



SFMTA

A black and white photograph of a subway train at a platform. The train is white with dark accents and has the number '2001A' on its front. The platform is tiled and has an 'EXIT' sign. A person is walking on the platform in the distance.

# Subway Performance and Train Control Upgrade

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**Muni Technology Systems Manager**

# The problem

Muni Metro service regularly experiences delays and crowding, resulting in an overall poor quality of service

## Acute Delays

**Vehicle  
Breakdowns**

**Track Failures**

**Overhead Line  
Failures**

**Communication  
Failures (ATCS)**

**Failed Entries**

**ATCS Computer  
Failures**

**Passenger Issues**

**Operator Issues**

**ATCS Equipment  
Failures**

## Chronic Congestion

**Subway  
Congestion**

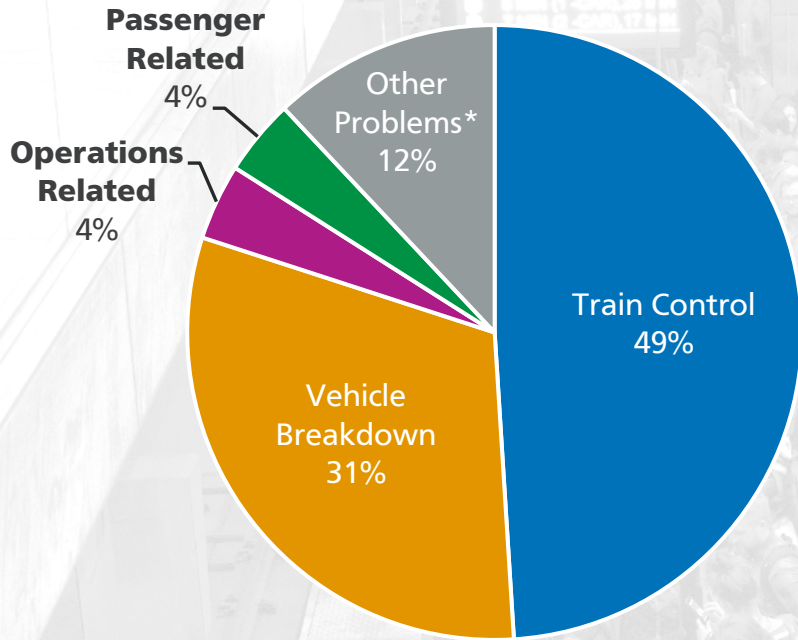
**Bunching/Gaps**

**Slow-moving  
subway trains**

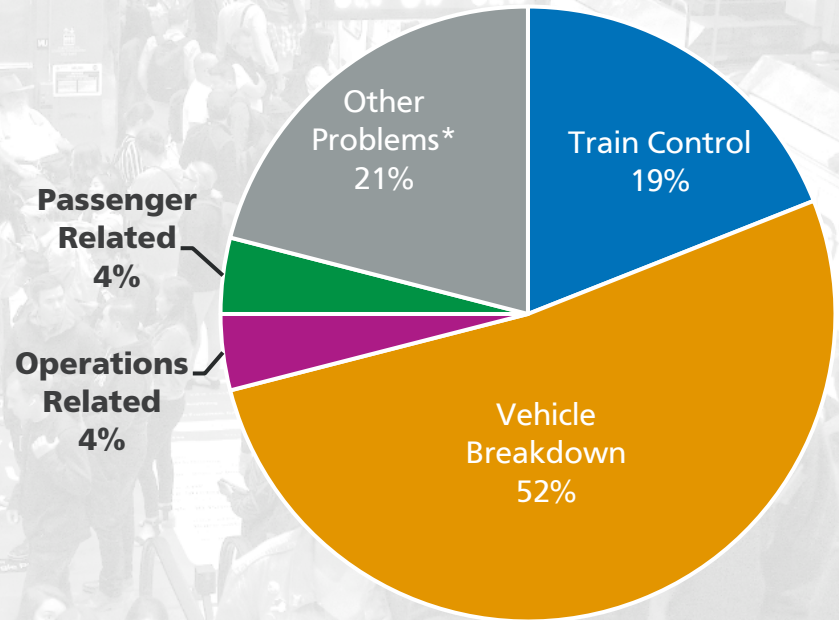
**Street  
congestion**

# Sources of Acute Delays (Jan-Dec 2018)

## Delays by Quantity



## Delays by Impact (minutes)



Source: Muni Central Control Log

\*Other problems include wayside infrastructure failures in addition to delays that were uncategorized in the control log. These figures do not include delay due to congestion, only the acute delay associated with each incident.

