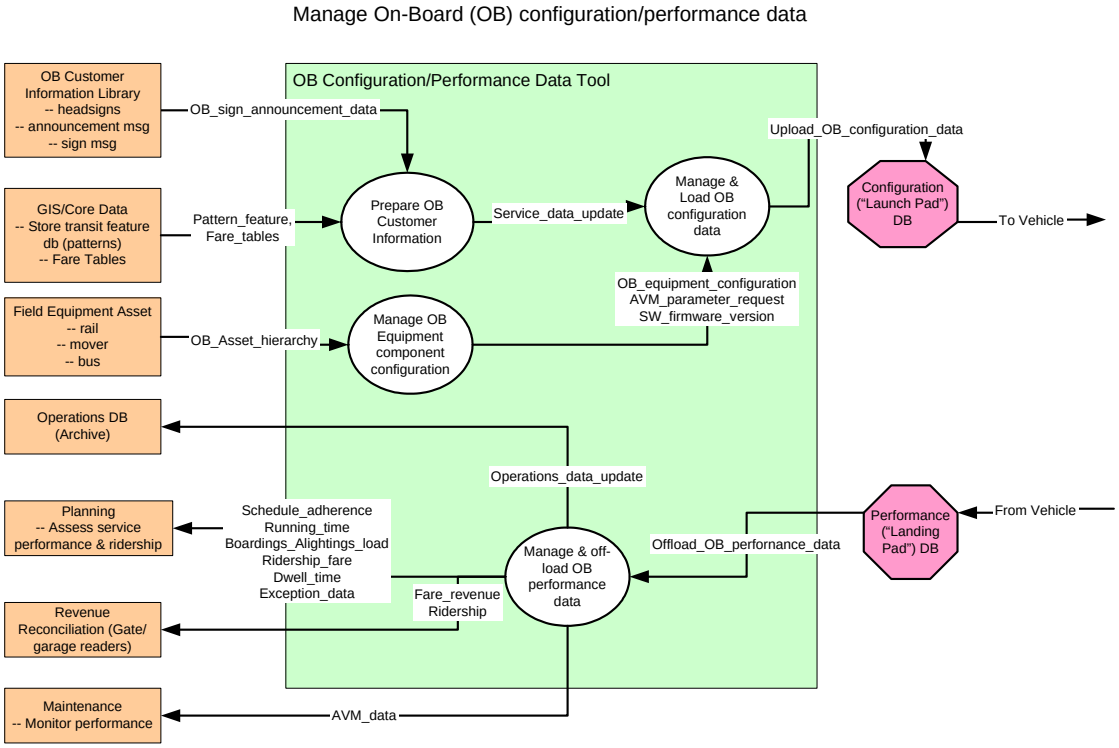
Manage and load on-board service data
The on-board technologies require service data related to the route/run/block which the vehicle will traverse. The on-board technologies include the functions described in Chapter 2, "On-Board Subsystem Description." Among the on-board service data are: OB customer information library (sign and announcement library and event triggers for annunciator/ signage), pattern/trip definitions with event triggers for passenger counting, and route and schedule adherence. Automated vehicle monitoring may require minimum/maximum or high/low levels that trigger recorded and "over the air" warning messages about drive-train alarms.

Each vehicle may require a special data set depending on the equipment installed on board and the route/run/block that it is assigned. Uploading the correct data set via wireless LAN (as the vehicle leaves the garage) to the right bus will become very difficult since Bus Dispatch is now assigning vehicles based on a nesting parking configuration. (This will impact the physical specifications for the on-board data storage unit. The configuration files will need to be compiled spontaneously as the vehicle is assigned a block and matched with the operator assignment.)

Manage and off-load on-board performance data
Data that is generated and collected on board the revenue vehicles is off-loaded via wireless LAN. The data needs to be directed to the appropriate operating and archiving data stores.

Typically, the protocols (including file formats) for uploading/off-loading data sets are managed by proprietary vendor systems. (Figure 1-5 depicts the proprietary nature as the Launch and Landing Pads.)

Figure 1-5 Manage On-Board (OB) Configurable Performance Data



1.2.1.5 Manage Paratransit Services (Medicaid/STS)

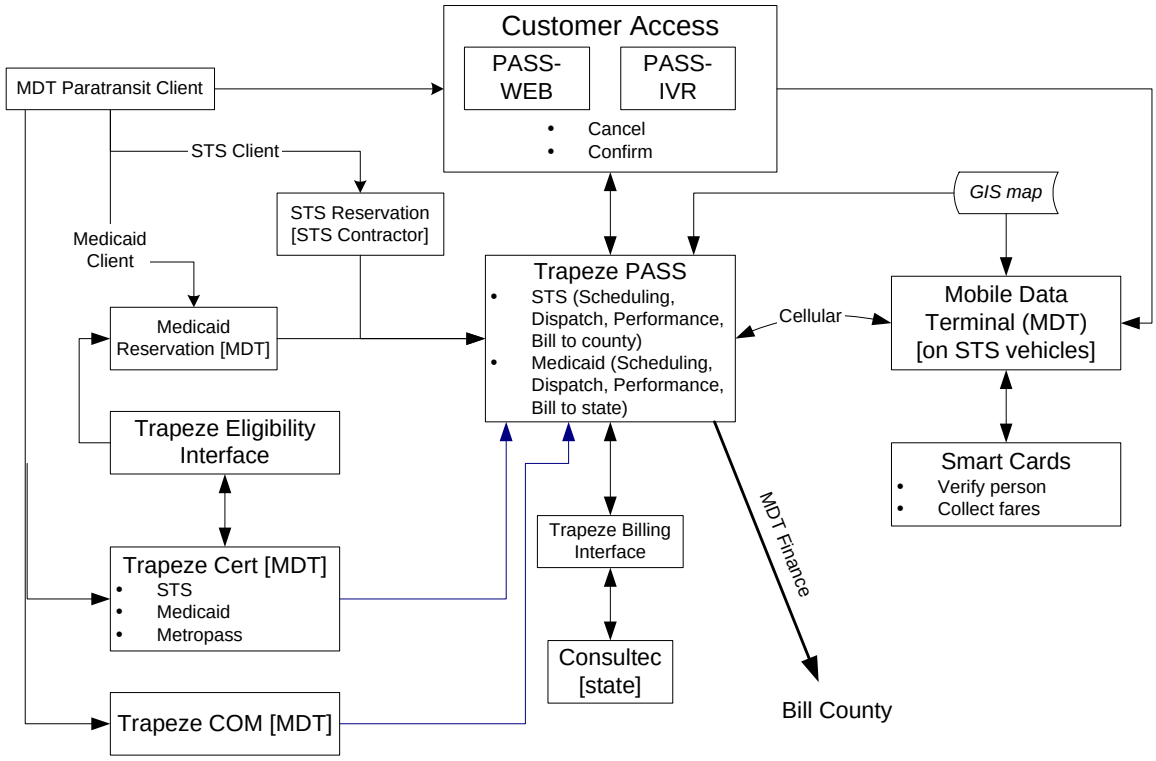
The paratransit services are overseen by MDT. Medicaid dispatch and operations and STS reservations, dispatch, and operations are outsourced to outside suppliers. All certification, state and county billing, and complaint/commendation dispositions are handled by MDT. MDT manages all the software tools and information technologies used by its suppliers. The specific suite of applications is listed in Table 1-4 below.

Table 1-4 List of Business Functions and Corresponding Applications

Business Function	Application	Functions
Provide Certification	Trapeze CERT and Eligibility	• Certification and eligibility • Verify Eligibility (for Medicaid and STS)
Manage Medicaid Service	Trapeze PASS	• Reservations (MDT function), Schedule generation, Dispatch (contractor function)
Manage ADA Service	Trapeze PASS	• Reservations, Schedule generation, Dispatch (contractor function)
Manage Complaints and Commendations	Trapeze COM	• Customer complaints and commendations
Manage County Billing	Trapeze PASS	• (Contractors submit billing to Finance Division)

Business Function	Application	Functions
Manage State Billing	Consultec (State) and Trapeze Billing Interface	• Submit Medicaid billing

Figure 1-6 New Trapeze Systems Under Deployment



To date, the Paratransit System deployment is based on the following phasing:

Phase 1: Medicaid Implementation

- Implement Trapeze PASS, COM, and Cert with interfaces to verify eligibility and to submit billing to Consultec. This implementation provides for Medicaid reservations, scheduling/routing, dispatching, and complaint resolution. It also provides for certification and eligibility checking for Medicaid, STS, and MetroPass clients.

Phase 2: STS Implementation

- Implement PASS and COM at STS Contractor and service provider sites for reservations, scheduling/routing, dispatching, and complaints and commendations.

Phase 3: Implement Trapeze PASS-IVR

- Implement PASS-IVR for client trip confirmation and cancellation over the phone

Phase 4: Implement Trapeze PASS-WEB
- Implement PASS-WEB for client trip confirmation and cancellation over the internet

Phase 5: Implement on-board equipment (mobile data terminals)
- This service will be implemented following confirmation of new STS contract. Implement mobile data terminals in STS service provider vehicles to monitor vehicle location and on-time performance. Driver manifests and changes to schedules may be automatically sent to drivers via the MDT units, thus reducing voice communications.

1.2.2 Service Management

Service management handles the daily operations and maintenance of providing service to the customer. The primary process includes managing field, facilities, infrastructure, and vehicle maintenance, managing the workforce, and finally managing and controlling operations for Metrorail, Metrobus, Metromover, and paratransit. The primary process is categorized into three sections: general functions that apply to all the modes; functions that apply to bus only; and functions that apply to rail and mover. Differences among the various modes are discussed in the functional descriptions.

Stakeholders
- Bus operators
- Rail operators
- Control Center
  - Bus Traffic Controllers (BTC)
  - Rail Traffic Controllers (RTC) and yard/tower staff
  - Mover control
- Supervisors (rail, bus)
- Field, Facilities, Vehicle system Maintenance personnel
- Maintenance control
- Contractors/Vendors
- Human Resources
- Customers
- County
- Union (union rules)
- Traffic Management Center (FDOT)
- Scheduling

Major Functions
- General
  - Manage maintenance
  - Manage operations workforce
  - Manage field supervisors
  - Manage communications
  - Manage on-board vehicle subsystems (see Chapter 2)
- Bus
  - Manage bus dispatch

    - Manage bus operations
    - Manage garage parking
- Rail and Mover
    - Manage rail dispatch
    - Manage rail operations
    - Manage mover operations
- Paratransit (these services are outsourced and therefore are not included in the service management architecture)

1.2.2.1 Manage Maintenance

Manage maintenance covers maintenance for all modes, facilities, equipment and maintenance cycles.

Perform Scheduled Work Including Preventive Maintenance (PM)
Manage scheduled work is based on either daily upkeep or work that is known in advance and scheduled for repair, overhaul, campaign, or new installations. Preventive maintenance (PM) and other scheduled work is monitored by Maintenance Control from the Manage Asset process. Maintenance Control Staff review maintenance schedules for serialized assets and subsystems and generate timelines for the work to be performed (i.e., work order requests). Maintenance supervisors assign work to maintenance personnel. This process may also be called Manage Work Orders. As part of performing maintenance work, maintenance staff must update the asset history with descriptions of the work performed to each asset, including changes to asset serialization, disposal, retirement, or repairs.

Manage and Respond to Incident Requests
Manage and Respond to Incident Requests includes handling calls on issues involving assets including vehicle subsystems, infrastructure, computers, e-mail, equipment, etc. The call center (which may be Bus or Rail Traffic Controllers in the case of service vehicles or operators) will dispatch a service team to identify the problem and determine whether work should be scheduled to fix the item.

Generate Maintenance History/Reports
When responding to an incident or working on a part or asset, maintenance personnel may look up maintenance history or reports. Mean-time-between-failures analysis also requires analysis and reporting tools for generating information for making decisions. Generated maintenance history and reports provide access to performance information on assets.

Manage Maintenance Contractors
Quality assurance and other performance tracking procedures support monitoring and managing maintenance contractors. Schedules for work and quality inspection are planned, and invoices are reviewed as part of Manage Maintenance Contractors.

Manage Maintenance Workforce
Manage maintenance workforce schedules maintenance staff to perform work in their certified area based on personnel "picking" their work schedules. This process is shared with Manage Operations and Maintenance Workforce.

1.2.2.2 Manage Operations and Maintenance Workforce

Scope of Operations

Workforce Operations includes vehicle operators and supervisors (rail, bus), and maintenance personnel (rail, bus, mover, field, facilities). For these staff, Manage operations and maintenance workforce includes: assignments, discipline/evaluation, work rule enforcement, personnel information, incentive programs, payroll, and reporting functions.

Operators and maintenance staff select their work assignment by seniority and training certification. When they arrive at work they check in and are dispatched to their daily assignment. The time they check in and check out (operators check out when they log off the revenue vehicle) is recorded and reported to Payroll. Staff is monitored for absences, incidents, complaints, and work rule compliance. Work rule compliance may be based on federal, state, county or collective bargaining agreement requirements such as drug testing, medical appointments, uniform/tool allowance, training and certification programs, etc.

Manage Operator Dispatch

The dispatch functions are described in Section 1.2.2.5 for bus operators and 1.2.2.8 for rail operators below. Maintenance staff are assigned work differently and do not require a dispatch function.

Manage Operator Payroll

This function aggregates operator actual time spent at different pay rates. Exceptions and deviations from regular pay are sent to county (via Manage Payroll and BOPS interface) on a daily basis.

Manage Operator Performance

Manage operator performance entails tracking performance of operators and maintenance personnel, including tracking their absences and tardiness, incidents and complaints, and medical (physical) and drug tests needed to comply with legal and contractual requirements. In the case of incidents and complaints, a formal investigation may be initiated (***Investigate complaints***) to review and dispose of the complaint. If the complaint is found to be true and the personnel violated agency policy, rules, or laws, action may be taken and recorded in the employee files.

Manage Workforce Timekeeping

All personnel keep track of the time they spend at different tasks during the day. Staff may swipe their badges to check in and receive their assignments. [Bus] Operators must log on to the vehicle they are assigned. When they complete their work, operators log off the vehicle. This act automatically checks them out. Maintenance personnel "punch" a time clock. (Maintenance staff who drive buses for diagnostic purposes are also required to log on to the vehicle.)

Manage Operations Reporting

Manage operations reporting includes archiving and reporting on performance issues related to operators and maintenance personnel.

Manage Incentive Program
Manage incentive program includes accounting for leave (medical and other), uniform allowance (for operators), and tool allowance (for maintenance). It also includes tracking training and certifications provided for and achieved by personnel and other incentives such as awards.

Manage Operator/Maintenance Assignment
Operators select their work assignments three or four times a year. The "shakeup" lists are generated by Scheduling and implement many of the collective bargaining agreement rules in the schedules (e.g., number of layovers, platform vs. operations time, seniority). Bus operators pick their assignments for work (report board), extra board, extra list, and vacation board. Rail operators pick their roster and vacation. Maintenance staff engage in a similar work selection process. This process overlaps with the Manage Maintenance Workforce process described in Manage Maintenance.

1.2.2.3 Manage Supervisors

Supervisors monitor and manage operations in the field. They are directed by the Bus Traffic Controllers, Rail Traffic Controllers, and Rail Yard and Tower personnel.

Their duties include:

- Monitor and manage service schedule and route adherence
  - record and survey schedule adherence
- Manage incidents and accidents (from the field)
- Respond to BTC/RTC dispatch
  - investigate problems
  - diagnose problems and incident reports
- Respond to emergency conditions (i.e., implement emergency management plans)

In performing these duties they may need to look up information on operators and vehicles, physically locate revenue vehicles, report conditions to BTC/RTC, implement operational strategies, or transport operators. For BTC/RTC to better do their jobs and to ensure the safety and security of supervisors, supervisor vehicles may be outfitted with vehicle location technology.

1.2.2.4 Manage Communications

Field maintenance manages wireless communications between the field, vehicles, central control, and remote sites (including garages). They manage voice and data channels and log transactions on each channel.

1.2.2.5 Manage Bus Dispatch

Paired with the Workforce Management function, Manage bus dispatch describes in more detail the bus operator dispatch process. An operator receives his/her assignment after signing in. If an operator does not show up or calls in an absence, the dispatcher replaces that operator with an operator from the extra board. First, the dispatcher will verify the extra's eligibility and then

he/she will process the absence. The extra board operator will be given the replacement assignment. When the operator gets the assignment, he/she will go to the "bus nest" and be assigned to the next available vehicle. The operator will inspect the vehicle and if there is a problem will return to the dispatcher with a pre-inspection report. If there are no problems, the operator boards the bus, logs on, and pulls out of the garage.

