



**SFMTA**

A blue-tinted photograph of a subway train (number 2001A) stopped at a station platform. The train is white with blue accents. The platform has a brick floor and a white safety line. An 'EXIT' sign is visible in the background.

# **Subway Design and Performance**

**Julie Kirschbaum, Director of Transit**

# What makes great subway service?

Mass transit works best when it takes you from where you are to where you want to go more easily, reliably, and cheaply than other modes.

Dedicated right of way	High frequencies	Reliable	Accessible
Gets everything and everyone out of the way, permits high speeds and low incidence of disruption	You can just wander into the system with confidence your wait will be short and your connections will be plentiful	Passengers are confident they know the length of time their trip will take	The system is easily navigable—people of all abilities and backgrounds understand how to use the system

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## High frequencies

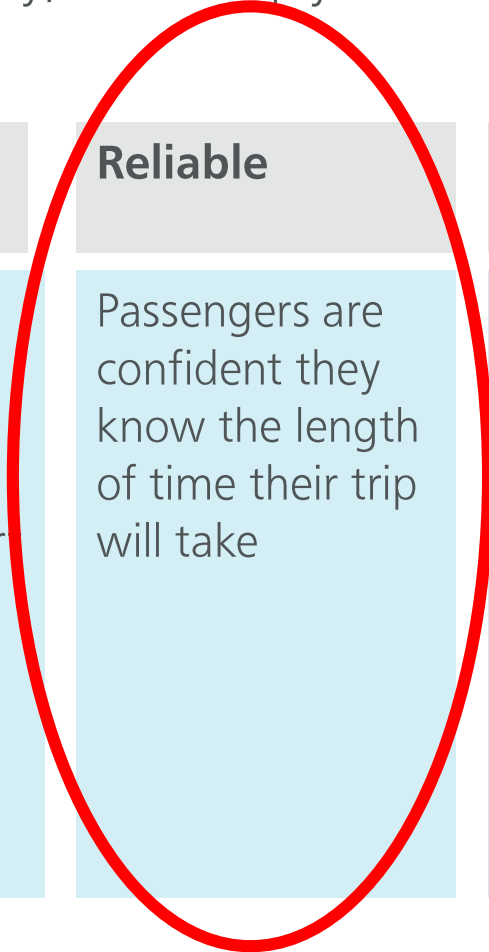
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## Reliable