# Muni's train control today

## Subway

### Automatic Train Control

*In service 1998*

- A train entering one of three portals and pings the central computer
- The system does a "handshake" with the vehicle, and routes it automatically
- System keeps vehicles safely spaced
- System controls use and activation of switches to route vehicles (first come, first serve)
- Operators open/close doors, but all other movements are automated

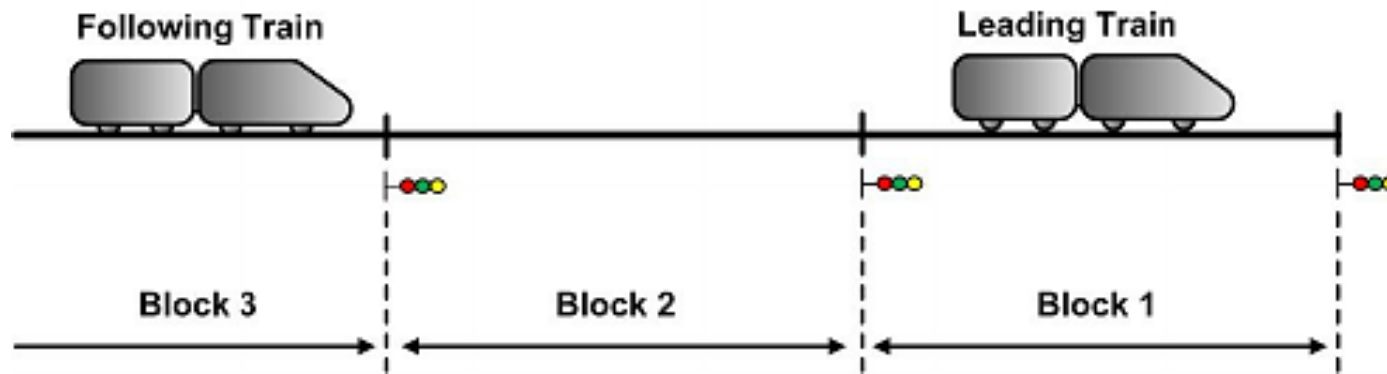
## Surface

### Independent Operation

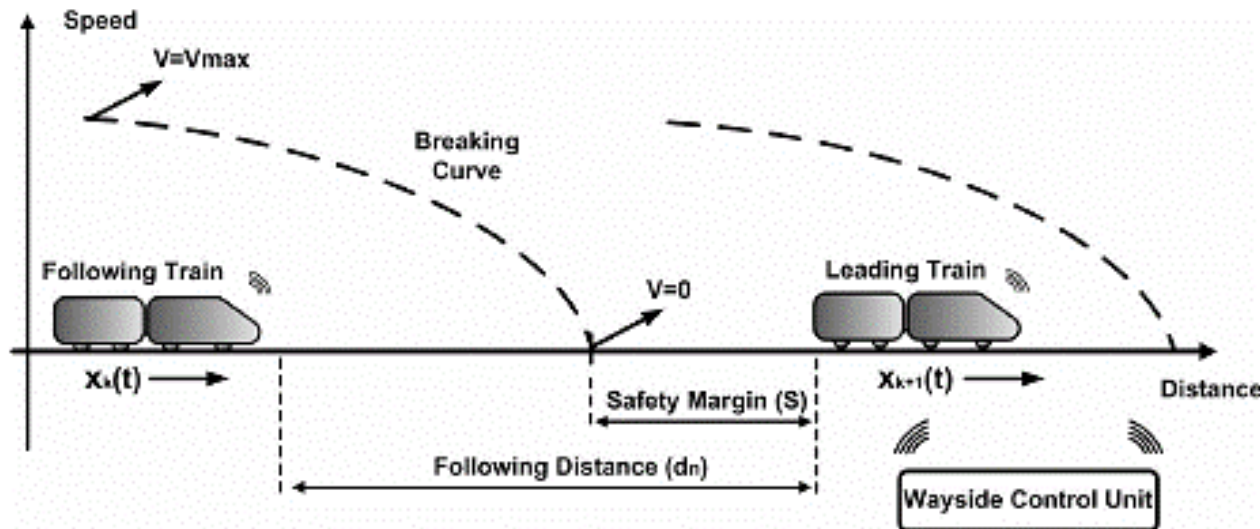
- Vehicles on the surface are fully controlled by the operator unsupervised by Central.
- Signals and switches are controlled by independent wayside computers.
- Routes are requested as trains are detected by the "VETAG" system, and assigned first come, first serve.
- No spacing management