When a problem arises, the vehicle may be replaced and the operator will start again from the pre-inspection stage.

At the end of his/her assignment, the operator arrives at the garage and is directed to park (in the nest).

1.2.2.6 Manage Bus Operations

Manage bus operations consists of the central control functions performed by the BTC. They manage the fleet (headways, schedule/route adherence, operational strategies, special events, and emergency coordination procedures) and supervisors; they monitor and oversee incidents/accidents, react to vehicle alarms, handle communications with operators and supervisors, monitor operator performance, handle customer-related issues, coordinate with emergency organizations, dispatch supervisors, maintenance and service personnel, and vehicles to troubleshoot reports, and oversee the replacement of vehicles and operators.

In performing these duties, the BTC may need to look up information on an operator/supervisor, operator performance or vehicle maintenance history, emergency management coordination plans, and vehicle or operator availability. The BTC may generate an incident report (using a system-generated request for an incident report number), and initiate voice radio contact with a maintenance, operator, or supervisor vehicle. When replacing a vehicle or operator, the BTC will need to split a block or run to record the substitution. The BTC may need to pull up a map of revenue and non-revenue vehicle locations, identify missing vehicles, or find specific vehicles. The BTC may want to view traffic and weather conditions (video or congestion–flow/occupancy) from regional traffic management centers. Another BTC may be assigned the responsibility of managing the supervisors and service trucks in the field, and if a supervisor or service truck is required by the BTC, the incident report is passed to the operator console.

1.2.2.7 Manage Garage Parking

Buses are nested by groups according to their size: articulated, regular (40') and mini buses in rows. Supervisors direct operators to park their vehicles in certain rows as they pull in. Vehicle pull outs are based on first-in first-out. Deployment of APCs on only a few vehicles per garage will require attention to vehicle assignments to specific route/run combinations.

1.2.2.8 Manage Rail Dispatch

The Dispatch function is performed in the yard. Operators are assigned work based on a roster during the shake-up period. The Yard Master manages the assignments and dispatches the operators. As part of the dispatch activities, operators sign in; late; absent, or call-in absences are replaced by the Yard Master. Replacement assignments are offered through the extra board.

Operators perform a pre-trip check. When ready, the train is released to the rail by the Yard Masters.

1.2.2.9 Manage Rail Operations

The RTC manages rail operations, including all vehicles on and systems related to the rail line (end-to-end). In the current SCADA system, the operator only opens and closes the door and handles announcements, so RTCs must monitor the SCADA system. RTCs manage and monitor the Public Announcement (PA) and sign and communications systems, taking over control when necessary.

Similar to BTCs, RTCs handle incidents and accidents, detect alarms (in the SCADA system) and through messages sent by the vehicle or operator, manage consist/car replacements, additions, and availability (PVR).

RTC also dispatches maintenance vehicles and crews to deal with incidents and accidents. Moreover, Preventive Maintenance crews must work on the rails 24/7, so monitoring of the rail line is critical for safety and security of rail bridge and rail maintenance personnel.

(**Note**: Some rail dispatch functions are handled by RTCs who are responsible for end-to-end rail line. Yard and tower staff serve as dispatchers, dispatching rail operators and releasing trains onto the track.)

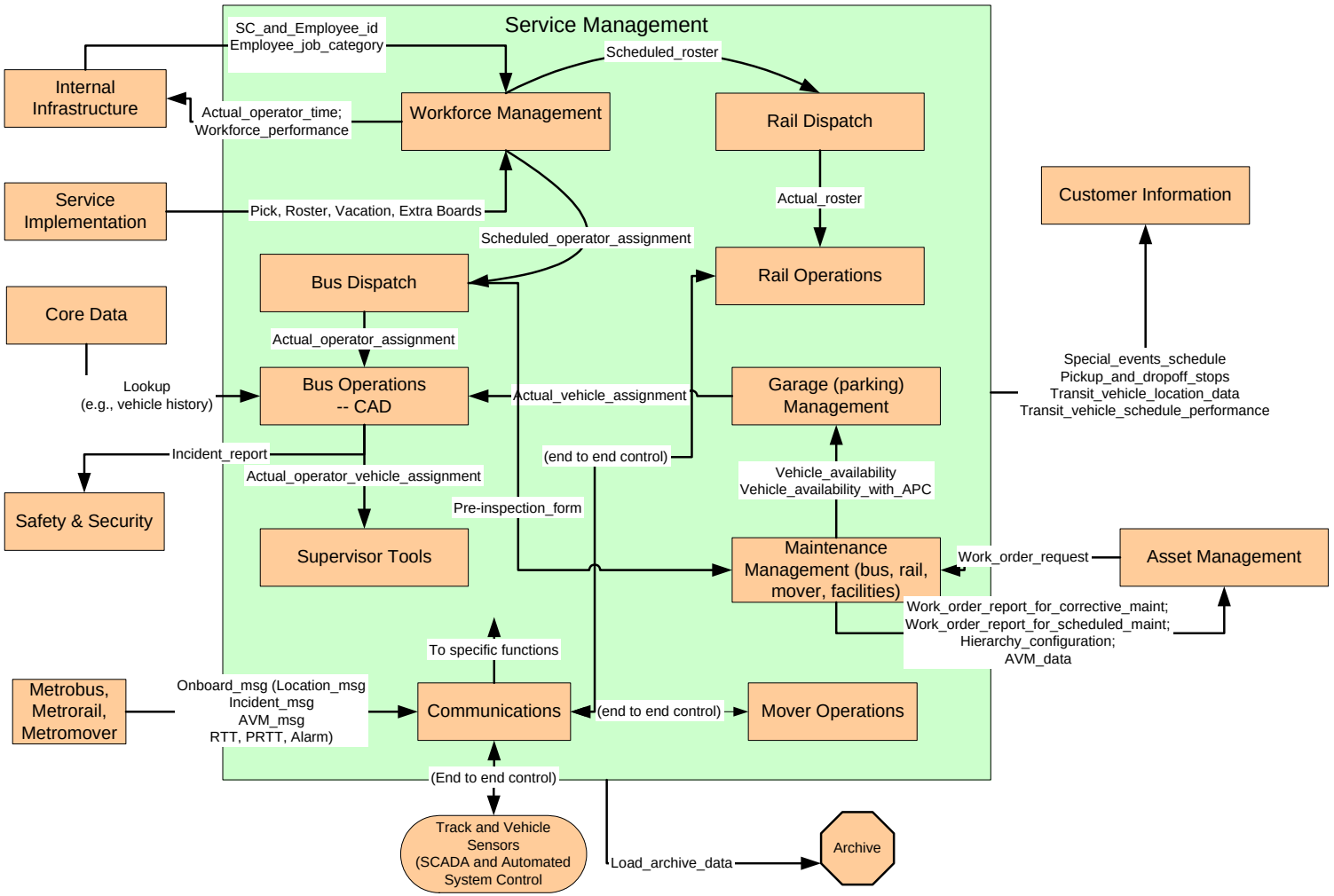
1.2.2.10 Manage Mover Operations

Manage mover operations is similar to Manage rail operations except there are no operators in the loop. The mover functions are all automated, so functions performed by the rail operators, such as monitoring door opening/closing and monitoring security, are all transferred to the RTCs monitoring the automated system controls.

(See Appendix A for decomposition of the Service Management primary process diagram and data flows.)

Figure 1-7 Service Management

Service Management



1.2.3 Safety and Security

Scope of Operations

Incidents and accidents are reported and tracked; security personnel monitor video surveillance at stations and stops, monitor emergency calls, and communicate with field security personnel.

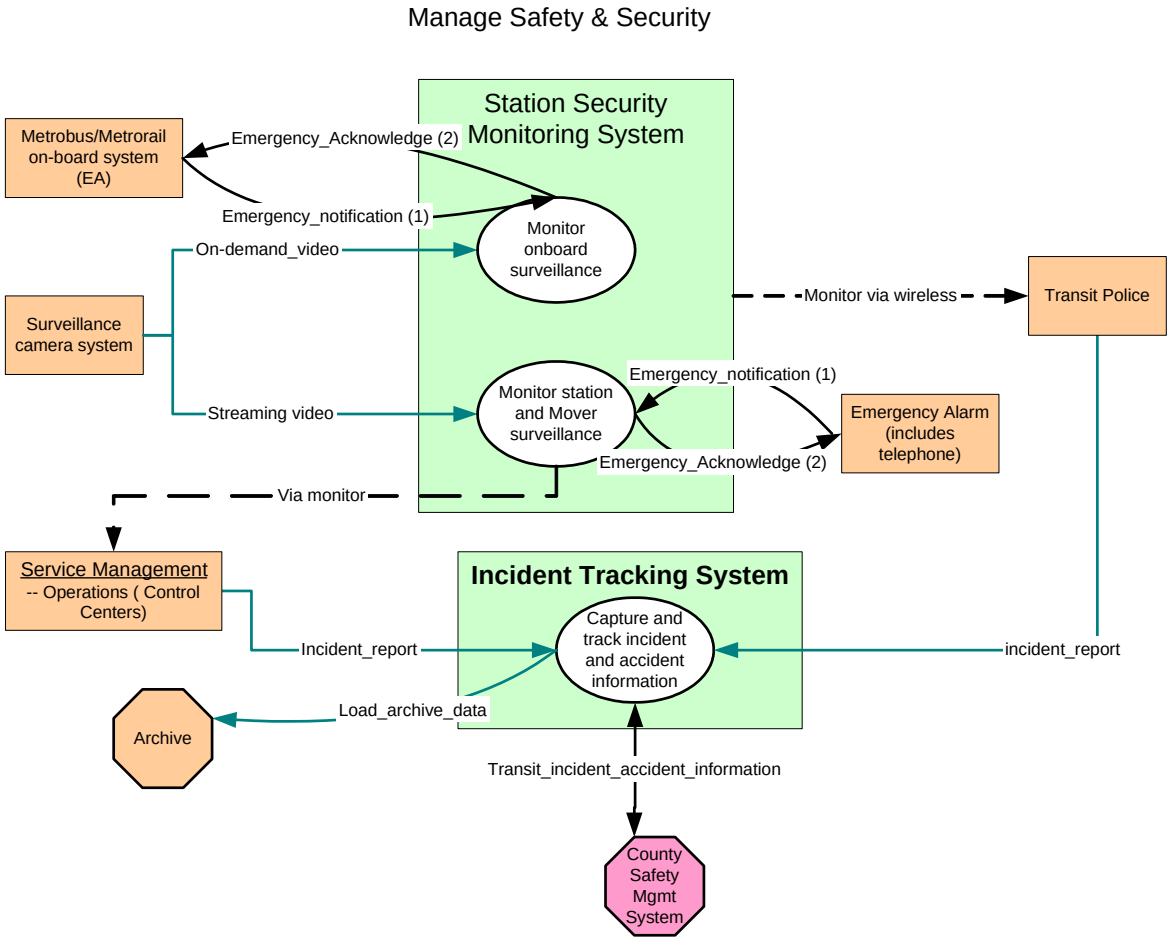
Stakeholders

- Safety and Security
- Bus Traffic Control/Rail Traffic Control (BTC/RTC)
- Transit Police
- Customer
- County safety management system

Major Functions

- Manage video surveillance
- Manage and track incident reports

Figure 1-8 Manage Safety and Security



1.2.4 Customer Information

Scope of Operations

A customer makes a request of the Customer Information System (CIS) for information (i.e., fare information, ride guides, hours of service, or trip planning information). The request may also be made for real-time information (i.e., general or specific information on schedule adherence [next service at stop, status of route], service disruption, special events, or temporary service changes). The CIS identifies or compiles the available information pertaining to the service area and types of information requested. The CIS provides the available information to the customer (via remote devices such as kiosk, web browser, wireless internet, interactive voice response, etc.). The data that feeds these applications is loaded into the customer information applications, including schedules, maps, list of publications, subscription services, real-time schedule performance, exceptions, detours, disruptions, evacuation and special event pickup locations, etc. These scenarios apply even if the Customer Information application is managed by the Customer Information Network or equivalent 511 services.

Customers may purchase fare media or add value to their existing fare media via the internet or other secure link.

Customers may subscribe to certain types of information such as the "Dade-Monroe Express schedule adjustment: The 5:35 AM trip from the Florida City Wal-Mart will depart at 5:40 AM, arriving in Tavernier at 6:40 AM."

Customer usage and system performance are monitored and analyzed for trends and to improve effectiveness.

(**Note**: Disclosure of certain types of customer information should be reviewed so that decisions on providing certain information are consistent and not arbitrary.)

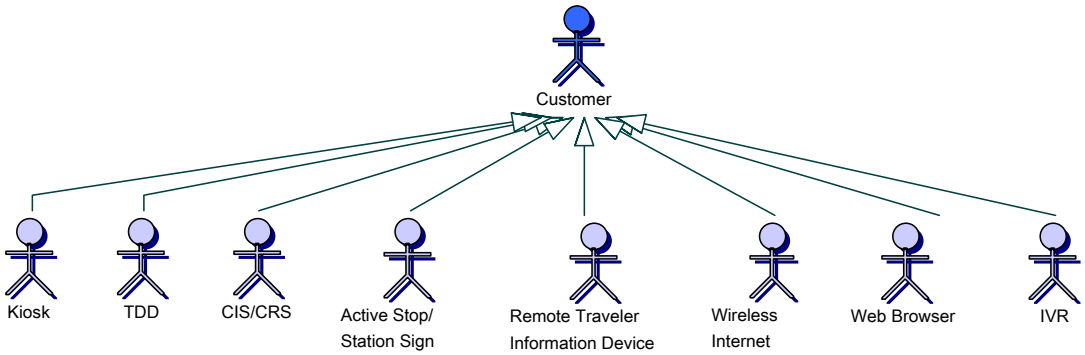
Stakeholders

- External stakeholders
  - Customers
  - Press
- Internal
  - Customer Information
  - Customer Information Representatives (CIR)
  - Customer Service Representatives (CSR)
  - Treasury
  - BTC/RTC
- Regional and other external partners
  - Consumer Information Network (511)
  - Regional Smart Card Consortium

Customer Information Access methods are referred to as customer information actors (illustrated as generalizations of the Customer in Figure 1-9). They include the following:

- Kiosk
- TDD
- Customer Information line staff (CSR/CIR)
- Active stop and station signs
- Remote traveler information devices (e.g., PDA using wireless modem and Wireless Application Protocol (WAP) and/or Wireless Markup Language (WML) technologies)
- Wireless Internet (e.g., "hot spots" using WiFi [wireless fidelity]/wireless network)
- Web browser (to view MDT web pages)
- Interactive Voice Response (IVR -automated telephone)

Figure 1-9 Customer Information Actors



Major Functions

- Provide customer information
  - Provide fare information/sell fare media
  - Provide regional trip itinerary
  - Provide transit information and publications
  - Process commendations and complaints
  - Provide en-route information
  - Provide special events, evacuation, and detour information
  - Process subscription services
  - Load real-time service status
  - Load exceptions/service disruptions

Included Functions

- Collect performance/usage data
- Load service information and map
- Generate reports

Provide fare information/sell fare media

Provide fare information deals with providing general fare information and information on the various types of fare instruments (based on rider classification, mode, and usage) that are

available. The fare media may be sold via the MDT web site. Financial transactions from the sales will be handled directly by Treasury.

Provide regional trip itinerary
Provide regional trip itinerary is a direct link to the regional Customer Information Network (CIN) or 511 services. MDT will update its service information to the regional system.

(**Note**: Geocoding stop information to the regional base map may become a problem even if all parties are using the same Trapeze backend to supply their data. The regional base map may not be the same base map used by MDT and the county. Furthermore, if the base map is similar, base map update schedules will need to be synchronized with the application upgrade schedule to ensure consistency and minimize redundant maintenance.)

