The Connected Bus Project

A Partnership of Cisco and the City and County of San Francisco

Written specifically for
Connected Urban Development Global Conference 2008

Authors

Peter Albert, Deputy Director of Planning
Kylie Grenier, IT Program Manager
San Francisco Municipal Transportation Agency

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Background

The San Francisco Municipal Transportation Agency (SFMTA) moves about 700,000 riders a day on its Muni system. The system consists of buses, light rail vehicles, cable cars, and street cars. Maintaining and operating this fleet efficiently requires innovative use of technology. The various systems used to monitor vehicle health, real-time location, fare collection, mileage, and other operating data are not integrated, which hampers the efficiency and reliability of the system. All of these systems require a separate central processing unit (CPU) and wireless transmission antenna to collect and transmit data from the vehicle to a computer at the Division Garage.

Currently, Muni has CPUs and antennas installed or planned as described:

- Automatic Vehicle Location Global Positioning (AVL/GPS): This antenna receives GPS data from the GPS satellite for the passenger information system.
- Automatic Vehicle Location Cellular Transmission: This antenna transmits GPS data and receives configuration data for the passenger information system.
- Digital Voice Announcement System (DVAS): This antenna receives GPS data from a second GPS satellite for on-board digital voice announcements of stop locations.
- 400MHz Radio: This antenna transmits and receives information from the operator radio to the Operations Control Central. The same need will exist for the planned 800Mhz upgrade.
- Fleetwatch: This antenna transmits mileage data from the vehicle to the maintenance system to calculate preventive maintenance cycles.

- TransLink® Regional Fare Collection System: This antenna transmits and receives fare data and rider smart card information from the central fare collection system.
- Automatic Passenger Counter (APC): This antenna transmits passenger load information from the vehicle to the central passenger counting system.
- Vehicle Health Monitor (VHM): This antenna transmits engine and transmission data to a central maintenance system to alert mechanics to potential mechanical problems.
- Closed Circuit TV Cameras (CCTV): Muni plans to transmit real-time video from the vehicle to a central operations location for safety and security monitoring.
- Farebox: Muni plans to transmit farebox data from the vehicle to the central farebox system for cash fares.
- Signal Priority: Muni and the Department of Parking and Traffic (DPT) plan to transmit data from the vehicle to the traffic signal controller to enable prioritization for transit vehicles.
- Operator Training: Muni plans to transmit data from an inertia device on vehicles to the central training system for operating performance monitoring.

In addition, new systems are being planned on a regular basis to keep pace with the changes in technology meant to reduce emissions and enhance the rider experience.

Justification for the Connected Bus Project On-board Integration Device

1. Compliance with FTA standards:

Since April 2005, the **Federal Transit Administration (FTA)** has required that all transit agencies using federal funds for Intelligent Transportation Systems (ITS) projects comply with national standards that support regional and national interoperability. Muni looks to create a single on-board device to comply with these standards that will:

- Enable vendors to connect to one standard device, exclusive of vehicle manufacturer, for both bus and rail.
- Increase the chances that each device will operate effectively because there will be fewer on-board devices and points of failure.
- Enable on-board integration of systems such as APC and Transit Signal Priority to ensure that priority is given based on vehicle load to create a smarter vehicle.
- Create one device that needs to be upgraded as technology changes over the 12- to 25-year life span of the transit vehicle, rather than replacing multiple on-board components.

2. Reduction of Emissions

An improved, more reliable Muni system results in lower emissions as more drivers turn to transit and as the vehicles themselves run more efficiently. Emission reduction factors fall into four categories:

- Reduced Dwell Time: Dwell time is the amount of time that a transit vehicle remains idling at a stop while passengers board, make inquiries of the operator, pay fares, and exit the vehicle.
- Timely Maintenance: Transit vehicles in good repair produce fewer emissions. They stay in good repair through a rigorous preventive maintenance program geared to each specific vehicle manufacturer.
- Efficient On-street Operation: Efficient operation of the vehicle at the individual operator level will reduce emissions, as will efficient management of vehicles on each line of service.
- Enhanced Rider Experience: San Francisco is a "Transit First" city, and promotes Muni to lure drivers onto transit and out of emission-producing cars. Real-time information and enhanced safety and security make transit a more attractive option.

