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1. Executive Summary

1.1. Introduction

1.1.1. Scope

AC Transit’s existing computer aided dispatching and automated vehicle location (CAD/AVL) system is over ten years old and the system's end of life is imminent. While the existing system has served the Agency adequately over many years, the current servers and central software are aging, and the existing CAD system is reaching the end of its service life. In 2014, the system warranty expires and the system will no longer be supported by the vendor, thereby exposing critical operations to an increased risk of failure.

The Agency's existing voice and data radio communications system is a Motorola “Transit Trunked” system that provides integrated voice and data radio communications. The OrbCad 2000 CAD/AVL central software interfaces with the Motorola Centracom ELITE consoles. This enables controllers to manage voice and data radio communication via radio base stations between revenue vehicles and the Operations Control Center (OCC) located in Emeryville, California. The communications system has a single point of failure with no redundancy, thus exposing the agency to catastrophic failure if the system were to crash.

1.1.2. Needs

The operational needs were identified through a needs assessment with key project stakeholders, along with analysis of the Current Operating Environment (Section 4) and the CAD/AVL Project Purpose and Objectives (Section 4). These needs represent the necessary changes from today’s operations to achieve the goals set out in the project purpose. The key elements that have led to development of the operational needs required to meet the project goals are:

- **Better Service Management** by better regulating service.
- **Better Asset Performance** by enhancing the agency’s whole life-cycle asset management capability.
- **Better Customer Information** through improved accuracy, quality, flexibility, and timeliness of information gathering and dissemination.
- **Better Operational Plans and Schedules** through improved, open, and flexible analysis of historic performance data.

1.1.3. Purpose

The purpose of this Concept of Operations (ConOps) is to identify the current operating environment with respect to the CAD/AVL system and document potential impacts that may result by upgrading to a newer, more robust system.

1.2. Current Environment

AC Transit’s existing computer aided dispatching and automated vehicle location (CAD/AVL) system is an ACS/Xerox (previously Orbital TMS) system called OrbCad 2000, version 5.023. CAD/AVL systems provide schedule adherence information for drivers (Operators); real-time vehicle location and schedule adherence information at dispatch (Controllers); and automatic data collection of the date, time, and location for many onboard events. Messages from Operators and exception reports are automatically generated by the onboard system and sent via data radio back to the Operations Control Center (OCC). The combined system features provide an effective means for Operators and Controllers to share information on the current service status being delivered to the public.

The overall CAD/AVL system is best thought of in terms of operational units (those who operate within the system) and systems units (the elements that make up the physical system).
The operational units include:

- **Window Dispatch** – Ensures the on-time dispatching and return of vehicles for revenue service, monitors; the scheduled crewing of vehicles; coordinates crewing and dispatching coverage issues with central and field operations; updates reports of all crew and fleet vehicle movements at AC Transit properties; coordinates with field deployed personnel, and coordinates with maintenance operations when necessary.

- **Maintenance** – Carries out scheduled and unscheduled inspection and maintenance of vehicles and associated systems through coordination with the Controllers, Window Dispatch, Road Supervisors and other AC Transit entities.

- **Road Supervisors** – Support service through field-deployed Road Supervisors who support the resolution of disrupted and degraded service incidents; coordinate with Controllers, Window Dispatch, and Maintenance systems and personnel, as well as vehicle crew, the general public, and emergency services such as fire and police.

- **Bus Operator** – Primary field end user of the onboard system; coordinates with Controllers and Road Supervisors to operate the transit vehicle and maintain operations; transmits information and receives instructions from Controllers for degraded service including incidents, detours and other service corrections; follows onboard instructions to maintain schedule adherence.

- **Controllers** – Located at the OCC, Central command and control authority for all bus service delivered by AC Transit; oversee the smooth delivery of service through coordination of field and central personnel and systems, as well as with external systems such as traffic, weather, and emergency services.

Examples of systems units include:

- **Central Systems** – These centrally located systems include NextBus, OrbCad, and AC Transit’s Enterprise Database, strategically used by operations personnel to build situational awareness and communicate in the process of their duties.

- **Communications** – Integrated voice and data radio system that supports transit operations and communications between OCC, Road Supervisors, and the transit vehicles.

- **Customer Information Systems** – These systems are provided through third party applications and centers. NextBus provides transit customers with real-time transit arrival predictions online and in selected transit stops and centers. It also provides information for the regional 511 website. AC Transit also contracts out to a call center to answer questions from transit customers.

- **Service Planning** – The service planning and scheduling processes are supported by field data from on and off-board systems, both within AC Transit and externally (e.g., traffic, weather).

- **On-board Vehicle Systems** – These systems are deployed on vehicles and interface with the Operator and/or CAD/AVL onboard computer system, or operate independently from the CAD/AVL onboard computer system. These include the farebox, headsign, Public Address system (PA), Automatic Vehicle Announcements (AVA), Automatic Passenger Counters (APC), silent alarm switch, and video recording system.

### 1.3. Proposed Concept

The proposed operational concept is a solution-independent, high-level, operational representation of the proposed approach. It addresses the operational needs, and fulfills the project purpose and objectives. Figure 1 shows the relationship between external, central, and field systems that will interface with the new CAD/AVL system. The exact configuration and full capability of the external, central, and field systems has yet to be identified by AC Transit. Conceptually, however, this upgraded CAD/AVL system must be flexible and able to support a number of new systems as needed.
1.4. Operational Impacts

The existing operational units (e.g., Controllers, Operators) that interface with the system will not change. The new systems will create efficiencies and facilitate the dissemination of better, more accurate information to stakeholders and transit customers. The system units will undergo slight modifications to create these efficiencies. This may include streamlining processes and tools, direct center-to-center integration, and development/deployment of new applications. Detailed information on the overall operational impacts can be found in Section 8 of this document.

1.4.1. Operational Unit Impacts

Roles that each operational unit play will, in essence, remain the same; however, it’s anticipated that with the addition of more accurate information, availability of new information, and advanced features and functions, current processes and activities may change.

- **Window Dispatch** – Implementation of the new crew management system (Hastus) Integrated Daily Operations project will allow Window Dispatch to enter changes occurring daily in real time (e.g., changes made to vehicle and crew assignments). This will allow Controllers to have the most accurate and up to date information.

- **Maintenance** – Availability for remote vehicle monitoring will provide the agency with proactive monitoring of vehicle health and allow the maintenance department to troubleshoot issues remotely. Access to automated status messages from the CAD/AVL system will also facilitate better communications between the various responders about maintenance issues (Controllers, Windows Dispatch, Road Supervisors, and Maintenance.).

- **Road Supervisors** – The new system will help Controllers easily locate Road Supervisors to facilitate incident response. Controllers will also be able to better manage the work distribution to Road Supervisors using the new system.

- **Bus Operators** – With the new onboard architecture, Operators will be able to log into all systems integrated with the Vehicle Logic Unit (VLU) using a single log on. This will reduce the number of log on errors and issues.
With the advanced automated message and support tools available to Controllers, their communications with Operators will be more clear and consistent.

- **Controllers** – As with Operators, Controllers will also see significant changes with using a newer system. These changes will primarily center on new tools and processes to assist with daily activities, by streamlining and providing decision making support tools for actions that are currently performed and recorded manually. Controllers will have more accurate information to fulfill their duties, and will move from reactively to proactively managing transit service.

### 1.4.2. System Unit Impacts

The proposed central system architecture consists of a single direct workstation interface for the System Administrator to the CAD/AVL system, which will include a direct interface with the Hastus scheduling system for provision of daily operational data. Additionally, real-time vehicle location data will be sent directly to the region’s 511 information systems for providing stop arrival predictions. Accumulated real-time data stored in the CAD/AVL system will be available through database views, using which AC Transit will copy this data into their Enterprise Database (see Figure 2).

![Figure 2: Proposed System Architecture for the new CAD/AVL system](image-url)
1.4.3. OnBoard Vehicle Systems

As CAD/AVL systems have become more modular, transit agencies are realizing the benefits of incorporating an onboard network similar to that in an office IT environment, to help future-proof vehicles. AC Transit’s future onboard system will include a mobile access router (MAR) to provide multi-path data communications between the onboard equipment and central systems and the ability to integrate such data communications access for both new and existing devices. The diagram below illustrates an example future replacement system using a MAR.

![Diagram of future high-level onboard system architecture](image)

**Figure 3:** Future high-level onboard system architecture
2. How to Use This Document

This Concept of Operations (ConOps) describes the operational impacts of upgrading the CAD/AVL system in solution-independent terms. It will be a valuable resource through the design, implementation, testing, and implementation of the new system.

2.1. Organization of the Document

This ConOps is presented in a sequence such that each section builds on the previous material.

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2.2. Who Should Read This ConOps?

The ConOps should be read by all stakeholders expected to have a role in the design, implementation, operation, and/or support of the proposed system, or otherwise expected to be impacted by the system during its lifespan. This includes:

- System users
- System maintainers and administrators
- Design teams, both internal and external to AC Transit
- Project/Construction Management teams
- Contractors/suppliers
- Validation/testing teams
- Organizational planning units (e.g. Labor Relations, Human Resources, and Operations Training)
- Financial planning units
It is important that affected stakeholders have an opportunity to review this document as early as possible. For example, implementation groups (such as Labor Relations) must be aware of potential impacts identified during the design process – well in advance of implementation.

2.3. Purpose of the ConOps

The ConOps describes how a proposed system works from the users’ perspective, which:

- Ensures a common understanding and consensus on the purpose and goals of the system among its end users (including both operators and maintainers), designers, and implementers, what it will do, how it will be used, and who will use it;
- Allows designers and implementers to visualize the expected environment in which the system will operate;
- Allows the design team to confirm (including through subsequent revision as design progresses) the users’ understanding of what is being provided and ensure that the system being delivered matches the expected functions and uses within the expected operational environment;
- Serves as a basis for developing operating and maintenance plans;
- Serves as a source design document from which user and system requirements will be developed; and
- Serves as a “contract” between all stakeholders, committing to the high-level system functionality and capability that will be delivered and the resources to operate and maintain it.

The ConOps considers the system in its broadest sense, including the tangible system components, people, organizations and operational procedures that support the service delivery. It is not the end of user engagement; instead, it provides a firm foundation for continued exploration of users’ needs.

The ConOps is intended to support key project decision-making and document the agreed systems operational concept. It identifies and addresses the business requirements, needs, and functionality that AC Transit requires and can reasonably expect from the new systems based on an understanding of the agency’s existing CAD/AVL systems.

2.4. Keeping the ConOps Current

The ConOps is often described as a “living” document, in that it should be revised as necessary (under strict document change control) during the Design, Construction, and potentially Operation phases to reflect changes in the operating concepts and impacts that arise as the system’s design and operation is developed and finalized.
3. Project Background

3.1. Project Scope

The Alameda-Contra Costa Transit District (AC Transit) provides public transit service to approximately 200,000 riders daily in the East Bay area including Oakland and surrounding communities. AC Transit has a fleet of over 600 buses, utilizing three bus garages and a separate central maintenance facility. AC Transit’s service area extends from western Contra Costa County to southern Alameda County. The agency’s non-revenue fleet also includes 180 district cars and service vehicles used for district business, Road Supervision, and Maintenance.