# Types of train control

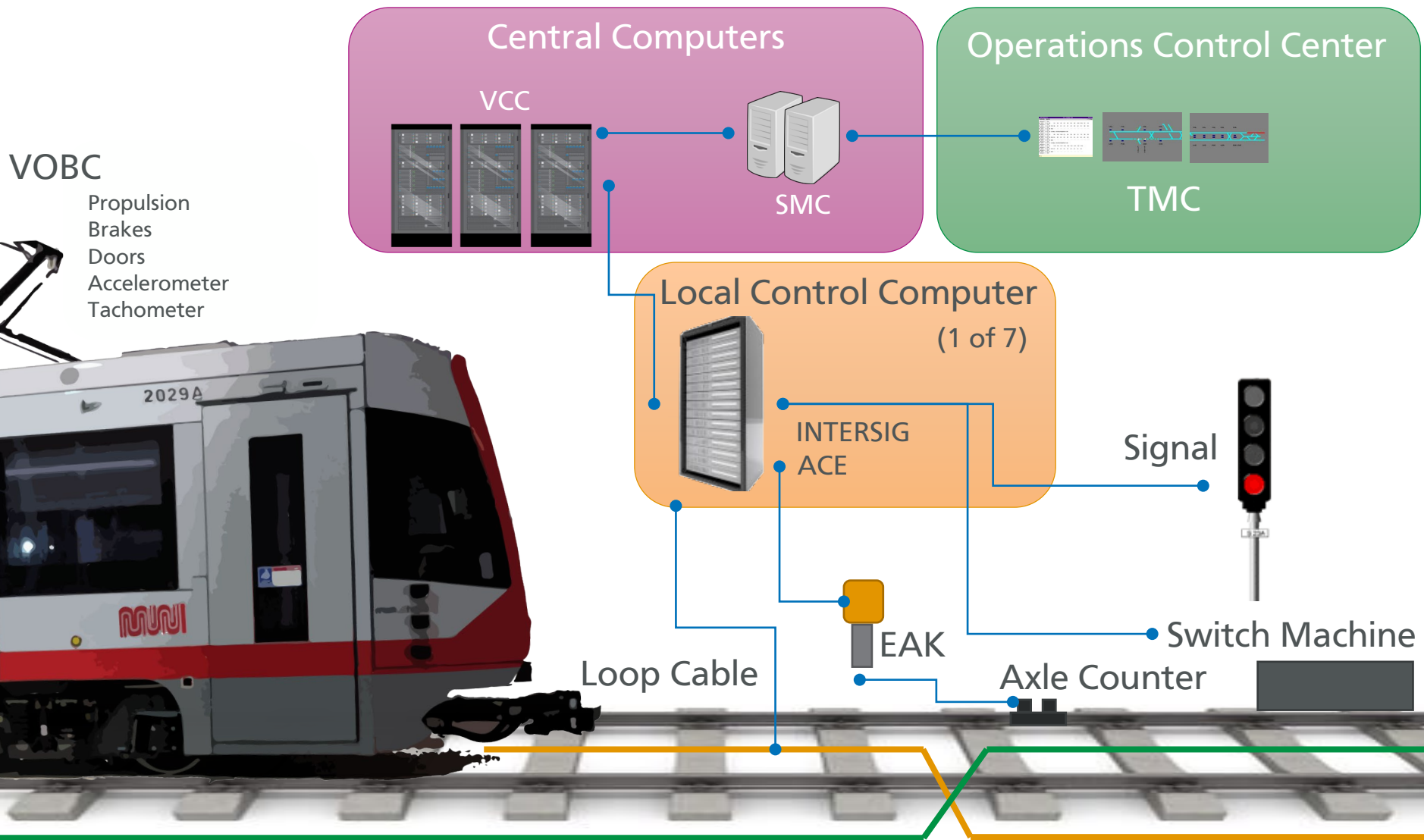
## Fixed block



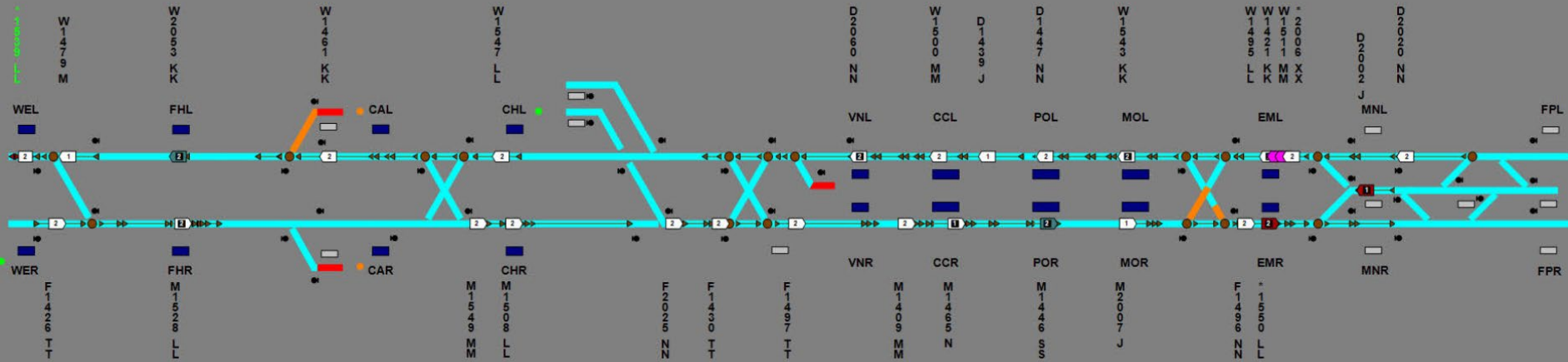
## Moving block



# ATCS System Overview



# SMC – System Management Center



09/25/19 08:35:39 am ©SFMTA



# What are the key reasons for poor train control system performance?

The present system designed in the 1980s and was rolled out in the 1990s—it experienced significant issues then, and continues to cause headaches today

