SR 22-002
Attachment 2

IT Major Projects and Strategic Plan Annual Report 2022

Department of Innovation and Technology

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Introduction

This document provides detailed information about the numerous projects and accomplishments of the Innovation and Technology Department (IT Department) for AC Transit. The Department has completed year 1 of the IT Strategic Plan by implementing the IT Strategy Framework, guiding principles, as well as strategic pillars. The following sections highlight the continued commitment by the IT Department to achieve the District's mission and strategic initiatives.

IT Strategic Plan

IT Strategy Framework

The IT Strategic Plan is comprised of an IT strategy framework, guiding principles, strategic pillars, and IT Initiatives. The IT strategic pillars of Data, Security, Resiliency, Collaboration, Customer Focus, Efficiency, High-Performance Workforce, and Innovation were vital in allocating resources and setting project priorities during year 2 of the IT Strategic Plan (FY 2021/2022).

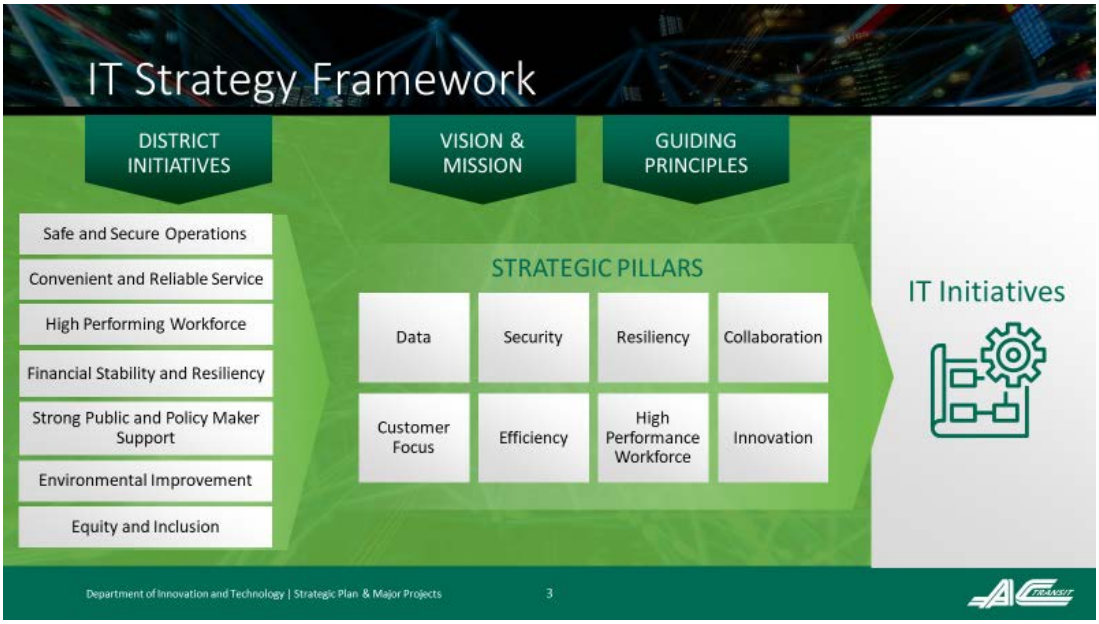

Diagram 1.0

IT Guiding Principles and Strategic Pillars

The IT Strategic Framework includes both guiding principles and strategic pillars for the IT Department to reference when prioritizing projects and resources leading up to a budget submittal. For example, a new project not included in the adopted District budget and that does meet one or more of the strategic pillars, would be tabled. The following guiding principles are integral to the IT Department discussions regarding existing or new department activities and helps that priority and resource decision making. Moreover, these guiding principles are also referenced in the IT Project Management Office methodology now under development (see IT PMO pg. 9).

IT Guiding Principles

These guiding principles were helpful when reviewing existing projects especially if the purpose of the project had multiple objectives.

	IT Guiding Principles	Outcomes ***" Does the project or resources ……***
✓	**Transforming Transit**	*improve the transit rider experience"*
✓	**Innovation**	*drive business advantage through the application of improved or innovative technologies"*
✓	**Data-Driven Enterprise**	*empower decision-makers with accurate, reliable, and accessible data for company-wide decision making"*
✓	**Cloud-First**	*realize Cloud solutions over on-premises IT solutions"*
✓	**Enterprise**	*implement solutions that benefit the entire District"*
✓	**Enhance>Buy>Build**	*leverage existing assets and systems being utilized, before building custom solutions or procuring an external solution"*
✓	**Security and Cybersecurity**	*secure the District's by protecting the confidentiality, integrity and, availability of data and systems"*
✓	**One IT**	*shared vision and foster a culture of respect and professionalism"*
✓	**Productivity**	*increase the production of quality work that maximizes the return on investment"*
✓	**Simplicity**	*focus on solutions that minimize complexity and avoid costly customization*

Diagram 2.0

The IT Strategic Planning Process is comprised of Guiding Principles and Strategic Pillars, proved invaluable while prioritizing projects and when assigning IT Department resources, the past year. Here is a diagram of that planning process.

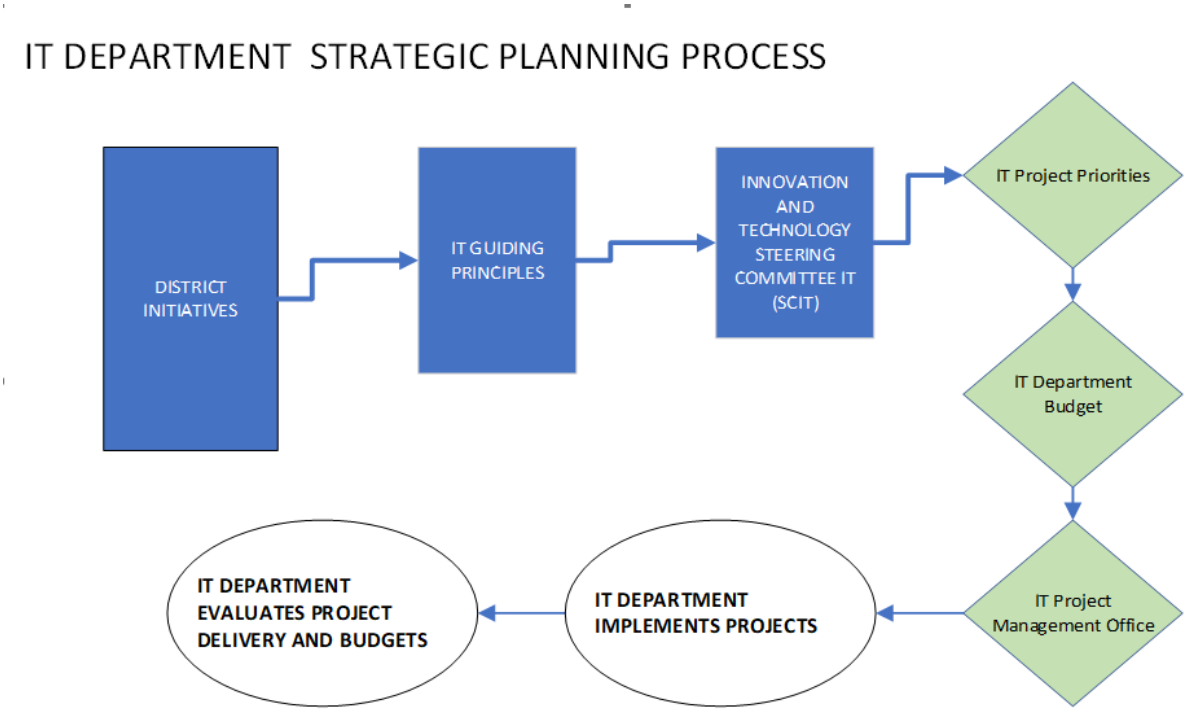

Diagram 3.0

Annual IT Diagnostic Survey

In early 2021, an IT Diagnostic Survey was conducted by a third-party company, InfoTech Research Group, an independent IT research and advisory firm, using industry benchmarks, guidelines, and tools. The primary purpose of this diagnostic was to gauge the effectiveness and alignment of IT initiatives with the overall District goals and objectives. The Survey included customer satisfaction measurement, asked for customer feedback, and performed qualitative and quantitative performance analysis. Annual measurement of the business stakeholder satisfaction enables the Department to take a step back from day-to-day operations and look at the big picture. Understanding key stakeholder satisfaction with IT assists in reshaping the strategy. The Diagnostic Report:

1. Measures Business Stakeholder Satisfaction
2. Highlights the Business Impact of IT Constraints
3. Helps to Prioritize Key Issues and Create an Improvement Roadmap
4. Identifies an Action Plan to Manage Critical Stakeholders

Enabling the District with reliable, secure, cost-effective, and innovative technology solutions and satisfying stakeholders is the mission of the IT department. The purpose of this annual diagnostic survey is to collect and present stakeholder feedback.

