SFMTA

Train Control Upgrade Project

SFMTA Board of Directors

Subcommittee

November 3, 2023

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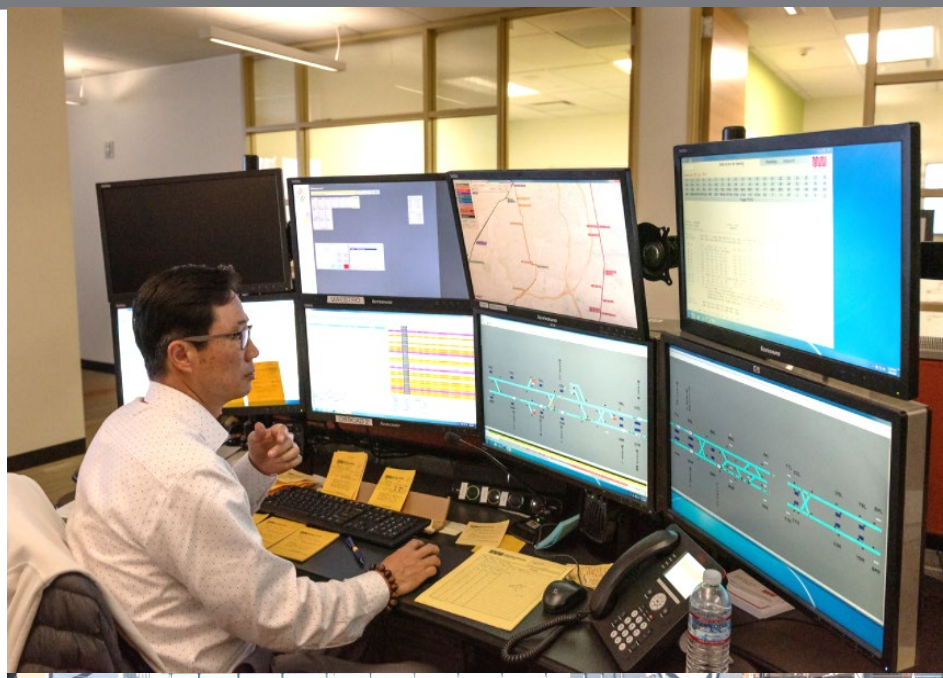
- Contracting Strategy
- Budget and Funding

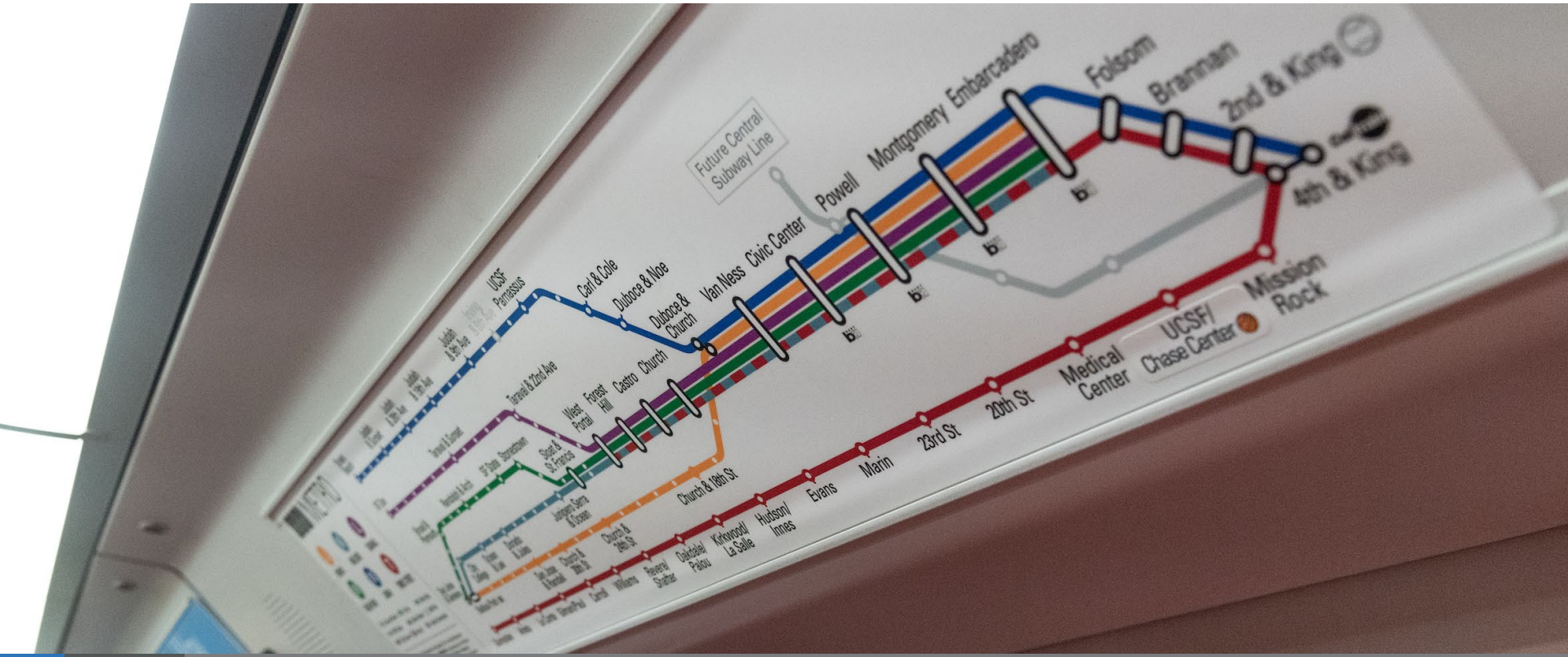


Muni Metro challenges

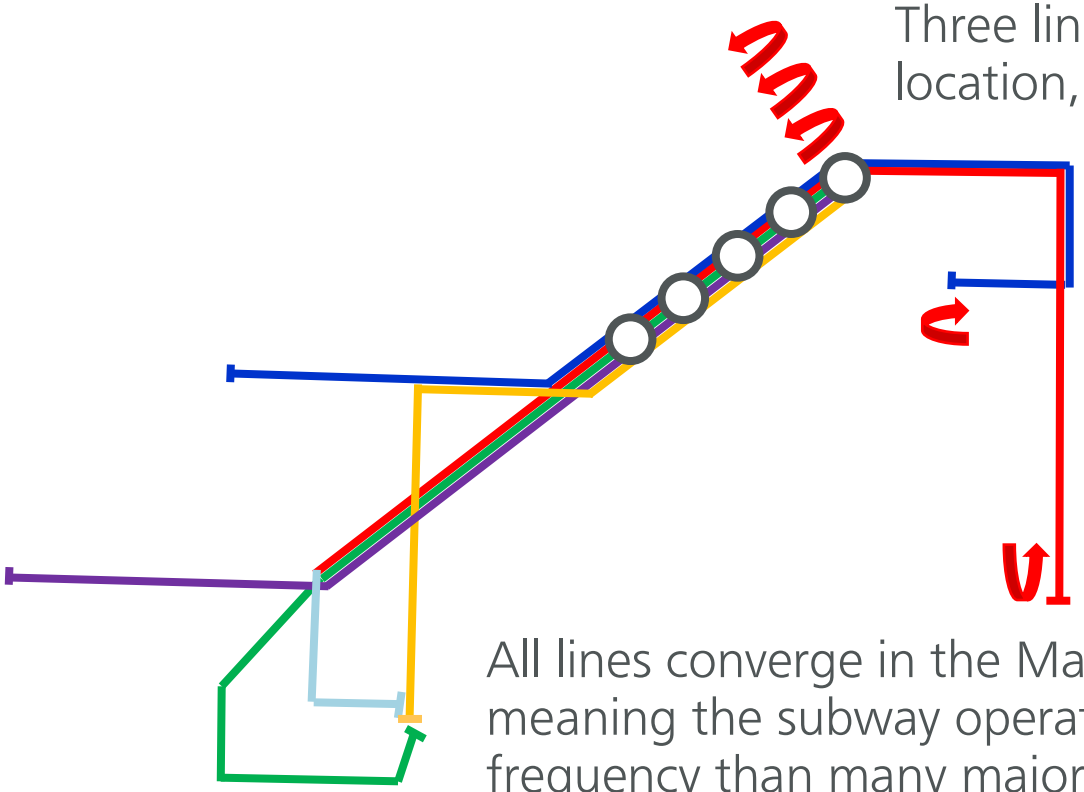
The Muni Metro subway has yet to live up to its potential. Challenges include the design of the subway and age of the current train control system.

