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Train Control Upgrade Project

Improving Service Across the Entire Muni Light Rail Vehicle Network

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Project Introduction

The Train Control Upgrade Project (TCUP) is a critical, once-in-a-generation investment to modernize and grow Muni Metro for decades to come. TCUP aims to replace the outdated system that controls our light rail vehicles in our subways and on surface rail with a new, state-of-the-art system. Following the example of London and Vancouver, the SFMTA is on track to be the first transit agency in the United States to modernize its train control system. The new system will provide the tools to deliver more reliable, faster, higher-frequency, higher-capacity Muni Metro service throughout San Francisco.

TCUP is projected to be completed in three phases. The first phase would pilot a new Communications-Based Train Control (CBTC) system at street level along the Embarcadero and Third Street corridors. This new system would serve high-traffic destinations such as Oracle Park, Chase Center, Mission Bay and UCSF. We would also install Communications-Based Train Control in the subway alongside the existing system. The second phase would complete the transition in the Market Street subway from the old system to the new. Phase three would expand the new Communications-Based Train Control to the surface branches of the J Church, K Ingleside, L Taraval, M Ocean View, N Judah and T Third.

Project Timeline

Why do we need to replace our train control system?

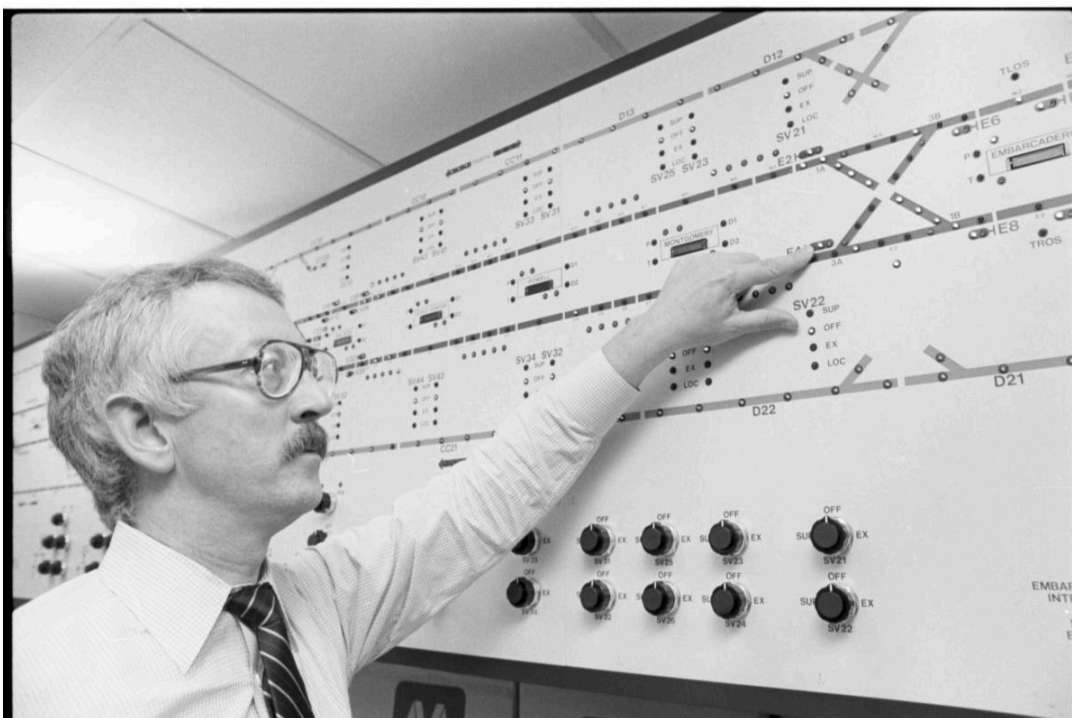
Today, Muni Metro runs on an Automatic Train Control System that was installed in the Market Street subway in 1998, and still runs on floppy disks (<https://sfstandard.com/2023/02/02/sfs-market-street-subway-runs-on-reagan-era-floppy-disks/>). This system was designed to last 20 to 25 years. Some of its parts are no longer available. For this reason alone, it's vital that we replace the existing system.