Survey Results

Diagram 4.1

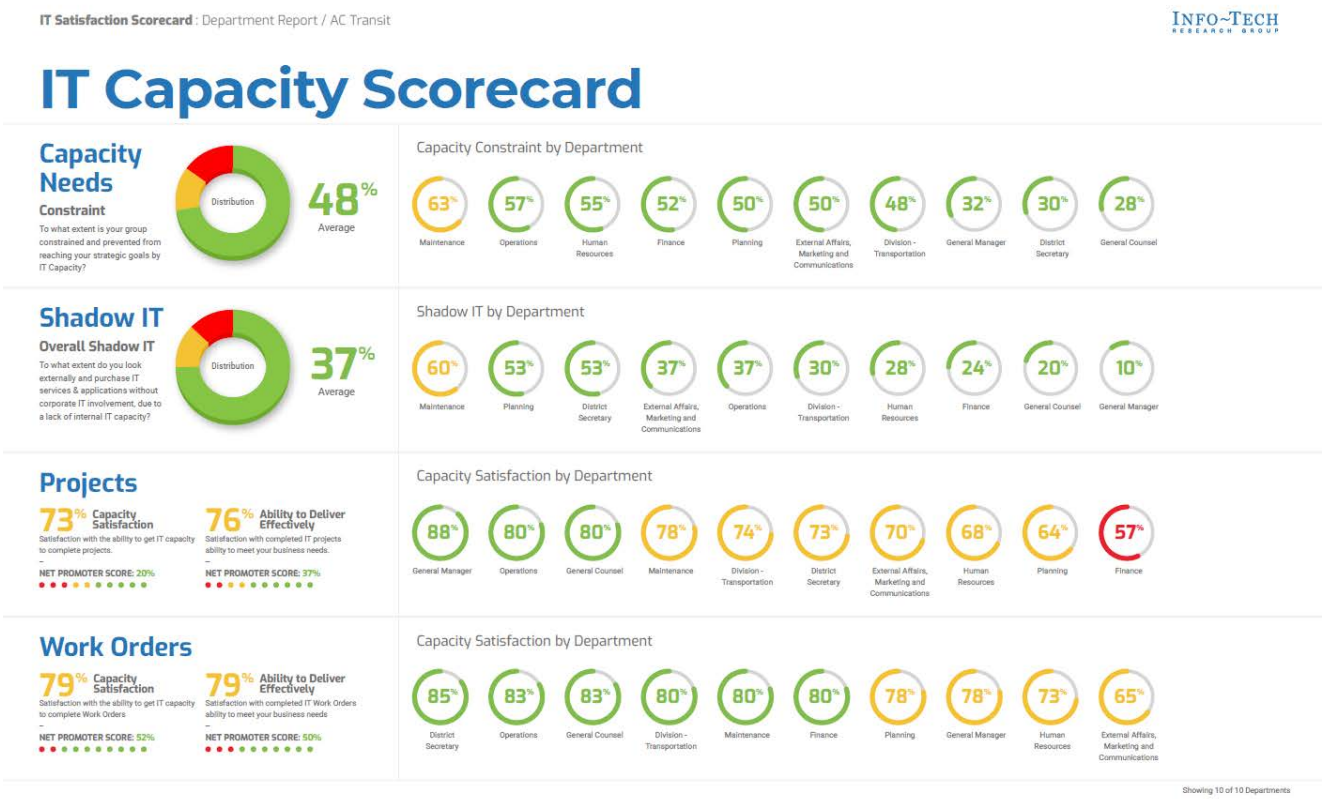

Diagram 4.2

This scorecard is the first step in the stakeholder management process. It helps IT connect with individual stakeholders to understand their needs, ensuring ongoing communication, ways to improve services delivery, and build transparency.

The major findings of this annual diagnostic results are as follows:

Benchmarks	Results	Industry Average
IT Satisfaction	80%	5% above industry average
IT Value	78%	4% above industry average
IT Staff	1.8% as % of Users	2.9% below industry average
IT Budget	3.1% as % of Revenue	1.4% below industry average

Diagram 4.3

Diagram 4.4

Here are some of the quotes and feedback from key stakeholders:

"IT has been incredibly flexible with our ever-evolving learning management system. Training calls upon staff often as some reports do not perform in the manner they were originally designed. IT is always accepting of the challenge to improve the inquiry processes."

"I would like to see a quicker response time or a better line of communication."

"The biggest opportunity is to be transparent about the library of applications available to employees. Employees need to know what tools are available to help make their work more efficient. It would be neat if the IT department could issue an email each week highlighting the features and the availability of an application in the library. It would also be good to provide employees with more training and education information so they can help themselves."

"The main thing is to think about how a hybrid workforce will be accommodated when we return to the office. Will new conference rooms be needed and how will hybrid meetings be accommodated in the conference rooms. How will staff be able to communicate both in person from their desks as well as with staff working from home and how do they do that without bothering all of their in-office neighbors."

"Over the last 12+ months, the IT Department have responded very well to the evolving priorities and needs of the District. As we move post-pandemic, the workforce set-up and environments inevitably shift to a more remote workspace for most of non-frontline employees. Conducting an IT assessment focused on this particular area would be ideal."

IT Major Projects and Initiatives

The IT Major Projects and Initiatives were determined based on the IT Strategic Planning process outlined above as well as compliance with one or more strategic pillars (Diagram 1.0). This report provides the details of accomplishments from October 2020 through December 2021 by the Innovation and Technology Department.

COVID 19 Response

The IT Department continues to respond to the District's needs during the COVID 19 crisis. This includes the flexibility to respond to changing return to work states, urgent work from home needs and the work-from-home infrastructure such as software, Zoom and remote meeting capability and cloud-based security measures.

During the onset of the COVID-19 emergency, IT Staff built an IT infrastructure that allowed District staff to work from home. The computer network and data circuits resulted in improved high-speed and reliable connectivity to Azure Cloud and our cloud-based datacenters continue to function as designed. The team increased the District Internet bandwidth at the GO by a factor of four to avoid any performance degradation.

The IT Staff also migrated agency user data from on-premises to Cloud-based storage; this enables users to access data securely from anywhere and any device. To continue improving our operation resiliency, the Staff set up a portion of our IT infrastructure in a Tier-1 private Data Center in Oakland. This Data Center will provide high-speed data connectivity between the District, the Public Cloud, our Disaster Recovery site, and the CAD/AVL system and improve business continuity.

Cybersecurity

Cybersecurity initiatives and prevention have particular importance to the District and businesses worldwide. Cybersecurity is a business risk and requires ongoing education and user training. While the District has made progress in building a Cybersecurity practice, the threat landscape is continuously evolving due to rapid technological changes.

A comprehensive cybersecurity roadmap was completed and includes cybersecurity assessments, security awareness and training, and application security improvements.

Cybersecurity Accomplishments

- Simplified and secured access to District Apps by Integrating and Centralizing Identity and Access Management to over 60% of Cloud-based District applications
- Improved security for remote users by enforcing Geo-fencing
- Deployed endpoint detection and response technology to endpoints (remote systems and servers) with next-generation protection

- Deployed advanced security email gateway to protect against advanced email attacks such as Malware, Phishing, BEC, Spoofing, and other
- Enhanced login security by extending Multi-Factor-Authentication (MFA)
- Launched cybersecurity video channel for the District Users, which features short video tutorials to educate users on various security technology
- Payment Card Industry compliance and certification for Tempo stations and Customer Service Center
- Completed Incident Response Exercise with Norwich University of Research Institute
- The District is now 100% compliant with new Email security standards and protocols to prevent spoofing of District emails
- Built vulnerability-driven cyber security maturity model for measuring critical risks
- Automated physical security badge access for lateral movement
- Developed new Password guidelines and Standard Operating Procedures to enhance and simplify password security
- Deploying self-service password tools to allow users to change, reset passwords, or unlock their accounts
- Built resilience in the District's Firewall Infrastructure

Data Governance Program

The District's Data Governance program oversees data management activities to ensure that policies and data ownership are enforced in the organization. The emphasis is on formalizing data management functions along with associated data ownership roles and responsibilities.

The District's Data Governance Plan was developed in FY 2020-21 following completion of a data gaps analysis in FY 2019-20. The Data Governance project implementation is also based on the IT Strategic Plan and alignment with the District Strategic Goals. Data is one of the eight (8) IT strategic pillars that ensure data-driven decision-making.

This crucial strategic pillar is comprised of three parts: Collect, Organize, and Analyze. A key role of the IT Department is to collect and organize data from all available data sources so that real-time, daily, and monthly reporting can be provided without compromising quality, security, and reliability for various District business units and programs. In addition, the IT Department staff ensure that the District's complex technologies work together for data management, backups, retention, recovery, and security and that data confidentiality and sensitive data remain secure.