AC Transit’s existing computer aided dispatching and automated vehicle location system is an ACS/Xerox (previously Orbital TMS) system called OrbCad 2000, version 5.023. The system’s end of life is imminent and the agency will be required to replace the system to maintain service.

The agency’s existing voice and data radio communications system is a Motorola “Transit Trunked” system that provides integrated voice and data radio communications. The OrbCad 2000 CAD/AVL central software interfaces with the Motorola Centracom ELITE consoles. This enables controllers to manage voice and data radio communication via radio base stations between revenue vehicles and the Operations Control Center (OCC) located in Emeryville, California.

3.2. Project Drivers

Computer aided dispatch and automated vehicle location (CAD/AVL) systems provide schedule adherence information for the Operator, real time vehicle location and schedule adherence information for Controllers, and automatic data collection of the date, time, and location for many on-board events such as door openings, wheelchair ramp/lift use, and dwell times at service stops. Messages from the Operators and exception reports are automatically generated by the onboard system and sent via data radio back to the OCC. The combined system features provide an effective means for Operators and Controllers to share information on the current service status being delivered to the public.

While the existing system has served the Agency adequately over many years, the current servers and central software are aging, and the existing CAD system is reaching the end of its service life. In 2014, the system warranty expires and the system will no longer be supported by the vendor, thereby exposing critical operations to an increased risk of failure. As the agency continues to expand services offered to customers through bus rapid transit (BRT) initiatives, real-time transit information via NextBus and data to the regional 511 system, it is necessary to upgrade or replace the existing system to maintain existing service and include operational support for expanded BRT and other rapid line service.

The current system lacks many of the advanced features and functionality to operationally support new and expanded AC Transit initiatives such as headway management, proactive service management, accurate real-time transit information, integration with other vendor onboard equipment, and better vehicle diagnostics and data management for service planning and reporting. The communications system has a single point of failure with no redundancy, thus exposing the agency to catastrophic failure if the system were to crash.

Due to the “transit trunked” network architecture, the existing CAD system is heavily intertwined technically with the integrated voice and data ratio system. Because both the radio system equipment and the CAD system are nearing end of life, AC Transit is looking in parallel with the CAD/AVL system assessment into different communications options and alternative network configurations for a replacement voice and data system.
4. Project Purpose

The purpose for this CAD/AVL project is to:

Provide centralized monitoring of fleet and personnel location and status, advancing AC Transit’s ability to make safer, more reliable, and more timely transit service decisions.

The successful delivery of integrated location and status information has been further defined as depending on the realization of the following key system-level objectives, which collectively will lead to improved service, safety, and security:

- **Tracking location and status** of vehicles and personnel in a timely fashion that will improve service delivery, regulation, and incident response;
- **Sharing location and status views** across all necessary AC Transit divisions improving the coordination between previously disparate operational units;
- **Simplifying service delivery processes** by reducing operator tasks on and off board vehicles and providing better control of remote systems from centralized operations; and
- **Enhancing processes service depends** on by improving the efficacy of maintenance, scheduling, and customer information systems with better integrated data systems.

This project’s purpose and objectives, in turn, support a broader set of enterprise goals that AC Transit has across the wider agency. These include the following:

- **Better Service Management** by better regulating service.
- **Better Asset Performance** by enhancing the agency’s whole life-cycle asset management capability.
- **Better Customer Information** through improved accuracy, quality, flexibility, and timeliness of information gathering and dissemination.
- **Better Operational Plans and Schedules** through improved, open, and flexible analysis of historic performance data.

Several agency business units are tasked with realizing these objectives, some directly and others in a cross-functional capacity. They are the beneficiaries, and thus the key customers and stakeholders, of the upgraded CAD/AVL system. These business units include the Operations, Fleet Management, Facilities Management, Technology, Customer Service, and Planning groups.
5. Summary of Current Environment

A key stage in developing any ConOps is investigating and documenting the current operation and its environment. Understanding and validating the current system with stakeholders helps capture the principal operational goals and needs that any new system must meet, as well as identifying deficiencies and redundancies that exist within the current operation.

The operational environment at AC Transit can be described as a set of operational and system units and through the processes and information exchanged within and between these units. Operational units include operations personnel performing various duties at locations such as the OCC, Garages, and Vehicles. System units include the CAD/AVL system and the radio communications system, and support the exchange of intelligible information between assets, systems, and operations personnel.

5.1. Operational Units

The AC Transit’s Transportation Department is the predominant end user of the system. This includes Road Supervisors, Operators, Controllers, Window Dispatch, Maintenance, and Scheduling. Other departments (such as System Administrators, Network/Software Engineers, and Customer Service) within AC Transit provide a supportive role to the system and are treated as stakeholders to the overall operations of the system. The focus of the operational discussion for the operational units, however, will focus on the primary units represented in the garages, in the field, and at the OCC. This provides the “where” and “who” for the processes and flow of information.

5.1.1. Division Yard/Garage

AC Transit’s service area is divided into three centers of operations, called Divisions: Division 2 (Emeryville), Division 4 (East Oakland), and Division 6 (Hayward). Each Division includes Window Dispatchers, Operators, and Maintenance personnel. Window Dispatch ensures the on-time dispatch and return of vehicles for revenue service, monitors the scheduled crewing of vehicles, coordinates crewing and dispatching coverage issues with central and field operations, updates reports of all crew and fleet vehicle movements at AC Transit properties, coordinates with field deployed personnel, and coordinates with maintenance operations when necessary. Maintenance carries out scheduled and unscheduled inspection and maintenance of vehicles and associated systems through coordination with the Controllers, Window Dispatch, Road Supervisors, and other AC Transit entities.

Automated systems communicate with vehicles to upload and download vehicle system and schedule information.

5.1.1.1. Window Dispatch

The Window (or Division) Dispatch governs and records all movements of vehicles in and out of the division garage. Their primary responsibility is operator and vehicle assignments at pullout. The Window Dispatch has
access to the crew management system (Hastus) in order to manage vehicle and operator assignments, and keep this record up to date in real-time. Throughout the day they also maintain communications with the Controllers, Road Supervisors and Maintenance to resolve degraded service or emergency issues.

5.1.1.2. Maintenance

Each Division has a maintenance department to oversee maintenance and repairs of vehicles located at that yard. Additionally, AC Transit has a Central Maintenance Facility location that serves all vehicles regardless of assigned Division. This location is staffed by maintenance managers and foremen who are responsible for maintenance duties such as the testing; repair (scheduled and unscheduled); and replacement of vehicles, vehicle parts, and on-board vehicle systems. The reporting of asset maintenance is done using the Ellipse system.

Maintenance teams at each Division coordinate closely with Window Dispatch and Controllers in the event of a vehicle failure that they need to recover from in the field.

5.1.2. Field

Field operations involves the roles of individuals that predominantly spend their time in the field, meaning along the routes. These operational units include Road Supervisors and Operators. Field support is done through field-deployed Road Supervisors who support the resolution of disrupted and degraded service incidents and coordinate with Controllers, Window Dispatch, and Maintenance, as well as Operators, the general public, and emergency services such as fire and police. Operators spend the majority of their time on the vehicle performing service. They are the first line of contact for issues and incidents occurring on the bus and are in direct contact with Controllers throughout the day.

5.1.2.1. Road Supervisor

Supervision of field operations is performed by Road Supervisors deployed in the field to monitor, report, and coordinate on degraded or emergency situations. They maintain constant communications with Controllers and are dispatched to fleet locations in the event of breakdowns.

Road Supervisors maintain a manual incident logbook on board their vehicle. They can also remotely access the Apollo video surveillance system on board vehicles using secure wireless access.

5.1.2.2. Bus Operator

Operation of buses is done through Operators. They are required to check in and be assigned to their duty for the day from Window Dispatch prior to boarding a bus. When beginning their operating day from the yard, Operators are required to perform a series of vehicle checks and then log on to the vehicle before beginning their work for the day. Often interaction between the Operator and other operational units will occur throughout the operating day. Incidents, equipment defects, and other issues occurring on the vehicle are reported by the Operator through radio calls, forms, and other such means. Operators are required to refer to their standard operating procedures in response to incidents that occur while in the field or during their operating day.

5.1.3. Operations Control Center (OCC)

The Operations Control Center (OCC) is the central situational awareness and command center. Using the OrbCad workstation and communications systems, OCC Controllers and their supervisors maintain situational awareness of field operations. They have the authority to delegate tasks to Road Supervisors and Operators to enable the smooth running of service.

5.1.3.1. Controllers

The central command and control authority for all bus service delivered by AC Transit is located at the OCC. Controllers and OCC supervisors oversee the smooth delivery of service through coordination of field and central personnel and systems, as well as coordination with external systems such as traffic, weather, and emergency services.
5.2. System Units

The existing CAD/AVL system impacts many Agency stakeholders, as well as regional partnered stakeholders. Data generated from the CAD/AVL system is transferred to the AC Transit Enterprise Database where it is used to supply several departments with information needed to run reports, research incidents and perform other necessary tasks within the agency. The CAD/AVL system also feeds (and/or is fed by) other third-party vendor systems such as: NextBus, Hastus, Ellipse, and the regional 511 website. The diagram below provides a high-level system overview of the CAD/AVL system.

![Figure 4: Existing System Overview](image)

**Figure 4: Existing System Overview**
Primary systems units include:

- **Central Systems** – These centrally located systems include NextBus, OrbCad, Hastus scheduling and daily operations, and the Agency’s Enterprise Database, strategically used by operations personnel to build situational awareness and communicate in the process of their duties.

- **Communications** – Integrated voice and data radio system that supports transit operations and communications between OCC, Road Supervisors, and the transit vehicles.

- **Customer Information Systems** – These systems provide ongoing customer information to travelers and include a call center, NextBus arrival predictions in the field, and web information via the region’s 511 system and NextBus.

- **Service Planning Systems** – The agency is undergoing a significant Hastus upgrade project that will replace many systems with the latest suite of Hastus solutions. This includes upgrades to the existing Hastus modules Vehicle, Crew, Crew-Opt, Minibus, GEO, Roster, ATP, Rider and Checker. The agency is also currently undergoing a larger project called HIOPS (Hastus Daily Integrated Operations) that will deploy Daily Crew, Daily Vehicle, and BID/BID Web.

- **Onboard Vehicle Systems** – These systems are deployed on vehicles and interface with the Operator and/or CAD/AVL on-board computer system, or operate independently from the CAD/AVL on-board computer system. These include the farebox, headsign, Public Address system, Automatic Passenger Counters, silent alarm switch, and video recording system.