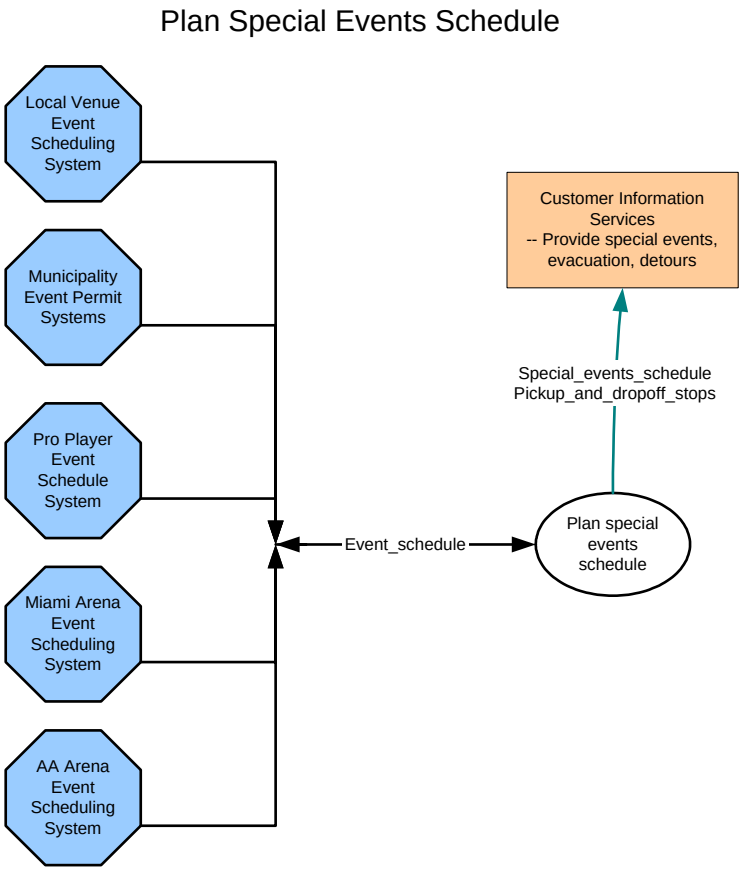
Provide transit information and publications
Providing transit information and publications may require dynamic uploads of quarterly/monthly changes to the schedule and other periodicals, periodic loading of known exceptions and detours, special loading of special events pick up points, and emergency loading of hurricane evacuation points, accidents, and service disruptions.

Process commendations and complaints
Process commendations and complaints accepts comments through e-mail or customer service representatives on Transit service, operators, status of amenities and equipment, customer requests, lost and found, and other pertinent information. This information may trigger a work order or investigation by numerous divisions, including Operations, Passenger Facilities, Facilities Maintenance, Safety, Security, etc.

Provide en-route information
Provide en-route information offers different methods of accessing information on current performance of the service provision. Customers may view active bus stop or station signs, web maps, and pagers/PDAs with next bus information and numerous other customer devices.

Provide special events, evacuation, and detour information
Provide special events, evacuation, and detour information provides planned changes and special service information to customers. This information is typically provided by Operations.

Figure 1-10 Plan Special Events Schedule



Process Subscription Services

A customer may request information on a subscription basis. (The types of subscriptions that Transit will support should be identified.) The customer requests information (via specific access media) on Transit service based on events or time triggers. The Process subscription services manages the requests and fulfills the subscriptions. Customers may validate, suspend, renew, and cancel subscription services. For example, a customer may use a web browser interface to request a daily (weekdays only) message (via pager) on the status of the outbound Route 99 at Central and Union at 5:05 PM. This subscription information can also be made available at service kiosks. Internal devices such as active bus stop signs may also be subscribers to certain information. Technical and policy issues such as security/permission/ validation of the subscribers, cost of service delivery, and information dissemination levels may need to be explored as part of this function.

(**Note**: The back-office systems needed to handle subscription orders (new, renewal, drops, length of terms, etc.) should also be explored. For example, should there be web self-care for subscription service (online renewal, etc.); should there be a link to financial systems to collect subscription revenue?)

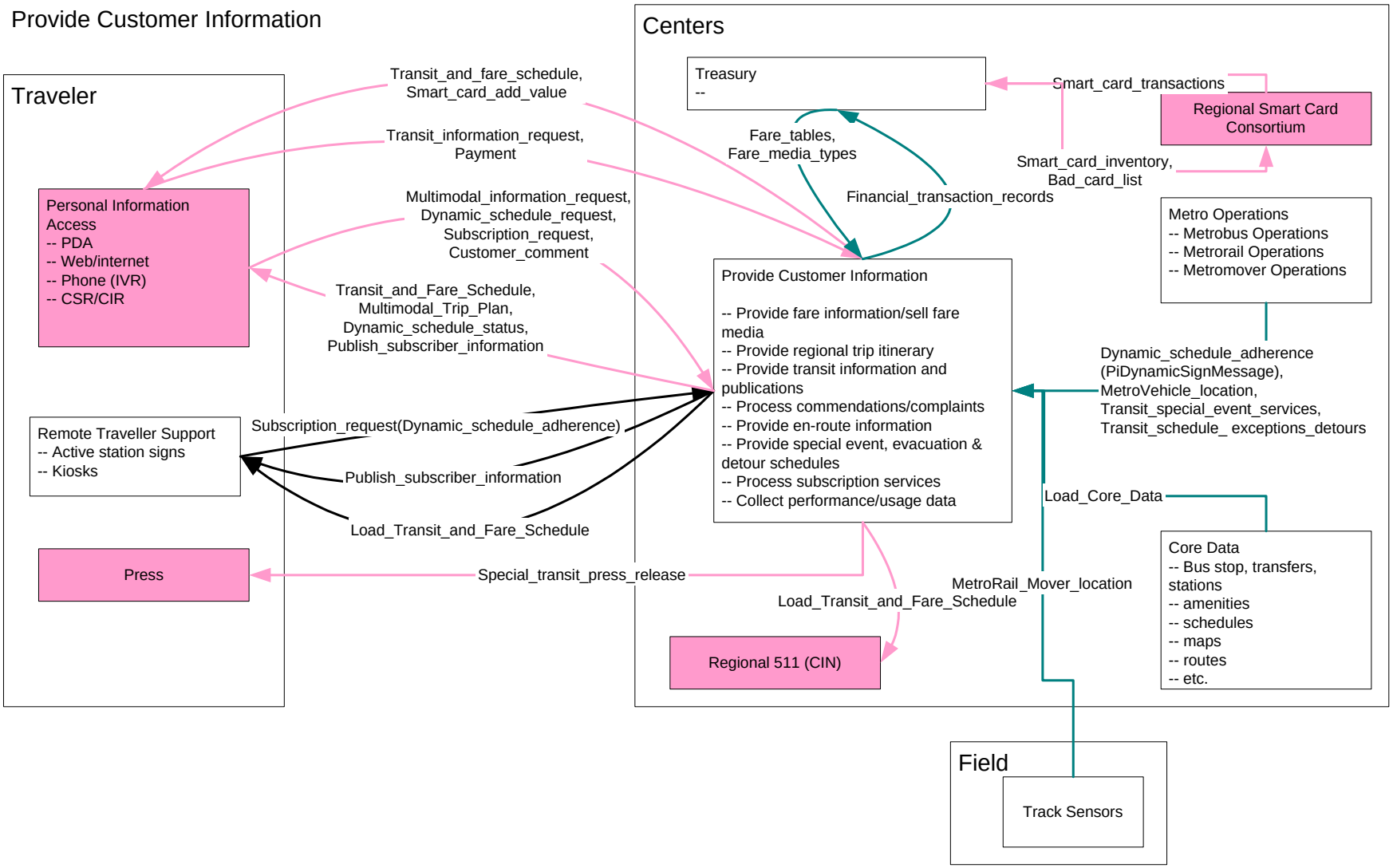
Collect performance/usage data
Collect performance/usage data records the transactions between the customer and the customer information applications, including type of transaction, transaction duration, request-response, etc. This information can be used to spot check for quality, efficiency, and reliability.

Load real-time service status
Update information from the transit vehicles, communications controller, or traffic control on the real-time status of the service.

Load exceptions/service disruptions
Update information from bus and rail traffic controllers on unplanned disruptions or changes to service.

Load service information and map
Update general information on Transit service, fare policy, media and instrument types, publications, and base maps and attributes.

Figure 1-11 Provide Customer Information



1.2.5 Internal Infrastructure

Basic Scope of Operations

The higher level Internal Infrastructure process includes functions such as human resources, finance, and payroll.

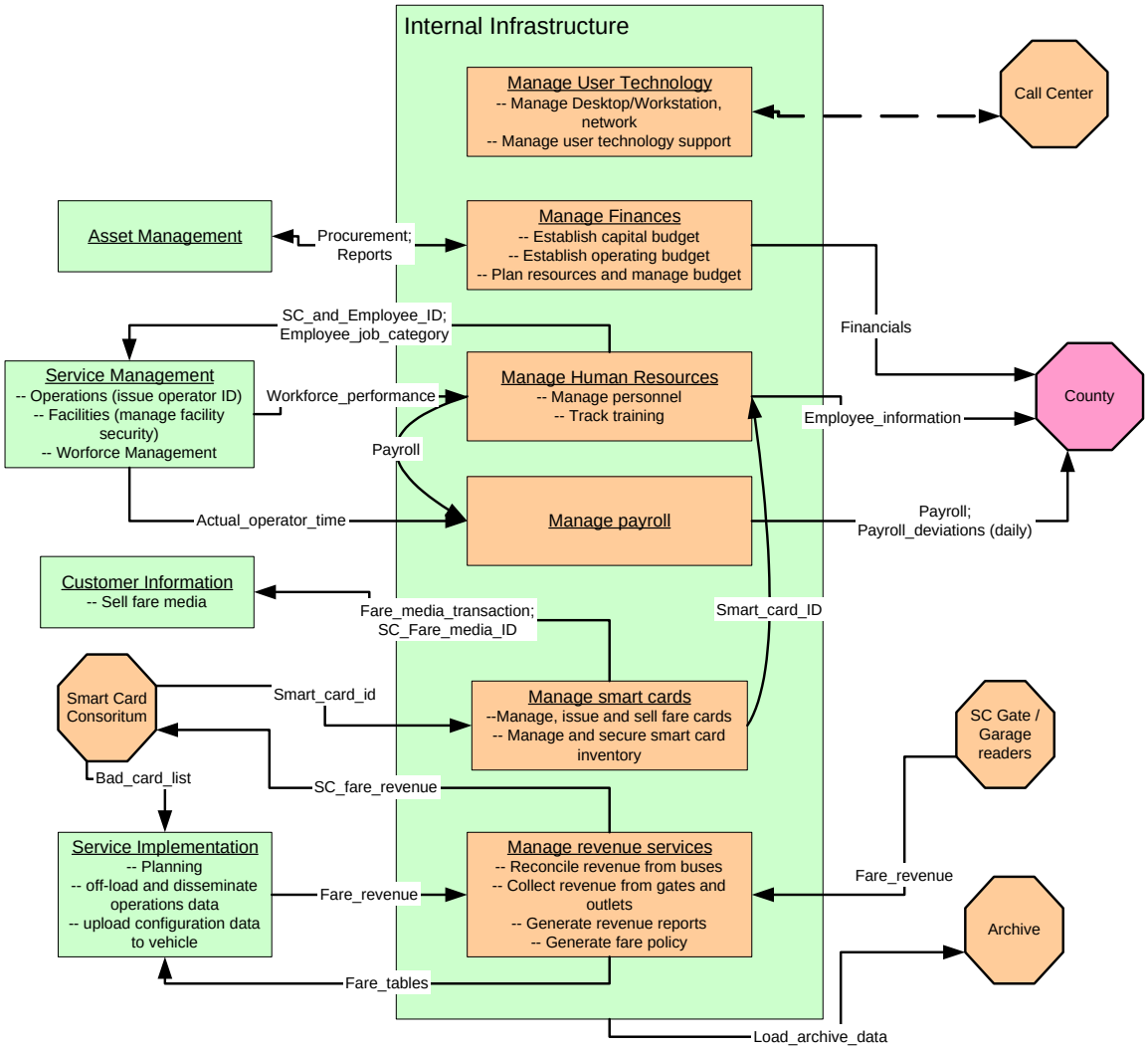
Stakeholders

- Finance/Treasury/Revenue Services
- Human Resources
- Payroll
- Transit operators/staff
- Materials Management
- Regional Smart Card Consortium
- County (systems for payroll, finance, and human resources)
- Marketing

Major Functions

- Manage finance
- Manage human resources
- Manage payroll
- Manage revenue services
- Manage smart card
- Manage user technology

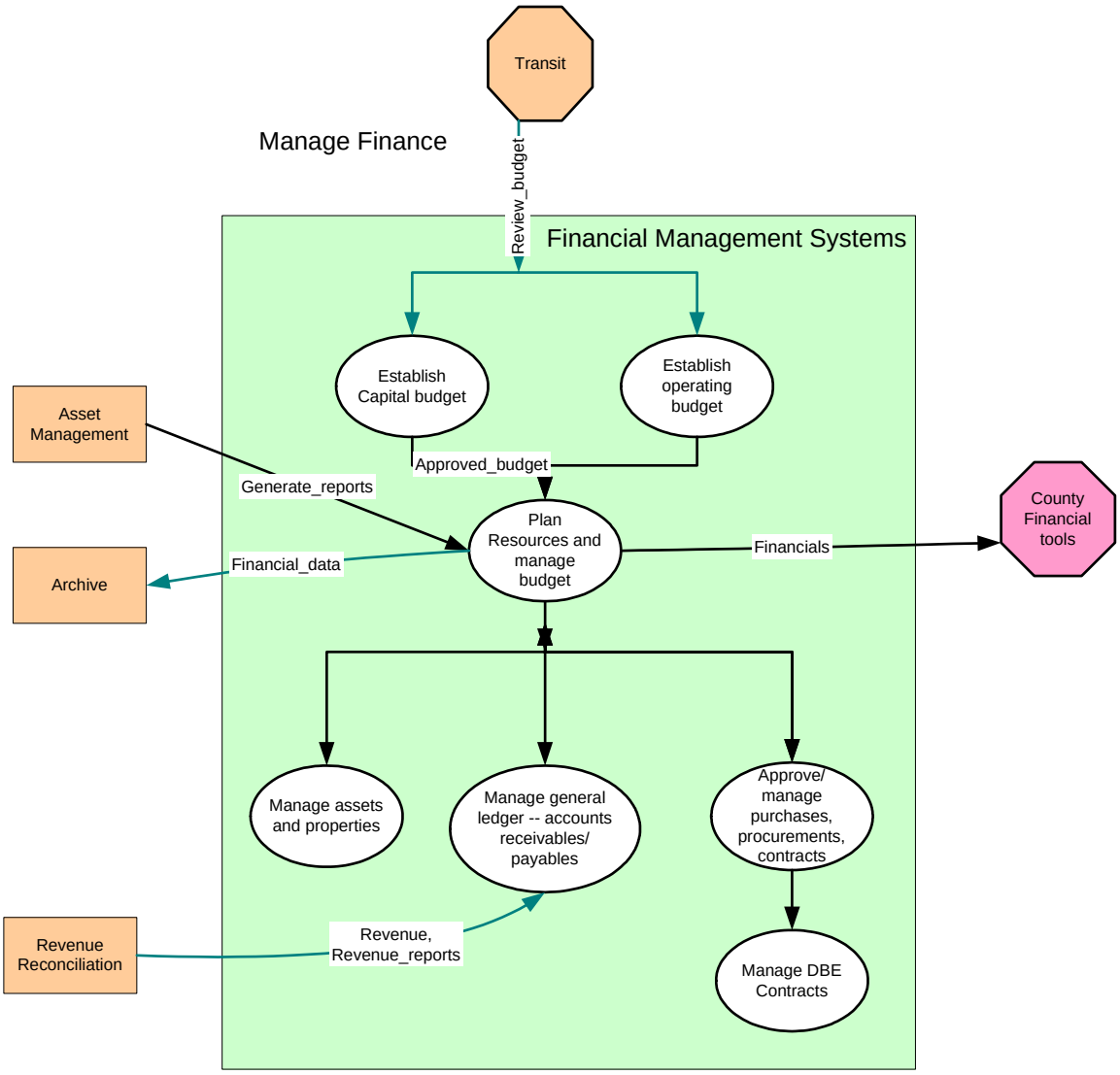
Figure 1-12 Internal Infrastructure



1.2.5.1 Manage Finance

Manage Finance handles managing the budget, contracts, accounts, and fixed assets; it also includes planning the budget and resources, and approving and monitoring expenditures, purchases, procurements, and contracts. A key stakeholder is the county which is the ultimate arbiter of the financial management systems used by Transit. As the PTP evolves over time, this financial relationship is likely to become more complex.