Similarly, a common Enterprise Business Intelligence platform provides tools to analyze, integrate, and visualize data for business units and programs. A District-wide or 'enterprise' Business Intelligence platform has expanded the number of Power BI Pro users from twenty (20) to seventy (70). A survey of the AC Transit organization informed the content of the Data Governance Plan, whose goals, organization structure, and committee structure were established in large part based on that input. The Data Governance Committee and working groups started meeting monthly in FY 2020-21, emphasizing all Departments' collaborating.

TEMPO IT Systems and Fiber Optic Network Infrastructure.

The mission-critical communications systems were installed, tested, and accepted as part of the Tempo Bus Rapid Transit (BRT) project. This infrastructure requires 24/7 fiber network monitoring, maintenance, and support. The first operational year of the Tempo BRT line relying on the fiber optic communication network has affirmed the network design and reliability. On-going issues related to operations and

maintenance are being addressed in coordination with city and state partners and the IT Department's Cloud Manager and staff.

The IT department's network engineering and project management experts played a crucial role in completing the communication systems, network infrastructure, and rider-facing technologies on the Tempo Bus Rapid Transit corridor. The in-house expertise and support required to monitor and manage the complex communications systems is an example of the IT Department's staff commitment to the District's mission.

Management of the BRT Lane Enforcement of Tempo bus lanes is also supported by the network and communications team. This team completed the Tempo San Leandro Southern Layover technology infrastructure installation as well.

Project Management Office

An Innovations and Technology Project Management Office (ITPMO) has been created to provide structure and governance to projects that require department resources. This project management office is comprised of a team of three (3) IT Staff. The IT PMO is now establishing the methods, templates, and diagrams to:

- Manage project scope, design, development, testing, and acceptance, for new and existing projects
- Create and Manage a Digital Dashboard for management of Department project budget, resource allocation, project status and track department-wide priorities
- Provide data analytics and improved project tracking for continued improvements

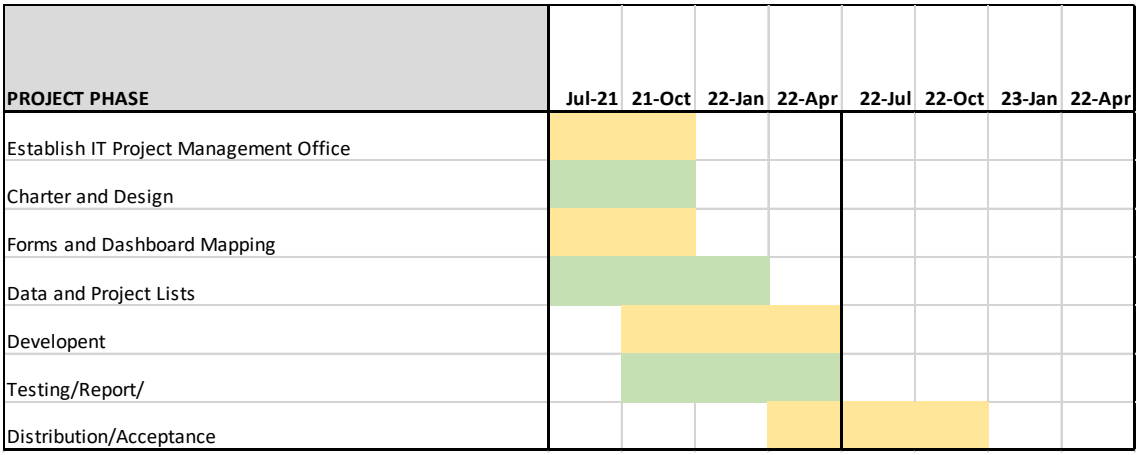

Diagram 7

Clever Devices and Computer-Aided Dispatching Systems

Phase I of the Clever Devices Computer Aided Dispatch and Automated Vehicle Location (CAD/AVL) project has been closed. The District has entered Phase II of a contract with Clever Devices that includes:

- Deployment of Secure Bus Technology (SBT)
- Continuous improvement in the performance of the voice communication system
- Integration with Badge ID system for seamless operator logon,
- Enhanced data collection capabilities

The Secure Bus Technology (SBT) guarantees only authorized employees (Bus Operators, maintenance staff) can operate a bus to help ensure the safety of employees, passengers, and the public. Now that the Hastus Daily software project was completed in October 2021, the data exchange interface between Hastus scheduling software and the Clever Devices system can move forward. In order to work correctly, the Clever Devices system will validate the accuracy of employee information from both Hastus and PeopleSoft Software applications. Only after the successful validation [of employee identification] will the bus be enabled for safe vehicle operation.

The newly deployed Disruption Management feature allows Controllers to make changes in real-time to scheduled bus routes assigned to Bus Operators and bus coaches due to disruptions such as detours and accidents. Staff is now looking at how this feature can best support supplementary service changes that occur after the Bus Operator sign-up has been completed.

Accomplishments

- Initiated tracking and managing of the 'tickets' requesting assistance from Clever Devices via their Help Desk Portal
- Participated in 3 'shadowing' training sessions for importing Hastus scheduling data into the CAD/AVL system where AC Transit subject matter experts and IT staff observed key data cleaning and data quality process
- Identified the roles and responsibilities for the enterprise quarterly Bus Operator sign-up and the 'service delivery' data processes

Asset Management System (Ellipse and WorkLog)

AC Transit's mobile asset management web app (WorkLog) supports maintenance staff with daily tracking work in the field. Bus stop teams use a built-in work order system to manage bus stop changes, while other departments use Work Log to report bus stop issues. New upgrades inform maintenance staff about facility repair work requests from all staff. All of this is connected directly to our primary asset management system. New features are being added to track daily work performed by platform and IT staff to meet the FTA requirement for our TEMPO line and platforms. Checklists and multi-team workflows will enable the many needs of our mobile staff, including analytics for reporting.

Ellipse Cycle Count Process

The IT Department is working with the Materials Department in automating the supplemental stock take process that is currently being completed and maintained outside of Ellipse and bring it into Ellipse using the Ellipse native cycle count business process. In addition, COSOL North America (AddOns) guides AC Transit on using Ellipse Cycle Count data to develop custom reports using the existing Enterprise Database & Enterprise Business Intelligence System. This is a more efficient and cost-effective inventory counting process. Adoption and training are underway.

Ellipse Warranty Recovery Implementation Project

The Warranty Recovery Project was implemented in 2020 to move AC Transit from a legacy Access Database to the Ellipse Warranty Recovery Module. The Implementation project accomplished 1) automation of manual Warranty Recovery processes 2) elimination of all paper-based warranty processes 3) provide the ability to document additional Warranty Recovery Types that were not tracked 4) clearly define Warranty Recovery roles and responsibilities for repeatability, sustainability, and scalability. Additionally, warranty Legacy data has been migrated to the new module.

PeopleSoft HR and Financial Modules

PeopleSoft HR and Financial software continue to evolve and improve as the requirements for timekeeping, purchasing, HR, and employee information continue to grow. To improve the decision-making process, IT will continue to advance the Enterprise Resource Planning system, PeopleSoft. In addition, to decentralize, automate, and control purchasing, IT plans to partner with the procurement department to implement the PeopleSoft e-procurement module.

The key accomplishments this past year include:

- Successfully implementing the mobile-friendly Peoplesoft Supplier Contracts and Strategic Sourcing module to manage procurement contracts. These modules will better track contract records, associated spending, responsible parties, and timelines for renewal. The new Modules also provide straightforward navigation, data search capabilities, and extensive information access for core users and vendors.
- Prepared PeopleSoft System for the Hastus Daily transition from legacy HP 3000 Operator Time Keeping System
- Integration with the emergency notification system called Everbridge
- Automated data integration between PeopleSoft and a new drug and alcohol tracking system
- Upgraded maintenance staff timekeeping system
- Automated integration between PeopleSoft System and Bank Technology
- Integration of inventory items with PeopleSoft General Ledger
- Automated bank statement upload in PeopleSoft

Hastus Daily Software

Hastus Daily software module was launched company-wide on October 17, 2021. Bus Operator pay is calculated in PeopleSoft based on information from Hastus software application instead of the District's legacy Operator Timekeeping System (OTS). The Hastus Integration Operations Project (HIOPS) was completed over seven-years and cost $3.17 M of District operating funds. The IT Department was integral to each phase of the project by supporting over 24 software releases and three computing server environments while supporting user workstations and data accuracy and reporting capabilities.

The implementation of Hastus Daily is the last phase of the HIOPS project that followed improvements to the network infrastructure, other Hastus scheduling modules, and BID and BIDWeb modules. Specific

business practices in the Transportation, Finance, Leave Management, and IT Departments were impacted. The HIOPS project has entered the closure phase that includes a project budget review and completion of project closure documentation.

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The Final Months - A steering committee supported the Hastus Daily project, a project core team, and a team specifically assigned to testing and accepting the Payroll data interface. These teams included GIRO experts and in-house subject matter experts from IT, Payroll, HR, Project Controls, Transportation, and Project Management.