### 5.2.1. Central Systems

The existing system has adequately served AC Transit; however, the system servers and software are over ten years old and are approaching their end of service life with the current vendor, putting operations at an increased risk of failure. The current system feeds into many other applications that rely on the data provided by the CAD/AVL system. This includes customer information. Currently the agency contracts with NextBus, which uses AVL.
positioning to predict arrival times at transit stops. This information is relayed to customers via next stop arrival
reader boards at selected stops and over the web via NextBus.com and the region’s 511 website. Information from
the CAD/AVL system is downloaded into the AC Transit’s Enterprise Database along with other vendor application
data such as APC, scheduling information, and Time Keeper Systems (soon to be replaced with Hastus). The
diagram below was provided by AC Transit and is a snapshot of the existing system from 2007. Since that time,
the agency has implemented or began several projects such as the AVA upgrade project, Enterprise Database
project, Hastus upgrade and enhancement project, and the Apollo surveillance replacement project that are not
represented accurately in this “existing” system diagram.

5.2.2. Communications
At central and field locations, AC Transit staff maintain continuous radio and telephone communication with
each other in order to carry out their duties. The current system is a Motorola “Transit Trunked” system with
eight frequencies (six for voice and two for data). The current data system is insecure, and the T1 Wide Area
Network links are unreliable. AC Transit staff have reported “blind spots” within the radio coverage area. There are
three tower locations: Black Canyon (San Rafael), San Bruno Mountain (Daly City), and Walpert Ridge (Hayward).
Controllers currently have access to six Motorola Centracom ELITE consoles, and a single console at the Trans
Bay Terminal with a single Elite server. There is no backup dispatch capability beyond that supported by the OCC.
The onboard communications setup includes a Motorola voice radio, and a covert alarm button and microphone
that cannot be deactivated remotely from the OCC. All voice and data interactions are recorded using a Nice
Voice Recording system, and the system supports a request to talk (RTT) function. The system is limited to a one
minute polling rate for data/location reports from each vehicle due to the limited system capacity of the two radio
channels allocated to data.

5.2.3. Customer Information Systems
Customers request and receive information about service status from a number of sources both on and off fleet
vehicles. AC Transit’s OrbCad system pushes vehicle location information to the NextBus system, which provides
off-board information about next arrival time predictions to customers based on these locations via dynamic
message signs (DMS) at bus shelters, via the AC Transit website, and through interactive phone applications.
Onboard, vehicle systems inform passengers when approaching the next stop location via the on-board DMS
and automatic PA. Announcements, such as safety messages, route information, stop requests, or instructions to
passengers are also played automatically over the PA system. These messages are in reaction to events (front
door opening, stop request button hit), based on virtual triggers (next stop announcements) and on a timed basis
(“Please exit through rear doors”). Also, the operator can make manual PA announcements directly from an on-
board microphone.

5.2.4. Service Planning
Service planning and scheduling processes are supported by field data from on- and off-board systems, both
within AC Transit and externally (e.g., traffic, weather). AC Transit’s Service Development and Planning department
produces service plans for operations and customers. Scheduling compares route adherence and incident data
generated from the CAD/AVL system with the actual schedule. Service planning also maintains the effective dates
for the applicability of specific service types called service contexts (e.g. school day on or off; school holiday,
Sunday service). The department also uses APC data to improve schedules so that available crews and fleet can
deliver the most effective service to customers.
5.2.5. Existing OnBoard Vehicle Systems

A number of existing onboard systems on each AC Transit vehicle are supported as part of the OrbCAD system and as part of additional non-OrbCad systems. AC Transit’s fixed route fleet includes many different vehicle types and manufacturers. The agency operates articulated vehicles, and non-articulated vehicles from Gillig, New Flyer, Vanhool and others. The figure below illustrates a typical onboard configuration.

Features and locations of equipment vary by bus model. The primary components of the onboard CAD/AVL equipment include:

- **Advanced Mobile Data Terminal (AMDT)** – allows the Operator to input log-on information and send, receive, and manage text messages. The AMDT displays current system time and on-time performance status to the Operator and correlates the bus location data to the schedule and stop information using an odometer input and an input from the GPS receiver. It reports exceptional conditions to Controllers via data communications.

- **Voice and Data Radio System** – the Agency’s existing voice and data radio system is a Motorola “Transit Trunked” system controlled by the existing CAD/AVL system.

- **Global Positioning System (GPS)** – allows the CAD/AVL system to accurately determine vehicle location. GPS data is used to determine accurate time, schedule/route adherence, and to tag data with spatial references.

- **Automatic Vehicle Announcements (AVA)** – provides onboard next stop announcements through an automated voice announcement and internal text signs integrated with the next stop requests. The agency is currently undergoing an upgrade project that will improve backend processing and deploy AVA internal text signs on the fleet.

- **Emergency Alarm (EA)** – Also known as the covert mic or silent alarm. This is an Operator safety function of the CAD/AVL system that allows the Operator to notify Controllers of an onboard emergency event.

- **J1708/1939 Connections** – the lift, ignition state, door open/close, and odometer are currently connected to the AMDT.
Other onboard equipment that does not include interfaces to the CAD/AVL system are:

- **Automated Passenger Counters (APC)** – located on approximately 35% of buses, APC uses infrared beams to count boarding and alighting passengers with the accumulated APC data automatically uploaded at the depot.

- **Apollo Security System** – allows video to be continuously captured on digital media on the bus. Up to twelve cameras are installed on each bus, depending on type. This video may be accessed wirelessly via secured access by transit security when within close proximity.

- **Transit Signal Priority (TSP)** – allows transit vehicles to request signal priority. Currently the TSP system is “always on” meaning the system is always requesting priority regardless of schedule adherence.

- **Vehicle Destination Signs** – displays the trip destination messages along AC Transit routes, as manually set by the Operator when approaching the end of each trip.

- **Smart Media Fare Card Reader (Clipper)** – provides customers with smart media fare payment. Due to the nature of the proprietary Clipper system, the Clipper unit is not integrated with the existing onboard equipment, nor is it expected that the unit will integrate with the new system.

- **Farebox** – existing cash and ticket farebox collection system is not currently integrated with the CAD/AVL system. The agency is currently in the process of upgrading their farebox to a new system (not yet determined), and it is envisioned that the new CAD/AVL system will integrate with the new farebox.

- **Other Onboard Equipment** – Other existing onboard equipment such as FleetWatch, Public Address system, engine control monitoring (ECM), stop request, and others are not currently integrated with the onboard system.

### 5.3. Operational Scenarios

A complete description of all process and information exchanges between operations and systems units would be prohibitive given the complexity of the entire AC Transit system. However, a series of representative operational scenarios can be explored in order to describe the current environment. Scenarios are grouped under broad headings and are included as an appendix to this document. In general, the scenarios are broken into four core categories, with representative diagrams illustrating an operational flow and roles:

- **Daily Operations** describes a standard Pull in/out for a fixed route bus.

- **Degraded Operations** examines the actions taken by Controllers to restore service impacted by a non-safety related issue.

- **Emergency Operations** category looks a service impacted by a critical safety related issues.

- **Supporting Programs** are operational units that support the smooth operation of service.

#### 5.3.1. Operating Environment

The Operations Control Center (OCC) is located at the Emeryville Division. The OCC is designed for six Controller workstations and one supervisor/management station for training and system management in the event of an emergency. Each Controller workstation holds four monitors that provide the following information: radio communications, OrbSat application (maps, route schedule adherence, incident log screen, etc.), and access to the agency’s intranet for email and other applications internal to the agency.

![Figure 7: Controller at workstation](image-url)
As discussed earlier, AC Transit operations are summarized in four representative categories that illustrate typical operational flows. Within each core category are subflows that provide an operational scenario to illustrate the standard flow of activities for the current system. Brief descriptions of the flows are provided below, and the process diagrams are included as Appendix A to this document.

5.3.1.1. Normal Operations

A typical day begins with “pull-out,” meaning an Operator logs onto the vehicle AMDT and various components (destination sign and farebox), cycles the wheelchair lift, performs a brake test and drives to the start of the first trip. The service day generally ends when the transit vehicle pulls back into the yard and the Operator logs off the vehicle equipment. AC Transit has two end-of-day scenarios, one for the vehicle and one for the Operator. Daily operations are illustrated in the Start of Day and End of Day process flows.

5.3.1.2. Degraded Operations

Throughout the transit day several common situations often require some form of interaction between the OCC, Road Supervisors, and Operators. These situations, such as mechanical issues and missed or late pull-outs, can sometimes require a schedule adjustment and may require interaction between several different departments. AC Transit also uses real-time performance monitoring to adjust operations to preserve or enhance service quality. This may include schedule adherence, headway management, transfer protection, and similar techniques to maintain or improve service quality in real-time during the operating day. Flows describing these scenarios are described on the next page.

- **Service Correction** – This process describes actions taken at OCC to return operations to a normal, steady state following a localized disruption or irregularity in service affecting a single vehicle (e.g., running late), a single line or interlined corridor (e.g. bus bunching), or a specific sector of the system (e.g., impacts of a traffic accident).
- **Detour/Reroute** – This scenario describes the flow of necessary steps to reroute transit vehicles along a route for 1) pre-planned short- and long-term events and 2) unplanned events such as traffic incidents, blockages, and other unplanned events.
- **Non-Emergency Degraded Service Correction** – These are localized security incidents impacting a single location or vehicle that does not represent an immediate threat to the welfare of passengers on board (“Non-Emergency” Operator and Controller response). Examples include a violation of the AC Transit passenger Code of Conduct, such as disruptive passengers. These events have the potential to escalate to a level that threatens the Operator and/or passengers or safe operation of the vehicle, requiring an Emergency Response.
- **Bus Bridge** – Occasionally, Bay Area Rapid Transit (BART) requests AC Transit’s services to perform a “Bus Bridge”. This occurs when BART is unable to move between stops and requires buses to shuttle passengers from one BART station to another.

5.3.1.3. Emergency Operations

AC Transit strives to provide a safe environment for transit customers and staff and uses safety features of the existing CAD/AVL system. An emergency response for the agency generally involves medical, security or accident response that is more significant than an “incident”. These scenarios are divided into two sub flows:

1. **Bus Emergency** – Bus-specific emergencies involve medical, security, or accident response that is more significant than an “incident”. Bus Emergencies typically follow two paths, a priority request to talk (PRTT) or covert alarm activation. Issues involving PRTT allow Controllers to open two-way voice radio communications with the Operator to gather important information that can be relayed to emergency responders or Road Supervisors. If a covert alarm is triggered on the vehicle, Controllers are able to open a covert microphone to gather information about the situation. During covert alarms, one-way voice radio communications only is available so as not to alert the aggressor that someone is monitoring the situation by only being able to listen.
2. **Major Incident** – These types of events pertain to significant major event slowdowns such as wide area flooding, an earthquake, or other such events. AC Transit has standard operating procedures (SOPs) to aid and recover from unplanned major events; however, the existing CAD/AVL only provides limited functionality needed to assist the OCC with recovering or aiding during major incidents. “Recovery” is defined as the ability to effectively operate portions of the system (based on vehicle and roadway availability) and then bring vehicles and lines back up as available, managing headways and traveler information dissemination to support these efforts.

5.3.1.4. Supporting Processes

In addition to operational flows focused on the delivery of day-to-day service, supporting processes such as maintenance and scheduling also impact the OCC and Operators on a semi-regular basis. These flows are illustrated as Maintenance and Scheduling. The Maintenance flow focuses on issues affecting vehicles that are in, or are imminently entering, revenue service (pull-out) and includes detection, evaluation, remote troubleshooting, and removal of disabled vehicles from service.