Figure 1-13 Manage Finance



1.2.5.2 Manage Human Resources

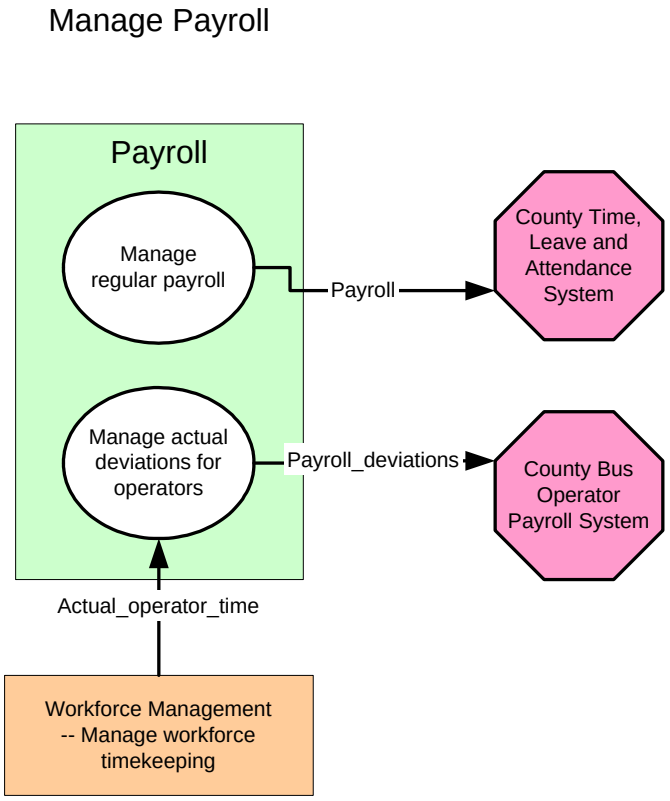
Manage human resources (HR) hires a diverse staff, and manages training, benefits, personnel records, medical, and leave program, as well as other staff evaluation and disciplinary policies related to employees. HR implements policies related to the employees who work in Transit. These policies may be driven by the county, and many of the applications used by HR are county applications.

1.2.5.3 Manage Payroll

Manage payroll, similar to Manage finance and Manage human resources, is driven by county rules and applications. The payroll is administered by the county through the "Time, Leave and Attendance System" and the "Bus Operator Payroll System (BOPS)." Transit is responsible

for reporting employee time, leave, and attendance. For operator staff, the work assignment will drive their salary. The deviations from regular work hours are sent through BOPS on a daily basis. This information is sent by the Workforce Management application. BOPS may be phased out over the next five years.

Figure 1-14 Manage Payroll



1.2.5.4 Manage Revenue Services

Manage revenue and treasury services manages the funds that are generated through fare media sales and revenue services. For that reason, they must have secure systems for collecting, counting, reporting, issuing, accounting, and storing cash, electronic transfers, and smart cards. Smart cards for employees, operators, and customer fare cards are included in the context diagram for Revenue Reconciliation, Fare Card sales and Smart Card Management , Figure 1-15.

1.2.5.5 Manage Smart Cards

Manage smart cards use includes managing the inventory, distribution, and registering (imprinting) of the smart cards. It also includes tracking the usage and managing the security of users. The smart cards will be used not only as fare media, but also as employee identification cards, secure entrance cards, and check in/logon for operators at the garage and on board the vehicle. For the operator, the badge number is the prevalent function in the media.

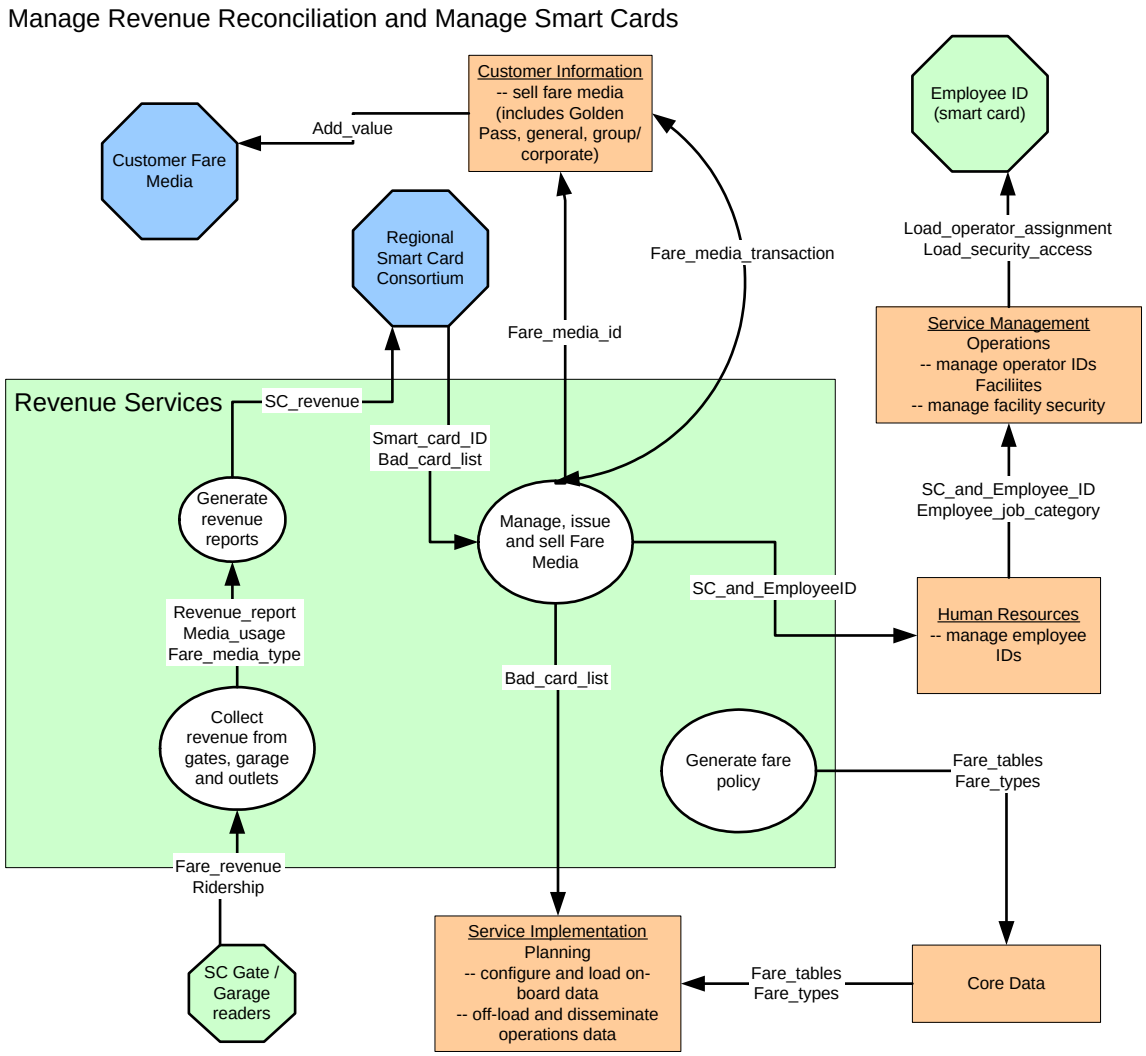
The Regional Smart Card Consortium will manage the smart card inventory and issue cards to stakeholders like MDT on an as-needed basis.

The technical functions required for the smart card read include managing the security of the key field (read only and read/write areas), reading/writing to the smart card, processing transactions, and logging the transactions.

Issues: Consider privacy issues related to tracking the fare media, for example, may police track usage? Where is the tracking data stored? Who can use that data? How much data is tracked (both fare cards and employee cards)? All transactions related to fare media will need to be tracked, including facility access (dates/times) and bus operator logon.

Also, core data for the smart card needs to be identified. Where is it stored? Can it use the same parameters used by other Internal Infrastructure systems such as Human Resources systems?

Figure 1-15 Manage Revenue Reconciliation and Manage Smart Cards



1.2.5.6 Manage User Technology

Manage User Technology is a subset of the IT and Support Services functions. It includes managing IT support services for users (e.g., the Call Center), as well as managing the physical Information Technology infrastructure. The scope of IT services is described in Volume II, *Chapter 3, "Information Technology Services."*

1.2.6 Asset Management

Basic Scope of Operations

Manage assets manages inventories and assets from purchase through disposal. It includes proactively monitoring assets to prolong their life for as long as possible. As such, it includes procurement, inventory control and storage, asset tracking, asset history tracking, asset disposal and retirement, and electronic document control (including maintenance manuals). Monitoring suppliers, procurement requests, warranties, and providing access on asset histories to maintenance control is another function of Manage Assets.

Stakeholders

- Finance
- Maintenance Management
- Vendors who supply and warranty ratables, expendables, and other assets
- County procurement
- Maintenance Control
- Organizational units which issue work orders and procurement requests

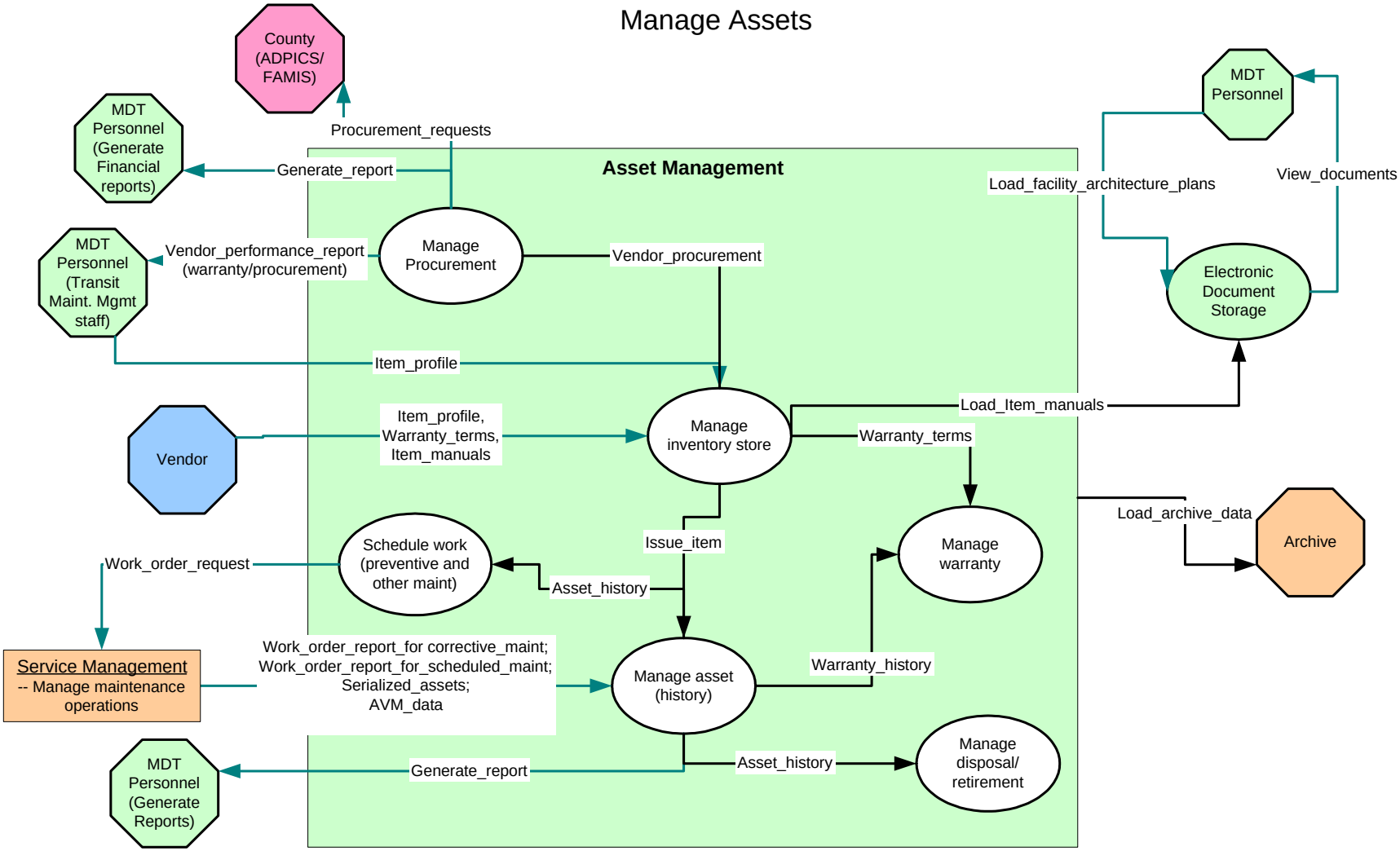
Major functions

- Manage inventory store (warehouse)
- Manage procurement
- Manage asset history
- Manage disposal/retirement
- Manage electronic documents

Included functions

- Manage warranty
- Generate reports

Figure 1-16 Manage Assets and Maintenance



Manage procurement
Manage procurement includes handling requisitions, managing vendors during purchasing, and managing vendor warranty and purchasing performance (i.e., quality, reliability, responsiveness, etc.). Finance monitors the process although Materials Maintenance has primary responsibility for issuing requisitions through the county systems (FAMIS/ADPICS).

Manage inventory store
Inventory is defined as "things" that have not yet been issued. They are not considered an asset until a unit (other than the inventory or storeroom) takes possession. The *Manage inventory store* keeps track of the items, their warranty (*Manage Warranty*) and the minimum/maximum number that should be kept on hand. An inventory item includes expendables and ratables, among other items. An inventory item excludes vehicles in the bus fleet. Many items will include a "profile" or description of the specifications. These are used to validate the item against the procurement specification and to support maintenance efforts. The profile may also include a min/max level that should be stored in the warehouse.

Manage warranty
Manage warranty stores the warranty information related to every item in the inventory and asset management systems. This function is used by the Manage inventory and Manage Asset use cases.

Manage assets history
Manage assets includes all assets that have been issued to users. All assets must be tracked for their history and as part of that, their warranties must also be checked (Manage warranty). This process also tracks asset serialization. Manage asset history records and stores information on scheduled and preventive maintenance activities and dates, hardware configuration hierarchies, and software and data load versions. In addition, it records corrective maintenance activities and records performance measures for each item. The specific parameters recorded depend on the item profile/specification. Maintenance Control monitors asset history.

(**Note**: Particularly for information layer devices on board revenue vehicles, serialization and version control of software and data loads will also need to be tracked.)

Schedule work (preventive and other maintenance)
Based on periodic maintenance schedules, campaigns, retrofits, overhaul, and new installation projects, the Maintenance control staff or automated controls trigger requests for work orders that depend on asset history. (Note this function is shared between Manage Assets and Manage Maintenance.)

Manage disposal and retirement
Each item will be used until it has reached the end of its usefulness. Some items have strict rules or regulations for disposal and retirement. Records on disposal and retirement may be kept for legal reporting requirements.

Manage electronic document
Accessibility to documents is needed throughout Transit. An electronic, intranet-accessible management of these documents serves this need. In particular, facility architecture plans and

material safety data sheets may be a priority for storage and management in an electronic document system.

1.3 Core and Archive Data Sets

1.3.1 Principles for Core Data

Significant obstacles arise when systems are built independently, without consideration of how an application fits into the overall information enterprise, what data it shares with other systems and applications, and how it supports business processes. **Core data**, such as bus stops or operator ID numbers, is used by a wide variety of systems and business functions. Core data becomes an enterprise asset, and as such, principles should be established to manage that asset. The six key principles identified by MDT staff are:

1. Avoid duplicating the development and maintenance of data and data sets
2. For a core data element, establish a single point of management, collection, "cleaning," and define an authority or "a system of record" to ensure data consistency and completeness throughout the organization.
3. Create enterprise awareness of critical data (understand processes that depend on data).
4. Create an awareness of the value and cost of data throughout the organization.
5. When creating core data, determine priority order based on overall criticality to application, operations, and the number of users.
6. Consider security, including access requirements and restrictions.

1.3.2 What are the Core Transit Data Sets?

MDT identified the data sets that may qualify as core data needed to meet Transit business goals. These data sets are listed in Table 1-5. Over time, as resources become available, additional core data items can be included and made available at an enterprise level.