Representatives from the ATU Local 192 were critical to configuring and testing the software, final acceptance, and go-live at all bus divisions. At bus division 4, OTS and Hastus Daily were operated in parallel to compare paid time, and to thoroughly test Daily.

Training on the Hastus Daily was a significant effort prior to October's launch. Training shall continue as new staff is assigned. The following chart shows the number of training hours provided, by position, to prepare the division staff for using Hastus Daily and retiring the OTS

Total Hastus Training Hours by Position

Dispatchers and Timekeepers	2,088
75 Supervision	70
Division Management (Spts & TOMs)	14
Sr. Clerks	4
GO Office (Drug & Alcohol, Leave Management, Legal)	5
Trans. Director	1
Asst. Trans. Director	1
Total	2,183

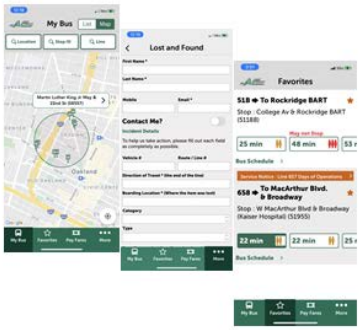
- 170 Total Hastus user accounts
- Testing of all interfaces completed over 16 months
- Over 120 business test cases
- Employee information and current leave management status is updated each day
- Over 125 Virtual desktop connections created for new Hastus users

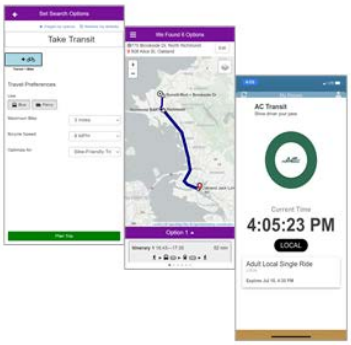
Restroom Finder App

During the pandemic, to meet OSHA regulations and because restroom closures were common, the administration features in the application received a significant upgrade. For example, Transportation Supervisors can manually input new restrooms or update the status of existing restrooms inside the application. These updates are then reviewed and updated in a central restroom database. In addition, Daily Feedback Reports were expanded to include issue tracking data to improve the accuracy of restroom availability for staff. The Restroom vendor's contact management module also received an upgrade.

AC Transit Official Mobile App

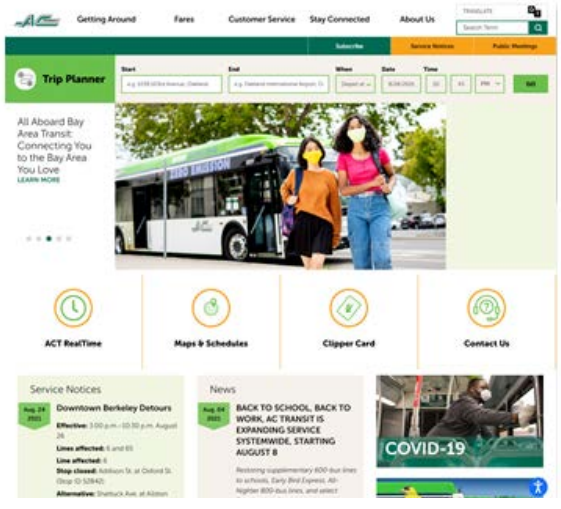
- "AC Transit Official" is our first mobility app found in Apple and Android app stores.
- The rider (customer) can now view bus line information and a bus stop locator.
- Get real-time arrival predictions with service notifications and rider capacity indicators.
- Pay fares in advance with links to the Token Transit app.
- Connect with customer service inside the app.
- Development of Innovative Regional Trip Planner and integrated with AC Transit.org website
- Multi-lingual availability.
- Push notifications for emergency alerts.

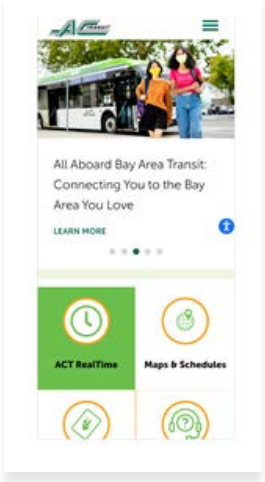




AC Transit Website

AC Transit launched a revamped website with an innovative regional trip planner. In addition, Staff continues to improve the AC Transit Website with: 1) real-time information; 2) Maps and Schedules; 3)Ward map improvements; and 4) the online map, including better accuracy and a more streamlined notification system.





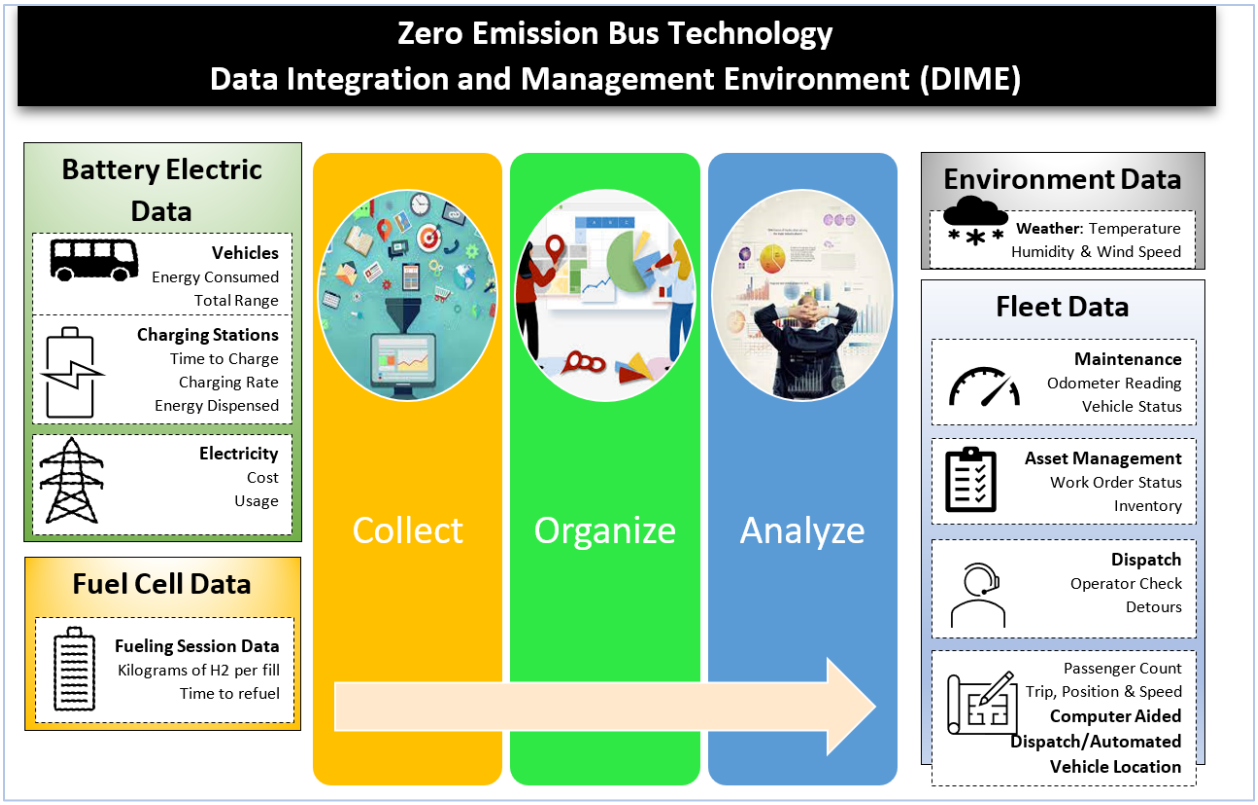
Passenger Load Information (PLI)

Allows real-time passenger occupancy rate notifications to the public to make informed decisions about which coaches to board. The successful pilot was completed for the BRT Tempo line (27 coaches). Phase II of the project will include the procurement of Automatic Passenger Counter smart sensors and analytic software. This project is connected to many technologies, including 1) installing automatic passenger counters on all buses; 2) real-time indicators on the website, mobile app, and third parties' apps via GTFS-RT; and 3) historical PLI information for static schedules and timetables. Improvements to PLI accuracy are on-going.

Zero Emission Bus Data Integration and Management Environment (DIME)

On June 23, the District published the Zero Emission Transit Bus Technology Analysis (ZETBTA) a comprehensive analysis that compares conventional fleets to battery electric bus (BEB) and fuel cell electric bus (FCEB) technologies. The analysis is the first-ever true, side-by-side evaluation of Zero Emission Bus (ZEB) technologies operated by the same agency, in the same service environment, with ZEBs from the same bus manufacturer and compared to conventional fleets. In addition, to support ZEB program growth and expansion, the District is investing in implementing secure and scalable IT infrastructure for ZEB communication, security, and data management.