We have the opportunity to invest in making significant improvements with brand new, cutting-edge technology.

Critical limitations of the Automatic Train Control System (ATCS)

The Automatic Train Control System is designed to communicate with light rail vehicles via a loop cable-based system. This is a type of wireless technology from the 1980s. This technology has less power than a modern cell phone. So, the bandwidth and range of communication are low, and the system can only transmit limited information.

The loop cable is fragile and easily disturbed. This makes subway maintenance more difficult. This also means the system cannot be extended outside the subway, along surface rail, where currently we don't have automatic train control.



What are the benefits of the new train control system?

We will modernize Muni Metro to meet San Francisco's transit needs well into the future with a new, cutting-edge train control system.

The Train Control Upgrade Project would replace the Automatic Train Control System with a Communications-Based Train Control system. Unlike the existing Automatic Train Control System, newer Communications-Based Train Control technology uses Wi-Fi or cellular connections to precisely track and continually communicate with every light rail vehicle in service.

Communications-Based Train Control can manage train movements throughout Muni Metro's entire 74-mile light rail network, both in the subway and above ground. In the subway, Communications-Based Train Control will work like the existing Automatic Train Control System and use automatic headway management to adjust the speed and dwell time of trains. On the surface, Communications-Based Train Control will communicate adjustments to Muni Metro operators who will remain in control of the train.

While GPS is currently used to track vehicles on the surface, Communications-Based Train Control telecommunications technology is more accurate and more directly accessible to staff in our Transit Management Center (TMC) – what we refer to as Muni's "air traffic control tower."

Communications-Based Train Control would also allow Muni Metro trains to take advantage of transit priority signals, improving Metro travel times and reliability. Currently, a separate Vehicle Tagging System (VETAG) detects trains above ground and communicates to the nearby traffic signal to request priority for the train to pass while holding other traffic with a red light. However, this technology is also outdated and ineffective.

These improvements would give operators and TMC staff greater visibility into the movements and operations of Muni Metro trains, resulting in more effective train management and better service for the entire Muni Metro system.

Service and capacity benefits of Communications-Based Train Control:

- More consistent travel times and headways. This means customers will experience faster trips and less time waiting, and trains will be able to serve more runs. **[Watch this video about the SFMTA's headway management. \(https://www.youtube.com/watch?v=SYcwLv1jkSk\)](https://www.youtube.com/watch?v=SYcwLv1jkSk)**
- Less bunching and fewer gaps and delays both in the subway and on surface rail. *With the current system it can be difficult to switch trains back in the event of delays and prevent vehicles from bunching up.*
- Better communication with traffic signals for priority right-of-way.
- Fewer delays entering and exiting subway portals. *Currently, trains have to connect to the train control system at the subway portal before entering the subway, which causes train delays. If the connection fails – which is common – the train has to move slower and other trains are held back for safety, causing further Metro delays. With Communications-Based Train Control trains will be connected to the system at all times.*
- The ability to expand the capacity of the Muni Metro system with more trains and longer trains. *The current system can only handle 2-car trains.*

Reliability and maintenance benefits of Communications-Based Train Control:

- Eliminate major subway delays and improve reliability by replacing outdated Automatic Train Control System equipment. *The old equipment needs to be replaced as soon as possible to keep Muni Metro running.*
- Modern technology that is easier to keep up to date with the latest components and software. While replacing old equipment, we will also upgrade to advanced, cutting-edge technology.
- Provide a train control system that supports Muni Metro service at all times. *Since the current system is only available in the subway, is very fragile and doesn't function during off-hours when trains aren't running, it provides limited benefits. The new system will resolve these issues.*

Safety benefits of the Communications-Based Train Control:

- Automatic train separation. This means the system knows where all trains are at all times and send guidance to operators to keep trains safely and appropriately spaced.
- Maintain the high standards of safety currently provided in the subway and extend automatic safety protections to surface operations. *The current system isn't available along the surface, so operators*

have to switch trains into manual mode. The new system will act like the driver assist in new cars to help prevent collisions.