Table 1-5 Core Data

GIS (ITD)	• Base map (ITD) • Landmark • Sidewalks • Radio coverage areas
GIS (ITS)	• Routes, patterns • Bus stops and stations (including transfer points) • ADA characteristics • Time points • Facilities • Rail/Mover alignment (modal paths), bus ways • STS/paratransit zones • Park/ride lots • Kiosk locations • TVM/sellers of fare media • Supervisor zones

Service Information	• Bus stop inventory (signs, shelters, benches) • Schedules (blocks, patterns, routes, trips (timetables)) • Service Performance • Running times, ridership/mode loads • Mileage (rev/non-rev; mtbf) • On-time performance (schedule adherence) • Complaints and commendations • PM completion • Accidents/incidents (IR data) and safety information
Other Core Data	• Material safety data sheets (document management) • Asset information • Vehicle (mode) maintenance history • (public) employee information (daily work, operator assignment, ID) • Ridership revenue • Financial o revenue o grants o project inventory/status

1.3.3 Core Data Standards, Procedures, and Practices

MDT identified data management procedures and practices that should be implemented as part of building an enterprise information infrastructure. These procedures and practices follow from the principles of core data and help fill in the gap.

- Identify and implement standard data access methods
- Develop a data dictionary of core data definitions (including standard naming conventions)
- Develop and document Metadata for core data sets
- Manage data life cycle
    - o Identify life cycle processes, update frequencies, etc.
    - o Archive old versions of data
    - o Document transformation rules for data sets (see Appendix B)
    - o Synchronize schedule data updates and configuration management procedures
- Develop and disseminate standard code lists (e.g., incident classifications)
- Document relationships (dependencies) among data sets
- Assign data stewards for core data from among line staff
- Standardize on a set of file formats (e.g., JPG, doc, XML, etc.)
- Manage user access and security
- Develop GUI style standards and reporting formats
- Define and manage security requirements

There are few industry standards related to data models and descriptions that apply to transit. In the area of ITS, the Transit Communications Interface Profiles (TCIP) is described for data exchange among transit ITS processes. The transit ITS processes include:

- Customer Information (trip planning and real-time information)
- Onboard and Control Center (some operations and on-board AVM and performance data)
- Fare Collection (fare tables, fare equipment status, and fare transactions)
- Incident Management (including some emergency coordination)

TCIP also includes supporting business areas such Scheduling/Runcutting, Spatial Representation, and Transit Infrastructure (e.g., organizational, bus stops, vehicle descriptions).

(The APTA version with a data description in XML will be issued soon.)

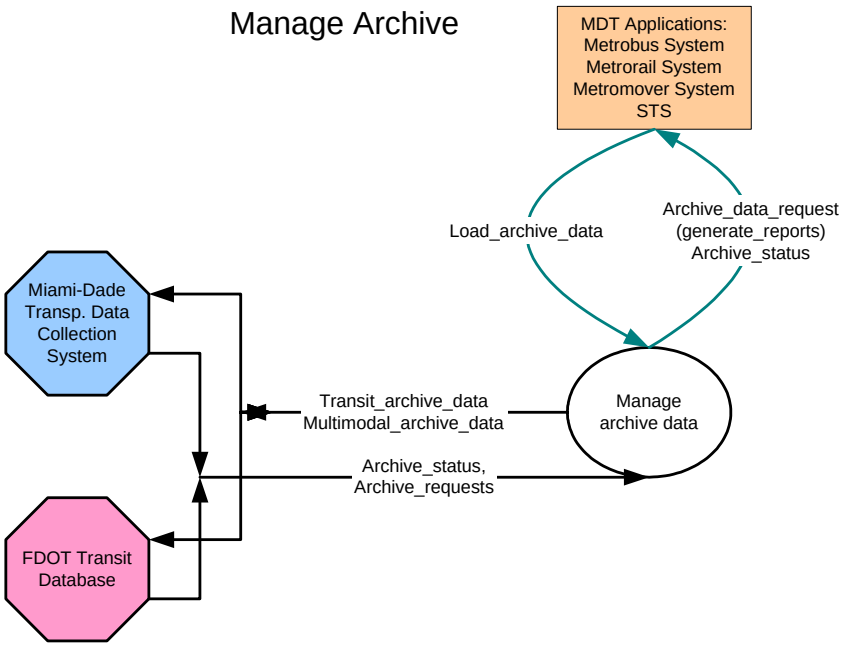
Furthermore, there are other industries that support transit data, including GIS (see Geospatial One-Stop, http://www.geo-one-stop.gov/about/index.html). The European Union developed a robust data model that mirrors many (although not all) of the relationships among US transit entities. Transmodel, the EU model, may be found on www.transmodel.org.

1.3.4 Manage Archive Data

The Manage Archive Data is a Regional ITS Architecture user service (ADUS) that supports many of MDT's business needs. Existing performance and operational data must be stored and filtered to support MDT reporting and analysis needs. Collecting and indexing data sets may take years. The Core Data set effort will support the eventual collection, management, and accessibility of historical data.

Specifically, the ADUS requirements are illustrated in Figure 1-17.

Figure 1-17 Manage Archived Data



1.4 Major Architectural Flows

The major architecture flows depicted in the application and data architecture diagrams in this Appendix are summarized in Table 1-6 below. These flows incorporate the regional architecture flows that are included in the Southeast Florida Regional ITS Architecture (see http://www.jeng.com/html/florida/districts/D3/sausage%20D3.pdf). External subsystem names are the same as ones used by the regional architecture. Internal names reflect specific applications/data management systems internal to MDT. The MDT may separate region-defined subsystems into more than one subsystem or application, or alternatively, combine three or four subsystems into a single MDT subsystem (e.g., Metrobus, Metrorail, Metromover and STS archive is now defined as a single archive). Furthermore, the conceptual architecture in Volume I, *IT/ITS 2003–2008 Strategic Plan*, Section 5, defines a single point of access in the portal for wireline data (except the interface to the CIN). This will simplify the interconnection and security requirements for MDT.

Table 1-6 Major Application and Data Architecture Flows

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
AA Arena Event Scheduling System	event_schedule	Customer Information System
Archive	multimodal_archive_data	FDOT Transit Database
Archive	multimodal_archive_data	Miami-Dade Transp. Data Collection System
Archive	transit_archive_data	FDOT Transit Database
Archive	transit_archive_data	Miami-Dade Transp. Data Collection System
Asset Management	generate_reports	MDT Personnel
Asset Management	issue_item	MDT Personnel
Asset Management	load_archive_data	Archive
Asset Management	load_core_data	Core Data
Asset Management	load_item_manuals	Electronic Document System
Asset Management	procurement_reports	Finance
Asset Management	procurement_requests	County
Asset Management	vehicle_types	Scheduling
Asset Management	vendor_performance_reports	MDT Personnel
Asset Management	work_order_request	Service Management
Communications	fixed_end_to_mobile_msg	Metrobus
Communications	fixed_end_to_mobile_msg	Metrorail
Core Data/GIS	base_map_update	Customer Information System
Core Data/GIS	base_map_update	Planning
Core Data/GIS	base_map_update	Scheduling
Core Data/GIS	base_map_update	Service Management (Bus Operations)
Core Data/GIS	base_map_update	Paratransit Services
Core Data/GIS	core_data	Customer Information System
Core Data/GIS	fare_tables	On-Board Data Management
Core Data/GIS	load_archive_data	Archive
Core Data/GIS	pattern_feature	On-Board Data Management

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
Core Data/GIS	pattern_feature	Planning
Core Data/GIS	performance_data	Planning
Core Data/GIS	ridership	Planning
Core Data/GIS	route_feature	Planning
Core Data/GIS	schedule_service_data	Planning
Customer	customer_comment	Customer Information System
Customer Information	add_value	Fare Media
Customer Information	load_core_data	Core Data
Customer Information Network (CIN)	transit_and_fare_schedule	Customer Information System
Customer Information System	dynamic_schedule_status	Personal Information Access
Customer Information System	dynamic_schedule_status	Remote Traveler Support
Customer Information System	multimoda_trip_plan	Personal Information Access
Customer Information System	multimoda_trip_plan	Remote Traveler Support
Customer Information System	publish_transit_subscriber_information	Personal Information Access
Customer Information System	publish_transit_subscriber_information	Remote Traveler Support
Customer Information System	special_transit_press_release	Press
Customer Information System	transit_and_fare_schedule	Customer Information Network (CIN)
Customer Information System	transit_and_fare_schedule	Personal Information Access
Customer Information System	transit_and_fare_schedule	Remote Traveler Support
Electronic Document Storage	view_documents	MDT Personnel
FDOT Transit Database	archive_requests	Archive
FDOT Transit Database	archive_status	Archive
Finance	financials	County
Finance	load_archive_data	Archive
Finance	paratransit_billing_interface	County
Human Resources	employee_information	County
Human Resources	employee_job_category	Service Management
Human Resources	load_archive_data	Archive
Human Resources	sc_and_employee_id	Service Management
Incident Tracking System	load_archive_data	Archive

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
Incident Tracking System	transit_incident_accident_information	County
Internal Infrastructure	load_core_data	Core Data
Local Venue Event Scheduling System	event_schedule	Customer Information System
MDT Personnel	load_facility_architecture_plans	Electronic Document Storage
MDT Personnel	review_budget	Finance
Metrobus	onboard_msg	Communications
Metrobus (EA)	emergency_notification	Station Security Monitoring Station
Metrorail	onboard_msg	Communications
Metrorail (EA)	emergency_notification	Station Security Monitoring Station
Miami Arena Event Scheduling System	event_schedule	Customer Information System
Miami-Dade Transportation Data Collection System	archive_requests	Archive
Miami-Dade Transportation Data Collection System	archive_status	Archive
Municipality Event Permit Systems	event_schedule	Customer Information System
OB Launch Pad (Metrobus)	offload_OB_performance_data	On-Board Data Management
OB Sign/Announcement Library	ob_sign_announcement_data	On-Board Data Management
On-Board Data Management	AVM_data	Service Management (Maintenance)
On-Board Data Management	boardings_alightings_load	Planning
On-Board Data Management	dwell_time	Planning
On-Board Data Management	exception_data	Planning
On-Board Data Management	fare_revenue	Revenue Services
On-Board Data Management	operations_data_update	Service Management
On-Board Data Management	ridership	Revenue Services
On-Board Data Management	ridership_fare	Planning
On-Board Data Management	running_time	Planning
On-Board Data Management	schedule_adherence	Planning
On-Board Data Management	upload_OB_configuration_data	OB Landing Pad (Metrobus)
Paratransit Services	paratransit_billing_interface	State (Consultec)
Paratransit Services	paratransit_billing_interface	Finance

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
Passenger Facilities Management	bus_stop_survey_data	Core Data/GIS
Passenger Facilities Management	coordinate_construction_and_maint	Local Government
Passenger Facilities Management	incident_report	Service Management (Facilities Maint)
Passenger Facilities Management	load_archive_data	Archive
Passenger Facilities Management	pattern_feature	Core Data/GIS
Passenger Facilities Management	requisition_item	Asset Management
Passenger Facilities Management	route_feature	Core Data/GIS
Passenger Facilities Management	work_order_request	Service Management (Facilities Maint)
Payroll	load_archive_data	Archive
Payroll	payroll	County
Payroll	payroll_deviations	County
Personal Information Access	multimodal_information_request	Customer Information System
Personal Information Access	transit_information_request	Customer Information System
Personal Information Access	transit_information_subscription_request	Customer Information System
Planning	service_design_update	Passenger Facilities Management
Planning	service_design_update	Scheduling
Pro Player Event Schedule System	event_schedule	Customer Information System
Regional Smart Card Consortium	bad_card_list	Service Implementation
Regional Smart Card Consortium	smart_card_id	Smart Card Management
Remote Traveler Support	customer_comment	Customer Information System
Remote Traveler Support	multimodal_information_request	Customer Information System
Remote Traveler Support	transit_information_request	Customer Information System
Remote Traveler Support	transit_information_subscription_request	Customer Information System
Revenue Services	fare_media_types	Customer Information System
Revenue Services	fare_tables	Service Implementation
Revenue Services	load_archive_data	Archive
Revenue Services	revenue_reports	Finance
Revenue Services	sc_fare_revenue	Regional Smart Card Consortium
Safety and Security	load_core_data	Core Data
SC Gate/Garage readers	fare_revenue	Revenue Services

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
Scheduling	extra_board	Service Management
Scheduling	operator_assignment_planned	Core Data
Scheduling	pick_list	Service Management
Scheduling	roster	Service Management
Scheduling	routes	Core Data
Scheduling	timetable_version	Core Data
Scheduling	vacation_board	Service Management
Service Implementation	fare_revenue	Revenue Services
Service Implementation	load_core_data	Core Data
Service Management	actual_operator_time	Payroll
Service Management	AVM_data	Asset Management
Service Management	dynamic_schedule_adherence	Customer Information System
Service Management	employee_performance	Human Resources
Service Management	Hierarchy_configuration	Asset Management
Service Management	incident_report	Incident Tracking System
Service Management	load_archive_data	Archive
Service Management	load_core_data	Core Data
Service Management	load_operator_assignment	Employee ID (smart card)
Service Management	load_security_access	Facility
Service Management	metro_vehicle_location	Customer Information System
Service Management	pickup_and_dropoff_stops	Customer Information System
Service Management	special_events_schedule	Customer Information System
Service Management	transit_and_fare_schedule_exceptions	Customer Information System
Service Management	transit_schedule_exception_detour	Customer Information System
Service Management	transit_special_event_services	Customer Information System
Service Management	transit_vehicle_location_data	Customer Information System
Service Management	transit_vehicle_schedule_performance	Customer Information System
Service Management	work_order_report_for_corrective_maint	Asset Management
Service Management	work_order_report_for_scheduled_maint	Asset Management
Service Management (Facilities Maint.)	work_order_report	Passenger Facilities Management

Source Subsystem/Application	Data/Application Architecture Flow Name	Destination Subsystem/Application
Service Management (Field Equipment)	ob_asset_hierarchy	On-Board Data Management
Smart Card Management	fare_media_transaction	Customer Information System
Smart Card Management	load_archive_data	Archive
Smart Card Management	sc_fare_media_id	Customer Information System
Smart Card Management	smart_card_id	Human Resources
Station Security Monitoring System	emergency_acknowledge	Metrobus
Station Security Monitoring System	emergency_acknowledge	Metrorail
Station Security Monitoring System	emergency_acknowledge	Transit Police
Station Security Monitoring System	emergency_acknowledge	Transit Station
Station Security Monitoring System	streaming video	Service Management
Station Security Monitoring System	streaming video	Transit Police
Surveillance Camera	streaming video	Station Security Monitoring Station
Transit Police	emergency_notification	Station Security Monitoring Station
Transit Police	incident_report	Incident Tracking System
Transit Station (EA or telephone)	emergency_notification	Station Security Monitoring Station
Vendor	item_manuals	Asset Management
Vendor	item_profile	Asset Management
Vendor	warranty_terms	Asset Management

2 ON-BOARD SUBSYSTEM DESCRIPTIONS

2.1 Concept of Operations

It is the intent of the MDT IT Division to provide for nonproprietary architecture and standards for on- and off-vehicle devices and systems. In this architecture, digital information can be accurately and unambiguously collected, transported, received, and understood by all subsystems, devices, and the fixed-end systems. Further, the on-vehicle system would be modular, expandable, and vendor-independent; and enhancements would not require the discarding of previous technology investments. The Interconnection diagram, as illustrated in Figure 2-1 shows a single nonproprietary communications network that integrates multiple physical devices on board the vehicle.

In the architecture described by this section, various "processes" are accomplished by Subsystem elements (these processes and subsystems are illustrated in Figure 2-2. The subsystems may be separate physical devices, or they may be integrated into "multiple process" physical devices. For example, the door sensors and the Automatic Passenger Counting System may be two separate subsystems or they may be combined into a turn-key system. The APC will then report the counts of boardings and alightings per occurrence (door open) to the Vehicle Logic Unit for storage along with GPS data, time, and confirming farebox receipts. So long as all of the described "functions" communicate with the Vehicle Area Network, the physical implementation is transparent. As example, if the GPS sensor is an integral component of the Vehicle Logic Unit (the prime controller on the vehicle) so long as it makes GPS data available and communicates with all other physical devices on the vehicle, then location data would be available to Annunciators, Fare Collection, and other subsystems on the vehicle. This transparent sharing of information, and subsystem control, is contained in the ITS SAE family of Vehicle Area Network specifications identified in the Applicable Standards section of each subsystem.