## Three entry portals

Multiplies the opportunity for system failures, makes systemic management of entire rail system complex

## Twenty-year-old system

Components fail regularly, technology has significant capacity issues, fewer and fewer people have expertise to understand system

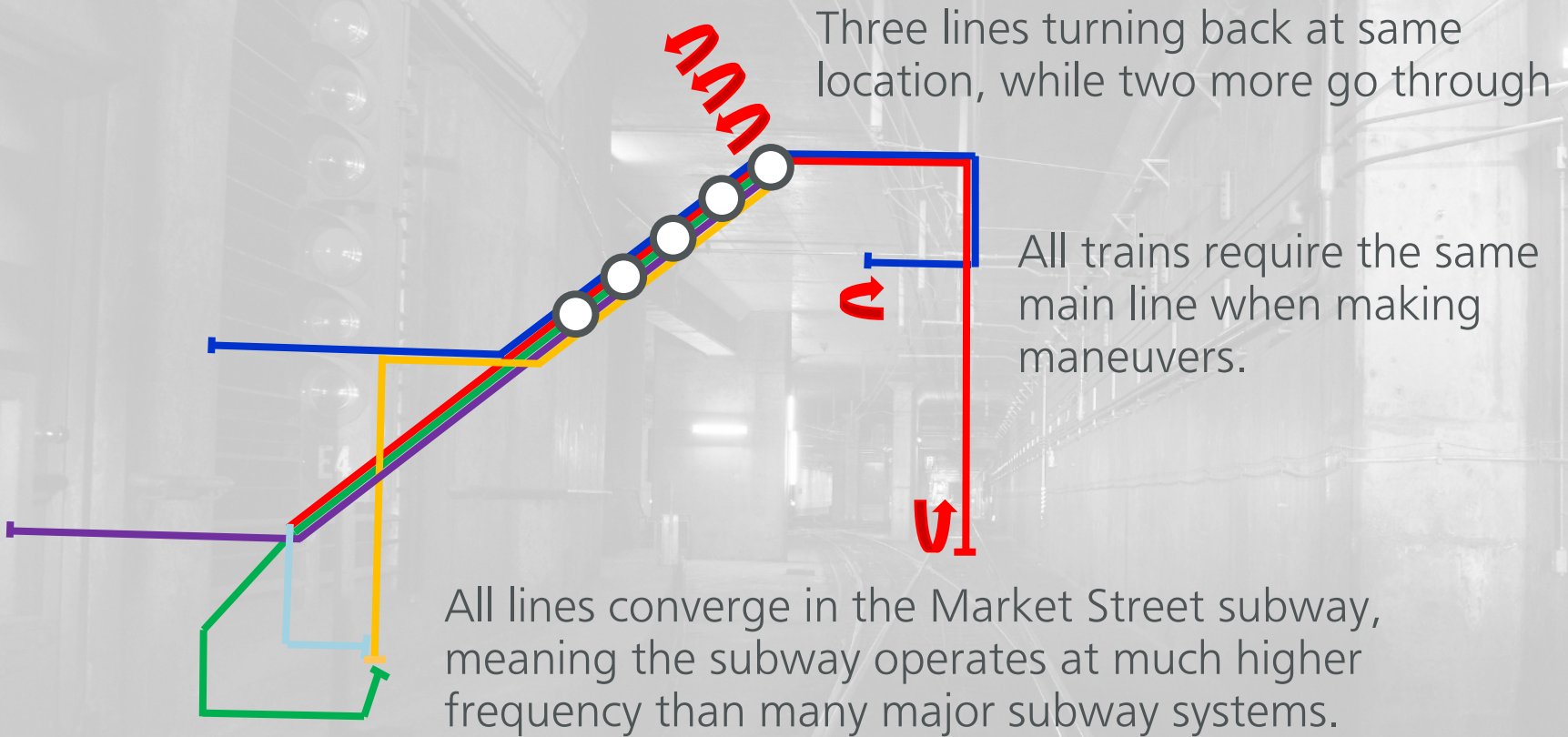
## Rigid infrastructure

Extremely unforgiving system design, system is slow to come back up and results in delays that are disproportionate to significance of initial failure