Environmental benefits:

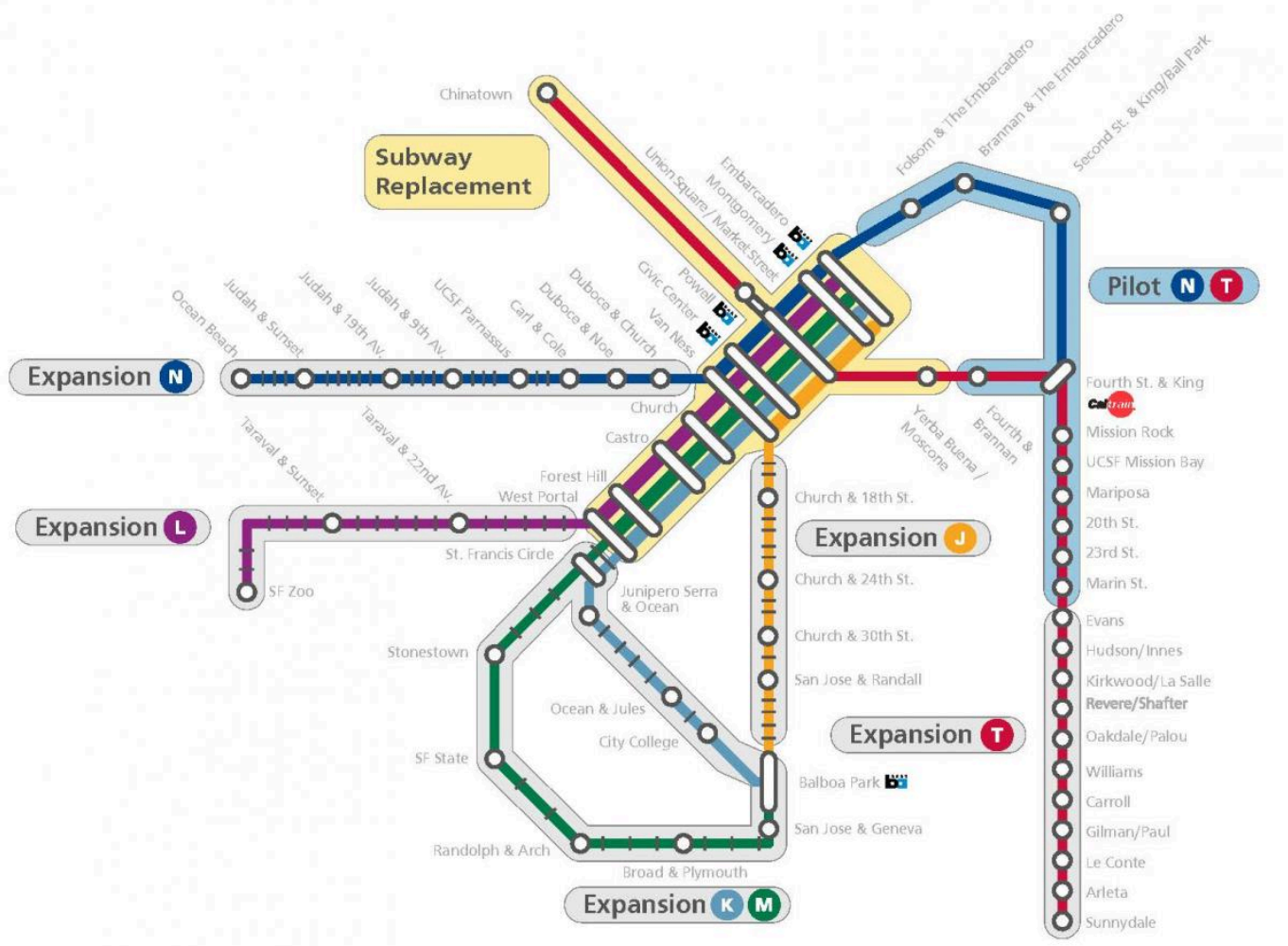
For almost 85 years Muni has continuously operated a network of vehicles, including light rail vehicles, that run on 100% greenhouse gas-free **Hetch Hetchy** (<https://sfwater.org/index.aspx?page=391>) hydroelectric power. Our light rail vehicle fleet played a key role in reaching the **San Francisco Climate Action Strategy** (<https://sfmta365-my.sharepoint.com/about-us/sustainability-and-climate-action/climate-goals-targets-and-trends>) goals in 2017. Upgrading the Muni Metro train control system from Automatic Train Control System to Communications-Based Train Control will help the City meet future environmental goals by allowing the SFMTA to expand sustainable light rail transit for a growing ridership on the greenest transportation system in North America.