Muni Metro structural design

Second busiest light rail in the U.S. and the last to use only one tunnel for operations. **Five lines operating mostly in one tunnel requires a high-performing system for more reliable operations.**



Muni Metro structural limitations



Three lines turning back at same location, while two more go through

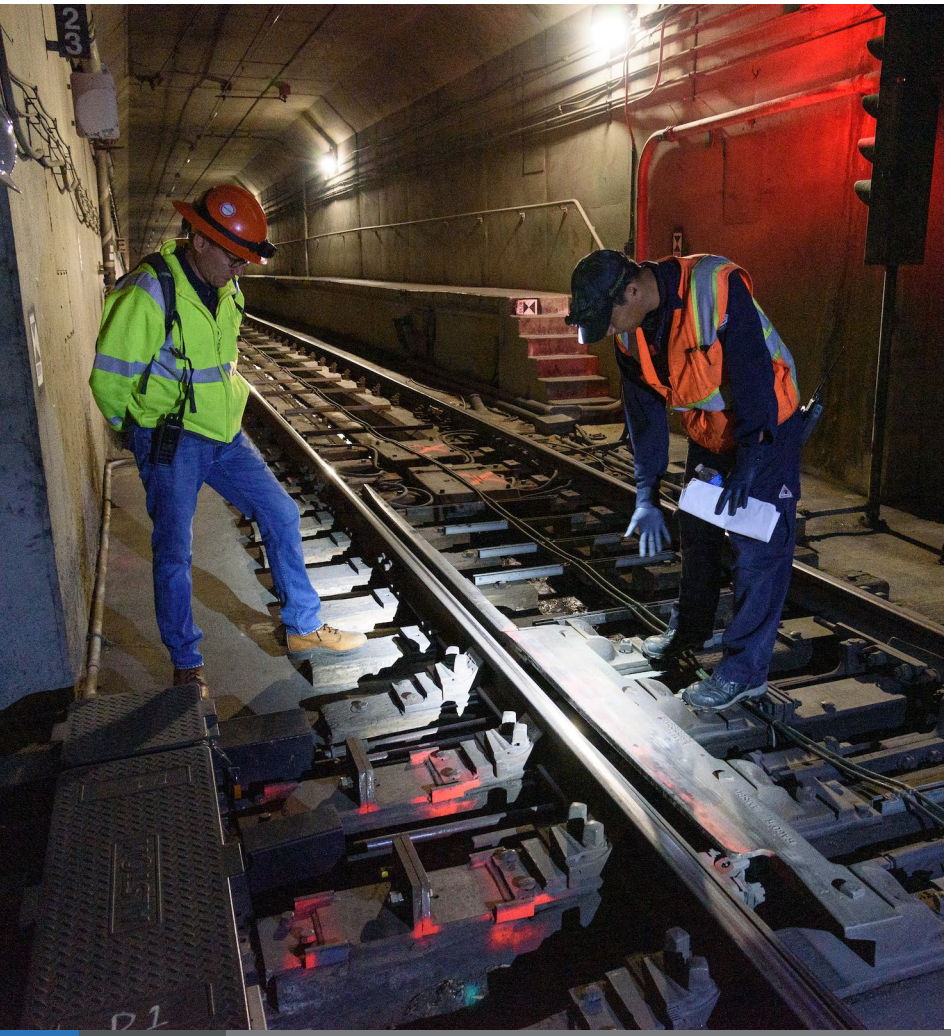
All trains require the same main line when making maneuvers.

All lines converge in the Market Street subway, meaning the subway operates at much higher frequency than many major subway systems.

Max trains on a single track per hour, peak hour

SF Muni	40
BART	22
WMATA	26

Impacts on Service



5 Metro lines in 1 tunnel causes frequent delays and congestion.

Good service requires 1- to 2-minute headways in the tunnel, or about 45 trains per hour. **This is beyond the capacity of the existing train control system.**

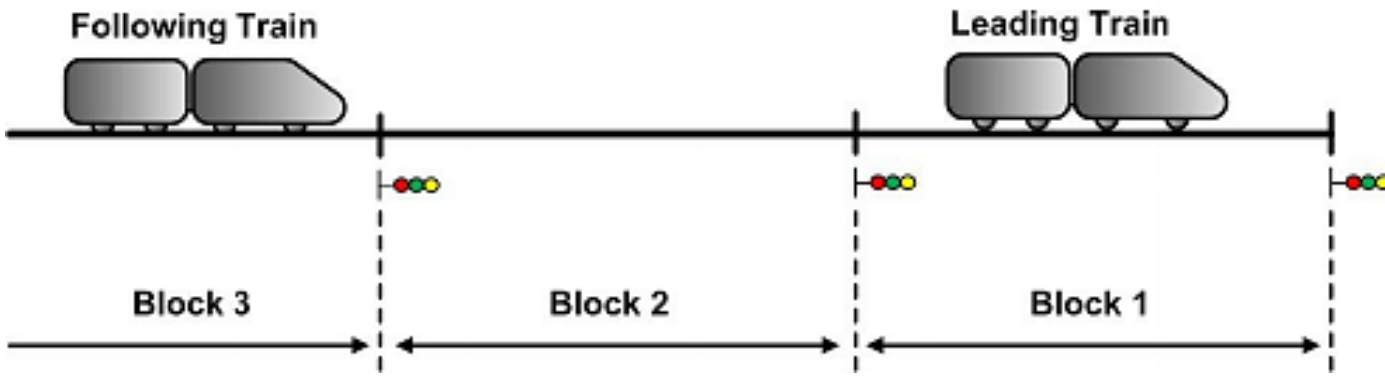
We have compensated by running a reduced service plan to reduce congestion delays.