Scheduling involves use of archived real-time operational data to support service planning functions including scheduling and schedule adjustments, performance monitoring, ridership analysis, and other tactical and long-range planning functions. These planning activities use data collected onboard vehicles as well as CAD/AVL data as part of a “feedback” process that supports continual system improvement and adaptation to changing circumstances. The planning function also supports pre-emptive preparation for emergency and incident scenario response, such as bus bridging.
6. Operational Needs

This section describes a set of high-level operational needs derived based on analysis of the Current Operating Environment (Section 5) and the CAD/AVL Project Purpose and Objectives (Section 4), as well as consultation with key project stakeholders through previous needs assessment workshops (see the High Level Summary of AC Transit CAD/AVL Needs memorandum for detailed information). These operational needs represent changes necessary from today’s AC Transit operations to achieve the goal set out in the project purpose. The operational needs have been classified in terms of objectives they support.

The key system requirements that have led to development of the operational needs are:

**Higher Quality Location and Status Gathering** – To better manage and regulate service delivery, operations, maintenance, and security staff (among others) need to know the location of all resources in the field in a timely fashion. For example, AC Transit currently has limited or no capability to automatically track the location of non-revenue vehicles or field staff. This can lead to unnecessary challenges for Controllers trying to assign field staff to emerging situations. In addition to gathering the location of resources, gathering the status of field resources or data from external interfacing systems is also key to delivering a safe and successful service. This may include integrating remote vehicle engine and transmission warnings into the Ellipse maintenance system, or associating the location of all Road Supervisors with their vehicle while in the field, or collecting real-time traffic or road-weather information from third parties. The CAD/AVL system must be flexible and support new inputs, as needs and technology advance over time.

**Timely and Accurate Location and Status Sharing** – The sharing of location and status information between key operations and maintenance stakeholders is crucial to success of the bus service. Without a shared view between control and the field, service delivery, safety, and maintenance decisions cannot be made in a fully coordinated and rational way. Information gathered from the field or external systems would otherwise continue to be shared in a number of manual, disparate ways. AC Transit, therefore, needs an integrated, automated view at the OCC and field locations. This may be presented on-screen at the desktop level, on a large-scale dynamic model board, or distributed to mobile devices in the field such as a Road Supervisor’s vehicle. Additionally, alerts from incidents, for example, or critical vehicle health status data can be shared directly with maintenance and safety systems at the appropriate facility to better coordinate the agency’s response.

**Simplifying Systems Integration** – A key concern with current systems is the increasing complexity and number of interfacing systems both on and off-board vehicles. For example, a revenue vehicle Operator must log on and log off multiple systems at the start or end of a trip. This process is time-consuming, slow, and unreliable. To better ensure compliance with Operator log on protocols, AC Transit needs to simplify onboard operational processes with the new system. It must be easy to use by Operators through minimizing complexity at the user level. Off-board maintenance of multiple interfacing systems also requires additional cost and effort that could be alleviated with a new system. Therefore, remote control and interaction between off-board systems and those onboard also needs to be streamlined such as through an easy and intuitive way to send and delete messages and instructions from the central system to the vehicles, as well as to better integrate the Hastus personnel system with key onboard systems.

**Supporting Service-dependent Processes** – Beyond service operations, there will be many other benefits to an improved CAD/AVL system. For example, scheduling and personnel divisions can benefit from an improved interface to the Hastus system. Service performance or post-event analysis may improve due to better tracking of vehicles and personnel to enable route and service cost-savings. Maintenance will benefit from broader full life-cycle asset management and potentially from more complete issue logs. Security personnel may benefit through being alerted to field emergencies immediately without waiting for Controller input. AC Transit has also stated they wish to provide more accurate and reliable transit traveler information to the public. Providing customer information will require a robust interface between the new CAD/AVL system and any such in-house or external information systems.
The Appendix B graphic maps AC Transit enterprise goals to key capabilities the new system must provide. A selection are discussed below:

**Service Monitoring:** To improve the ability of OCC and Road Supervisors to monitor service status through a shared current operating view, shared view of all vehicle locations, status of vehicles, the environment in which they are operating (congestion, weather, etc.), and the location of field personnel.

**Service Delivery:** To better regulate service, and to monitor and regulate on-board systems, to improve the customer experience.

**Full Life-cycle Management of Assets:** With improved integrated system data, the capability to expand or improve procurement strategies; administer systems; train operations staff; track scheduled, preventative, and unscheduled maintenance; track asset data using reporting tools though historic maintenance records, service records, current service data.

**Customer Information:** Providing better in-vehicle information through Operator control of the automated vehicle announcement (AVA) system; the ability to remotely update onboard customer information screen and PA systems; providing better information prior to boarding by pushing additional messages from central systems out to the public domain, providing better information to the call-center; providing a direct information interface to the region's 511 system instead of through NextBus.

**Service Plans and Schedules:** Improving post-event analysis through events playback and analysis of service related information with user-configurable reports; improving plans and schedules through better disruption and emergency planning through identification of deficiencies and inefficiencies in the current plans.

### 6.3.1. Context Diagram

*Figure 8* illustrates the environment the replacement CAD/AVL system must fit into. Many interfacing systems will use or provide information to the CAD/AVL system, and multiple groups within AC Transit will interface directly with the core system.
7. Proposed Operational Concept

The proposed operational concept is a solution-independent, high-level, operational representation of the proposed approach, addressing operational needs and fulfilling the project purpose and objectives. Figure 9 shows the relationship between external, central, and field systems that will interface with the new CAD/AVL system. The exact configuration and full capability of the external, central, and field systems has yet to be identified by AC Transit. Conceptually, however, this upgraded CAD/AVL system must be flexible and able to support a number of new systems as needed.

**External Systems** – These systems exist outside AC Transit such as traffic data, road weather, customers with requests, or emergency notifications from police or fire services. AC Transit must interface with these systems to provide a safe and reliable bus service. The means by which AC Transit collects this data must be flexible as the systems will not have standardized interfaces. For example, individual police may telephone the OCC with details of an emergency, while traffic data may be supplied by the local DOT electronically. Internally, AC Transit must process this data in a standardized fashion that will enable a consistent distribution between the Field Systems (e.g., onboard equipment) and the Central System (e.g., Controllers).

**Central System** – This element represents both the AC Transit central information systems and the central operational processes that take place at the OCC, as well as storage, maintenance, and security facilities within AC Transit. Information is collected at this level from a variety of sources. These include information from external systems to AC Transit, internal central systems (e.g., Hastus, Ellipse), or from the vehicles or field personnel such as Road Supervisors. The information is processed into a standardized format that works for the recipients to whom it is then distributed (e.g., Operators, local police, customers).

**Field Systems** – These include the AC Transit buses, supervisor/security vehicles, mobile data systems, personnel, and non-CAD/AVL onboard systems such as the APC or farebox. Notifications from the field systems, for example, a vehicle health status alert, can be distributed and trigger a central system such as maintenance to alert mechanics to an issue on board a vehicle. Alternatively, maintenance may turn off an alarm on a vehicle remotely, or the OCC may control an onboard system, such as the silent microphone or on-vehicle passenger information sign, by distributing a command.
8. Summary of Operational Impacts

With the Operational Concept described in Section 7 in mind, this section considers how current operations, described in Section 5, may change or be impacted. As such, this section offers an operationally focused, scenario-based view of the proposed concept.

For each process defined in Section 5, this section uses an annotated version of the process flow diagrams to identify impacts arising from the proposed Operational Concept. The analysis described in this section assumes the complete Operational Concept has been implemented. Impacts that change previous scenarios are highlighted in yellow in the flows.

8.1. Operational Unit Impacts

8.1.1. Division Yard/Garage

With the upgrade of the CAD/AVL system, it is not anticipated that overall responsibilities and roles in the yard will change. Many existing processes will remain the same; however tools by which these procedures are followed may change as efficiencies are found using the replacement system.

8.1.1.1. Window Dispatch

With the new Hastus upgrade project, Window Dispatch will enter changes to Operator/vehicle assignments in real time to the new Hastus system. This information will be used to help facilitate log on using only the Operator ID.

8.1.1.2. Maintenance

With the new system it is envisioned that additional vehicle monitoring data will be available to the maintenance department remotely. This includes ECM performed over the J1708/1939 connections that will be recorded and logged by the VLU in accordance with filtering parameters. If one of the specific configured mechanical messages is triggered on the vehicle (e.g., Stop Engine Warning), that message will be immediately forwarded to the OCC and Maintenance. Each maintenance department will include a workstation with limited CAD AVL access, either directly from the CAD/AVL vendor or via an in-house developed application, to pull information from the agency’s Enterprise Database.

8.1.2. Field

The roles and responsibilities for operational units in the field are not anticipated to change. With deployment of new and more robust equipment on the vehicle, as well as potential laptop computers for Road Supervisors, efficiencies in the field will help ease ongoing frustrations and improve on-time performance and response times.

8.1.2.1. Road Supervisors

Deploying laptops will provide Road Supervisors with more information to assist with responding to incidents and to improve coordination with the OCC.

8.1.2.2. Operators

Deploying new onboard equipment will create a more efficient means to perform daily duties. Operators will have a single point of log-on to streamline start of day duties and improve success for capturing end of day reporting data. Better accuracy in locations and improved voice and data communications will provide the Operator with the necessary information to improve schedule adherence and assist with planned and ad hoc service changes/corrections that may be required throughout the day. The new system should be easier to use, more accurate, and more efficient.
8.1.3. Operations Control Center

The OCC will undergo the most significant change with deploying the new system. Although roles will not change, the newer full-featured CAD/AVL systems have moved from a responsive to proactive monitoring system. This has often mandated that agencies make a paradigm shift in the way they do business.

8.1.3.1. Controller

Controllers will be provided with new tools and more accurate information to proactively manage system-wide service. Although overall responsibilities will not change, new CAD/AVL system tools and features will automate some manual activities that Controllers actively perform with the current system. Additionally, many actions will now be recorded to provide a more accurate account of the efforts Controllers and other field personnel took to maintain service. Service restoration tools, incident management tools, and other data will automatically collect and store the information such as lost service that the OCC must currently collect and calculate manually.

8.2. System Unit Impacts

The new system will not dramatically change the overall system architecture, rather it will help streamline and simplify management of the existing system. Many newer CAD/AVL systems have built-in “watchdog” applications that continuously monitor internal processes and automate corrective actions. AC Transit has also expressed a desire for a fully redundant system with a testing and training environment, to fully test in-house developed applications and changes to the internal agency data warehouse prior to their release into the operational system. With the addition of many ongoing technology upgrades and projects, a testing environment and redundant system will reduce risk of catastrophic failure.