For the District's ZEB program, the plan is to leverage the Data Integration and Management Environment (DIME), including data collection automation, data ingestion, real-time data ingestion, data processing, data warehouse design, integration, reporting, and analytics. Data originating from various systems, including vehicles, charging stations, utility usage, fuel stations, maintenance applications, financial systems, and other sources, will be collected and stored into this new data platform resulting in intelligent analysis. The DIME will be used for day-to-day operation and maintenance purposes, as well as for route planning and energy utilization analysis. In addition, it will capture the battery state of charge/health, equipment status, meter readings, fuel/energy usage, trip events, and more. The DIME will analyze planned trips, vehicle and yard needs, grid costs, load forecasting, battery aging, and more. Data quality ensures metrics are processed and reported accurately within Power BI and KPIs.



IT Department Customer Service

The District has identified IT Support (Help Desk) as one of the top 3 areas of importance. The IT Support Team has made continually improvements in service and support. As we continue to deploy laptops [as needed for remote Staff and new hires], we have also optimized our remote support capabilities. The IT department desk phones are now accessible from District laptops via Softphone technology allowing the IT Support team to answer Help Desk calls remotely.

The District's Software Deployment System has been optimized to push or pull software installation and upgrades on-demand even over the Internet if connected via Virtual Private Network (VPN) technology.

A central management console is managing thin Client devices used for Ellipse and some virtual desktop access. This console was migrated to the Cloud, allowing us to manage and support these devices remotely and efficiently.

The ever-growing Apple device presence within the District, both MacBook and Mac workstations, are now centrally managed to ensure software deployment ease and security requirements.

To help protect District Staff and Resources, Next Generation End Point Protection was deployed to District devices. Cybersecurity Awareness has been improved by migrating the District's Cybersecurity Awareness Training to a new platform, expanding our cybersecurity curricula, and ensuring Administrative Regulation (AR) 440B compliance. Multi-Factor Authentication (MFA) was rolled out, and training was provided to District Staff.

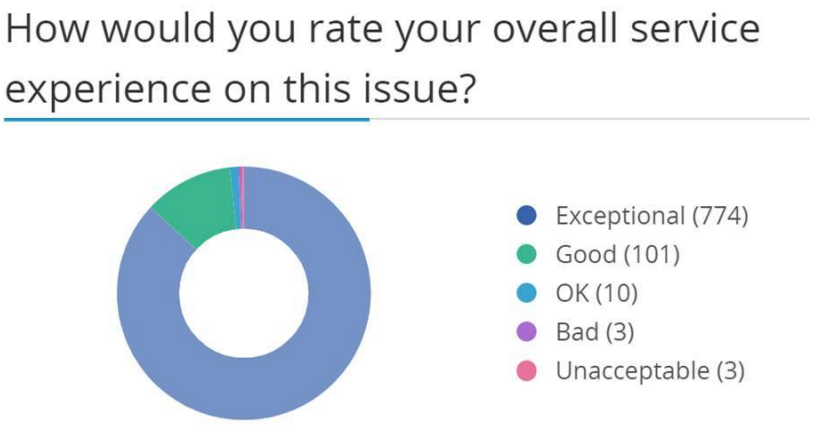
Even before the pandemic, collaboration tools were limited. Collaboration and communication needs were expanded and optimized, allowing District staff and the public to communicate and meet virtually.

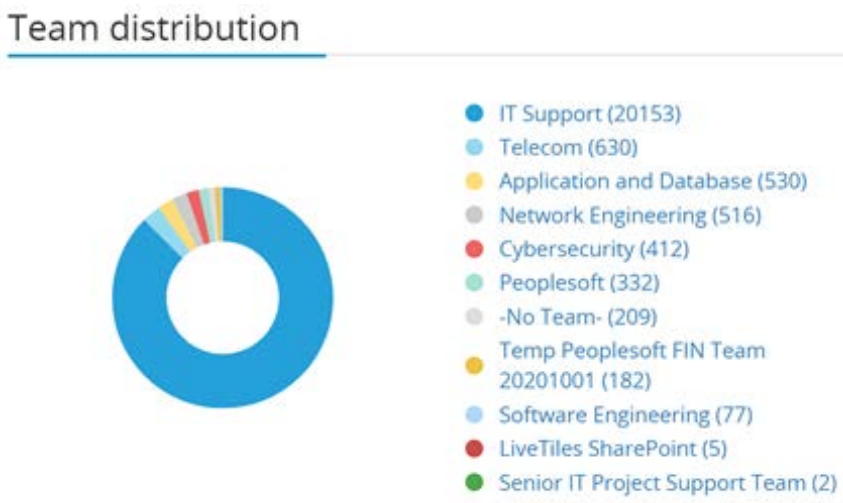
Microsoft Teams was standardized for internal District meetings. Zoom was expanded, and webinar capabilities were implemented to interact with ridership while maintaining safe social distancing.

To foster IT service quality, IT Service Management Metrics have been implemented and optimized. The Service Category designations are being overhauled to allow for better reporting and clarity. First Contact Resolution Statistics have been established to show when requests have been resolved during the first contact with the IT Department. Satisfaction Survey metrics have been enhanced to provide qualitative as well as quantitative measurements.

Of the 22534 Satisfaction Surveys that were sent, 4% of staff responded. 98% of those surveys were rated "Good" or higher for overall service experience. In the last 12 months, 24,696 tickets were created, with an average of 1900 tickets a month. Over the last 12 months, we double the number of tickets over the previous 12 months.

The First Contact Resolution Rate (FCR) is 92.8%. FCR is calculated by the rate of tickets resolved by IT without an update or response from the requester before being closed.





Accomplishments

- Expanded Zoom licensing and Webinar capabilities
- Established Virtual Emergency Operations environment
- Implemented Virtual Desktop Infrastructure (VDI)
- Optimized System Center Configuration Manager (SCCM) for workstation software deployment
- Deployed MyE911 and Jabber Softphone application to District Laptops
- Collaborated and coordinated technology workstation transition to remodeled Customer Service Center (CSC)

Everbridge Emergency Operations Center

Emergency Operations Center communications system known as Everbridge went live in January 2021, with the launch of a new Emergency Alert System for all District employees. A District employee, who neither has a District Device nor District Email address, can now register for important AC Transit Notifications to be sent to their personal mobile phone or email. The new Everbridge Emergency Alert System will help keep AC Transit Employees informed about major occurrences, critical incidents, or disruptions. To get Emergency Alert notifications, employees must opt-in by providing a personal Phone Number or personal email address via PeopleSoft.

In the event that mass emergency communication is necessary, registered employees will automatically receive a call or text from Everbridge # 89361 or an email from AC Transit ALERT nonreply@everbridge.net

Business Intelligence and Reporting

AC Transit Business Intelligence (ACBI) aims to provide interactive visualizations and business intelligence capabilities with a user interface simple enough for AC Transit Staff to create reports and dashboards. AC BI is a business analytics service by Microsoft known as *PowerBI*. This capability is being developed in-house on several sample projects envisioned to be launched in Q1 2022.

Network Infrastructure

The Network Engineers worked to complete several initiatives during this reporting period. These projects included Facilities and Innovation Technology infrastructure upgrades and enhancements which improved or implemented redundancy, resiliency and addressed security vulnerabilities.

The Heating, Ventilation, and Air Control (HVAC) control and management systems at the General Office were upgraded with the latest version of HVAC control software. This new software added additional functionality and corrected several software issues.

Staff inventoried all infrastructure technology assets and updated the TAM database. New technology purchased and implemented during the last year was added to the inventory.

The Active Directory infrastructure that controls authentication for all users and systems was upgraded to version 2016. This upgrade addressed many security vulnerabilities and added several security enhancements to the overall authentication infrastructure.

Security in the General Office elevators was enhanced when staff installed and configured new security cameras. In addition, video recorded in the elevators is stored on a video server for a minimum of 30 days to provide for incident management.

A new wireless network management system was installed and configured to allow troubleshooting of wireless network issues. In the event of a wireless network problem, Nyansa contains tools to diagnose and quickly remedy wireless technology performance or configuration problems. In addition, this technology provides network analytics and reports to track network performance.

If a disaster takes down all voice communications, the TeamSpeak satellite communications systems provide reliable voice and text communications between the Divisions and General Office using satellite Internet. The system hardware and software were upgraded to continue to provide reliable emergency communications.

A new rest stop for our operators was installed at Point Richmond. Network infrastructure was installed at the location to provide secure badge access for our operators.

The engineers upgraded our enterprise server and storage infrastructure with a hybrid technology solution. This hybrid model includes new on-premises servers and Microsoft cloud-based Azure technology. To add additional resiliency, a new datacenter was configured within our infrastructure. High-speed data links were installed to provide reliable communication between our datacenters.

A new datacenter was setup at Digital Realty in Oakland. Digital Realty provides Express Route connectivity directly to Microsoft Azure. High-speed connectivity between our General Office and Microsoft Azure was setup using this technology. New servers were installed to provide an additional layer of network resiliency.