Benefits of a modern train control system

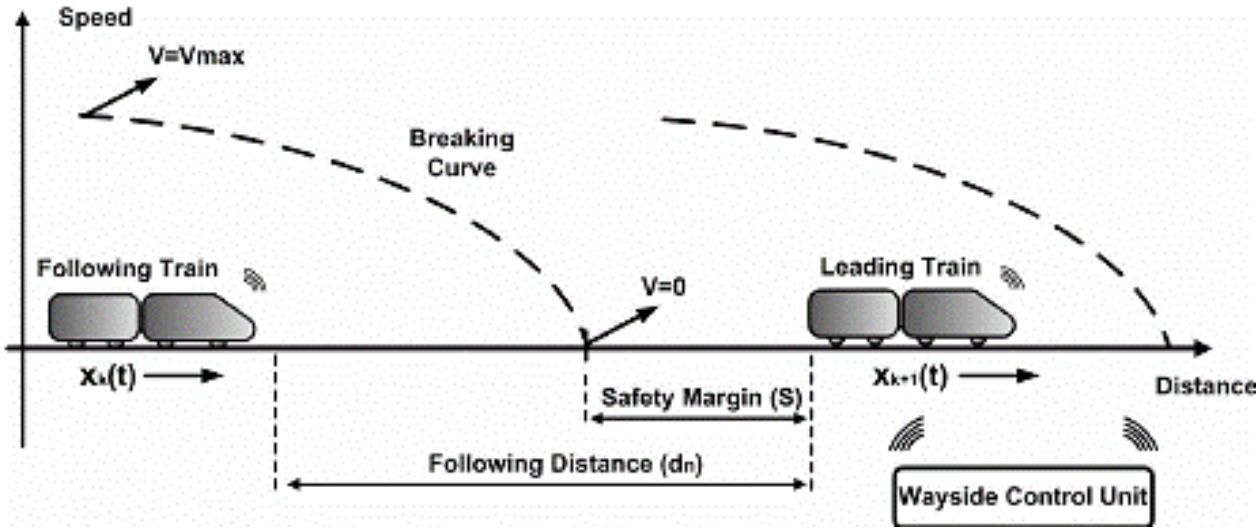
- Tracks the locations of all trains in the system at all times
- Prevents collisions and enforces safe spacing between trains
- Controls the trains' braking (and acceleration in auto mode)
- Sets the train's routing through the system
- Maintains consistent train spacing system-wide
- Ensures reliability of train service and frequency
- Allows greater flexibility of service plans and service during disruptions
- Prevents delays due to train congestion, traffic signals, or junction delays

Benefits of a modern train control system

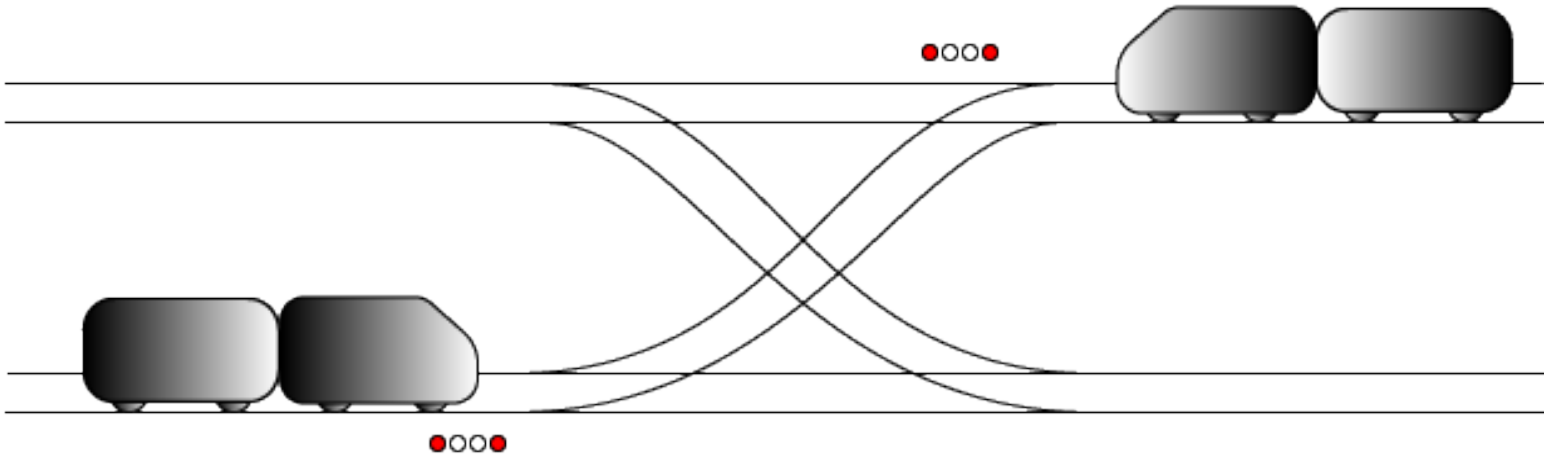
Fixed block



Moving block



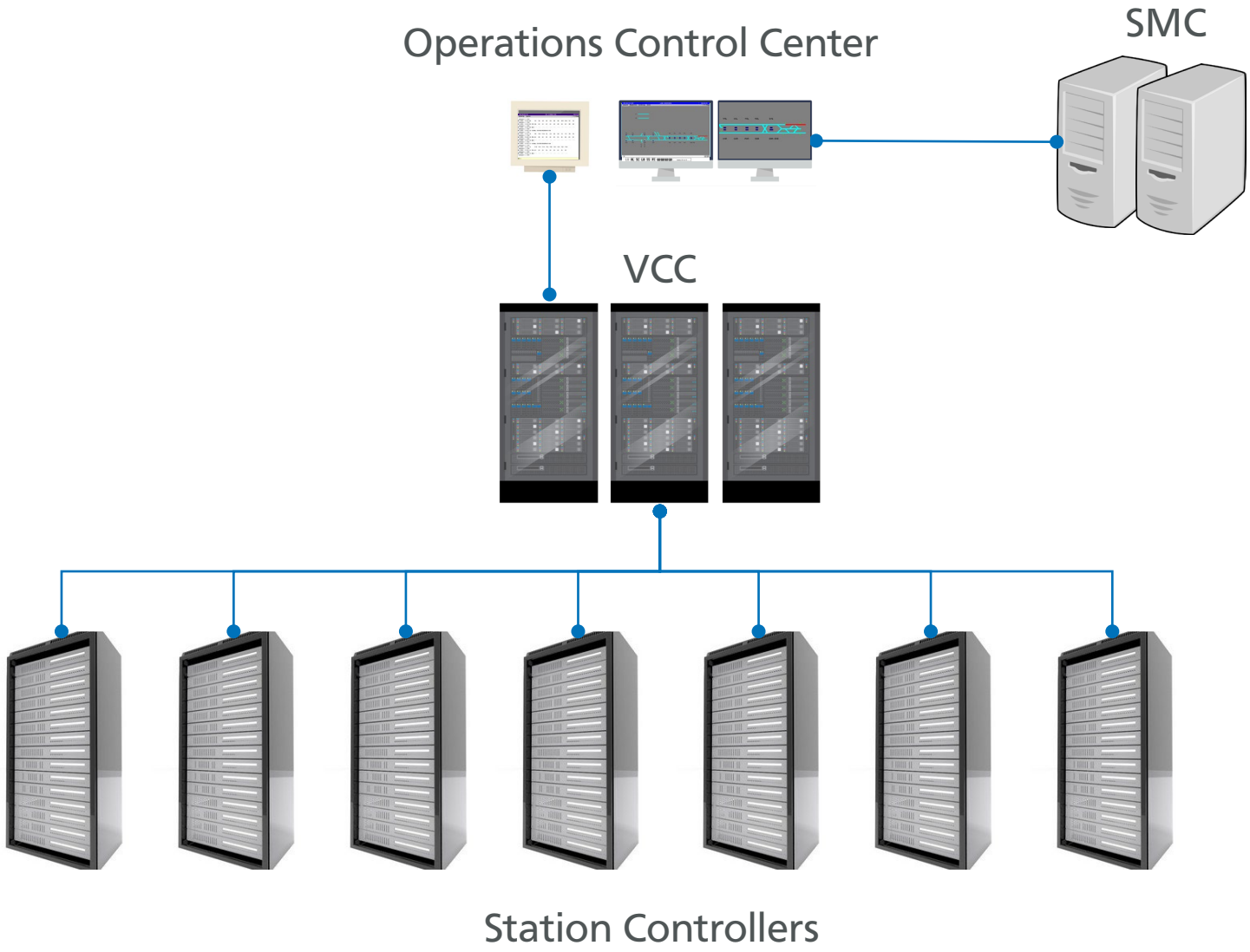
Benefits of a modern train control system