8.2.1. Central System

The diagram below shows the proposed system architecture at a high level. With many detailed design decisions yet to be made, this system architecture is intended to be solution independent and more illustrative of the vision for internal and third party applications. The new system interface closely resembles the existing interface. The exception being that direct integration with the new CAD/AVL system will be through the Hastus scheduling and daily operational system and the regional (www.511.org) real-time transit information applications. AC Transit’s Enterprise database will periodically fetch data from the CAD/AVL system through database views. This will provide other third party applications, such as Ellipse and agency-developed reporting tools, with CAD/AVL data.

![Figure 10: Proposed System Architecture for the new CAD/AVL system](image-url)
8.2.2. Communications

The replacement CAD/AVL system will require more frequent and reliable vehicle location updates, better integration with existing systems, and more robust dispatching features and functions. The current communications system is unable to support this and future initiatives for the agency. In a parallel effort, a detailed analysis of the existing voice and data radio communications options available to the agency is available in the technical memorandum Communication System Alternatives. For the purpose of this operational concept, it will be assumed that the voice and data radio communications system solution for the replacement CAD/AVL system will be able to support agency needs. The future radio system will have the capability to support a minimum of seven voice radio consoles for each existing controller workstation and if possible, expand to include potential new controller workstations. For example, this may include adding an additional console in the Superintendent’s office.

8.2.3. Customer Information Systems

AC Transit prefers the replacement system to provide transit information directly to the region’s 511 system, eliminating NextBus as the go-between. The new system’s features and functions will provide customer service applications with more accurate information when service measures are taken. This will increase the accuracy of information disseminated to the traveling public. With integration of the agency’s AVA system, Operators will have more control over the audio volume and the ability to repeat or replay announcements. The OCC will also have the ability to disable a malfunctioning onboard AVA system remotely. The agency would also like to expand the AVA system to include messages that are tied to specific locations, bus stops or other events not currently available (i.e. wheel chair ramp deploying).

8.2.4. Service Planning

Service planning and scheduling processes will generally remain unchanged. Field information and data will still be available. However, rather than pulling this information directly from the CAD/AVL system, AC Transit is considering using the Enterprise Database. More comprehensive information from the onboard systems will also be available to the scheduling department to improve schedules and generate more accurate and comprehensive reports.

8.2.5. OnBoard Vehicle Systems

Integration with other onboard equipment through the VLU will provide the agency with increased efficiencies allowing a single point of log-on for all integrated devices. The smart media reader (Clipper equipment) is a proprietary device that will not be able to integrate with the replacement system and is represented as a standalone system. The diagram below provides a high-level overview of the future onboard architecture.

As CAD/AVL systems become more modular, transit agencies are realizing the benefit of incorporating an onboard network similar to an office IT environment to help future-proof buses. AC Transit’s future onboard system will include a mobile access router (MAR) to provide the agency with multi-path communications between the onboard equipment and central system and the ability to integrate with new and existing devices. The diagram above illustrates an example future replacement system using a MAR. The MAR will integrate with the vendor provided VLU, and the existing APC and Apollo security surveillance system. If the agency chooses cellular data communications as part of the replacement project, or as a future consideration, the MAR provides flexibility to change carriers or upgrade modem cards with minimal costs to the agency.
8.3. Scenario Impacts

This section considers changes to processes carried out at AC Transit under the new concept. A brief description of the change is provided, followed by the altered flow diagram showing the system and operational impacts.

8.3.1. Normal Operations

Several key elements of day-to-day operations will be positively impacted by the new CAD/AVL system, primarily through better integration with existing systems and simplification of others (e.g., single point of log on for Operators).

8.3.1.1. Start of Day

Window Dispatch will enter changes to assigned vehicles and Operators in real-time during pullout. This will supported log on using operator ID alone. The new system will also support a single point of log-on so that when the Operator logs on to the MDT, they are also automatically logged on to the other onboard systems connected through the VLU such as the headsign and farebox. Stand-alone systems (such as the Clipper) will still need to be logged onto separately. If there is a missed or late pull-out, the system will automatically log this regardless of the reason (e.g., mechanical issues, bus Operator late). Finally, through integration with the upgraded Hastus system, when the Operator notifies the Controller they are delayed or unable to pull out, the new CAD/AVL system will be able to notify the Window Dispatch if new crew/vehicle is needed or if maintenance personnel are required.
**Figure 12: Start of Day Operational Flow**

**WHERE**
- Yard
- OCC
- Maintenance

**WHO**
- Operator/Controller
- OCC Controller
- Maintenance Operators

**INPUT**
- Update TIS
- Log Event in OnCAD
- Open Maint. Event

**PROCESS**

**OUTPUT**
- Operator shows up
- Operator vehicle log on
- Operator log on vehicle?
- Operator notifies Maintenance of delay
- Document additional event if necessary

**Impacts**

1. This would be managed in HASTUS Daily Ops which will have a direct tie into the CAD/AVL system.
2. Single logon action for vehicle. Logging onto the MDT would automatically log other accessories on the vehicle (overhead sign, farebox, CAD system, etc.)
3. Integration with HASTUS Daily Vehicle. These functions are now done in a separate system that relays info into CAD/AVL system.

**Operational Flow**

1. Operator arrives at TIS. If no shows, replace with extra board operator.
2. Operator vehicle logs on.
3. Control checks for Mechanical issues during pullout?

For major delays in pullout, Control will conduct service corrective measures that will be automatically logged and tracked in the new CAD/AVL system.

Controllers maintain continual contact with maintenance when mechanical issues arise with vehicles that impact the dispatching of a vehicle. Controllers will enter information into the CAD/AVL system that feeds the Enterprise Database. If the delay will adversely impact service, the Road Supervisor will be notified by the Controller.

Controllers are required to document any missed or late pullouts. This information will be automatically tracked and logged in the new system. A form will be created to help document reasons for missed/late pullouts. All changes to the form will be tracked and recorded in the system.

Operators must report for duty to Window Dispatch 30 minutes prior to pullout. They are given their “Pouch” that contains their assignment for that day, and the bus defect card.

The vehicles are assigned by the maintenance division. Maintenance maintains list of available vehicles in TIS.

The window dispatcher will give assignment to extra board operator, and will make assignment in TIS (internal AC Transit vehicle dispatching system). Dispatch will also call the OCC to confirm that they are aware of the Operator change.

If a Driver fails to log on, an automated message is generated in OnCAD. Control will attempt to have Operator log onto the vehicle, but when required, the Controller will manually log the Operator onto the bus.
8.3.1.2. End of Day

There will be no foreseeable changes to this process other than the single point of log off. Advanced technology could have the vehicle automatically log off at the end of the service day based on location, schedule data, and ignition state. This is a policy decision that the agency may want to explore and would also narrow the number of CAD/AVL vendors that would be able to provide this service.

8.3.2. Degraded Operations

The new system will give Controllers, Road Supervisors, Operators, and others affected the ability to respond to degraded operations more efficiently and effectively through access to better and more current data and the ability to generate automated messages/communications that can be distributed to individuals or groups, as needed, through the improved incident report forms.

8.3.2.1. Service Correction

When the Controller initiates a call to the Operator to provide an action to restore service, the actions and decisions that the Controller takes will be recorded for use with current automatic or pre-populated service recovery forms to allow more efficient response to service correction incidents. This will also allow for capture of better data and a more cohesive record of the response. In addition, the new system will allow for tracking Road Supervisor locations. Knowing where Road Supervisors are when assistance is required for a service correction allows

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**Figure 13: End of Day Operational Flow**

### Table: End of Day Operational Flow

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Log Event on ORCAD</td>
<td>Determine End of Day Scenario</td>
<td>Operator Logs off, performs end of day routine and W/S out/returns to coach</td>
<td></td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Operator sends RTT</td>
<td>Controller opens voice radio communications, gathers information and contacts Window Dispatcher</td>
<td>Vehicle begins automated download of daily statements via WAN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Road Relief Operator available?</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Road Relief Operator available?</td>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Automatic vehicle log off is vendor dependent but could be tied to the schedule, location and ignition state.
2. Current Operator log off requires use of the Operator badge. Future log off may be simplified to just use of a single button, or be logging on with a new badge number.

**End of Service Day Flow**

Controller has the ability to log off for operators. For more information, please see the Start of Day Flow diagram for issues regarding not logging onto vehicle or no Operator available.

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**End of Service Day Flow**

Controller logs off, performs end of day routine and W/S out/returns to coach.
more efficient allocation of resources. Road Supervisors will also be equipped with laptops to track vehicles and access performance reports. With this information readily available, Road Supervisors will be able to respond to service issues in a timely manner and will likely be able to assist with the proactive identification of issues (rather than being stuck in a reactive response mode).

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCC</td>
<td>Controller</td>
<td></td>
<td>Start</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Notification in CAD</td>
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<td></td>
<td></td>
<td></td>
<td>Controller initiates call to vehicle</td>
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<td></td>
<td></td>
<td></td>
<td>From &quot;Maintenance * (Service Adjustment Needed?)&quot;</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Will service correction affect entire line?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controller starts service restoration measure notification to specific groups automatically generated</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Determine where the vehicle needs to be inserted</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Relay/ Coach Exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controller initiates service restoration actions in CAD to restore service, information is automatically disseminated to all impacted vehicles</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Yard</td>
<td>Dispatcher</td>
<td></td>
<td>Update CAD Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field</td>
<td>Road Supervisor</td>
<td></td>
<td>Update CAD Event</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>What service is required?</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Relay/ Coach Exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Report Backs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coordinate with Road Supervisor and Window Dispatcher</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Call Window Dispatcher and coordinate action</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 14: Service Correction Operational Flow
8.3.2.2 Detour

Entering and activating detours will become more efficient and disseminate information automatically to all impacted vehicles, stakeholders, and downstream systems (e.g., regional 511 system, agency website, customer service applications). This information will also be automatically captured in the CAD/AVL database for use with scheduling and reporting applications.

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach</td>
<td>Operator</td>
<td></td>
<td>From Service Conviction [Detour]</td>
<td>From Major Event</td>
<td><strong>There are four possible detour scenarios:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Start</td>
<td></td>
<td>1) Short-term detours for expected events such as utility work, short construction events, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>is the detour Operator initiated?</td>
<td></td>
<td>2) Short-term detours that are unexpected such as traffic incidents, unexpected/ unplanned construction events, etc.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document</td>
<td>Operator sends RTI for voice call</td>
<td></td>
<td>3) Long-term events that incorporate planned detours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in CAD</td>
<td></td>
<td></td>
<td>4) Large scale short-term events, e.g. Parade and Holiday schedules.</td>
</tr>
<tr>
<td>Field</td>
<td>Road Supervisor</td>
<td></td>
<td>Is the Operator able to bypass route blockage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document</td>
<td>Operator notifies OCC</td>
<td></td>
<td>Controllers will call to verify information. If a Detour is needed, Central will notify the Road Supervisor who will need to determine a detour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in CAD</td>
<td></td>
<td></td>
<td>For long term detours, Road Superintends provide OCC with the adjustable detour routes, and temporary stops (if necessary).</td>
</tr>
</tbody>
</table>

**Figure 15: Detour Operational Flow**
8.3.2.3. Non-Emergency Degraded Service Correction

The greatest impact to operations for this scenario will come from the ability of Controllers to make better decisions about Road Supervisor resourcing through knowing their map location, and whether they are currently busy (e.g., another Controller has requested their assistance). Also, with the laptops, Road Supervisors will have tools/applications to complete work tickets/incident forms immediately in the field.