The existing end-of-life Cisco UCS server and Pure storage technology was replaced with new hyperconvergence server technology. These new high-speed servers combined compute, storage, and network technology in one platform. VMware is used as the hypervisor technology to host our virtual servers. 30% of the existing virtual servers were migrated to this new infrastructure. Servers that need to be locally installed are hosted on our VXRail technology. Our Cisco phone system servers were migrated to this new technology. VXRail servers were installed at our General Office, NTT Sacramento, and Oakland Digital Realty Datacenters.

A new 1Gbps data circuit from the General Office to Digital Realty was installed to provide high-speed connectivity to our server infrastructure in Azure.

Azure VMware Services (AVS) was setup to host 70% of our migrated virtual servers in Microsoft Azure. AVS provides reliable and resilient virtual machine technology within Microsoft Azure for a manageable fixed cost. This technology contains all the features and options available within VMware and is integrated with our new on-premises VXRail server technology. This new hybrid model provides reliability, resiliency, and survivability.

The Telecommunications team completed several projects to upgrade and enhance our communications technology. District cell phone users received a new iPhone XR. This new technology provides cell phone enhancements while reducing our overall telecommunications costs.

The end-of-life Wi-Fi systems on our Transbay buses were upgraded with new higher speed routers. These new routers provide our users with better high-speed Wi-Fi service on our buses.

The legacy AT&T Primary Rate ISDN (PRI) phone trunks at General Office and divisions were replaced with new AT&T IP Flex SIP trunks. These new redundant SIP phone trunks provide reliable local and long-distance phone service with higher reliability, redundancy, and trunk capacity.

The team rolled out new FirstNet Emergency Push to Talk XP8 phone for our Operations Control Center and Transportation Supervision teams. This new phone technology consolidated tablet, LMR radio, and cell phone technology into one device.

Clipper 2

The IT Department represents the District in support of the Metropolitan Transportation Commission's Clipper 2 project. As part of that project, AC Transit shall receive updated Clipper 2 devices on both the bus coach rolling stock and on the Tempo BRT platforms. MTC supports an executive steering committee and a working group attended by the District's Chief Technology Officer and Project Manager. For the past twelve (12) months, those groups have been working to secure delivery of the test hardware from Cubic for both the coach and BRT platform Clipper units. The Clipper equipment has been negatively impacted by delays due to COVID and is currently expected in February 2022 so that initial installation and testing can begin.

Clipper 2 Accomplishments

- Clipper Customer Service Center RFP awarded
- Published Clipper Mobile application
- Provided comments on Cubic Final Design Review (FDR) for Clipper 2 system
- Witnessed Clipper 2 bus coach system testing

Applications and Database Management Projects

During Pandemic IT Department developed MTC COVID19 Reports and automated the Data Collection from all the requested sources. Data Quality is critical to the district. Staff validated and automated all the District Key Performance Indicator and data collection processes for most Quarterly Reports, including Service Operated and Missed Trip KPIs. Post-COVID and BRT Fare Code update was completed, as well as fare structure update for TEMPO service updates. The tickets/Passes Treasury database was also updated in the district enterprise database. For the EasyPass program, LTS Calculator 2.0 was developed, including reverse geocoding improvements. EasyPass Data Model update and printing, vendor's new configuration is in progress. MTC Clipper Data Store 1 Data Collection integration completed, and Protective Service Data Collection is in progress.

Expansion and the Modernization of the Enterprise Database and Data Warehouse

New Enterprise Database and Data Warehouse environment set-up and configuration completed. Data Store and performance enhancement for Automatic Passenger Count (APC) and Stop Big Dataset completed. Role-Based Security for Databases in progress. Passenger Load Information data views and Restroom Finder reports enhancements completed. Training Application Database and Reports Enhancement completed. Genetec badge system application databases setup completed.

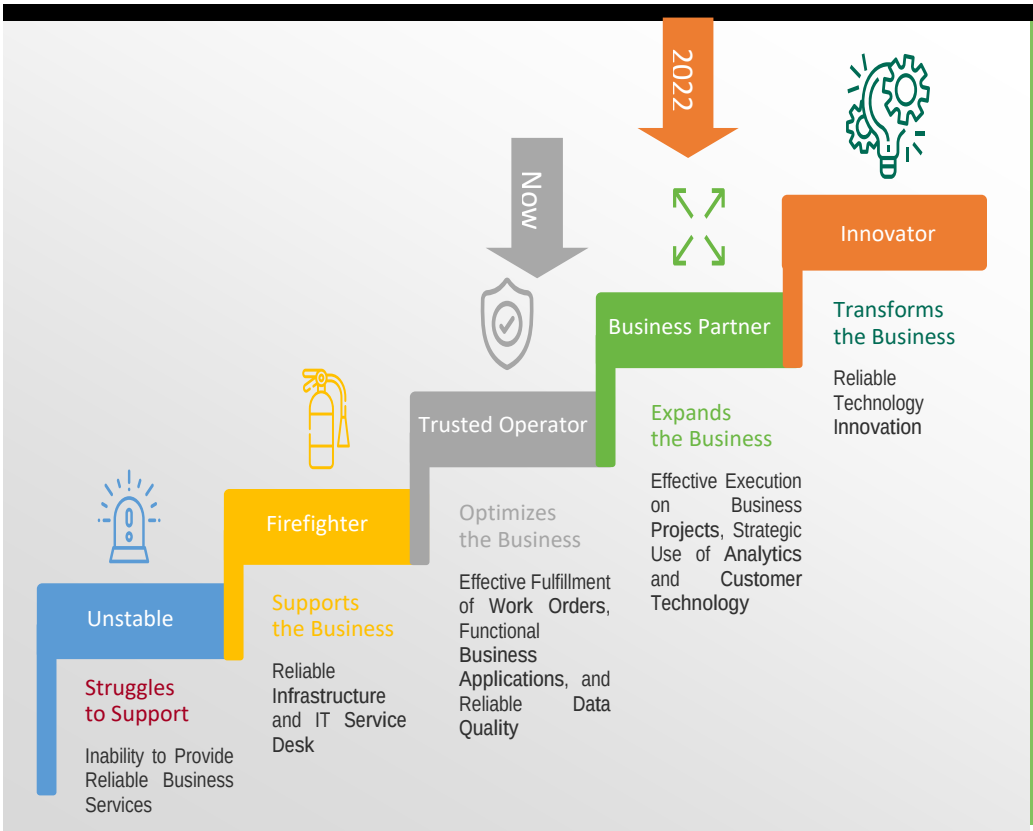
Azure Migration

Post Azure infrastructure migration, Application and Database validation and business cutover completed. Database backup process transition to Azure is in progress. Platform as a Service Azure Synapse and Cognitive Service Machine Learning is in the planning phase.

Automation of Business Process

Microsoft Power Automate implementation and retirement of InfoPath and SharePoint workflow completed. Ellipse to PeopleSoft General Ledger automated interface implementation completed. HASTUS workstation installation automation completed.

Future Roadmap



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2021 BAY AREA CIO OF THE YEAR® ORBIE® AWARDS

BAYAREACIO

The Bay Area CIO of the Year® ORBIE® Awards program honors chief information officers who have demonstrated excellence in technology leadership. Winners in the Super Global, Global, Large Enterprise, Enterprise, Large Corporate, Corporate and Public Sector categories will be announced September 24 at the virtual BayAreaCIO ORBIE Awards.

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2021 CIO OF THE YEAR

2021 CHAIR LETTER

PANDEMIC ELEVATES CIOS STRATEGIC ROLE IN 2021

Since last March Chief Information Officers everywhere have supported the largest work-from-home experiment in the history of the world. Thanks to these innovative technology leaders, most organizations have managed to continue operating through this pandemic disruption.

Technology has enabled our new virtual lives; provided access to entertainment, food, and products delivered to our homes; and connected us with colleagues, friends and loved ones. Technology has helped us adapt, adjust, and survive our new abnormal. Without the leadership, planning, and foresight of CIOs, conducting business would be impossible under these circumstances.

BayAreaCIO brings together leading CIOs of Bay Area's largest organizations to help CIOs maximize their leadership effectiveness, create value, reduce risk and share success. Through member-led, non-commercial programs, CIOs build meaningful professional relationships with colleagues facing similar challenges, solving problems and avoiding pitfalls.

Throughout this crisis, BayAreaCIO members have collaborated locally and nationally with CIOs from across industries. In any gathering of CIOs, the answer is in the room. The challenge one CIO is facing has likely been solved by another CIO. What was their experience? What did they learn? What would they do differently? How could other CIOs benefit from sharing their experiences?

There is no textbook for how to be a great CIO. The best way to sharpen your leadership acumen is to join a peer leadership network with other leaders working on solving similar challenges. The industries and size may be different, but winning approaches to effective leadership and problem solving are transferrable. Every leader's perspective is valuable and contributes to the conversation - and everyone wins when leaders engage, share ideas, experiences and best practices.