The "Intelligent" Vehicle Logic Unit on board the vehicle within the OB architecture will maintain operational data storage for all subsystems on the vehicle. Systems that maintain protected storage or common storage for all the subsystems include the Video Control and the Configuration Data/Inventory Management Systems.

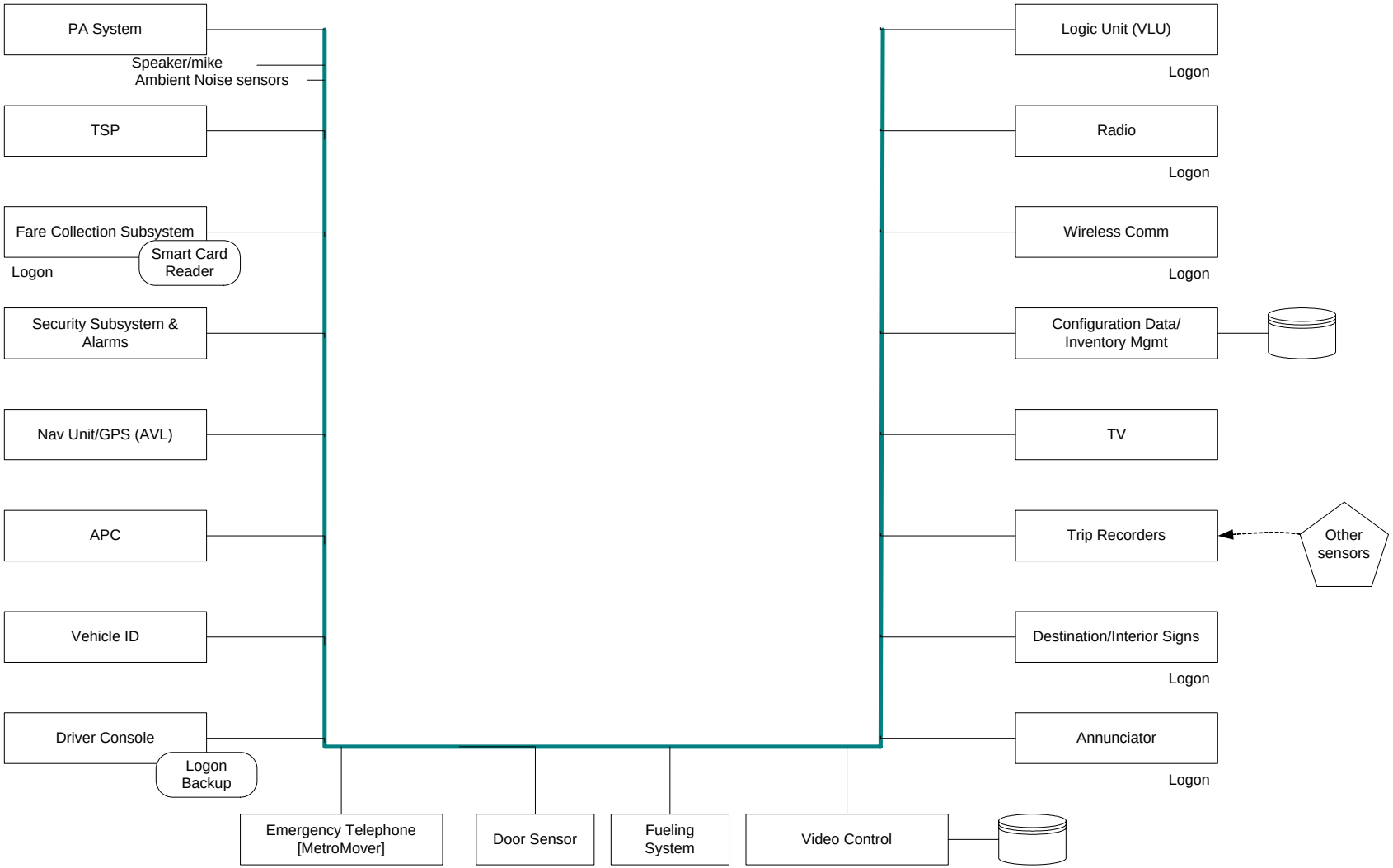
There are other multiplex networks on vehicles. One is for the drive train and is normally a SAE J-1708 network. Parts of the drive train may also communicate with SAE J-1939, but any data generated on the J-1939 network is also available on the SAE J-1708 drive train network and diagnostic port.

Additionally, bus manufacturers add another network for vehicle "controls" such as headlights, air conditioning, door opening mechanisms, head/tail lights, etc. These systems are proprietary in nature and unique to the coach manufacturer. They may include control systems from Allen Bradley, I/O Controls, or others. Figure 2-1 shows only the "information" SAE J-1708 network (not the drive train or I/O controls multiplex bus networks).

2.2 Introduction to Manage On-Board Vehicle Subsystems

Manage On-Board Vehicle Subsystems describes the functional processes that should be included on board the transit vehicle. In principle, the logical processes supported by the on board Metrobus functions should be similar if not identical to ones described for the Metrorail and Metromover. Because the various vehicle modes employ different operating procedures, control, and physical environment, implementation of the physical devices and components will not be identical. In procuring the actual systems, MDT may wish to procure systems that are similar in functionality, although they may not be similar in their connectivity with their environment.

Figure 2-1 On-Board Interconnection Diagram



2.3 Basic Scope of Operation (For Revenue Vehicle Operations Scenario)

Upon startup, all on-board systems are checked for health and registered. Bus vehicle communications between the fixed and mobile ends are established, and the vehicle registers with the control system. The operator logs on to the on-board system using a badge identification card and his/her logon information is validated with central control. At this time, the vehicle is assigned to the operator's route/run, and the appropriate configuration data is compiled and uploaded to the vehicle as the operator is preparing to pull out. As the configuration data is loaded onto the vehicle, the vehicle logic unit checks its validity and disseminates it to the appropriate components. When all systems are checked and updated a signal is sent to the operator interface that indicates to the operator that all systems are ready.

As the vehicle pulls out of the garage, the navigation system continuously tracks the location of the vehicle. This position is matched to an event queue that includes all the events along the path of travel. If the vehicle strays from the path of travel, the route adherence function will trigger an alarm. As the vehicle traverses a designated location, an event will be triggered. The event may be to initiate a change of sign, announcement, record number of passengers boarding /alighting the vehicle, and record time of approach/exit of that location. Upon pull-in to the garage, the system consolidates all the on-board transactions and logged information and off-loads it to the back-end operational database. The operator logs off, and when the vehicle is turned off, the vehicle deregisters from the communications system.

2.4 Major On-Board Subsystems

- Vehicle Logic Unit (VLU)
  - Manage security subsystems and alarms (includes AVM)
  - Determine location (AVL)
  - Manage schedule and route adherence
  - Log health/performance data
  - Load/manage component configuration and service data
  - Manage communications (radio/wayside)
- Monitor ridership (APC)
- Manage on-board customer information
  - interior/exterior announcements
  - interior/exterior signs
  - headsigns
  - Manage PA system
- Manage fare collection
  - Manage smart card reader (manage operator logon)
- Manage Operator Interface (driver display)
- Record Video Surveillance
- Manage Transit Signal Priority (TSP)
- Manage On-Board TV

Figure 2-2 Back Office Systems That Support On-Board Subsystems

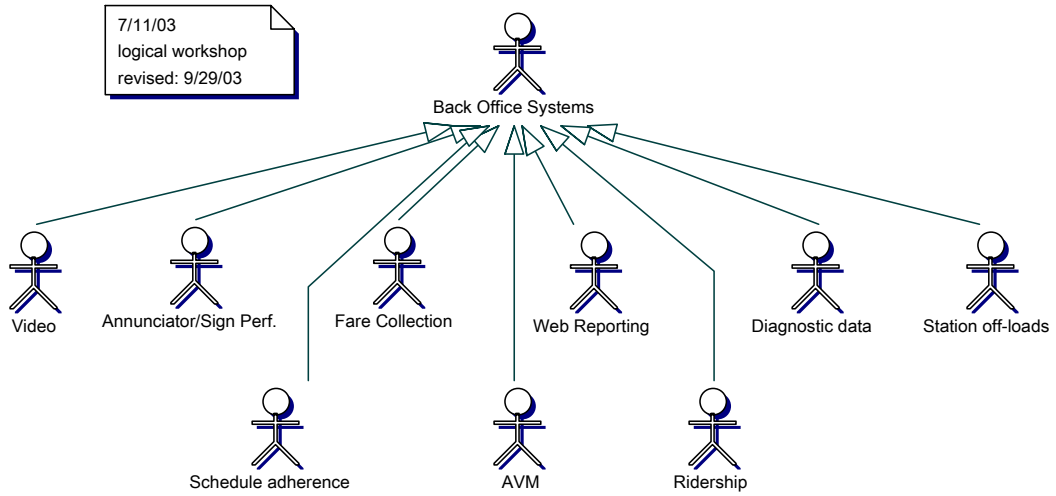
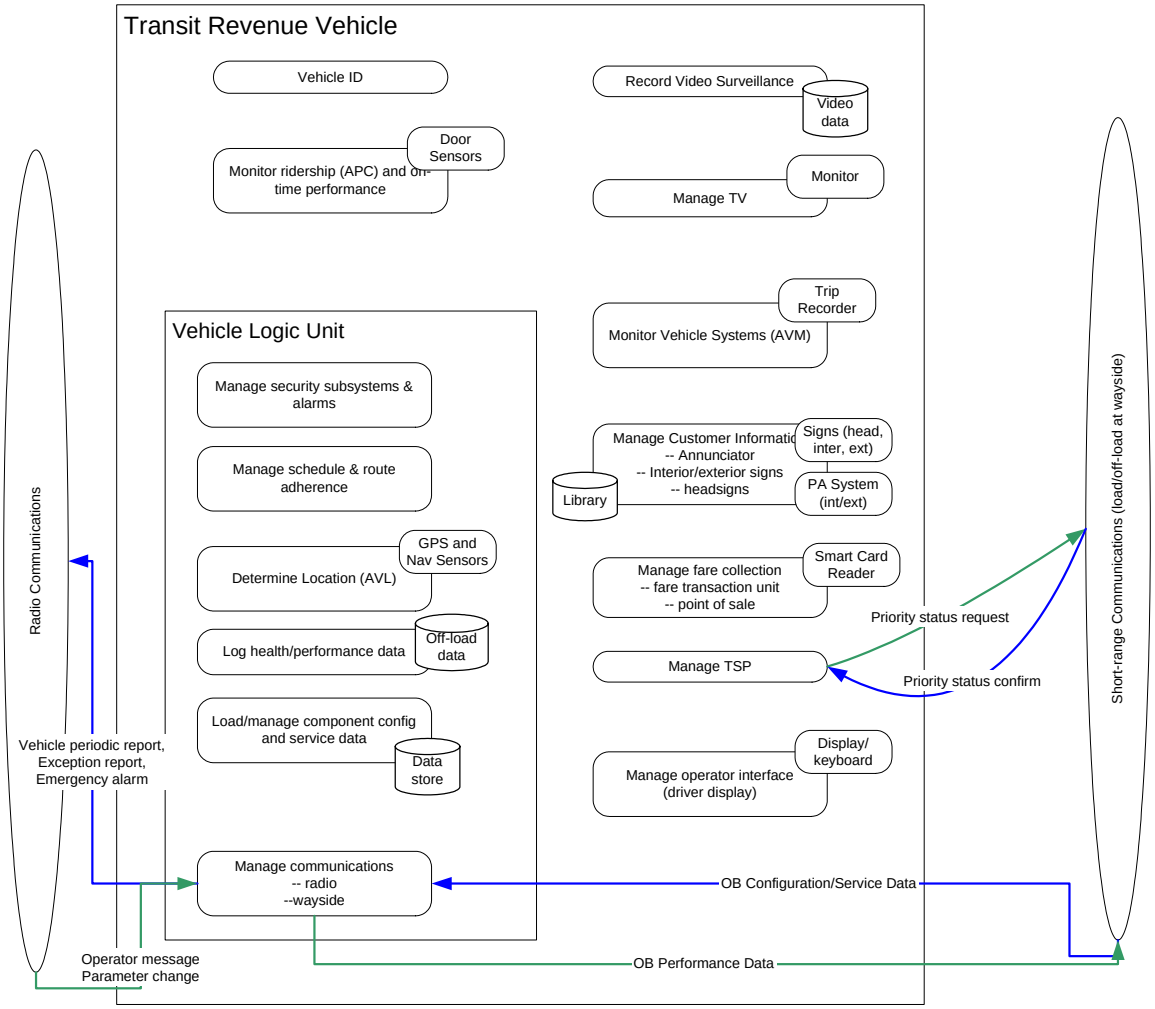


Figure 2-3 On-Board Architecture Flow Diagram



2.4.1 Vehicle Logic Unit (VLU)

Process: Manage Vehicle Logic Unit (VLU)

Description
The Vehicle Logic Unit is the core computer on board the vehicle. Its role is to manage the on-board components. It manages start-up and shut-down procedures, monitors the network and subsystem/device health status, monitors alarms, registers subsystems and devices, validates operator logon, and manages priority messaging and event processing, including driver console display, central control reporting, operator messages, schedule and route adherence, and persistent configuration data (inventory management).

2.4.1.1 Requirements

This is the heart of the Information Level on a vehicle. Its functions and uses are many:

- Data gathering and storage
- Data association (of related data by time/location/event)
- Data analysis (for alarms or automated control)
- Controls access to the trunked radio system
- Controls access to the wireless wayside communications
- Affects how other devices on the vehicle function
- Supports a single human-machine interface
- Supports a single point of vehicle log-in
- Supports calculation and display of schedule adherence
- Automates driver functions by location/time (Destination Signs, Fare Collection tables/turnaround, Annunciators, Transit Priority, and Connection Protection, among others).
- Collects, analyses, and reports real-time drive train alarms
- Collects, associates data, stores and reports ridership, schedule adherence, on-time performance, transit system priority utilization, drive train performance and alarms, Automatic Passenger Counter data, silent alarms, and alarms from all on-vehicle devices).

Any intelligent component may be allocated to this subsystem. In its most common configuration, the VLU:

- Manages security subsystems and alarms
- Manages schedule and route adherence
- Determines location (AVL)
- Logs health/performance data for off-load
- Loads and manages component configuration and service data
- Manages communications including vehicle area network, radio, and wayside
- Manages and controls other subsystems on board the vehicle

2.4.1.2 Available Standards

- NTCIP 1406:2001 TCIP Standard on On-Board Objects
- NTCIP 1407:2001 TCIP Standard on Control Center Objects
- SAE J-1708/1587/1939

2.4.2 Security and Alarm Subsystem (Includes AVM)

Process: Manage security subsystems and alarms

2.4.2.1 Description

The Manage security subsystems and alarms receives all the measurements from other systems on board the vehicle through a data bridge or trip recorder. For that purpose, it also serves as the on-board automated vehicle monitoring (AVM) process. "Manage security subsystem…" stores normal operating ranges for devices and sensors. When a device or sensor (in the drive-train or input/output network) is operating out of range, there are measurement thresholds that automatically trigger a critical alarm. Other alarms may also be sent to this component, for example, unauthorized person tampering with the cash box. These alarms are compiled into a message and communicated to central control. These alarms may also be communicated directly to the maintenance garage for immediate action or for remote troubleshooting. Whenever a device is recording measurements out of normal operating range, the values, time, date, and location are recorded for later review. This information is off-loaded as part of the vehicle pull-in procedures.

All Metrorail and Metromover vehicle alarms are automatically displayed to the RTC.

Some critical alarms may trigger other systems, for example, the driver's silent alarm or tampering of the cash box may toggle the video surveillance to save the video storage. For example, this subsystem can trigger the Security Video Subsystem to begin saving video frames at full speed, open the covert mike, and send a high-priority message to the BTC/RTC terminals via a SAE J-1708 interface.

2.4.2.2 Requirements

The security subsystem may be triggered by the operator or by an unauthorized person tampering with equipment. SAE-J1708 devices are capable of generating alarm messages to the vehicle logic unit for real-time transmission to the dispatcher.