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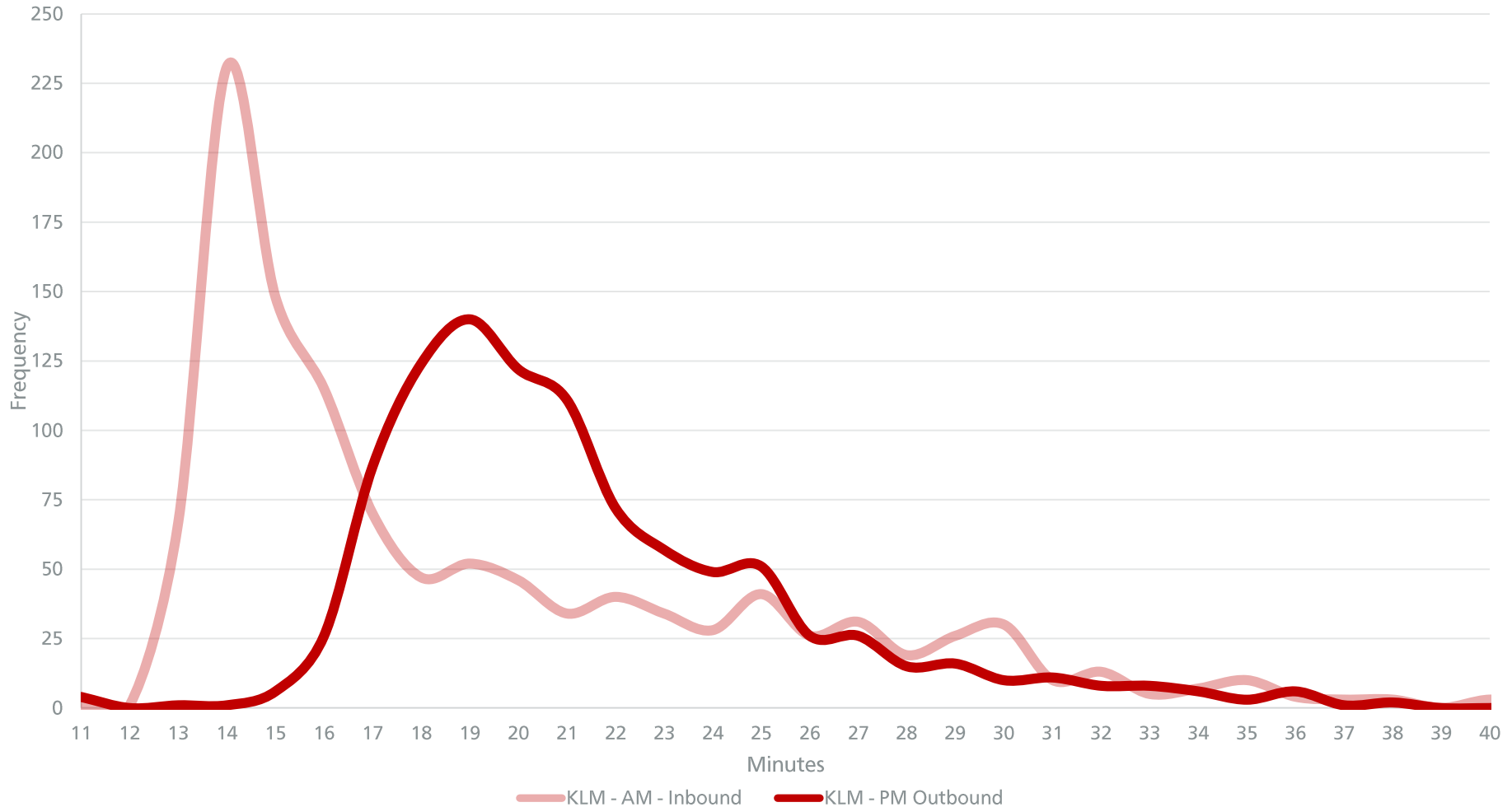
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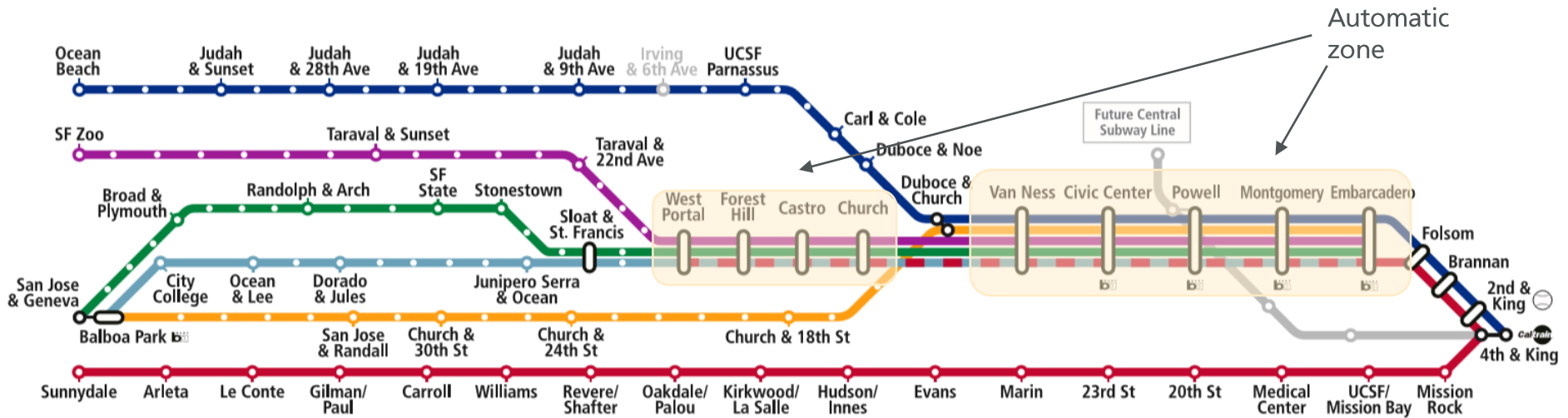