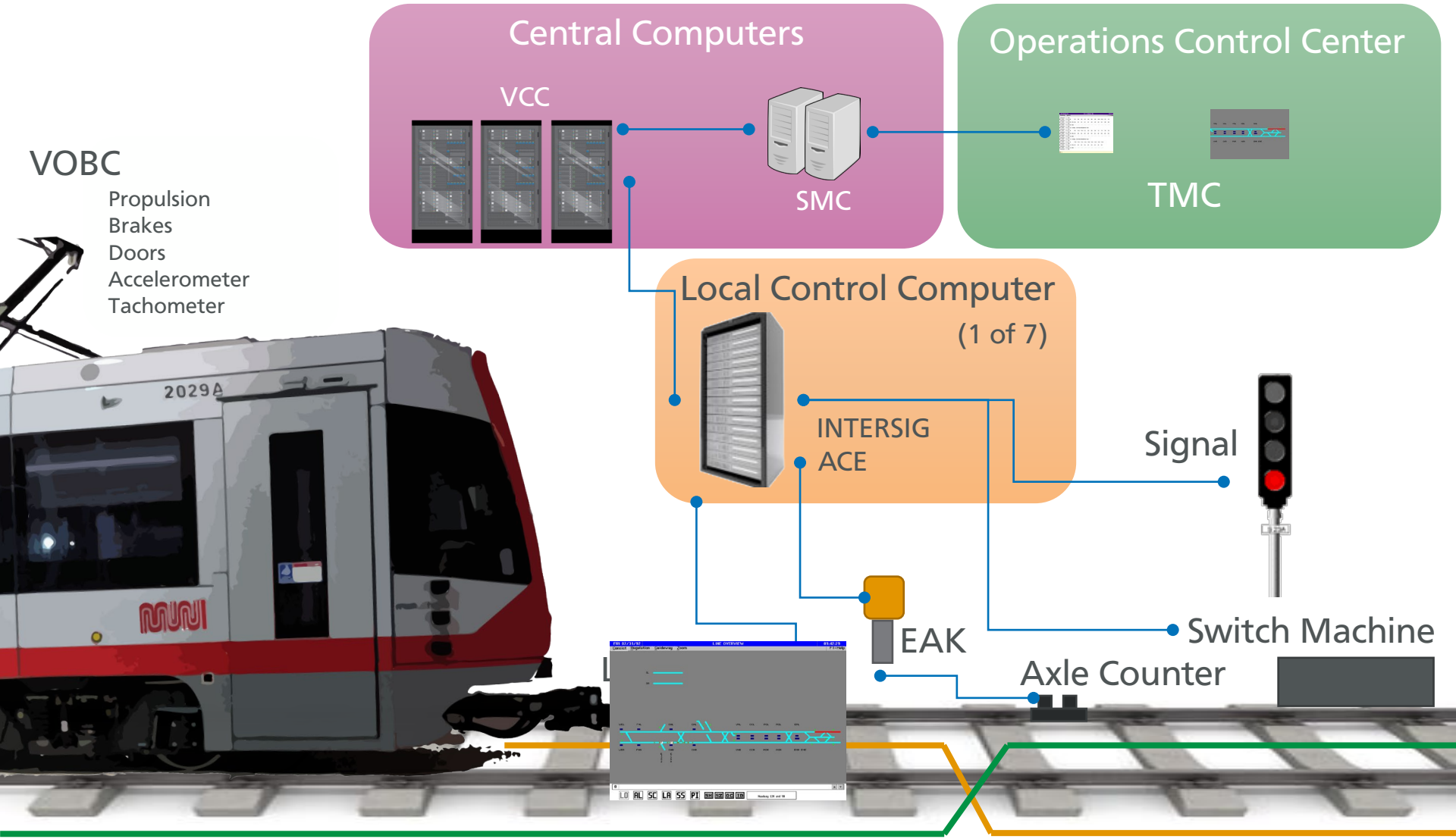
Need to control movement through junctions (called ‘interlockings’).

This includes occupancy control (fixed block and moving block) as well as switch position.

Current system: ATCS



Current system: ATCS



Current system limitations

The Automatic Train Control System (ATCS) is almost 30 years old with 1980s technology and 1990s components.

2019 Muni Reliability Working Group recommended **replacing the ATCS as the top priority.**

Aging train control infrastructure

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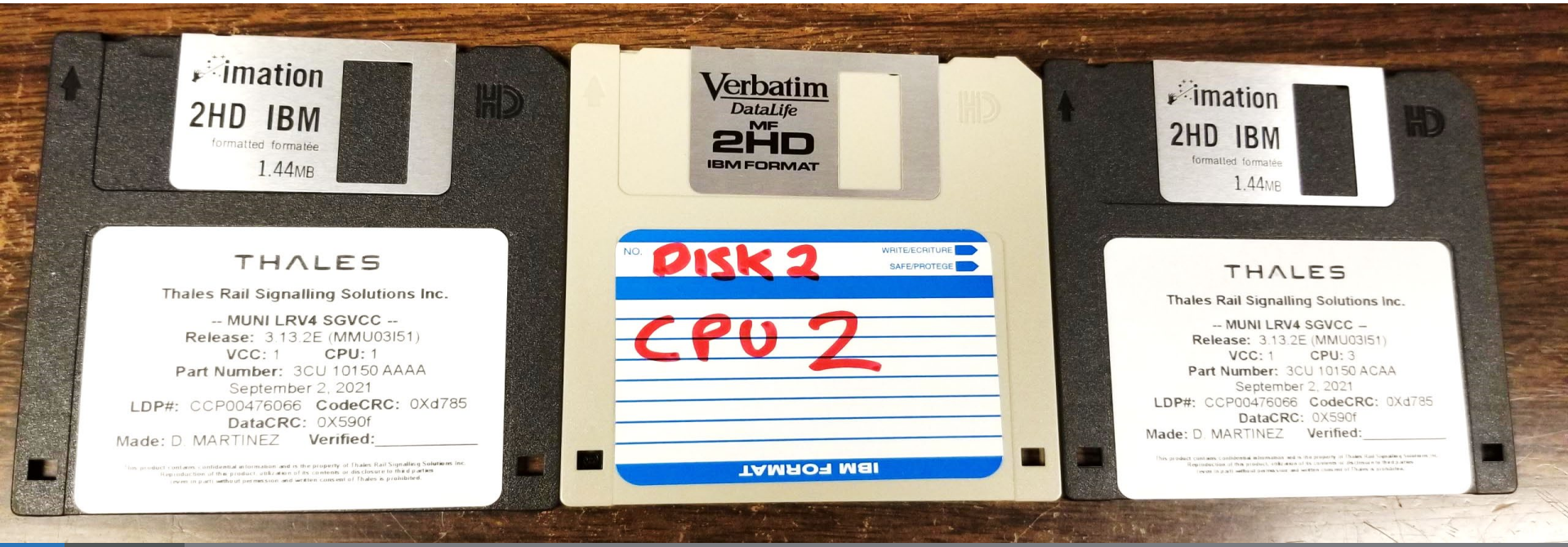
Outdated train control technology

- Computer failures
- Communication failures
- Lack of parts and expertise
- No surface train control

Why upgrade Muni Metro's train control?