TCUP is in line with the City’s voter-approved **Transit-First Policy** (<https://sfmta365-my.sharepoint.com/about-us/sustainability-and-climate-action/vision-sustainability-and-climate-action>) established in 1973. The policy prioritizes public transit, bicycling, and walking on SF Streets as an economically and environmentally preferable alternative to transportation by individual automobiles.

By providing safe, reliable, rapid, and environmentally sustainable transit service, this project will support our city’s economic and population growth while reducing greenhouse gas emissions and resource consumption.

Project phasing

We plan to implement TCUP in phases designed to allow us to troubleshoot and make adjustments without negatively impacting Muni Metro service, infrastructure and operations.



Pilot Phase:

We would install the new Communications-Based Train Control at street level along the Embarcadero and Third Street corridors to test and validate the new system. If any troubleshooting is needed, trains can easily switch into manual mode and operated as they are now with negligible impacts.

At the same time, we would install Communications-Based Train Control in the subway alongside the existing Automatic Train Control System, but we would wait to active it until we are confident in its performance above ground.

Replacement Phase:

Once we are confident that we are ready to activate Communications-Based Train Control in the Market Street subway we would switch systems, replacing the Automatic Train Control System. We would keep the Automatic Train Control System in place in case temporarily as a redundant system.

Expansion Phase:

We would roll out the Communications-Based Train Control to all remaining surface branching of the Muni Metro system.

Learning from the past and using best practices

TCUP is carefully envisioned, planned and managed to maximize lessons learned from past SFMTA projects, other agencies' experiences and industry best practices.

Project Phasing: Careful project phasing is one way we are implementing lessons learned from the past. For example, we have created a "pilot" phase which allows the SFMTA to create a proving ground for a fully functional system on a portion of the surface (above ground) right of way, before installing it in the subway and extending it to all surface Metro segments.

Support-Focused, Lifecycle Management: Negotiate supplier support early in the competitive bidding process, keep hardware and software up to date, and create contractual incentives for suppliers to partner in the success of the system.

Performance-Based: Award contracts based on product quality and long-term performance goals rather than short-term construction issues.

Risk Management: Anticipate risks early and plan for solutions.

Lessons From Other Agencies:

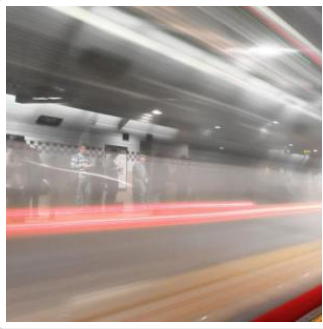
- Careful vehicle integration
- Time control integration
- Intuitive user interface for train controllers
- Key system design
 - Trains would connect to the new Communications-Based Train Control system once when they start service and stay connected until they finish service
 - The new Communications-Based Train Control will coordinate communication between street signals

Contact Information

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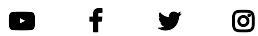
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