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenon</td>
<td>Operator</td>
<td></td>
<td></td>
<td></td>
<td>Currently Operators are able to communicate with Controllers through two methods 1) (priority) request to talk and 2) pre-defined canned messages.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td></td>
<td></td>
<td></td>
<td>When messages appear in the message queue, Controllers will attempt to gather any information they can and initiate a voice call to the vehicle to gather more information if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If no action is required. The event is logged and closed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Occasionally, incidents on the bus may escalate and require emergency response. In this case, Controllers will follow standard operating procedures and follow the high level flow outlined in “Bus Emergency”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dispatchers at the OCC will be able to make better decisions about Road Supervisor resourcing by having the ability to: 1) know where they are by looking on a map 2) know if they are currently working on something (i.e. if another controller has assigned them work) 3) provide them with the tools/applications they need to pull up their own information and complete work tickets/incident forms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If the situation requires a service adjustment, Controllers will follow the flow outlined in “Service Correction”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All events are logged and closed in OnCad.</td>
</tr>
</tbody>
</table>

Figure 16: Non Emergency Operational Flow

8.3.2.4. Bus Bridge

The beginning of this process will be improved by the new CAD/AVL system. The future system will know when vehicles have been taken off route and whether the vehicle is removed from service. This information will also be provided to downstream applications to allow for clearer data and better reporting on these situations. Vehicles taken out of service will be removed from reporting on all customer information applications (e.g., real-time information signs as bus stops) and replaced with information about the vehicle now placed into service. In addition, communication to Operators will be improved with the ability to route a single text message/canned instruction to a group of Operators, vehicles, blocks, or routes. Finally, when the bus bridge action is complete, all necessary individuals who need to know will be updated automatically based on the information entered into the service recovery form/incident management form.
8.3.3. Emergency Operations

Primary impacts to emergency operations will be in the access Controllers will have to onboard emergency alarm equipment and the ability to override or downgrade current alarms. In addition, increased automation of notifications will allow for more efficient use of resources through timely notification of situational changes.

8.3.3.1. Bus Emergency

The greatest benefit to emergency operations in the new CAD/AVL system will be the ability of Controllers to access or reset a current alarm rather than being required to send a Road Supervisor to the vehicle to reset the radio. This will be a significant operational improvement allowing for much better control and use of resources.
Additionally, Road Supervisors will have GPS enabled radios allowing their location to be sent to the OCC. This will allow Controllers the ability to quickly locate the nearest Road Supervisor to respond to bus emergencies.

Figure 18: Bus Emergency Operational Flow
8.3.3.2. Major Incident

Today, when a major event disrupts service, Controllers must contact the Road Supervisor to verify the event severity. As with Degraded Service Correction, Controllers will be able to make better decisions about Road Supervisor resourcing through knowing their location, will know whether they are currently busy, and will be able to provide them with tools and information needed to complete reports in the field. In addition, when determining which vehicles and/or routes are affected, Controllers will be able to proactively and reactively add or remove vehicles from service because the system will present information about which routes, vehicles, and schedules are impacted by the event. Finally, notifying agency personnel and customers of an event will be built into the incident logs and forms to allow for more automated notification of those affected.

Figure 19: Major Event Operational Flow
8.3.4. Supporting processes

Supporting processes will be improved with the new system through better and more streamlined access to data used in decision making.

8.3.4.1. Maintenance

The entire troubleshooting process will be better supported and streamlined through the maintenance personnel ability to pull ECM data directly from the vehicle.

---

**Figure 20: Maintenance Supporting Process Operational Flow**

- **Start**
  - Operator sends canonical mechanical message and then Request to Talk (RTT) to Control
  - Controller attempts to troubleshoot the issue

- **Does response require field supervisor?**
  - Yes
    - Log diagnosis issue and relay information to Control
  - No

- **Issue resolved?**
  - Yes
    - Send Tow Truck
    - Put replacement vehicle into service
  - No

- **New service connection needed?**
  - Yes
    - See Service Connection
  - No

- **Document exists?**
  - Yes
    - Document exists
  - No

- **End**

**WHERE**

- **Coach**
- **OCC**
- **Maintenance**
- **OCC**
- **Coach**

**WHO**

- **Operator**
- **Controller**
- **Mechanic**

**INPUT**

- **Document in CAD**
- **Document in CAD**
- **Document in CAD**

**PROCESS**

- Use AVL to determine vehicle location and information. Confirm with Operator
- Controller attempts to troubleshoot the issue
- Does response require field supervisor?
- Issue resolved?
- New service connection needed?
- Document exists?

**OUTPUT**

- Covers the operations for a maintenance call once the vehicle has left the division.
- Once the Driver has submitted a mechanical message to Control, Control will open a voice line to the vehicle and try to troubleshoot the issue.
- Often times, the Controller is the first one on the scene. Their primary objective is to maintain service and the safety of the passengers. If they are unable to troubleshoot the incident, it is documented in ODI/CAD and a record of it is logged in the Maintenance management software, Eclipse.
- If Control is unable to troubleshoot the item, a Road Supervisor will be dispatched to the vehicle to investigate.
- The Maintenance Division is notified by the Controller of the issue and the appropriate response is administered.
- Division 2 deploys a mobile maintenance vehicle to assist with mechanical issues in the AM and PM peak periods.
- Once Maintenance is notified, they will be able to pull ECM data from the coach to try and diagnose the issue. If they are unable to resolve the issue, Maintenance will drive a spare coach to the location of the affected vehicle.
- Control will put the affected Operator back into service with the replacement vehicle at the location where they would have been had the service not been interrupted. The original vehicle’s Defect Card will stay with that vehicle and the Operator will pick up a new Defect Card for the replacement vehicle.
- Event is created and documented, including last time, in CAD by the Controller. Once the event is entered, it cannot be changed and is distributed to downstream applications/systems. All CAD documentation occurs at Control.
- In the field, the Operator or Maintenance personnel will note the issue on the Defect Card in the pocket.
- Maintenance will document the issue in their Maintenance management system.
8.3.4.2. Scheduling

Planning uses data collected on the vehicle to run Performance Summaries that support their decision making. Because the new system will provide more accurate location data, the data quality available to planning will improve.

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Planning generates Trip/Stop Summary (Wideship Reports) &amp; Run Trip Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Existing data is used by various other departments (Managers, TIC, etc.) for reporting, analysis, and other various means</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily/Weekly Schedule adjustment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New schedules are downloaded into the coaches</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Start</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Real-time CAD data is “cleaned”, matched to schedules

Figure 21: Scheduling Supporting Process Operational Flow
APPENDIX A

EXISTING OPERATIONAL FLOW DIAGRAMS
**Scenario:** Key

**Resources Involved:** WHERE (WHO)

**Tools/System Utilized:** VENDOR (Applications)

### Scenario Description:

- **Start**
- **Decision**
  - **No** Notify Control
  - **Yes** Notify Control
- **End**

**WHERE** | **WHO** | **INPUT** | **PROCESS** | **OUTPUT** | **Comments**
---|---|---|---|---|---
WHERE | WHO | DATA INPUT | Start | DATA OUTPUT | DESCRIPTION OF THE PROCESS THAT IS BEING DOCUMENTED TO THE LEFT OF THIS COLUMN
## Scenario Description:
Pull out process at the start of the day for the coach/bus. On occasion there may be issues that require dispatch or other resources to intervene during pull out. These issues may include: mechanical issues, drivers who don’t log on, or log on challenges, vehicle or driver shortages, etc. Although not all issues are identified, many of the high level steps or processes are similar at a system level which is captured in the flow below.

### Resources Involved:
- Window Dispatcher
- Road Supervisor
- Maintenance
- Bus Operator
- Controller

### Tools/Systems Utilized:
- In-House AC Transit Systems (Randall Report)
- Time Keeper Systems (TIS, OTS)
- Maintenance Management System (Ellipse)
- ACS (OrbCAD)

### Scenario: Start of Day

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>OUTPUT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard</td>
<td>Operator / Controller</td>
<td>Update TIS</td>
<td>Notify Control</td>
<td>Missed/Late Pull-Out?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Log Event in OrbCAD</td>
<td>Operator logs on vehicle?</td>
<td></td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Log Event in OrbCAD</td>
<td>Control logs Operator on via OrbCAD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operator logs on vehicle?</td>
<td>Control notifies Operator they are unable to pull out or delayed</td>
<td></td>
</tr>
<tr>
<td>Yard</td>
<td>Maintenance</td>
<td>Open Maint. Event</td>
<td>Control notifies Garage Supervisor first, then the Window Dispatcher or Operator if a new vehicle or mechanic is required</td>
<td></td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document actions/ event in OrbCAD if necessary</td>
<td>Control notifies Road Supervisor</td>
<td></td>
</tr>
</tbody>
</table>

Operators must report for duty to Window Dispatcher 10 minutes prior to pull out. They are given their “Pouch” that contains their assignment for that day, and the bus defect card.

The vehicles are assigned by the maintenance division. Maintenance maintains list of available vehicles in TIS.

The window dispatcher will give assignment to extra board operator, and will make assignment in TIS (internal AC Transit vehicle dispatching system). Dispatch will also call the OCC to confirm that they are aware of the Operator change.

If a Driver fails to log on, an automated message is generated in OrbCAD. Control will attempt to have Operator log onto the vehicle, but when required, the Controller will manually log the Operator onto the bus.

Controllers are required to document any missed or late pullouts. This information is first recorded on a paper form, and then later entered by them into the report system. This is done to minimize entering incorrect information, since once information is entered into the reporting system, it can not be changed when the ticket is closed.

Controllers maintain continual contact with maintenance when mechanical issues arise with vehicles that impact the dispatch of a vehicle. Controllers enter information into the AC Transit reporting system (Randall Report) that feeds the Maintenance management system (Ellipse). If the delay will adversely impact service, the Road Supervisor is notified over the radio system by the Controller.

For major delays in pullouts, Control creates an incident report, and documents any service restoration in OrbCAD.
Scenario: End of Day

Resources Involved:
Controller
Operator

Tools/Systems Utilized:
ACS (OrbCAD)

Scenario Description:
End of day for either an operator or coach. Primarily includes operator log off and automated processes that download data at the end of the service day.

WHERE
WHO
INPUT
PROCESS
OUTPUT
Comments

Road Relief
End of service day for coach

Determine End of Day Scenario

Operator Log off?

Yes

Operator Log off, performs end of day routine and returns Pouch

Vehicle begins automated download of daily statistics via WLAN

No

Log Event in OrbCAD

Resources Involved:
Coach
Operator

Controller

DCC

Enterprise Database

There are two possible End of Day scenarios: 1) Relief Operator and 2) vehicle is done for the day.

Road Relief may happen at any location along the route, not just at pre-designated points.

In the event of an end of day scenario where the vehicle returns to the Yard, the Operator will return their Pouch to the Window Dispatcher.