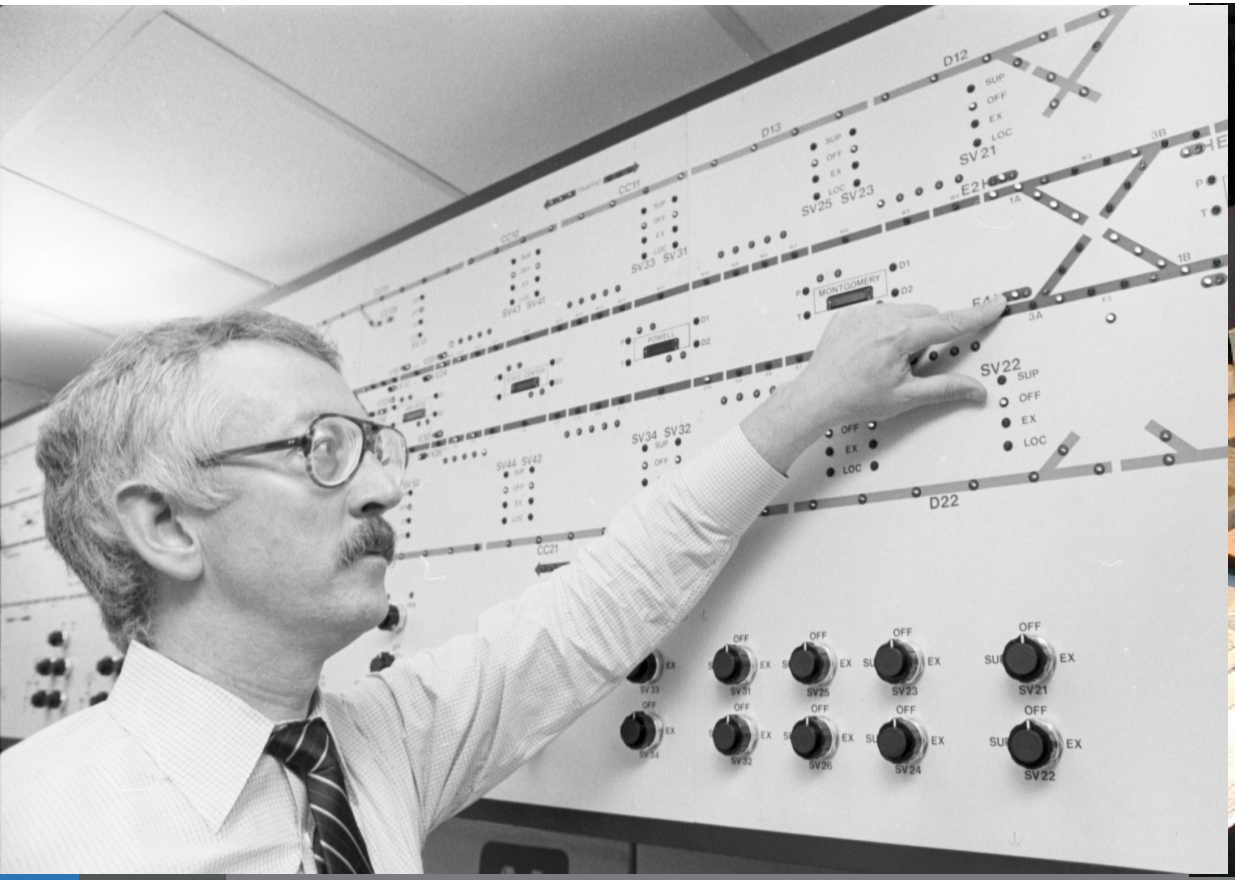
Critical need: Prevent critical equipment failure and ensure ongoing Muni Metro operations.

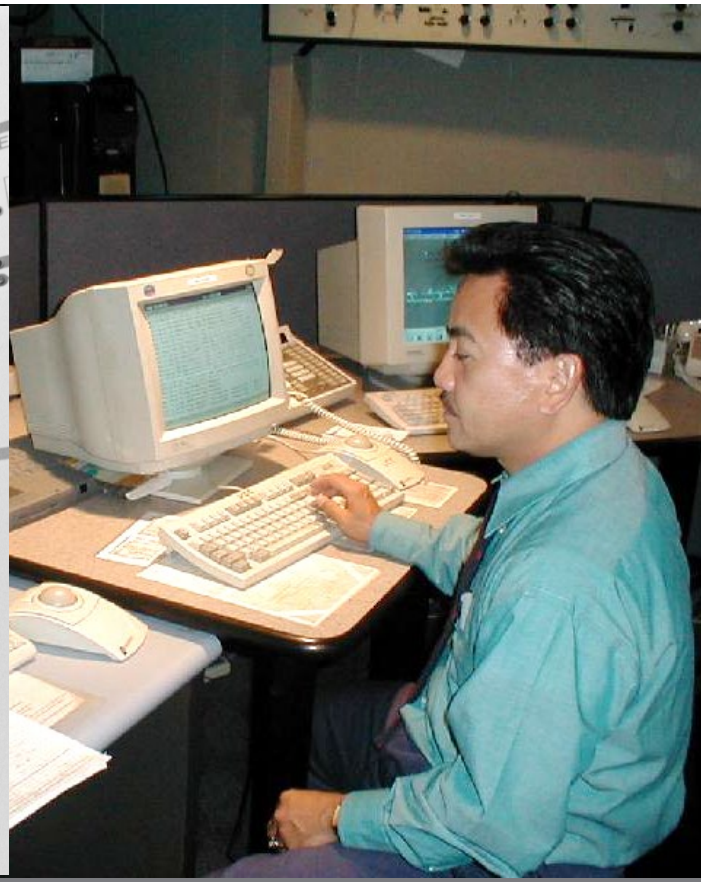
Unique opportunity: Centerpiece of subway renewal to modernize and grow Muni Metro for decades to come.



Critical Need

Replace the outdated Automatic Train Control System soon to prevent critical failure and keep Muni Metro running.





Unique Opportunity

Modernize the systems that make Muni Metro work to fundamentally improve service and enable future Metro growth.

Key Take-Aways

- Because of the physical layout of our rail system, Muni needs to **push as many trains as possible** through the Market Street subway.
- Train control systems are primarily designed for safety, but **our ATCS plays a critical role in subway performance**.
- Muni operates a moving block ATCS, but when there is a failure it reverts back to a fixed block system (half-speed, half the throughput).
- **We are asking for much more** throughput on a single track in our subway than other major world metros.
- Our ATCS is over 20 years old and we have not significantly upgraded it, so **components are becoming obsolete** and more prone to failure.
- Because of the older design and technology, **recovery from a failure is slower** with our ATCS than it would be with a modern train control system
- ATCS failures and subway congestion contribute to the subway's unreliability.

Project Overview

Train Control Upgrade Project (TCUP)

10+ year, phased upgrade to Communications-Based Train Control (CBTC) to modernize Muni Metro operations, expand service, capacity and reliability.

Key TCUP Objectives

Increase Muni Metro system capacity

Extend high safety standards system-wide

Enable shorter, more consistent train spacing and travel times

Support Muni Metro operations and service at all times, system-wide

Provide greater flexibility to service and contingency operations

Build in continual system upgrades to keep hardware and software current

TCUP Muni Metro Rider Benefits

Modern Communications-Based Train Control (CBTC) offers better coverage, reliability, efficiency, flexibility to boost Muni Metro performance.