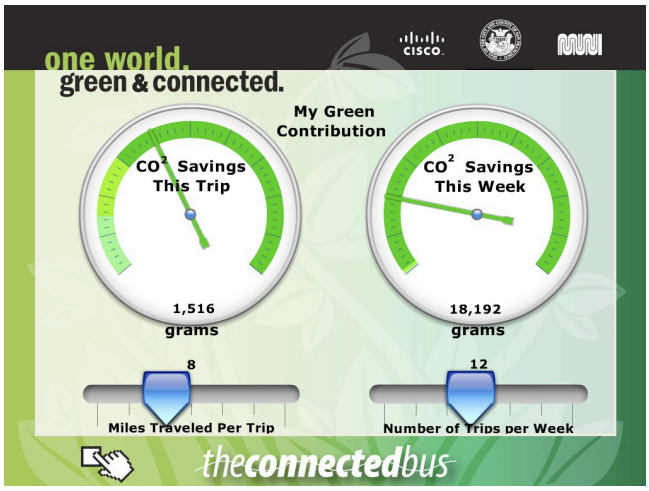
3. Improved Muni Reliability

In 1999, San Francisco voters approved **Proposition E**, which mandated the implementation of service standards intended to advance Muni's operating efficiency and effectiveness. This is supported by the **SFMTA Strategic Plan**, which focuses on the following:

- Customer focus
- System performance
- Community relations
- Financial capacity
- Workforce
- Information technology

Consistent with Prop E standards and the Strategic Plan, the **Transit Effectiveness Project (TEP)** was developed to review, evaluate, and make recommendations on the existing Muni system. A primary goal of the TEP is making Muni service more reliable. Reliability is measured by the following criteria:

- Schedule accuracy
- Operator availability
- Vehicle reliability
- Supervisorial coverage
- Congestion management



The Connected Bus on-board integration device addresses all five criteria. For example, it helps improve **schedule accuracy** by linking GPS to APC. It addresses **operator availability** by using AVL to manage headways that are impacted by missed runs. It increases **vehicle reliability** in tracking vehicle health and integrating the reporting-out data to better inform fleet deployment. It gives the **on-street supervisor** the technology to better cover the system through NextMuni AVL/GPS data, vehicle health monitoring data, APC, and other critical, real-time information. **Congestion management** is improved through the integration of signal timing, cameras, and other traffic-monitoring devices.

Who Benefits from The Connected Bus On-board Integrated Device?

This project capitalizes on the opportunity to marry the environmental benefits of transit with the technology to improve service reliability. It includes a marketing plan to showcase the innovative use of technology in San Francisco, where environmentalism and technology are particularly important.

This project benefits a variety of people with different "mindsets," including:

Frequent Muni Customer: Frustrated by unreliability, uncertainty in making connections, overcrowded conditions, and a feeling of being an environmental "martyr." This customer benefits from:

- More accessible passenger information through prominent display of on-bus, real-time information, including status of connecting lines at key transfer points, allowing riders to reliably reach their destinations.
- Improved passenger comfort through integration of real-time arrival information and passenger counts to help fleet managers ensure adequate capacity to address loading conditions and bus-to-bus transfers.
- Demonstration of environmental benefits of the project by a strong marketing plan to reassure customers of the "green-ness" of this project, in addition to operational benefits.

- Accessible, high-profile information as an innovation that integrates the project into fuller, measurable lifestyle benefits, including enhanced ability to plan transit trips while at home or in the office, or in connecting errands and leisure activities to commute trips.

New/First-time Muni Customer: Would ride Muni if comfortable that it was reliable and informative—objectives that can be reached through technological innovation that would include a "green" process:

- High-profile marketing of "fun" programs that include on-board interaction with real-time data display, etc.
- High-profile marketing of "green" programs that increase the reward for new riders who have switched from driving by offering data counts of environmental benefit per rider, and so forth.
- Online trackability of new, integrated data that allows potential riders to follow select routes on the network, inviting them to switch to transit with greater assurance.

Muni Operators and Fleet Managers: The lack of rich, integrated data limits the ability to use status of transfer lines, loading conditions, bus operating conditions, traffic conditions, and radio messages more efficiently, compounding job stress with customer dissatisfaction.

- Tighten and enrich communication between operator and Operations Control Center by introducing integrated information such as crowding conditions on subject bus and connecting buses, status of equipment, and traffic conditions to better access response.
- Relieve burden of information sharing between driver and customer through real-time display of key data—approaching destinations, transfer points, and arrival times of connecting buses are all immediately evident to customers.
- Improve fleet deployment and operating decisions by combining data on transfer volumes, TransLink usage, passenger loads that provide essential information for making short- and long-term service change decisions, on service frequencies, and schedules.

Non-Muni Rider: Not a Muni rider, yet depends upon improved Muni service for traffic/lifestyle reasons.

- New, publicly accessible data linkages that offer innovative lifestyle benefits such as a parent tracking a child's use of Muni by employing a mobile device and following a trip connection in real time, or a hotel concierge directing visitors to destinations with greater confidence.
- Promotion of "green" innovations to inspire broad popular support. Building a base that includes even passive beneficiaries is important to winning future support for further development/funding of project expansion.

All of the above benefits are consistent with the overall goals for The Connected Bus project: to promote the use of Muni and its positive impact on the environment through the innovation of integrated data that makes the Muni experience and system management more reliable, efficient, and safe.