## Congestion

We are operating at (or even above) capacity of the train control system, leaves zero room for error

# Structural Limitations



Max trains per hour, peak hour

SF Muni

40

BART

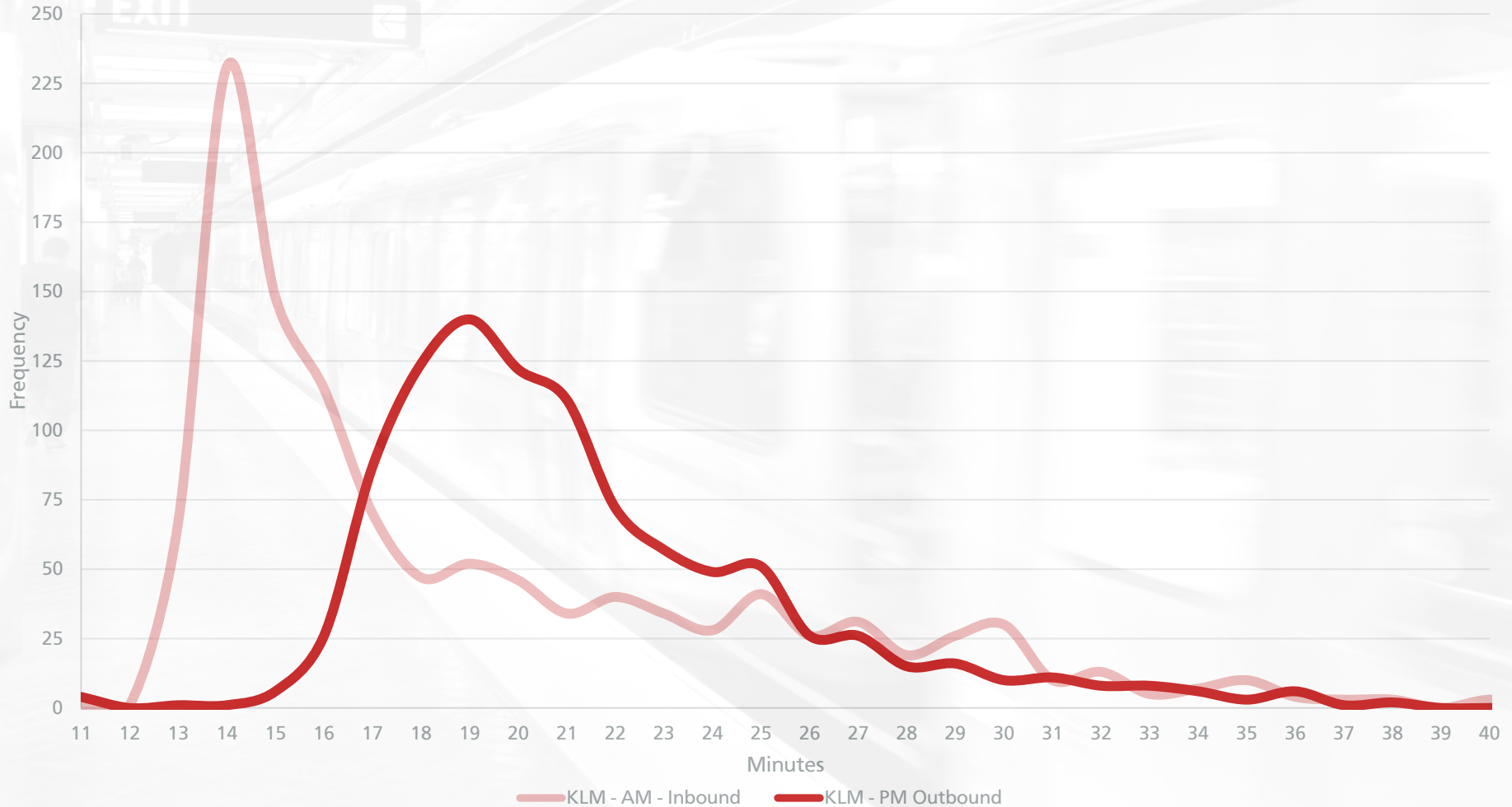
22

Boston

15

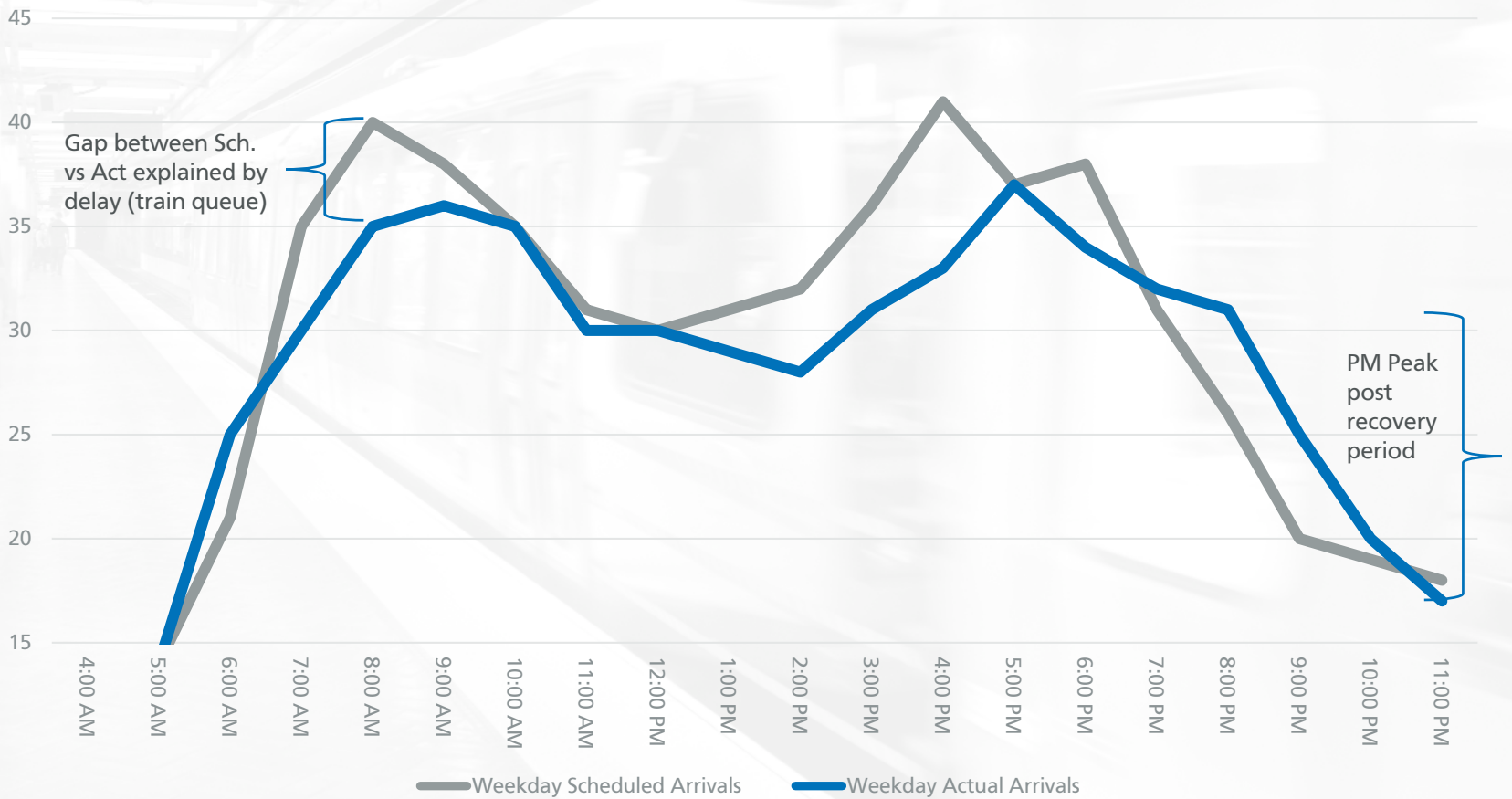
# Travel Time Variability

January 2019 Travel Time  
KLM



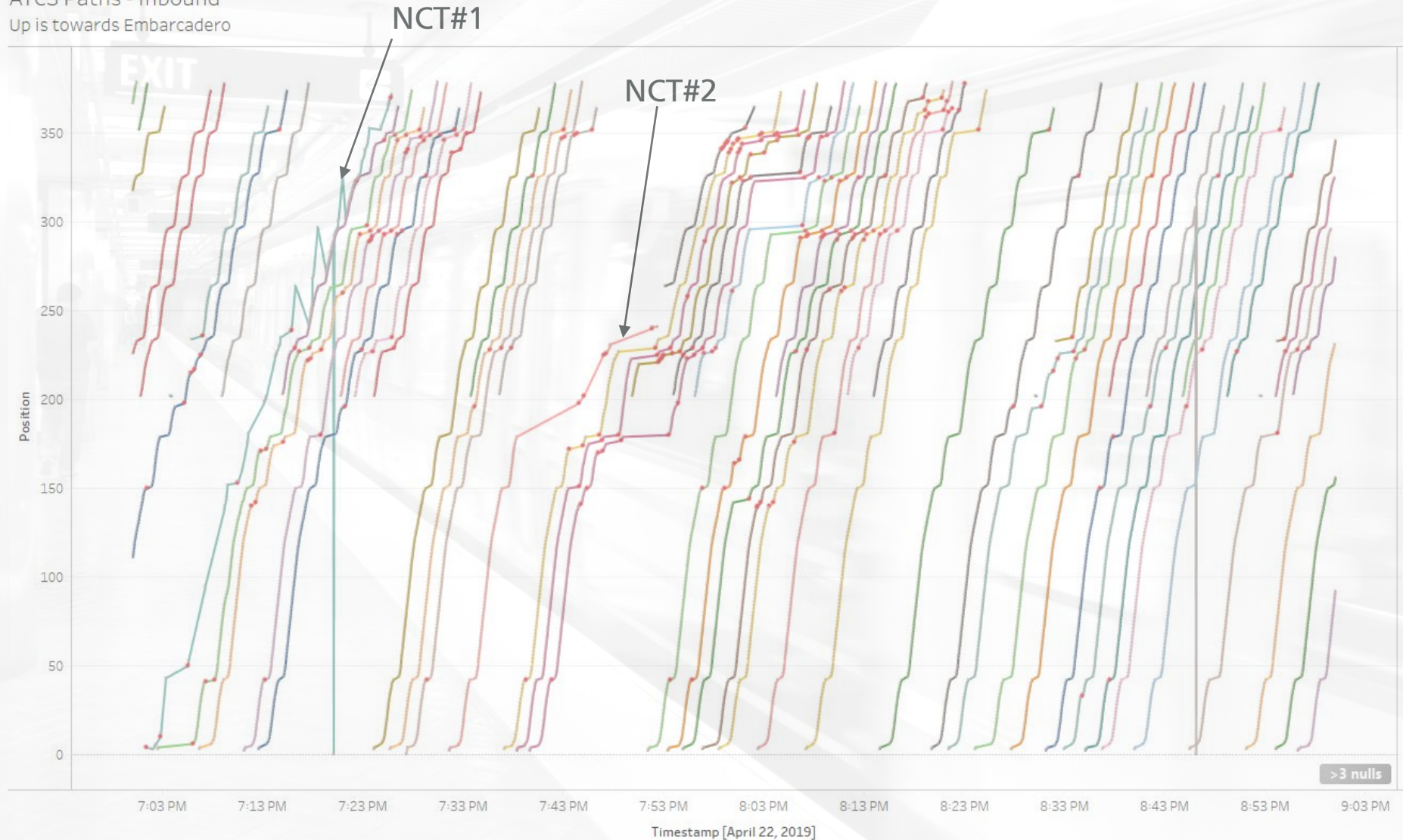
# Capacity

## Subway Hourly Throughput



# Non Communicating Trains

ATCS Paths - Inbound  
Up is towards Embarcadero



# The project

10-year upgrade and expansion of communications-based train control (CBTC) to improve Muni light rail service.

## Reduced Delays

Subway delays reduced by 20-25% through reduced train control failures and reduced congestion

## Improved Maintainability

System monitors redundant components for faults so preventative action can be taken before service is affected

## Consistent trip times

Expanding system to surface and integrating with traffic signals means trip times are less variable

## Greater capacity

System enables better supervision and management of trains, addressing bottlenecks and increasing capacity

# The project



Upgrades loop-cable based system in subway to redundant, reliable wireless communications



Installs same wireless communications equipment along the surface right of way



Ties isolated surface signals and switches into the same single, centrally controlled network as the subway



Replaces central computers, local computers, and onboard computers with latest technology