Fewer delays	20-25% fewer subway delays due to fewer train control failures and less train congestion.
Consistent trip times	Expanding system to street-level and integrating with traffic signals means more consistent trip times.
More capacity	More consistent, reliable operations means more trains can move through the system smoothly.
Modern technology	Wi-Fi and cellular connections track and communicate with every train, continually and precisely.
Better maintainability	System monitors redundant components for faults so preventative action can be taken before service is affected.

TCUP Muni Metro Rider Benefits

In addition to maintaining the excellent safety record of the previous system, following the project, customers will see:

Fewer delays	Customers no longer "stuck" on trains between stations due to subway congestion or slow-moving trains with a communication failure.
Faster trips and less time waiting	Trips on Muni will be faster with better timed traffic signals on the surface. The CBTC system will tell signals a train is coming well in advance.
More reliable service	More consistent wait times that match the advertised frequency of trains, making trip-planning more reliable.
Better service management	CBTC will give train controllers more flexibility to manage bunching and gaps.

Enabling Technology

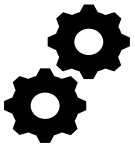
Centralized Network Management

Wireless Communications

Modern Computers

Traffic Signal Integration

Service Management Tools

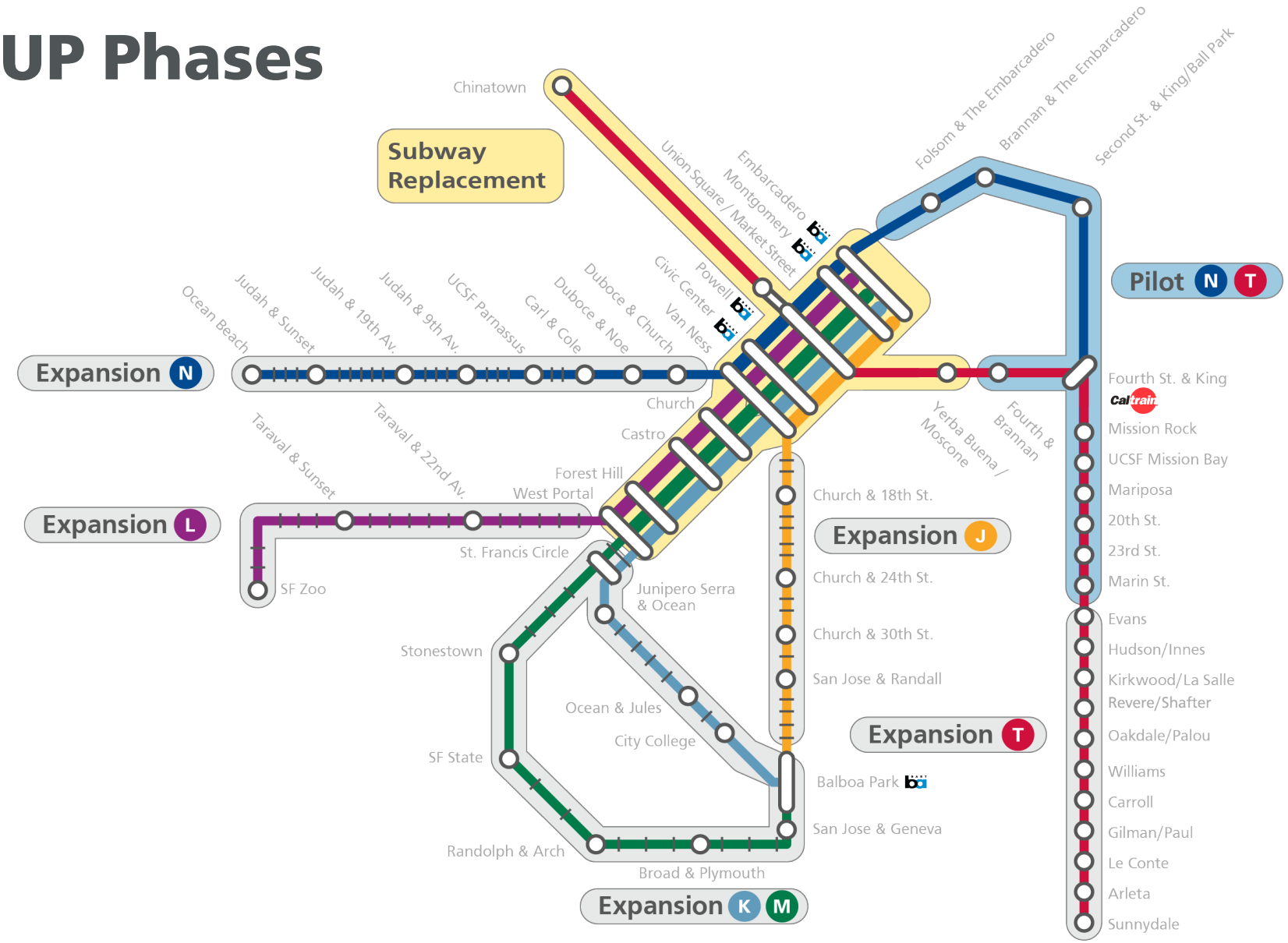


Data and Diagnostics

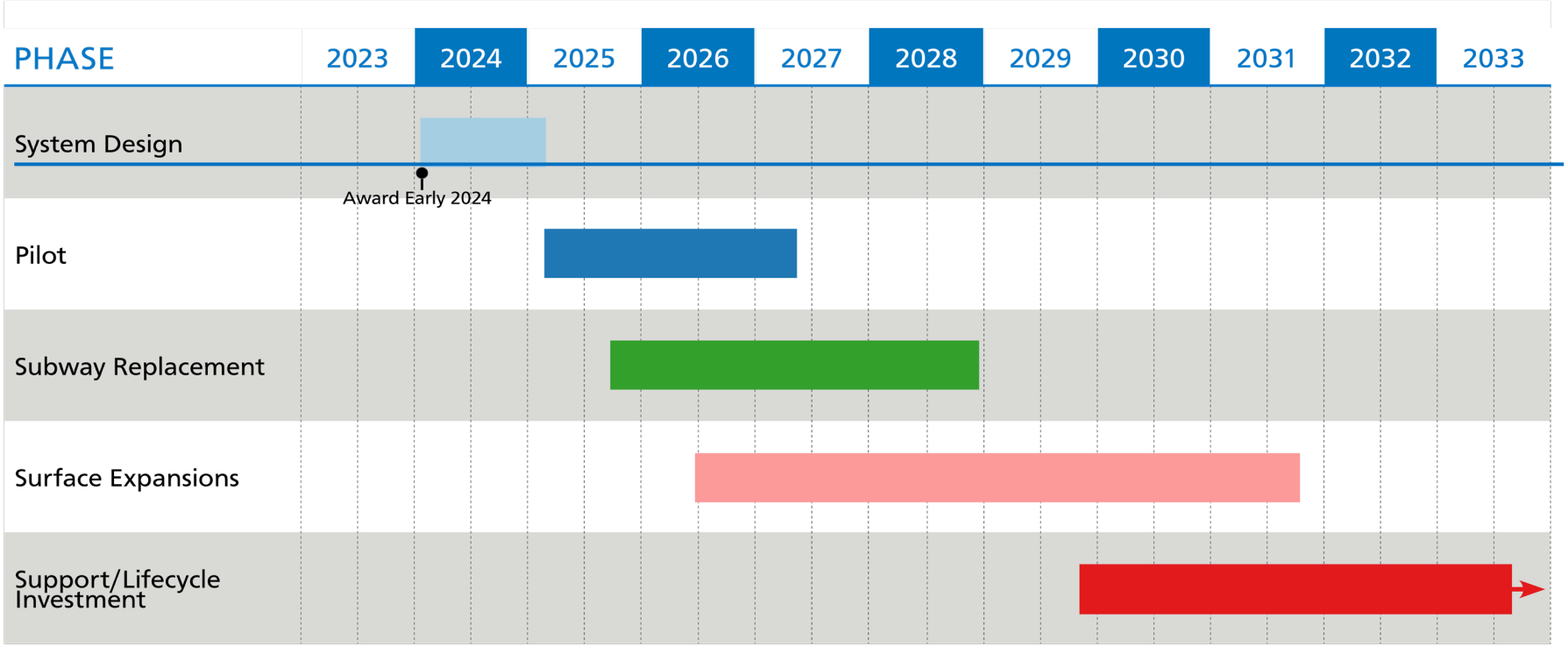
Spare parts and technical support

Software Upgrades

TCUP Phases


Subway Replacement
Chinatown
Union Square / Market Street
Embarcadero
Montgomery
Powell
Civic Center
Van Ness
Folsom & The Embarcadero
Brannan & The Embarcadero
Second St. & King/Ball Park
Pilot N T
Fourth St. & King
Caltrain
Mission Rock
UCSF Mission Bay
Mariposa
20th St.
23rd St.
Marin St.
Evans
Hudson/Innes
Kirkwood/La Salle
Revere/Shafter
Oakdale/Palou
Williams
Carroll
Gilman/Paul
Le Conte
Arleta
Sunnydale
Ocean Beach
Judah & Sunset
Judah & 19th Av.
Judah & 9th Av.
UCSF Parnassus
Carl & Cole
Duboce & Noe
Duboce & Church