For over twenty years, InspireCIO has been inspiring CIO success through the annual CIO of the Year ORBIE Awards – but this is just the tip of the iceberg. By joining BayAreaCIO, technology executives take their leadership to the next level through year-round, member-led programs and interaction. The power of CIOs working together – across public and private business, government, education, healthcare and nonprofit organizations – creates enormous value for everyone.

Together, we are transforming our organizations with technology and enriching our region and our world. On behalf of BayAreaCIO, congratulations to the nominees and finalists on their accomplishments and thank you to the sponsors, underwriters and staff who make the ORBIE Awards possible.

Sincerely,

RALPH LOURA
2021 South Chair, BayAreaCIO
SVP, IT & CIO – Lumentum

Sincerely,

TODD WILSON
2021 North Chair, BayAreaCIO
EVP & CIO – Kids2

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AHSAN BAIG | *CIO, AC Transit*

SUCCESS STORY

AC Transit is the third-largest public bus system in California. The Service consists of more than 151 bus routes throughout a 364-square mile service area serving 1.5 million people. COVID-19 has had drastic impacts on public transit, caused significant disruptions in daily routine, and created economic hardships for many of the communities we serve. In 2020, AC Transit invested in various Innovative Technology Solutions to meet the unique challenges arising from COVID-19. In this "new normal" world, we needed to collaborate and share information with our riders and employees in real-time, improve service delivery, and maintain safe social distancing.

LISA DAVIS | *SVP & CIO, Blue Shield of California*

SUCCESS STORY

My success is directly attributed to the incredible organizations and teams I have led over my career. Through a broad range of experiences in diverse sectors, I have continued to grow and develop as a technology executive. The greatest risks I have taken in my career have ultimately led to the greatest growth, learnings, and rewards. I lead authentically, staying true to my core values and principles. I prioritize building lasting relationships with team members, peers and partners. Lastly, my success would not be possible without the love and support I receive from my husband and three children.

STEVE GALLAGHER | *CIO, Stanford University*

SUCCESS STORY

Stanford's University IT and distributed IT organizations represent one of the most vibrant and innovative technology communities in higher education. My greatest honor is to serve as Stanford's Chief Information Officer by leading university-wide technology strategy while fostering an innovative, productive, and healthy workplace culture. A diverse and inclusive environment is a better place to work and produces better outcomes for our community. To that end, I am so proud of Stanford's IDEAL IT (idealit.stanford.edu) diversity and inclusion programs that demonstrate Stanford's tradition of investing in extraordinary people in support of Stanford's unparalleled teaching, research, and healthcare mission.

BILL HUDSON | *SVP & CIO, John Muir Health Network*

SUCCESS STORY

In January 2021, JMH released digital invitations to register for one of our initial COVID-19 vaccination appointments. Within 24 hours, all digital-scheduled appointments were booked. Call centers also conducted direct outreach to high-risk community members who might not have ready access to technology. After analyzing the registration data, an unexpected disparity was identified. Patients in areas with high COVID-19 rates were not scheduling vaccinations at the same rate as other locations. In response, we created a new program to ensure greater equity and opportunities for vaccinations. It was a great success with appointments and vaccinations increasing significantly.

EDWARD KOPETSKY | *SVP & CIO, Stanford Children's Health*

SUCCESS STORY

One of my greatest accomplishments is developing strong networks and trusted partnerships. Significant patient care improvements and innovations are achieved by partnering with clinicians, researchers, vendors, and our IT team. Our Clinical Informaticists collaborate with clinicians and staff on technology enabled patient care improvements. Through trusted partnerships, numerous pediatric healthcare innovations such as continuous glucose monitoring, predictive analytics and remote fetal telesurgery are developed, deployed, and shared nationally. The Healthcare Information Management Systems Society recognized our organization as a Davies Award of Excellence recipient for improving patient outcomes through advanced use of health IT and analytics by leveraging such innovations.

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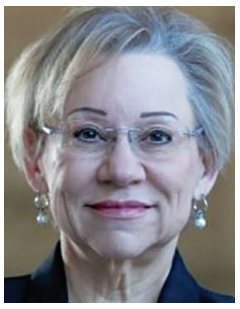

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AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

September 17, 2020

Manjit Sooch
Director of Systems and Software Development
AC Transit (Alameda Contra-Costa Transit District)
16 Franklin Street
Oakland, CA 94612

Dear Manjit,

Thank you for the time, talent, and expertise you have given to the APTAtech Virtual Conference through your planning effort and active participation. As the chair of the Research and Technology Committee you made a difference through your dedication and continued support of the conference program. You helped to provide our audience with a candid and genuine program full of value and substance.

APTA's members and transit industry stakeholders were thrilled to hear from the many industry experts on the various issues and challenges they face daily. During these challenging times of COVID-19 we have all had to make several adjustments. It was thanks to your contributions and dedication that we were able to pull off the switch to a virtual conference.

Thank you for making our first virtual APTAtech Conference a success. We look forward to working with you on next year's APTAtech Conference.

Sincerely,

Paul P. Skoutelas

Paul P. Skoutelas
President and Chief Executive Officer

1300 I Street NW
Suite 1200 East
Washington, DC 20005
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August 2021

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High-Availability Cloud Based Voice of IP Voice Communications

By Ahsan Baig, Mike Carvalho, Jim Willows, and Philip Bockrath

AI for Elderly Dietary Care: A Cyber-Physical System for Nutrition Management

By Alva Yeung and Charlie Wu

Standardization of Artificial Intelligence

By Daniel Tokody, Laszlo Ady, Dalibor Dobrilovic, Francesco Flammini, and Andrea Gaglione

Artificial Intelligence, Machine Learning & Internet of Medical Things (IoMT) for COVID-19 & Future Pandemics: An Exploratory Study

By Himanshu Sharma and Ahteshamul Haque

High-Availability Cloud based Voice of IP Voice Communications

Written by Ahsan Baig, Mike Carvalho, Jim Willows, and Philip Bockrath

In this article we describe our experience from the implementation of a high-availability multi Cloud-based VoIP system to a AC Transit, the third-largest public bus system in California. The AC Transit service area includes portions of Alameda and Contra Costa Counties, serving 13 cities and unincorporated areas from San Pablo down to South Fremont. AC Transit also provides commuter service across the Bay to San Francisco, San Mateo and Santa Clara counties. The Service consists of more than 151 bus routes throughout a 364-square mile service area serving 1.5 million people.

Real-time voice communications between Operations Control Center (OCC), Bus Operators, and Field Supervisors are critical components of maintaining service reliability and practicing safety. Historically, the voice communications at AC Transit were achieved by leveraging the traditional Land Mobile Radio (LMR) system. At the critical decision-making time, the options were to invest millions of dollars into the replacement and upgrade of the LMR system, including the long-haul communication hardware infrastructure and end-user radio equipment, or deploy the newly developed Voice Over IP (VoIP) software-based technology using the commercial cellular 5G network. As the computer industry moves towards Internet Protocol (IP) based voice connectivity, the IP protocols provide device interoperability, system reliability, spectrum efficiency, wide coverage areas at a cost-effective price. Based on extensive market research and assessment of technology maturity, AC Transit concluded that the VoIP communications option was more stable, reliable, and inexpensive than traditional analog radio communication solutions.

Network Architecture

AC Transit designed its cloud infrastructure utilizing industry best practices. The two privately-owned data center sites are set up to host the VoIP technology infrastructure for high availability and resiliency purposes, with full redundancy in connectivity and failover capability. This technology stack is the foundation of our private VoIP Cloud infrastructure. Additionally, the corporate office hosts the Radio over IP (RoIP) equipment and provides the core switch for Local Area Networks (LAN) devices. One of the Bus Division hosts the UHF Land Mobile Radio equipment, which is set up as a secondary backup. The Microsoft AZURE Cloud environment is also utilized to host the

third-party Apps for remote connectivity and emergency communications.

Scalable, secure, and resilient network infrastructure is key to the successful operation of this VoIP system. Each layer of our network technology has a precise role; system reliability, adequate bandwidth, Quality of Service, and same-day hardware and software service contracts allow for continuous, reliable operation. Each Local Area Network (LAN) provides connectivity for our servers, dispatch consoles, mobile devices, and user workstations. Multiple LANs are configured within the VoIP system, and each LAN is comprised of core switches, distribution switches, access network switches, wiring plants, and fiber optic backbones. These LANs are located at our data centers, corporate office, bus divisions, and even on our buses. Each network device must be able to provide Quality of Service (QoS) technology. QoS configurations provide traffic prioritization and resource reservation controls by elevating VoIP network traffic above all other IP based network traffic. Speed and reliability are essential to providing reliable VoIP communications. The Wide Area Network (WAN) provides connectivity between our data centers, corporate offices, and bus divisions. This high-speed backbone provides continuous, reliable communications for all our VoIP technology. This technology includes point-to-point circuits, leased ethernet circuits, point-to-point fiber optic connections, and virtual private networks (VPN) over the Internet.