2.4.2.3 Available Standards

SAE J-1708 provides for the issuance of a unique message when a Silent Alarm is declared. This message can trigger video systems, as well as appropriate messages on the vehicle's destination sign.

2.4.3 Location Determination Subsystem (AVL)

Process: Determine location (AVL)

Devices: Navigation sensors such as GPS receiver/antenna, radio triangulation, dead reckoning sensors (such as odometer, gyroscope, compass), atomic clock, and even "wayside correction" (known position) and navigation filter (i.e., Kalman filter).

2.4.3.1 Description

The Location Determination Subsystem generates an accurate and reliable position and time measurement from an integrated suite of navigation sensors. The vehicle includes a navigation suite of sensors that separately and together determine the current position of the transit vehicle. There are usually two or three location sensors, including Global Positioning System (GPS), compass, and differential odometer, gyros (2) or inertial navigation system. When integrated together using a Kalman filter, the results are more accurate and degrade more slowly than when operating as back-up sensors. This information is used by many other on-board subsystems, as well as fixed-end customer information, fleet and control management, and incident management systems. Only one location measurement should be used as a "system of record" for all the subsystems on board the vehicle. There are inherent errors associated with different units even of the same sensor type (e.g., two different GPS units) that will cause inconsistencies in customer information, performance, risk and operations analyses.

The rail and mover modes may also use the track circuitry to determine when a vehicle enters or leaves a track segment.

2.4.3.2 Requirements

In most contemporary radio networks, field radios made by Motorola, E.F. Johnson, and Ericsson require a time clock accurate to the microsecond range, which GPS receivers can easily provide. In order to maximize the number of vehicles that can communicate with a central CAD operation, radios are not "polled" but rather send their data without any solicitation based on various schemes based on time alone. However, if the GPS clock information had to suffer the latency of any multiplex serial communications standard, its accuracy would be lost. As a result, modern designs heavily integrate the GPS receiver into the hardware and software of the vehicle's Logic Unit or VLU. The marriage is typically inseparable by design, and changing brands of GPS receiver may be impossible. Since this tight integration cannot be avoided, the exact standard a particular vendor uses is of little matter as long as it works and keeps the radio network functioning correctly.

On the other hand, the radio network is not the only device on the vehicle that needs time or AVL data (APC, Annunciator, Destination Signs, etc.). These subsystem needs are not in the microsecond range, but typically the nearest 1/100th of a second. In Transit, the standard for transferring the time and current location related data to other subsystems on a vehicle is via the SAE J-1708 Vehicle Area Network (VAN) standard. This avoids redundant, and sometimes conflicting, GPS/AVL devices.

2.4.3.3 Available Standards

There are a number of published serial protocol standards for expressing location:

- For tight integration with the vehicle's VLU, documented standards include:
  - TAIP

- TSIP
- RTCM SC-104
- NMEA 0183 message format
- RTCM SC-104 input
- MAP27

- For time and location distribution to other subsystems on the vehicle, the SAE J-1708/J-1587 standard applies.

2.4.4 Schedule and Route Adherence Subsystem

Processes: Manage route adherence, manage schedule adherence

2.4.4.1 Description

Manage Route Adherence measures the deviation from the expected path taken by the vehicle. This function is applied to track vehicle travel along a route. The function requires information on the path taken along a vehicle assignment, from pull-out to pull-in (both revenue and non-revenue patterns).

Manage Schedule Adherence monitors the time a transit vehicle in revenue service traverses a point at which time is measured against the schedule. The closeness to the time will determine if the vehicle is on schedule, ahead, or behind schedule. This information is displayed on the operator interface for the operator and sent to the communications control center for dissemination to multiple fixed-end systems, including operations (Metrobus, Metromover and Metrorail), and provides en-route information.

This information may be aggregated by route/trip/trip time point and further categorized by time of day, weather, "shake up" period (e.g., winter, summer) or day type. The information collected for real-time operational management may not be the same as what is collected for planners and other performance measurements.

2.4.5 Automated Passenger Counting (APC) Subsystem

Process: Manage ridership
Components: Door sensors

2.4.5.1 Description

Manage ridership manages information about passengers (and time at) boarding and alighting a transit vehicle. The APC must determine that it is approaching a stop; when it arrives, this subsystem records the stop location/ID, and times at which the vehicle entered the stop location and opened the door, dwell times, and skipped stops. A passenger counting device begins to count the passengers alighting and boarding the vehicle. This subsystem records the times when the doors are closed, and the vehicle leaves the stop area. If the stop is not a planned stop, all the activities related to the stopping event are recorded. If the vehicle does not stop at a planned stop, that too is recorded.

Data that should be aggregated for planning includes:

- Boardings/alightings per stop
- Dwell time at stop (with doors open)
- Dwell time at stop (from time entered to time left) including the number of times that the doors opened at the stop
- Passed stops (with no passengers boarding/alighting)
- Unplanned stops with boarding/alighting statistics, location, time
- Unplanned stops without boardings/alightings (possible explanation for stop)
- Loads per trip and per stop
- Match (reconcile) data with fare and ridership data per stop (performed as a back-end function)

The granularity of the data may be important for assessing data collection and storage requirements.

2.4.5.2 Requirements

Included devices:

- Passenger counting sensor
- Door sensors
- (optional) AVL data capture (only if completely stand-alone)
- (optional) Route/trip/pattern/time of day capture (only if completely stand-alone)

2.4.5.3 Available Standards

- NTCIP 1406:2001 TCIP Standard on On-Board Objects (Stop point record)
- NTCIP 1404:2001 TCIP Standard on Scheduling Objects (pattern definition for stop point locations)

2.4.6 On-Board Customer Information Subsystem

Processes: Manage customer information systems, Manage PA system
Devices: Interior/exterior signs; PA system, Headsign

2.4.7 Annunciator/Signage Subsystem Description

Annunciator system: "A Subsystem which provides audible and visual announcements of next stop, stop requested and other information, both on and off the Public Transportation vehicle. The requests may derive from on-board the vehicle (e.g., passengers) from pointers to text and announcements or from ASCII messages, or from pointers received from wayside detection devices." [NTCIP 1406:2000]

Signage subsystem (interior and destination): "Posted displays installed inside and outside the transit vehicle that provides information to riders on the transit vehicle and transit service. These message signs may be changed dynamically." [NTCIP 1406:2000]

2.4.7.1 Annunciator/Signage Requirements

The configuration data is composed of event triggers ordered by trips along patterns or block (run/route) path. Signage may be changed manually if required. The data storage capacity on board the vehicle should allow at least enough memory for a daily vehicle assignment, or vehicle assignment from pullout to pull-in for both signs and announcements.

Configuration data should be unloadable via wireless transfer.

2.4.7.2 Annunciator/Signage Available Standards

NTCIP 1406:2001 TCIP Standard on On-Board Objects (annunciator and sign library definition)
NTCIP 1403:2001 TCIP Standard on Scheduling and Runcutting Objects (event trigger definitions)

2.4.8 Public Announcement (PA) Subsystem

The Public Announcement subsystem provides for in-vehicle travel information and safety announcements to patrons. The source of the audio may be from the driver, the dispatcher or from automated devices (annunciators).

2.4.8.1 Public Announcement (PA) Requirements

Implementation of this subsystem requires the following devices:

- Microphone
- (optional) Annunciator subsystem
- (optional) Voice pathway from the dispatcher's console

2.4.8.2 Public Announcement (PA) Available Standards

Basic Public Announcement systems are proprietary. If automatic announcements are provided for by annunciator subsystems, there are SAE J-1587/J-1708 standards that enable those systems to trigger their announcements at predetermined times, or to enable/disable the subsystem under fixed-end control (i.e., detours, route changes, etc.).

2.4.9 Fare Collection Subsystem

Processes: Manage fare collection; (back office: Manage revenue reconciliation and Manage smart card)
Components: Smart card reader, POS, cash box, TVM, TDM

2.4.9.1 Description

Manage Fare Collection includes on-board, back office, Ticket Vending Machines (TVM), and Ticket Dispensing Machines. Although on-board equipment does not include gates and point of sales, it does include the transaction and fare processing functions. The transaction unit processes financial transactions (e.g., collects fares, adds/deducts value, reads fare instruments) and the fare processing unit calculates the fares (based on fare tables and policies). The fare collection system will use cash, magnetic tickets, and smart cards. The smart cards will be managed by a regional consortium. Although all financial transaction information is processed

through the revenue reconciliation process (see Internal Infrastructure primary process), the smart card and magnetic ticket transaction data is provided to the Regional Smart Card Consortium.

The Fare Collection System includes the smart card reader. The operator logon and logout is initiated by flashing the badge ID through the smart card reader. The process that manages operator logon and logout may be contained within the Manage fare collection subsystem. Manage Operator Logon enables the operator to enter logon information to multiple on-board systems including fare collection, annunciator, signs, wireless LAN, and AVL. The operator flashes his/her smart card which reads the badge number, confirms the route/run, validates the operator assignment, and registers the vehicle. The operator may be asked to verify the information on the operator interface. The operator interface may be used as a backup to change login information. Manage operator logout process enables the logout of service either at the end of the run or if there is a disruption and the operator or vehicle is replaced.

2.4.9.2 Requirements

The Fare Collection subsystem must interface with both the driver and the patron during the payment of fares. Fares may include cash, magnetic media, or smart card as determined by need and regional payment forms. A secure cashbox is mandatory.

A non-financial data communications port must be provided on the Fare Collection subsystem if any of the following are required:

- Single log-on interface for all systems on the vehicle
- Ridership collected at a stop level
- Automation of selected functions (logging of trip start/end; fare zone changes)
- Real-time transmission of alarms (tamper alarm, equipment dysfunction, etc.)
- Correlation of boarding and alighting patrons at a stop to fares collected
- Validation of Operator Console (passenger counter and farebox match counts)

2.4.9.3 Available Standards

- NTCIP 1408:2001 Fare Collection Objects
- NTCIP 1406:2001 TCIP Standard on On-Board Objects (operator logon)
- TBD: Universal Transit Farecard Standard (APTA)
- (ISO/IEC 7816 Smart Card standards)
- SAE J-1708/1939

2.4.10 Operator Interface Subsystem

Process: Manage Operator Interface
Device: Driver console, smart card reader (optional)

2.4.10.1 Description

Manage operator interface is a single point where the operator can observe operational status, device health status, send and receive text messages, and initiate voice. The operator interface may be the back-up for logging on the vehicle if the smart card reader fails to work. The

operator interface will support a keyboard and display and will prioritize incoming and outgoing messages.

This is the primary human-machine interface for control, communications, display, and status on the transit vehicle.

2.4.10.2 Requirements

The Driver Console can serve as the central point for operator logon.

The driver console shall include software APIs or CGIs that are available for other on-board subsystems to use.

2.4.10.3 Available Standards

- SAE J-1708/1587 defines an object-oriented control head, directly accessible from all subsystems on a vehicle.
- SAE J-1708/1587 defines an Alpha/Numeric/Graphics display for control by a VLU.
- Any number of keys or function keys, up to a full 101 keyboard, are defined by SAE J-1708.

2.4.11 Video Surveillance Subsystem

Process: Record video surveillance

2.4.11.1 Description

A subsystem that records and stores video frames on board a Transit vehicle for security purposes. The subsystem may be triggered automatically and controlled by remote centers or subsystems (e.g., central control).

The process Record Video Surveillance involves continuously running a covert video system with four to five cameras in any type of Transit vehicle (Metrobus, Metrorail, Metromover). When the video system is triggered, the video is tagged with run/route/operator data, time, and location information, and stored until the trigger is turned off. Types of triggers include silent alarm, door sensor (when the door opens), Central Control (BTC/RTC), an accident involving the vehicle, fare box, or a remote control. A BTC/RTC, or supervisor/emergency personnel with a remote monitoring device driving behind the vehicle may control and view the target of any of the cameras.

2.4.11.2 Requirements

Included devices: 4 to 5 cameras for 40' buses; more for articulated vehicles; data storage device that can store video as required.

The video subsystem requires use of the Wireless Communications system for remote control by, and communications with, emergency vehicles.

2.4.11.3 Available Standards

- If the Vehicle Logic Unit issues the appropriate SAE J-1708 message, a Video Controller can receive the message (regardless of its source) and alter its recording mode.

2.4.12 Transit Signal Priority (TSP) Subsystem

Process: Manage transit signal priority

2.4.12.1 Description

A subsystem that requests priority treatment at signalized intersections. The process, Manage Transit Signal Priority (TSP), covers the needs related for generating priority request messages for a traffic signal controller. The primary functions of the request priority treatment may include:

- To determine whether a vehicle is in need of preferential treatment (priority) at a signalized intersection according to a series of user-defined criteria (i.e., lateness, occupancy level, etc.)
- To produce an estimate of the vehicle's estimated time for service desired at the signalized intersection. This estimate, measured in seconds, is intended to represent the vehicles arrival time at the intersection and can range from zero (0) (representing a request for immediate service) to some time in the future.
- To communicate the vehicle's request for priority and its time of service desired to the signal controller.
- To produce a log of all priority requests for processing by Transit.

The Transit Signal Priority subsystem generates a priority request to a roadside (traffic controller) device when route and schedule adherence trigger criteria are met. The traffic controller responds with a traffic-timing pattern that favors the progress of the transit vehicle.

2.4.12.2 Requirements and Issues

The equipment, standards and strategies for newer priority request technologies are currently in the early deployment stage. Optic, inductive, and wireless communication technology is needed to communicate with the roadside traffic controller devices.

Priority treatment by the traffic controller is not the same as Pre-emption, which is reserved for emergency vehicles (fire, police, EMS, etc.) and results in an immediate green target to those types of vehicles.

2.4.12.3 Available Standards

- NTCIP 1211 Objects Definitions for Signal Control and Prioritization (in ballot form)
- NTCIP 1409 TCIP Standard on Transit Signal Priority Objects (TBD)
- SAE J-1708/J-1587 currently provides for an enabling trigger to wayside emitters and the ability to provide vehicle identification (bus number/route) to the traffic controller.

2.4.13 On-Board TV Subsystem

The On-Board TV subsystem will be managed by an independent vendor. BTC/RTC will be capable of controlling a scrolling message and the audio in the case of emergencies or public service announcements. En-route information may be sent to the on-board TV as a scrolling message.

2.4.13.1 Requirements

A TV is mounted inside the transit vehicle. The TV subsystem is a "siloed" system that may receive shared time and location information from the VAN or include its own redundant navigation sensors and other audio and video devices.

Functionality of the TV includes showing programming and also similar en-route information as that provided by the Signage subsystem.

2.4.13.2 Available Standards

- NTCIP 1406:2001 TCIP Standard on On-Board Objects (signage library definitions)
- NTCIP 1403:2001 TCIP Standard on Scheduling and Runcutting Objects (event trigger definitions)

2.4.14 Vehicle ID

2.4.14.1 Description

The primary number used to uniquely identify the transit vehicle.

2.4.14.2 Requirements

All other vehicle identification numbers are associated with this ID, including VIN, mobile data unit ID, locally assigned vehicle number, vehicle type (needed by VLU software), etc.

2.4.14.3 Available Standards

SAE J-1708 and J-1587 define a device that can report a vehicle's locally assigned number, vehicle type, and VIN identification.

2.4.15 Emergency Telephone (Metromover only)

2.4.15.1 Description

An emergency headset that automatically dials a security staff monitoring Transit vehicles and stations.

2.4.15.2 Requirements

The telephone is only available on board the Metromover. (This device is already installed on board mover vehicles.)

2.4.15.3 Available Standards

None

2.4.16 Fueling Subsystem

2.4.16.1 Description

A subsystem that monitors and reports on fuel and other fluid usage on board a transit vehicle.