Church
Castro
Expansion N
Taraval & Sunset
Taraval & 22nd Av.
Forest Hill
West Portal
Expansion L
St. Francis Circle
SF Zoo
Yerba Buena / Moscone
Fourth & Brannan
Church & 18th St.
Expansion J
Church & 24th St.
Church & 30th St.
San Jose & Randall
Junipero Serra & Ocean
Stonestown
Ocean & Jules
City College
SF State
Expansion T
Balboa Park
San Jose & Geneva
Randolph & Arch
Broad & Plymouth
Expansion K M

TCUP Schedule and Budget



Total Project Budget: $608 million
Support Costs: $100 million over 10 years

Project Budget and Funding

Funding Approach

Carefully planned funding commits to project and prioritizes discretionary sources.

Capital Improvement Plan (CIP) FY23-27 Funding Plan: **$290M**

Full Project Estimate: **Over $600M**

Funding Highlights:

- TCUP has been successful in competitive grants and discretionary funding sources.
- 10-year funding plan shows commitment to the project necessary to compete for funding, but without adjustment will siphon formula funds for SOGR.
- Staff anticipate the strength of this project will continue to attract competitive discretionary funding sources and local opportunities.

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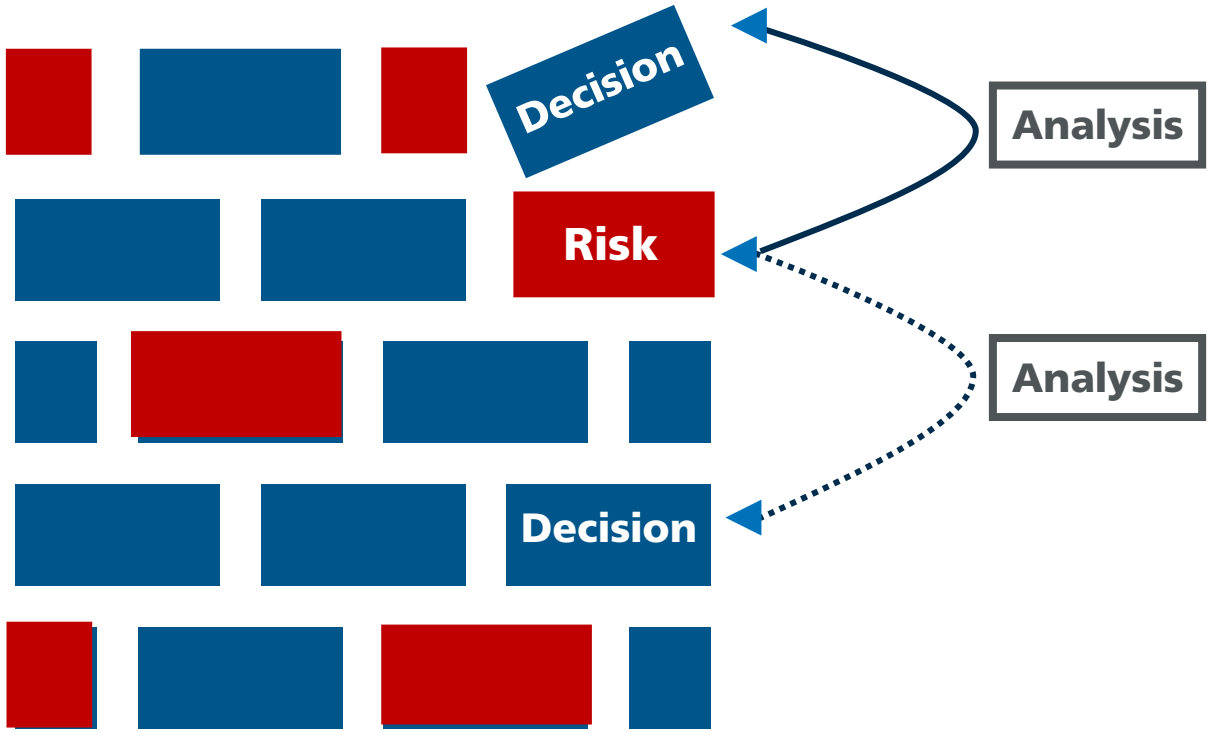
Risk Management

TCUP Risk Management Ethos

Proactive risk management early and often to minimize challenges.

Decision → Analysis → Risk → Analysis → Decision ....



A project of this magnitude has many unavoidable risks including cost overruns and project delays.

Each decision carries potential risk that the team analyses carefully before choosing a path.

Learning from Peers and Past Projects

The SFMTA has drawn from multiple sources of lessons learned to set the Train Control Upgrade Project up for success.

Major SFMTA capital projects like Central Subway and Van Ness Bus Rapid Transit

Peer agencies in North America and Europe

Past SFMTA technology projects

Current Automatic Train Control System (ATCS)

Harnessing International Expertise

AMERICAN PEERS

MBTA Green Line
BART
New York City Subway

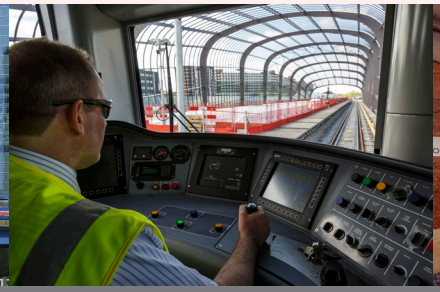
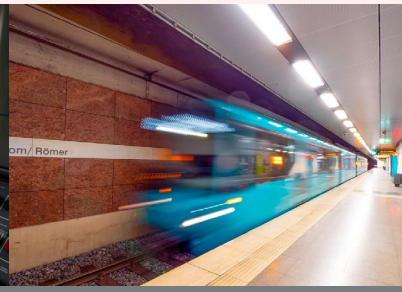


CANADIAN PEERS

Vancouver SkyTrain
Edmonton
Toronto (Eglinton LRT)