# Subway Metrics – Travel Time Variability

January 2019 Travel Time  
KLM



# How does our system work?

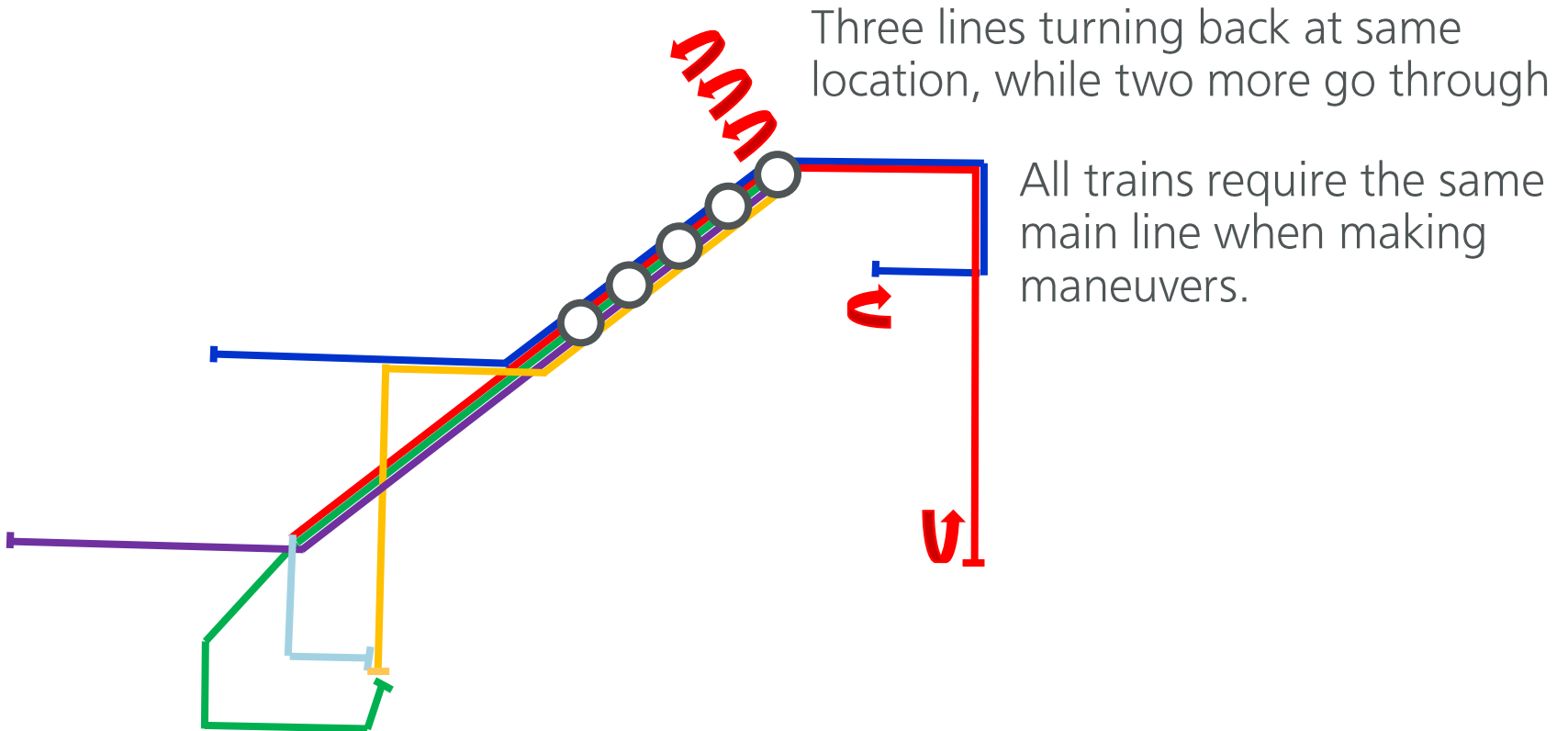


Our system features a combination of train control:

- Automatic control: West Portal-Embarcadero is controlled by a computer system
- Manual control: All other segments are managed by an operator