Log off requires the Operator to use their badge number. If the Operator forgets to log off, a Controller can log them off.

During a Road Relief, if the previous driver fails to log off, the Relief Operator is unable to log in (current log off requires the badge number). The Relief Operator must contact the DCC and a Controller will need to log off the previous Operator. For more information, please see the Start of Day flow diagram for issues regarding not logging onto vehicle or no Operator available.

Start

End

Operator Log off?

Yes

Operator Log off, performs end of day routine and returns Pouch

Vehicle begins automated download of daily statistics via WLAN

Relief Operator available?

Yes

Operator sends RTT

Operator Log on?

Yes

Controller opens voice radio communications, gathers information and contacts Window Dispatcher

See “Start of Service Day” (Operator vehicle log on?)

Relief Operator log on?

Yes

See “Start of Service Day” (Operator vehicle log on?)

No

Controller opens voice radio communications, gathers information and contacts Window Dispatcher

See “Start of Service Day” (Operator vehicle log on?)

Extraboard operator available?

Yes

Log Event in OrbCAD

Resources Involved:
Coach
Operator

Controller

DCC

Enterprise Database

There are two possible End of Day scenarios: 1) Relief Operator and 2) vehicle is done for the day.

Road Relief may happen at any location along the route, not just at pre-designated points.

In the event of an end of day scenario where the vehicle returns to the Yard, the Operator will return their Pouch to the Window Dispatcher.

Log off requires the Operator to use their badge number. If the Operator forgets to log off, a Controller can log them off.

During a Road Relief, if the previous driver fails to log off, the Relief Operator is unable to log in (current log off requires the badge number). The Relief Operator must contact the DCC and a Controller will need to log off the previous Operator. For more information, please see the Start of Day flow diagram for issues regarding not logging onto vehicle or no Operator available.

Start

End

Operator Log off?

Yes

Operator Log off, performs end of day routine and returns Pouch

Vehicle begins automated download of daily statistics via WLAN

No

Log Event in OrbCAD

Resources Involved:
Coach
Operator

Controller

DCC

Enterprise Database

There are two possible End of Day scenarios: 1) Relief Operator and 2) vehicle is done for the day.

Road Relief may happen at any location along the route, not just at pre-designated points.

In the event of an end of day scenario where the vehicle returns to the Yard, the Operator will return their Pouch to the Window Dispatcher.

Log off requires the Operator to use their badge number. If the Operator forgets to log off, a Controller can log them off.

During a Road Relief, if the previous driver fails to log off, the Relief Operator is unable to log in (current log off requires the badge number). The Relief Operator must contact the DCC and a Controller will need to log off the previous Operator. For more information, please see the Start of Day flow diagram for issues regarding not logging onto vehicle or no Operator available.
Scenario: Service Correction

Resources Involved:
- Operator
- Window Dispatcher
- Road Supervisor

Tools/Systems Utilized:
- ACS (OrbCAD)

Scenario Description:
Return of operations to a normal steady state following a localized disruption or irregularity in service affecting a single vehicle (e.g., running late), a single line or interlined corridor (e.g., bus bunching), or a specific sector of the system (e.g., impacts of a traffic accident, etc.). Includes operator, Field, and dispatch response to abnormal circumstances and interventions to restore on-time scheduled service.

WHERE | WHO | INPUT | PROCESS | OUTPUT | Comments
--- | --- | --- | --- | --- | ---
OCC | Controller | OCC | Controller initiates call to vehicle | Notification in OrbCAD | Controller initiates call to the vehicle to gather information and determine the appropriate response to restore regular service.

WHAT recovery type is needed?
- From "Maintenance Service Adjustment Needed?":
  - Controller initiates call to vehicle
  - Controller brings up Train Card, determines vehicle location, and reviews headways
  - Controller notification for major service disruptions
  - Controller initiates call to Operator and provides action to restore service

WILL service correction affect entire line?
- Yes:
  - Controller initiates call to Operator and provides action to restore service

- No:
  - Determine where the vehicle needs to be inserted
  - Relay/Coach Exchange
  - What service is required?

WHAT service is required?
- Relay/Coach Exchange
- Report Backs

Yard | Dispatcher | Report Backs | Call Window Dispatcher and coordinate action | End | Planned and unplanned reroutes have been pulled out and developed within their own flows. See the Detour flow diagrams.

Field | Road Supervisor | Coordinate with Road Supervisor and Window Dispatcher | Call Window Dispatcher and coordinate action | End | For Relay/Coach Exchange: Controller must provide the route and block that Operators are filling, where and when to begin the run and the appropriate overhead codes to the Operator over the air. Controller will follow-up with text for record.

Enterprise Database | | | | | *Future* All major service disruptions should be automatically relayed to Customer Service

Appendix A: Existing Operational Flows
March 19, 2013
Scenario: Detour/Special Events

Scenario Description:
Covers the re-routing of transit vehicles along a route for pre-planned short and long term events, as well as unplanned events such as traffic incidents and other unplanned events. Winter (snow and ice) Detour situations are not covered under this event.

Resources Involved:
Operator
Controller
Road Supervisor

Tools/Systems Utilized:
ACS (OrbCAD)

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>From Service Correction [Detour]</td>
<td>From Major Event [ENTER]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Start</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is the detour pre-planned (i.e. Parade, Raider game, etc.)?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operator notifies OCC</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controller determines appropriate detour</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supervisor notifies Road Supervisor</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Road Supervisor determines appropriate detour</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controller enters detour into OrbCAD</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Detour is distributed to Operators along the route, key individuals are notified</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Detour is pre-planned and included in the schedule</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Enterprise Database</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Close CAD Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>End</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are five possible detour scenarios:
1) Short term detours for expected events such as utility work, short construction events, etc.
2) Short Term detour that are unexpected such as traffic incidents, unexpected/unplanned construction events, etc.
3) Long Term events that incorporate planned detours.
4) Large scale short-term events, (e.g. Parade and Holiday Schedules).

Controllers will call to verify information. If a Detour is needed, Control will notify the Road Supervisor who will need to determine a detour.

For long-term detours, Road Supervisors provide OCC with the advisable detour routes, and temporary stops (if necessary).

Controllers enter the route into OrbCAD which sends out to all vehicles along that route, as well as key individuals (e.g. Road Supervisors).

Pre planned detours are disseminated to the public on the RTD website.
Scenario: Non Emergency Bus Communication

Scenario Description:
Localized security incidents impacting a single location or vehicle and which does not represent an immediate threat to the welfare of passengers on board ("Non-Emergency" operator and dispatch response). Examples include a violation of the RTD passenger Code of Conduct, such as disruptive passengers. These events may escalate to a level that threatens the operators and/or passengers or safe operation of the vehicle, requiring an Emergency Response.

Resources Involved:
Operator
Controller

Tools/Systems Utilized:
ACS (OrbCAD)

WHERE | WHO | INPUT | PROCESS | OUTPUT | Comments
--- | --- | --- | --- | --- | ---
Coach | Operator | | Start | | Currently Operators are able to communicate with Controllers through two methods 1) (priority) request to talk and 2) pre-defined canned messages.
OCC | Controller | | Operator sends message to Controller | Controller Pulls up information and initiates call to the vehicle | When messages appear in the message queue, Controllers will attempt to gather any information they can and initiate a voice call to the vehicle to gather more information if necessary.
 | | | Action Required? | | If no action is required, the event is logged and closed.
 | | | Yes | Emergency Response Needed? | Occasionally, incidents on the bus may escalate and require emergency response. In this case, Controllers will follow standard operating procedures and follow the high level flow outlined in “Bus Emergency”.
 | | | No | Message Logged | If the situation requires a service adjustment, Controllers will follow the flow outline in “Service Correction”.
 | | | | Service Adjustment Needed? | All events are logged and closed in OrbCAD.
 | | | No | Control Documents Issue | |
 | | | Yes | See Service Correction | |
 | | | |See Bus Emergency | |
 | | | |Assign Road Supervisor | |
 | | | |Document in CAD | |
 | | | |End | |
Scenario: Bus Bridge

Resources Involved:
OCC (Controll)

Tools/Systems Utilized:
OrbCAD

Scenario Description:
RTD uses "Bus Bridge" operations to respond to single line/car rail stoppage. Scenarios have been developed for virtually all situations. RTD desires that the CAD include decision support technology to better support dispatchers in managing the Bus Bridge process and better notify customers.

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Open CAD Event</td>
<td>Start</td>
<td>Determine number of vehicles needed for Bus Bridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Notify necessary individuals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assign vehicles/Operators to serve the Bus Bridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Notify Window Dispatch of all assignments</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Send message to affected routes instructing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bus Bridge Complete?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td>Update necessary individuals</td>
<td>&quot;Future&quot; Bus bridge information should be automatically sent to road supervisors, Customer Service, etc. This is either an automated process, or is set up so that all OCC needs to do is review message and push &quot;send&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No</td>
<td>Send message to Operators on affected routes notifying that the Bus Bridge is complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Close CAD Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Update CAD Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Send message to Operators on affected routes notifying that the Bus Bridge is complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Update CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 19, 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix A: Existing Operational Flows
Scenario: Bus Specific Emergency

Resources Involved:
Controller
Operator
Emergency Responder

Tools/Systems Utilized:

WHERE | WHO | INPUT | PROCESS | OUTPUT | Comments
---|---|---|---|---|---
Coach | Operator | Document in CAD | Start | Document in CAD | In-the-event of bus specific emergencies, a great deal of the response falls on the vehicle Driver’s shoulders, but is coordinated by Controllers. Additionally, some situations may begin as a non-emergency notification and escalate into a situation requiring emergency response.

OCC | Controller | Document in CAD | Driver sends PRTT to Control | Document in CAD | Silent alarms are used only when it is not safe to openly talk to Control, and a person is threatening the Driver or the passengers. During these situations Control has the ability to view AVL data and turn on a covert microphone to assess the situation.

911 Dispatch | Emergency Responders/OCC Controller | Document in CAD | Contact Transit security/emergency responders | Document in CAD | Bus-specific emergencies include:
- Accidents
- Silent Alarm situations
- Fire Emergencies
- Police Emergencies
- Medical Emergencies

Field | Road Supervisor | Document in CAD | Identify and assign the closest Road Supervisor to the incident | Document in CAD | In-the-event of an emergency, Control can push an internal AC Transit alert via intranet email, voice, text to notify affected divisions of the issue.

OCC | Controller | Notify TIC/PIO and Manager of Street Operations (if applicable) | Is the media at the scene? | Notify Control to inform PIO | If the situation warrants an emergency response, Control will call the 911 dispatcher directly.

OCC | Controller | Service Adjustment needed? | Service Correction | Close CAD Event | Control cannot remotely downgrade any emergency alarms. In the event that a silent alarm is accidentally triggered, a Road Supervisor must be dispatched to the vehicle and manually reset the radio.

OCC | Controller | Enter Event | End | Enterprise Database | Control is unable to locate the nearest supervisor. Dispatching Road Supervisors is a manual process that occurs using radios to determine location and who is available to assist with the incident.