INTERNATIONAL PEERS

London (LU and DLR)
Amsterdam
Frankfurt VGM

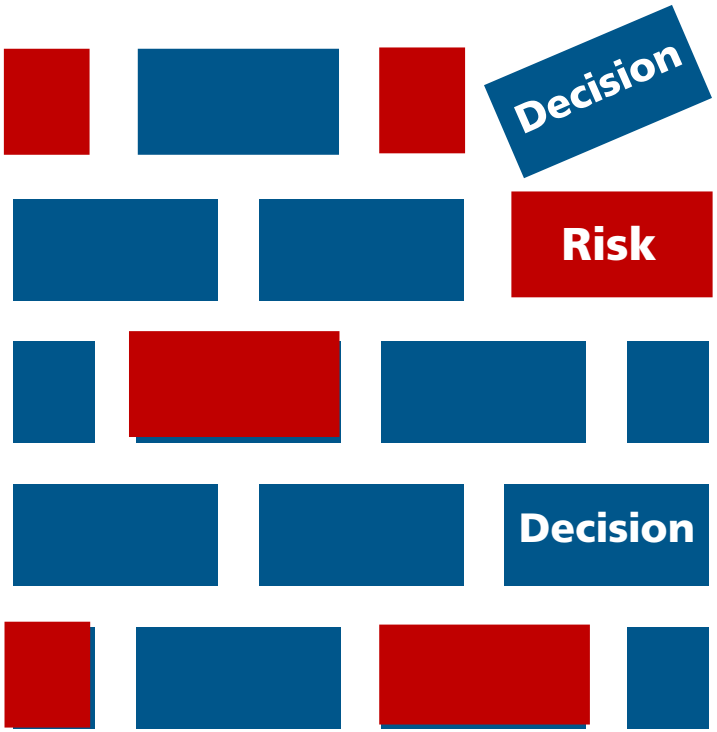




Applying Lessons to Risk Management

Procurement Method	Based on product quality and expected long-term performance.
Harness Opportunities	Negotiate support terms while supplier is in competition with its peers.
Supplier Partnership & Performance Incentives	Contractual incentives for supplier to partner in the success of the system.
Support-Focused Lifecycle Management	Plan to keep hardware and software up to date.
Risk Assessment	Anticipate risk points early and plan mitigation.

Risk Management: Contract Strategy

Partnering with knowledgeable CBTC consultants is a vital part of the TCUP risk management strategy.



RISK	MANAGEMENT
System quality	One contract for support + procurement
Limited ability to select system/supplier	Separate contracts – supplier, installer
Supplier-installer conflicts	Consultant to hold contractors accountable and mediate disputes

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Contracting

Innovating Contracting

Multiyear contracts and negotiated procurement improve price and terms because firms are in competition with peers

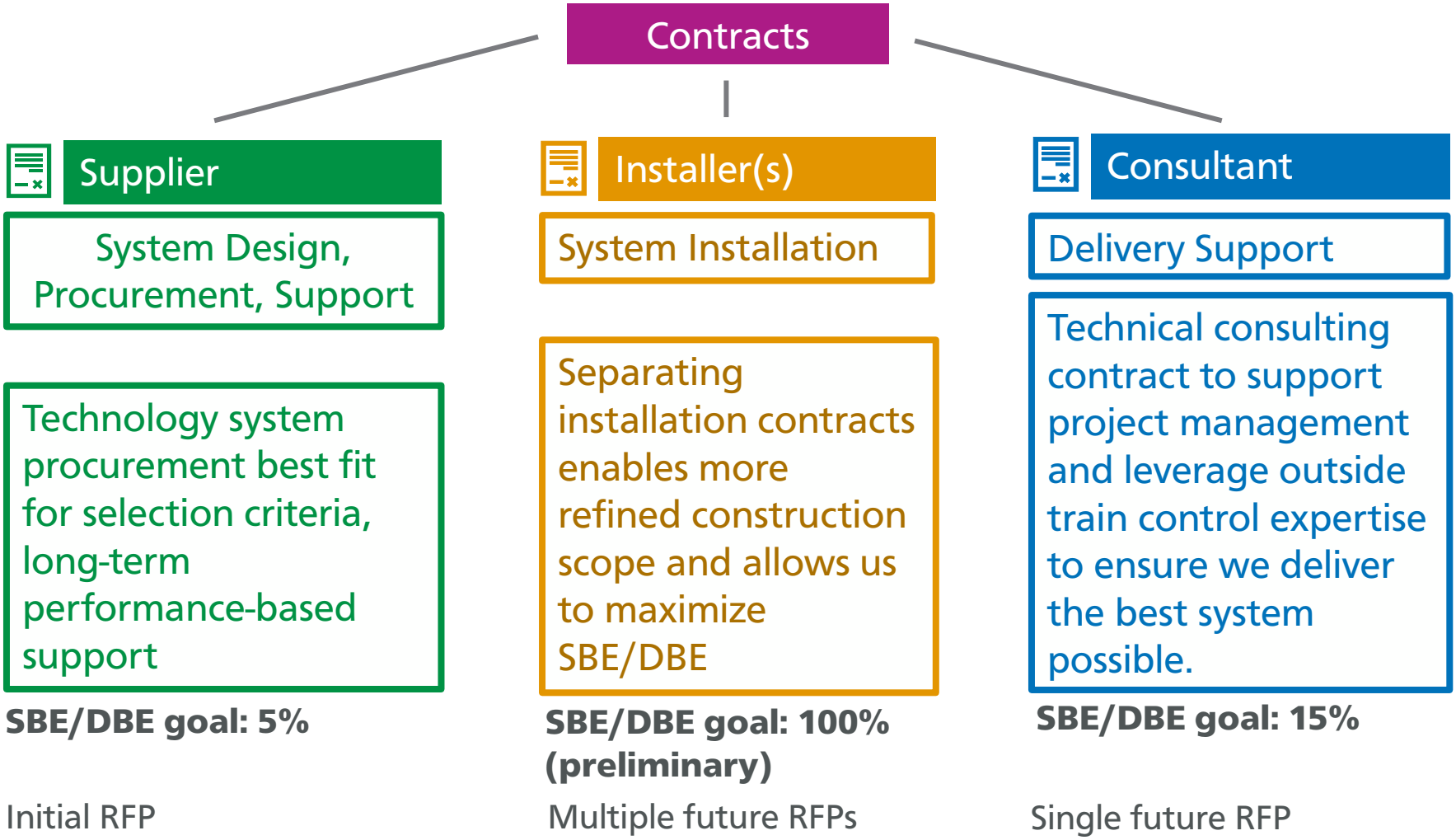
Key elements linked to strategic goals:

Performance-based support fee creates contractual elements for supplier to build reliability into initial design

Vendor-Managed Spares Inventory designed to incentivize reduced parts replacement

Regular software updates keeps hardware and software up to date

Contract Diversification



Consultant Request For Proposal (RFP)

As-needed technical services supporting SFMTA not to exceed 10 years and $36,000,000.

Key rationale for consultant contract:

Consultant helps SFMTA mitigate risks identified in project risk assessment

Consultant augments SFMTA technical staff and grows in-house CBTC knowledge so that SFMTA can self-support in the future

Consultant helps SFMTA hold Supplier & Installer accountable

Services in Consultant RFP

- Project Management & Administrative Support
- Construction Management Support
- Design and Engineering Support
- System Integration Support
- Quality Assurance Support
- Testing & Commissioning
- Safety and Security Evaluation
- Post-Delivery, Ops & Maintenance Consulting

Questions?