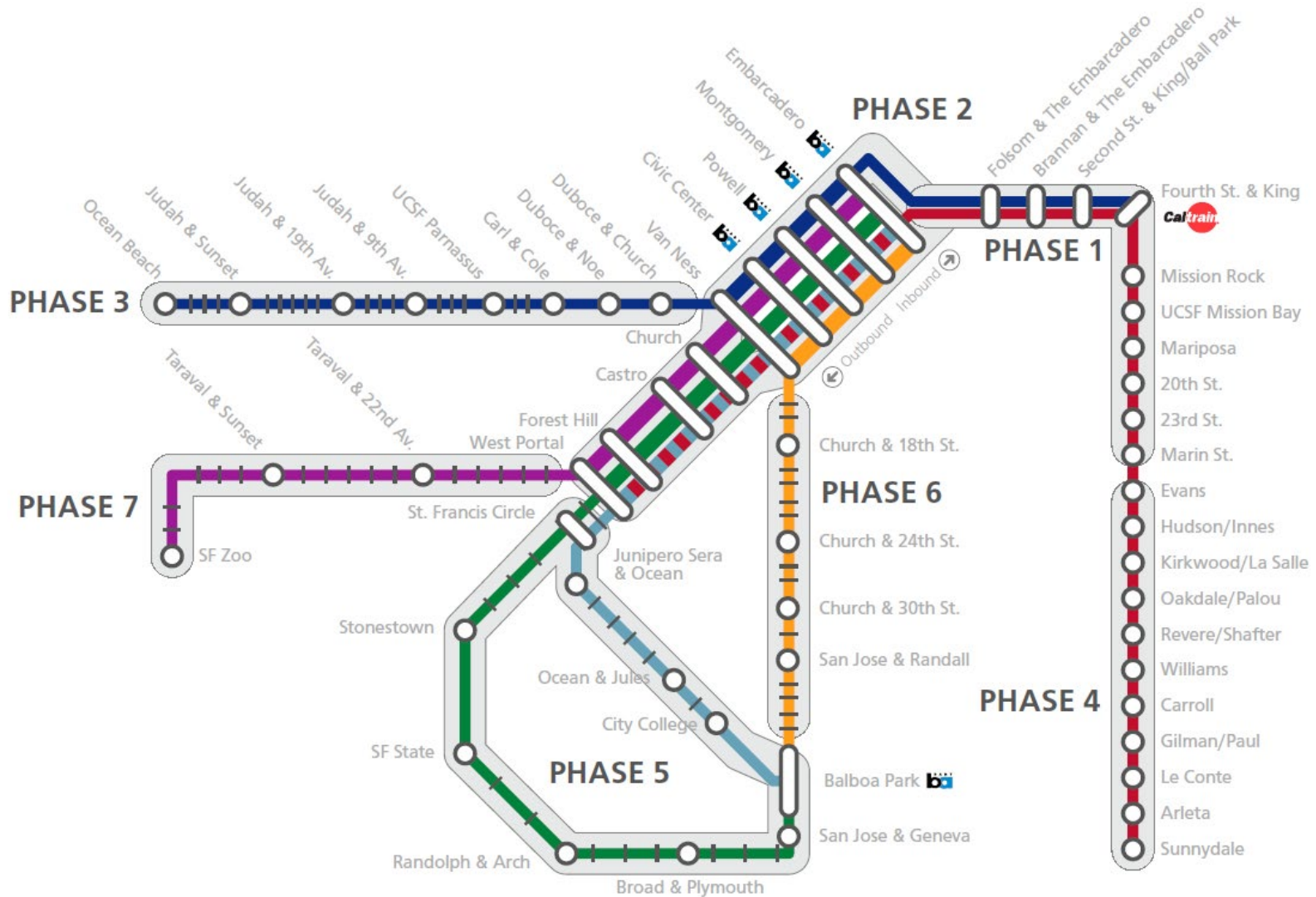


Interfaces with traffic signals to provide train priority (trains don't get stopped at red lights)



Provides central control with tools to adjust train dwell and speeds anywhere on the system to manage bunches and gaps

# Preliminary project phasing



The background of the slide is a faded photograph of a city street. In the foreground, a person wearing a white safety vest and a hard hat is walking across the street. In the background, a white bus is visible, with the number '2034A' and the destination 'EMBARCADERO' on its front. The overall scene is in grayscale, with the text overlaid in various colors.

# In the meantime...

- **Streamline Turnback Operations at Embarcadero**
  - **Manual Control of West Portal Intersection**
  - **Early Shutdown for Preventative Maintenance**
  - **Quicker Response to Breakdowns**
  - **Provide Better Customer Information During Disruptions**
  - **Use Gap Trains to Close Gaps**
- **Reduce Number of Turnbacks at Embarcadero**
  - **Activate New West Portal Crossover**

# Short Term Congestion Relief

- MMT is currently the bottleneck; if we are able to reduce the number of trains through MMT per hour, we can reduce the congestion.
- Activation of the West Portal crossover will enable longer, higher capacity trains.
- By running fewer, longer trains we can reduce congestion while maintaining capacity.



# Next Steps

**Fall 2019**

Train control upgrade strategy; provides a plan for future upgrades and investments in train control

**Spring 2020**

RFP for new CBTC on surface and subway

**Summer 2020**

Activation of West Portal Crossover; new service plans possible

**2023**

First benefits on initial segment (Embarcadero to C. Chavez)

**2026**

New system fully operational in subways

**2029**

Entire Muni Metro system fully integrated into new CBTC



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# Questions?