Scenario Description:
Bus-specific emergencies involve medical, security or accident response that is more significant than an “incident”. AC Transit desires that the CAD, in concert with other systems, including remote video, and integration with security branches and/or public safety agencies, better support Controllers and other AC Transit resources in responding to these scenarios.
## Scenario Description:

These types of events pertain to significant Major Event slow downs. AC Transit is interested in features or tools that complement their Standard Operating Procedures (SOPs) to aid and recover from unplanned major events. “Recovery” is defined as the ability to effectively operate portions of the system (based on vehicle availability and roadway availability) and then bring vehicles and lines back up as available, managing headways and traveler information dissemination to support these efforts.

### Resources Involved:
- **Controller:** 911 Dispatch / Security / Emergency Response
- **Road Supervisor:** Window Dispatcher
- **Operator:** Management

### Tools/Systems Utilized:
- VENDOR (Applications)

### WHERE | WHO | INPUT | PROCESS | OUTPUT | Comments
--- | --- | --- | --- | --- | ---
Coach | Operator |  | Operator sends PTT message | Start | *Future* All information should be automatically shared with the Key Individuals.
DCC | Controller | Document in CAD | Controller opens voice call to gather information and determine the appropriate response | | SOPs on Earthquakes of other Major Events (i.e. Flooding, Evacuations, etc.) provides procedures for Controllers and Operators to follow in the event of severe weather or other extenuating circumstances.
Field | Road Supervisor |  | Call Road Supervisor to verify event severity | | *Future* Able to track all non-revenue resources (i.e. Supervisors, Maintenance vehicles, etc.)
Yard | Yard Supervisors | Update CAD Event | Notify Public Information Officers of the situation | | *Future* All information should be automatically shared with the PIO and traveler information systems

---

*Future* All information should be automatically shared with the Key Individuals.

Enterprise Database

March 19, 2013

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**Appendix A: Existing Operational Flows**
Scenario: Maintenance Event

Resources Involved:
Controller
Operator
Maintenance

Tools/Systems Utilized:
ACS (OrbCAD)
Ventex (Ellipse)

Scenario Description:
Vehicle maintenance issues that affect vehicles that are in or are imminently entering revenue service (pull-out). Includes detection, evaluation and remote troubleshooting, and removal of disabled vehicles from service.

<table>
<thead>
<tr>
<th>WHERE</th>
<th>WHO</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Operator sends canned mechanical message and then Request to Talk (RTT) to Control</td>
<td></td>
<td>Covers the operations for a maintenance call once the vehicle has left the division.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document in CAD</td>
<td>Use AVL to determine vehicle location and information. Confirm with Operator</td>
<td></td>
<td>Once a Driver has submitted a mechanical message to Control, Control will open a voice line to the vehicle and try to troubleshoot the issue.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document in CAD</td>
<td>Controller attempts to troubleshoot the issue</td>
<td></td>
<td>Often times, the Controller is the first troubleshooter. Their primary objective is to maintain service and the safety of the passengers. If they are able to troubleshoot the incident, it is documented in OrbCAD and a record of it is logged in the Maintenance management software, Ellipse.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Mechanic</td>
<td>Document in CAD</td>
<td>Can maintenance vehicle resolve issue?</td>
<td></td>
<td>If Control is unable to troubleshoot the item, a Road Supervisor will be dispatched to the vehicle to investigate.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document in CAD</td>
<td>Determine required resource</td>
<td></td>
<td>The Maintenance Division is notified by the Controller of the issue and the appropriate response is administered.</td>
</tr>
<tr>
<td>OCC</td>
<td>Controller</td>
<td>Document in CAD</td>
<td>Put replacement vehicle into service</td>
<td></td>
<td>Division 2 deploys a mobile maintenance vehicle to assist with mechanical issues in the AM and PM peak periods.</td>
</tr>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Help diagnose issue and relay information to Control</td>
<td></td>
<td>Once Maintenance is notified, if they are unable to resolve the issue, Maintenance will drive a spare coach to the location of the affected vehicle.</td>
</tr>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Does response require Road Supervision?</td>
<td></td>
<td>The spare coach is identified in the yard by the Window Dispatcher.</td>
</tr>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Issue resolved?</td>
<td></td>
<td>Control will put the affected Operator back into service with the replacement vehicle at the location where they would have been had the service not been interrupted. The original vehicle Defect Card will stay with that vehicle and the Operator will pick up a new Defect Card for the replacement vehicle.</td>
</tr>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Service Correction needed?</td>
<td></td>
<td>Event is created and documented, including lost time, in CAD by the Controller. Once the event is entered, it can not be changed and is distributed to downstream applications/systems. All CAD documentation occurs at Control.</td>
</tr>
<tr>
<td>Coach</td>
<td>Operator</td>
<td>Document in CAD</td>
<td>Document event</td>
<td></td>
<td>In the field, the Operator or Maintenance personnel will note the issue on the Defect Card in the pouch.</td>
</tr>
<tr>
<td>Appendices A: Existing Operational Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maintenance will document the issue in their Maintenance management system.</td>
</tr>
</tbody>
</table>

March 19, 2013
Scenario: Planning / Scheduling

Resources Involved:
WHERE (WHO)

Tools/Systems Utilized:
VENDOR (Applications)

Scenario Description:
This scenario involves the use of archived real-time operational data to support service planning functions including scheduling and schedule adjustments, performance monitoring, ridership analysis, and other tactical and long-range planning functions. These planning activities utilize data collected onboard vehicles as well as CAD data as part of a “feedback” process that supports continual system improvement and adaptation to changing circumstances. The planning function also supports preemptive preparation for emergency and incident scenario response, such as bus bridging.

WHERE   WHO   INPUT   PROCESS   OUTPUT   Comments
---   ---   ---   ---   ---   ---

Start

Real time CAD data is “cleaned”, matched to schedules

Planning uses data collected on the vehicle to run Performance Summaries

Existing data is used by various other departments (Managers, TIC, etc.) for reporting, analysis, and other various means

Planning generates Trip Stop Summary (Ridership Reports) & Run Trip Analysis

Daily/Weekly Schedule adjustment

New schedules are loaded into the Enterprise Tables and uploaded onto the BDS cards

End

The Planning department generally focuses on how to improve performance. They currently use multiple programs to accomplish this.

One of the largest concerns for the Planning department is to maintain the current reliability and types of data that are currently being captured.

Data collected includes:
- Door Opens
- Door Closes
- APC Data (17% of fleet equipped)

Resources Involved:
WHERE (WHO)

Tools/Systems Utilized:
VENDOR (Applications)
APPENDIX B

MAPPING ENTERPRISE GOALS TO KEY CAPABILITIES
Appendix B: Mapping of Workshop Needs to Goals

March 19, 2013

AC Transit Goals to Activity Mapping

Enterprise Goal

Provide an integrated service and fleet management system that advances AC Transit staff and customers’ ability to make safer, more reliable, and more timely transit service decisions

Entity Has Part

Enterprise Goal 1. Better service management

Entity Has Part

Enterprise Goal 2. Better fleet performance

Entity Has Part

Enterprise Goal 3. Better customer experience

Entity Has Part

Enterprise Goal 4. Better operational plans and schedules

Capability

Improved service monitoring

Capability

Improved service regulation

Capability

Improved asset maintenance

Capability

Improved asset management

Capability

Improved accuracy, quality, and timeliness of information to the traveling public

Capability

Improved analysis of historic service data

Concept Activity

1. Capture internal and external system information

Concept Activity

2. Integrate information on-board and at the central system

Concept Activity

3. Distribute information between the on-board, central, and external nodes

Concept Activity

4. Support and maintain the new system
Appendix B: Mapping of Workshop Needs to Goals

March 19, 2013

Better Fleet Management

Enterprise Goal
2. Better fleet management

Enterprise Goal
Better full lifecycle management of assets

Capability
Support a migration strategy that will maintain FTA requirements

Requires
Support for iPad, phones, etc.

Enterprise Goal
Better procurement strategy

Capability
Ability to track new moving and fixed assets into the system

Requires
Train staff using the system

Enterprise Goal
Better systems administration

Capability
Secure remote maintenance login

Requires
Train staff using the system

Enterprise Goal
Better training of operational staff

Capability
Trainers and trainees can access a training version of the system

Requires
Trainers and trainees can securely login to the training version

Enterprise Goal
Better maintenance of vehicles

Capability
Know when to carry out scheduled maintenance

Requires
Provide reporting tools

Enterprise Goal
Better maintenance of fixed assets

Capability
Know when to carry out preventative maintenance

Requires
Provide reporting tools

Enterprise Goal
Better maintenance of on board vehicle systems

Capability
Know when to carry out unplanned maintenance

Requires
Provide reporting tools

Enterprise Goal
Better maintenance of non vehicle systems

Capability
Provide reporting tools

Enterprise Goal
Better monitoring of assets

Capability
Track asset data

Requires
Provide reporting tools

Enterprise Goal
Better monitoring of vehicles

Capability
Track asset data

Requires
Provide reporting tools

Enterprise Goal
Better monitoring of fixed assets

Capability
Track asset data

Requires
Provide reporting tools

Enterprise Goal
Better systems administration

Capability
Access to historic maintenance data

Requires
Provide reporting tools

Enterprise Goal
Better training of operational staff

Capability
Access to current service data

Requires
Provide reporting tools

Enterprise Goal
Better monitoring of assets

Capability
Provide reporting tools

Requires
Provide reporting tools

Capability
Set filters on the reporting tools

Requires
Provide reporting tools

Metric
More accurate reports

Requires
Provide reporting tools

Capability
Diagnostics to identify and troubleshoot issues

Requires
Provide reporting tools

Metric
More accurate reports

Requires
Provide reporting tools
Appendix B: Mapping of Workshop Needs to Goals

March 19, 2013

Better Customer Information

Enterprise Goal
3. Better customer information

Capability
- Remotely update on-board customer information screens
  - Requires
  - Customer access to Wi-Fi internet on-board
    - Requirements
    - Encryption/security
    - Cost to customer
  - Capability
    - Controller can turn on or off the AVA remotely
  - Requires
  - Operator control of the AVA
    - Metrics
    - Volume control
    - Message delivery types
  - Requires
  - Data bandwidth per customer
  - Encryption/security
  - Cost to customer
  - Requires
  - Easy, intuitive

Enterprise Goal
- Better on-vehicle information
  - Requires
  - Operator control of the AVA
    - Metric
    - Volume control
    - Message delivery types
  - Requires
  - Add/remove messages and instructions from central system
    - Requires
    - Remote access to the messaging service in the central system
  - Requires
  - Provide customer information from the central system to vehicles
  - Requires
  - Provide customer information from the central system to outside world
    - Requires
    - Easy, intuitive
    - In-house developed, supported, owned
  - Requires
  - Cost to customer
    - Requirements
    - Encryption/security
    - Cost to customer
  - Requires
  - Provide real-time information to call-center
    - Requires
    - Provide real-time information to 511 instead of NextBus
  - Requires
  - Provide real-time information to website, developer data feed, etc.
  - Requires
  - Provide stop arrival prediction
    - Requires
    - Provide information to 511 instead of NextBus

Metric
- Easy, intuitive