2.4.16.2 Requirements

- Sensors to measure fluid levels
- Sensors to measure mileage
- Interconnection with the vehicle's VLU

2.4.16.3 Available Standards

None

2.4.17 Trip Recorders

2.4.17.1 Description

"A Subsystem that acquires and disseminates current or historical data obtained from the constant monitoring of the drive train communications network and/or sensors." [NTCIP 1406:2000]

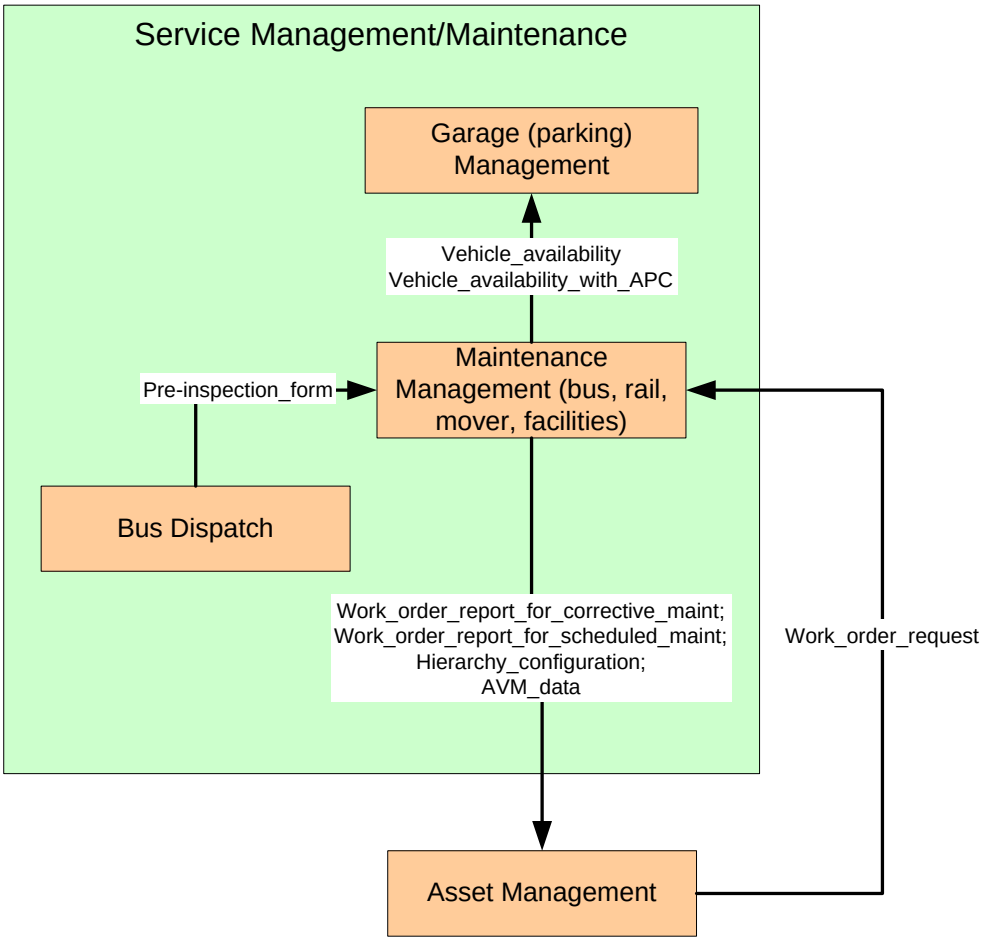
2.4.17.2 Requirements

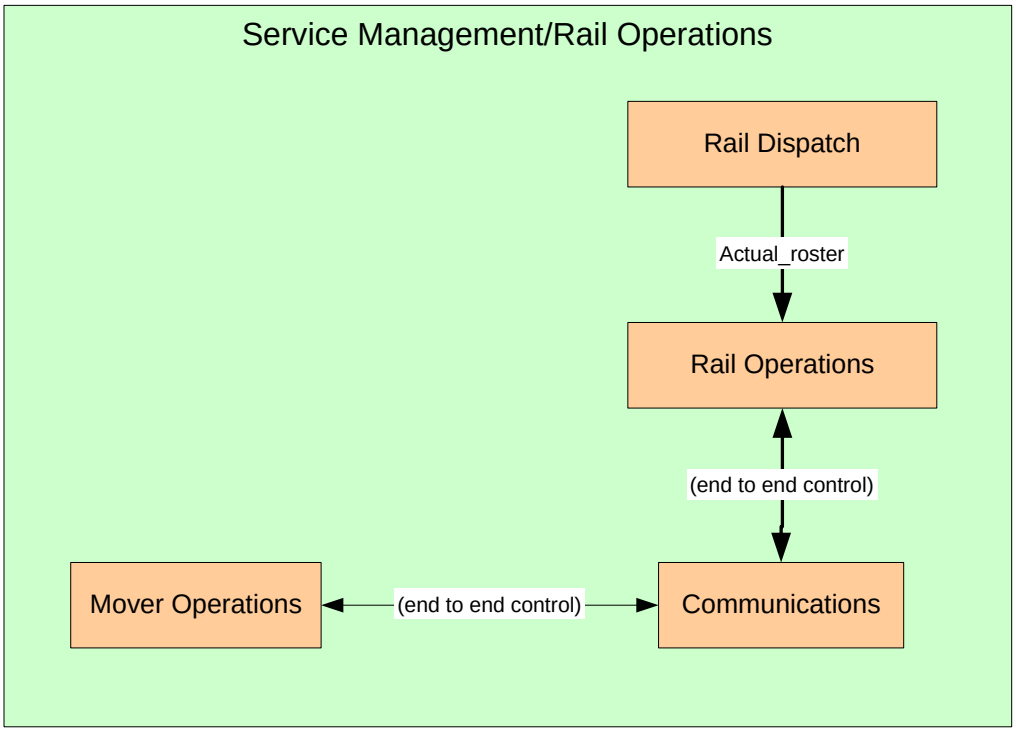
Almost all Transit vehicles use fly-by-wire SAE J-1708 standards for coordination of engine, transmission, and braking systems. This communications channel is rich with performance data, fault data, and out-of-range alarms. Currently, this data is accessed by means of an SAE J-1708 test set at maintenance facilities. But this is often too late to save drive train components from damage or a tow-in. This information can be filtered by the Vehicle Logic Unit and critical or desired operational data can be radioed into a Maintenance Dispatcher, where vehicles can be monitored in real time and ordered stopped before damage occurs, if necessary. Further analysis of collected data can reflect fleet trends, fleet defects, and recurring faults on one vehicle, or all vehicles on fixed-end systems.

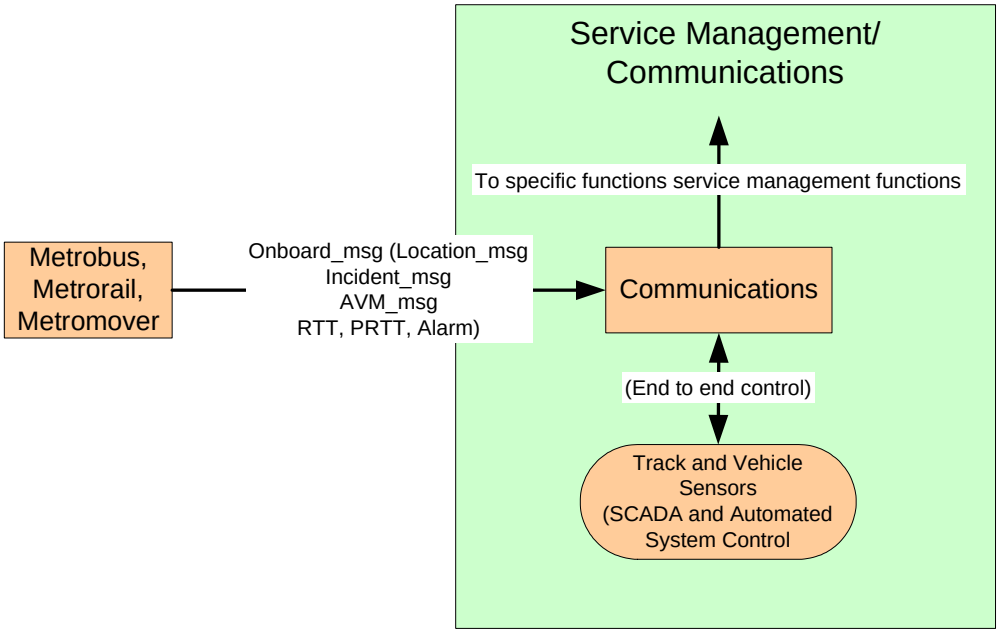
2.4.17.3 Available Standards

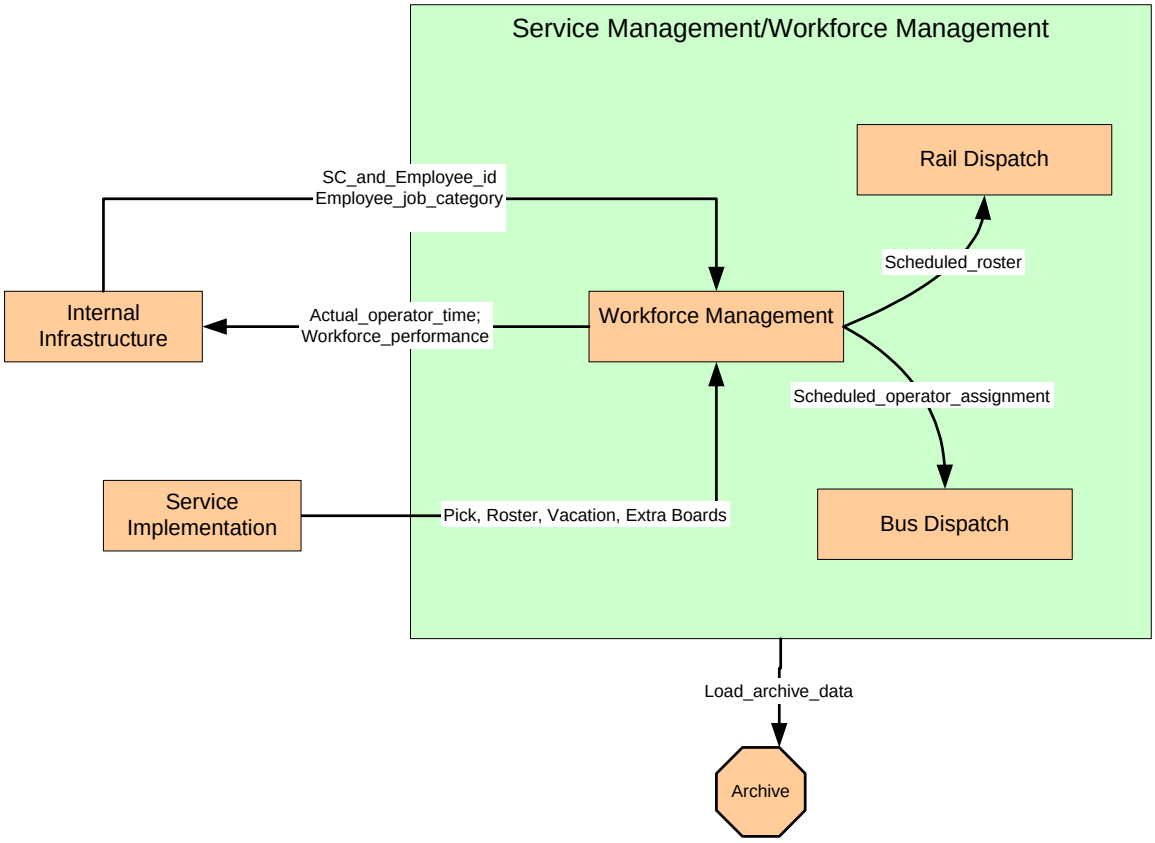
- NTCIP 1406:2001 TCIP Standard on On-Board Objects (AVM threshold and reporting messages)
- SAE J-1708/1587/1939 (AVM parameters)

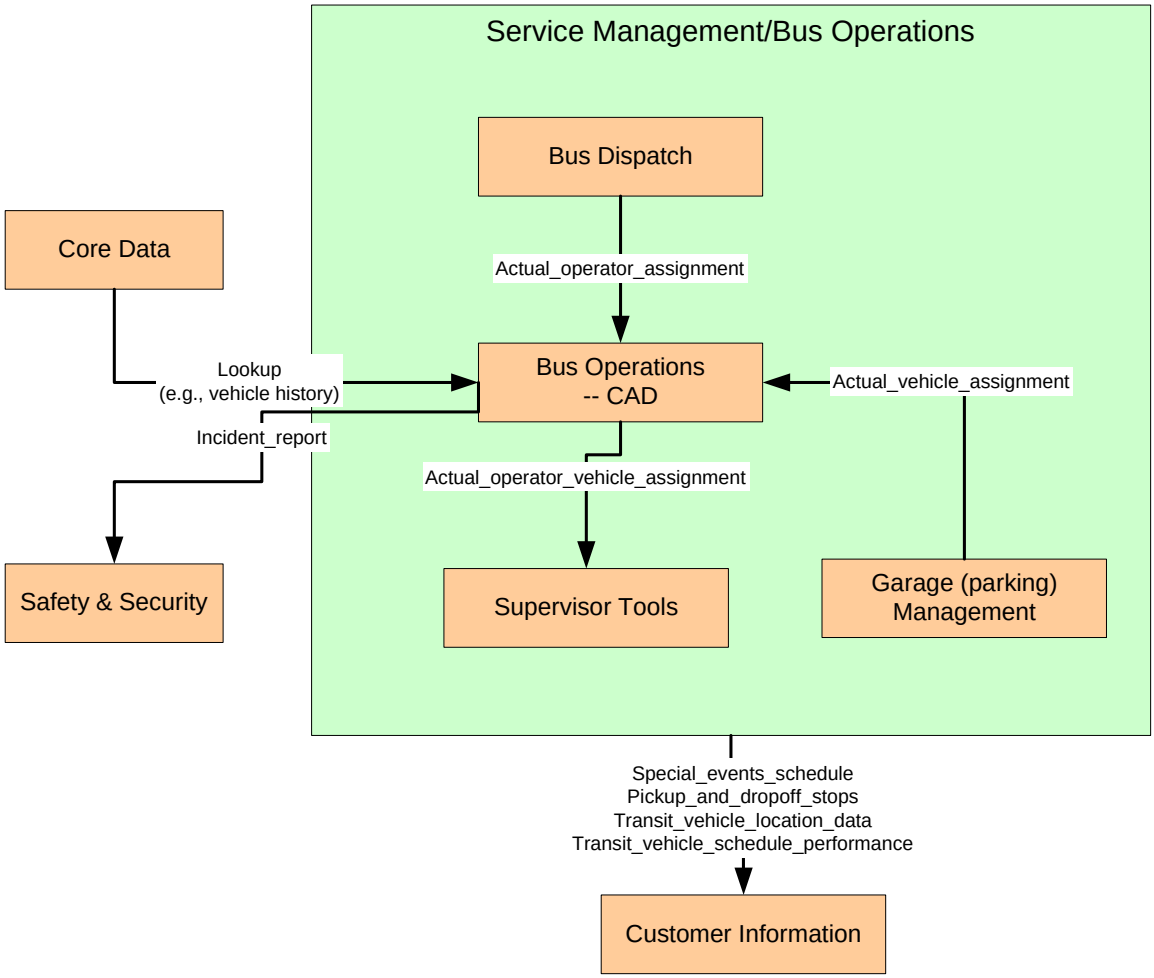
3 APPENDIX A: DECOMPOSITION OF SERVICE MANAGEMENT PRIMARY PROCESS AND DATA FLOW DIAGRAM




Service Management/Rail Operations
Rail Dispatch
Actual_roster
Rail Operations
(end to end control)
Mover Operations
(end to end control)
Communications


Service Management/
Communications
To specific functions service management functions
Metrobus,
Metrorail,
Metromover
Onboard_msg (Location_msg
Incident_msg
AVM_msg
RTT, PRTT, Alarm)
Communications
(End to end control)
Track and Vehicle
Sensors
(SCADA and Automated
System Control


Service Management/Workforce Management
Rail Dispatch
SC_and_Employee_id
Employee_job_category
Scheduled_roster
Internal Infrastructure
Actual_operator_time;
Workforce_performance
Workforce Management
Scheduled_operator_assignment
Service Implementation
Pick, Roster, Vacation, Extra Boards
Bus Dispatch
Load_archive_data
Archive


Service Management/Bus Operations
Bus Dispatch
Core Data
Actual_operator_assignment
Lookup
(e.g., vehicle history)
Bus Operations
-- CAD
Actual_vehicle_assignment
Incident_report
Actual_operator_vehicle_assignment
Safety & Security
Supervisor Tools
Garage (parking)
Management
Special_events_schedule
Pickup_and_dropoff_stops
Transit_vehicle_location_data
Transit_vehicle_schedule_performance
Customer Information