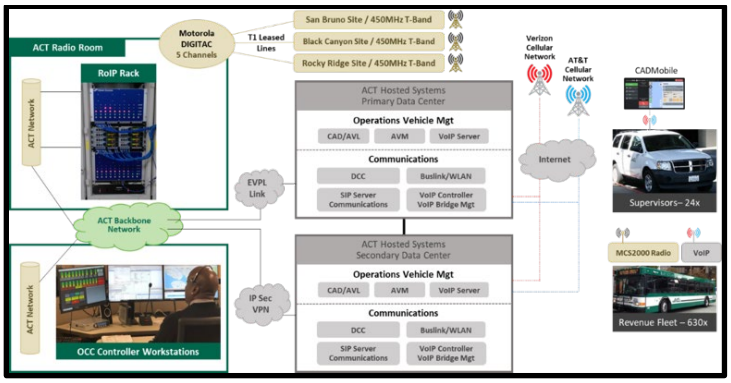


Figure 1 - AC Transit Wide Area VoIP Communications Solution

Hybrid Cloud Implementation

Hybrid Cloud setup, using Public and Private Clouds, enables resiliency and a cost-effective way of managing resources, as these are the most critical parts of our VoIP implementation. Various backup technologies and systems are in place to provide reliable operations in the event of hardware failure, network outages, or software issues. A dual data center configuration is used to provide maximum system uptime. Both data centers have all the server and network infrastructure to independently operate the VoIP system. The data centers utilize an N+2 redundancy scheme for power conditioning, power generating, UPS battery backup, and equipment cooling. The data centers are geographically located with different power grids and experience different natural disasters.

Routing Topology

AC Transit operates a highly resilient routed network consisting of an EIGRP core with OSPF

branches for vendor-neutral compatibility and several static and BGP-based networks redistributed into the core at strategically chosen points. This fully autonomous system self-corrects any single point of failure for our most critical traffic. Automatic mechanisms, such as IP Service Level Agreement (SLA) with object tracking and customized administrative distances for static routes, are employed to preconfigure the routing system for any condition and avoid the need for human interaction to correct for a link or device failure. This extends to the VoIP remote data centers, which span two geographically distinct locations and utilize dual BGP circuits that do not directly integrate into the organization's core EIGRP and OSPF protocols. Despite those technical complications, the automatic routing mechanisms in place perfectly facilitate failover of these networks from AC Transit's HQ just as easily and smoothly as the failover mechanisms built directly into EIGRP.

End to End Quality of Service (QoS)

To ensure reliable voice service even when the network is heavily saturated, the organization utilizes a single comprehensive QoS marking, queueing, and shaping policy similar to our routing policy. The tool we use to accomplish this is Differentiated Service Code Point (DSCP) tags. Initially set up and installed as part of the organization's original VoIP phone implementation more than ten years ago, the QoS marking and queueing scheme has been updated over the years as capacity improved and required throughput increased. AC Transit proudly achieves latency values of about 50ms or less for most internal voice calls and jitter less than 20ms, which is extremely adequate for high-quality voice and video calls.

We can achieve excellent voice quality in terms of latency and jitter by employing a similar policy for Quality of Service. Despite the difficulties of integrating remote data centers that utilize different routing protocols and different link technologies, AC Transit operates a single autonomous system that is highly available for all voice communications, thanks to our strict adherence to these important policies.

System Performance - Where the Rubber Meets the Road

With the design of any safety-critical communication solution, many factors come into play including security, reliability, redundancy, flexibility, scalability, and authentication. Like many other Public Transit agencies, AC Transit deals with around-the-clock incidents from mundane to life-threatening daily. Therefore, when critical events transpire, it is necessary to ensure that reliable voice communication is in place for situational awareness that can meet demand even when failures occur.

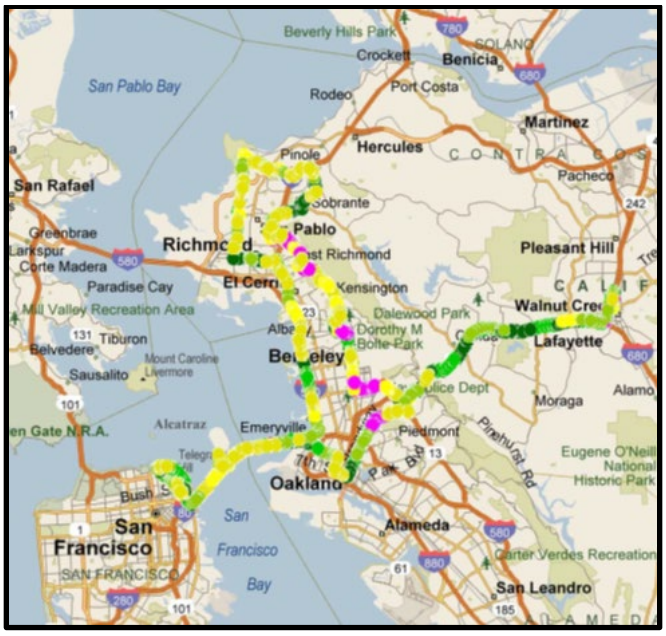


Figure 2 - AC Transit Service Area

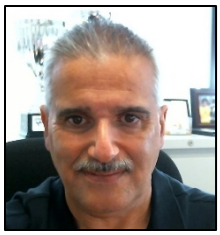
AC Transit's VoIP communication system has been in production use for almost two years. Thorough network design, implementation, and validation testing are critical in ensuring end-users experience high-reliability communications. Throughout the design, evaluation, and deployment segments of the process, all links in the network were evaluated for latency, jitter, and packet loss throughout the process. This included fixed-end networks, broadband links, and on-vehicle solutions. The AC Transit service area was evaluated using ITU G.107 standards-based testing using 0.25 mi x 0.25 mi grids. Data collected was evaluated using both spatial and temporal tools to ensure that QoS DSCP fields were adhered to for expedited forwarding of critical packet streams.

Conclusion

A multi Cloud-based VoIP implementation, based on geographically diverse data centers, provides redundancy and high availability for the network. The Quality of Service design elements and engineering the tight time-delay metrics for voice quality are obtained through detailed network traffic engineering. A unique perspective in this implementation is the complete paradigm shift for a Public Transit agency, whose focus is in providing safe and reliable mobility services, instead of spending scarce technical resources in developing and maintaining the private LMR systems.

This article was edited by Shafi Khadem

Ahsan Baig provides strategic direction, policy guidance, and responsible for overseeing and coordinating all IT investments, including innovation, digital transformation roadmap, infrastructure modernization, development of zero-emission bus energy management software platform, and implementation of an enterprise cybersecurity framework. Ahsan has over 27 years of private and public sector Information Technology experience, leading and managing high-performing teams in critical, high-visibility projects. Ahsan has extensive experience in designing, deploying and maintaining several intelligent transportation and smart transit related projects, both nationally and internationally. Ahsan earned a bachelor's degree from Pakistan; and a Master of Science in Electrical Engineering from the City College, City University of New York (CUNY).
Mr. Baig is a Chairperson of the California Transit Association IT Committee. He is an active member of IEEE, APTA, and CTA. He is a public speaker and has published research and technical papers in various journals and magazines.



Mike Carvalho is the Head of IT Infrastructure and has been at AC Transit for the last 12 years. A USAF veteran and a graduate of Southern Illinois University at Carbondale he has been designing and implementing IT technology and infrastructure for 35 years. While at AC Transit, Mike has redesigned and upgraded all the datacenter, network, wireless, server, and storage systems using reliable next generation technology hardware and software solutions.

Many of these new solutions have been implemented using cloud technologies. His unique "always live" disaster recovery and business continuity solutions have maintained reliable and redundant backup IT systems for many years. AC Transit was one the very first companies to roll out Office 365 email, implement Pure Technology SSD based storage solutions, and rollout out Clever Devices CAD/AVL and VOIP solutions on our entire bus fleet. Mike was key to finding and introducing to AC Transit these revolutionary new technologies.

Jim Willows is a lead engineer on the AC Transit network infrastructure team, where he is primarily responsible for managing routing and switching infrastructure equipment. His duties including analyzing, designing, and implementing all new network transmission solutions. He has worked on a variety of large projects, including most recently the Tempo Bus Rapid Transit (BRT) project in East Oakland, where he was a primary design architect for routed systems. Jim has a bachelor's degree in Network and Communications Management, and has held a variety of certifications including Cisco, CompTIA, and The Linux Foundation. Jim lives in Oakland, CA with his partner and their dog.

Philip Bockrath leads a group of innovative embedded systems, applications and communications engineers to create exciting next generation wireless technologies. He has spent 27 years working at Motorola, Harris and various government contractors. Philip has an extensive background in the design, development and deployment of cross platform communications using POC, MCPTT, LTE, LMR, TETRA, Cellular, DMR, point to point and point to multipoint wireless communications. Current design and project implementations allow for seamless switching of disparate voice and data communications allowing for graceful degradation in the event of catastrophic failures or circumstances.