Strategy

The strategy to achieve these objectives involves engineering the integration of the 12 different central processing units and/or antennas to interrelate the data that each system creates and manages, and then to make this data accessible to two different audiences: 1) the full array of data to Muni Operations Control Center, and 2) a more select realm of data to the general public. Finally, the data being made available to the general public should be managed in a marketing campaign that includes equipment and media for disseminating data (such as touch-screens on buses, online monitoring programs, bus wraps, voice announcements, and controlling user access to ensure privacy when warranted). Ultimately, the demonstration project should be designed to support broader installation in the Muni fleet beyond this pilot application. To confirm this, SFMTA proposes to conduct a post-demonstration cost-benefit and operational evaluation on the outcome of this pilot project, and possible inclusion in the Short-Range Transit Plan as a future fleet development program.

Content Overview

Cisco will integrate multiple communications systems currently on city public transportation vehicles (buses, light rail vehicles, cable cars, and street cars) into one another and into a central operations system that can add value by relating one system to another. This includes:

- Creating a working model of The Connected Bus and its interface to the urban context—e.g., operations center, bus stop, or traffic lights—and reinserting into San Francisco's public transportation fleet.
- Developing a business case for carbon emission reduction, operational costs, and customer satisfaction.
- Generating a Connected Bus vision and thought leadership.
- Participating in the February 2008 CUD Global Conference in San Francisco.

SFMTA will provide:

- One hybrid electric bus
- Installation support
- Engineering support
- Quality assurance testing in the real environment
- Project management resources

List of Physical Modifications Expected

Modifications will be expected on the inside of the bus to support The Connected Bus design, including a Mobile Access Router (MAR), personal computers, touch-screen monitors, "green gauge" digital displays, and software content. The exterior of The Connected Bus will be wrapped to promote the "green" message for the program.

Success Criteria

- Improved customer experience for public transportation users
- Increased use of public transportation
- Reduced environmental footprint for San Francisco
- Integration of public transportation resources
- Clear leverage of best practices in all related core areas
- Incorporation of industry standards developed by others
- Presenting pilot project material with meaningful content
- Able to feed solid content into the CUD program
- Citizen and civil society engagement
- Media exposure and increased awareness of the project
- Transferable from demonstration pilot to project that could be installed throughout Muni fleet, funding permitting

Deliverables

- Connected Bus system architecture
- Three use cases: real-time integration for connection times, "go green" interactive messaging, and mobile Internet access for passengers to stay connected
- Value case model to demonstrate the economic and carbon reduction benefits of The Connected Bus
- Functional Connected Bus demonstration explaining how the technology benefits passengers, transit operators, and bus maintainers
- Objectively measured assessment of operator-focused benefits of data integration (post-demonstration)
- Customer surveys measuring degree of support for integrated data accessible to public (post-demonstration)
- Post-demonstration evaluation of the project in view of a system-wide installation, justified by operational and customer-response benefits of the project

- Pending completion of this post-demonstration evaluation, inclusion of broader installation across Muni fleet in Short-Range Transit Plan and Capital Investment Program

Milestones

Connected Bus milestones include:

- Commitment from all parties by September 17, 2007
- Use cases and storyboard delivery by November 1, 2007
- Connected Bus demonstration by Mayor Newsom and John Chambers at CUD Global Conference, February 20–21, 2008

Call to Action

The Connected Bus will be showcased at Connected Urban Development Global Conference 2008 in February. The wrapped bus will provide a rolling message and increase anticipation for The Connected Bus. Muni riders will benefit from the experience of The Connected Bus, particularly with knowledge of when connections are to be had, and the ability to demonstrate the benefits to Muni riders, operators, and to the environment.

Distribution and Communications Plan

The Connected Bus will be presented at the first CUD Global Conference in San Francisco in February 2008, co-hosted by Cisco Chairman and CEO John Chambers and San Francisco Mayor Gavin Newsom. The "wrapped" Connected Bus will be showcased as part of this conference.

Media coverage of the global forum as well as the effects of The Connected Bus will be initiated through press conferences, information on the SFMTA Website and on "NextMuni," as well as on screens available in The Connected Bus. The wrap configuration of the subject bus will provide a rolling branding of The Connected Bus.

Integration of The Connected Bus into service will enable Muni riders to benefit from the experience of interaction with real-time data display, status of connecting lines at key transfer points, and online with "NextMuni."

Metrics

Success of this initiative will be ascertained from customer satisfaction, increased ridership and a related decrease in greenhouse gas emissions, response to real-time arrival and transfer information, adjustments due to passenger counts and real-time traffic information, facility of project installation across the fleet beyond the demonstration project, and reception of "green" innovation to build popular support.