# Muni Subway Today

## 2 Turnbacks



# SFMTA system today

## Automatic Control (Subway)

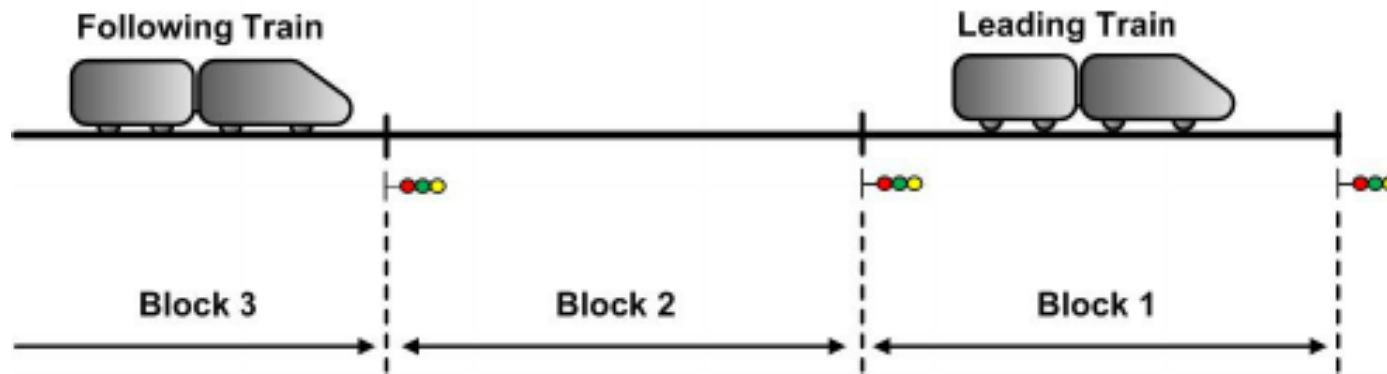
- A train entering a portal (we have three) pings the central computer system
- The system does a “handshake” with the vehicle, and routes it automatically
- System keeps vehicles safely spaced
- System controls use and activation of switches to route vehicles
- Operators open/close doors, but all other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

## Manual (Surface)

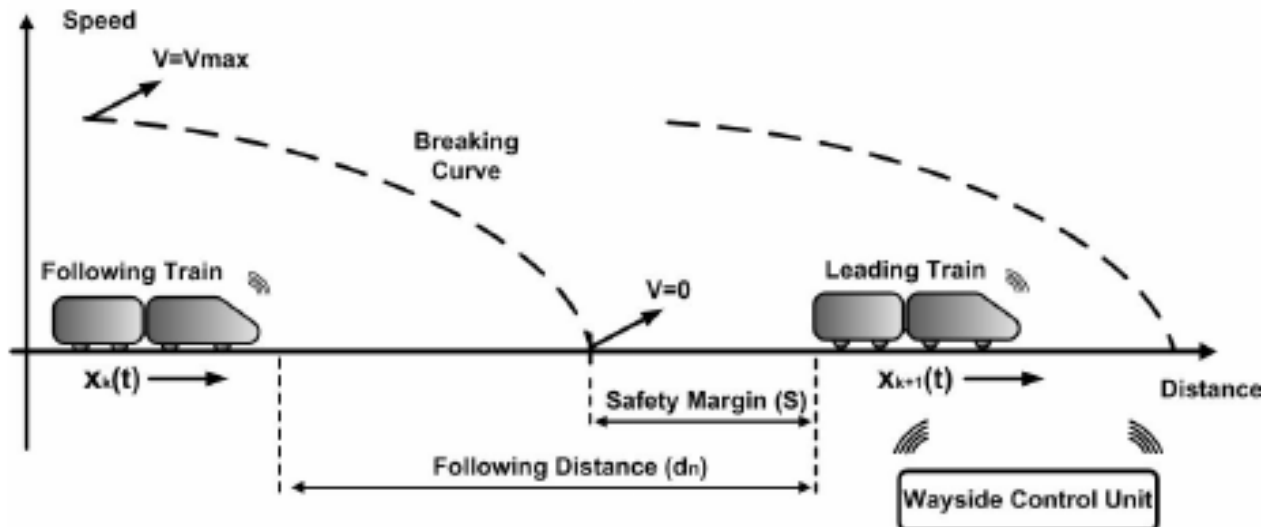
- A vehicle on the surface is controlled by the operator
- Signals and switches are controlled by “VETAG”, an onboard system that pings a wayside computer
- Signals are all independent of one another, no central spacing management

# Types of train control

## Fixed block

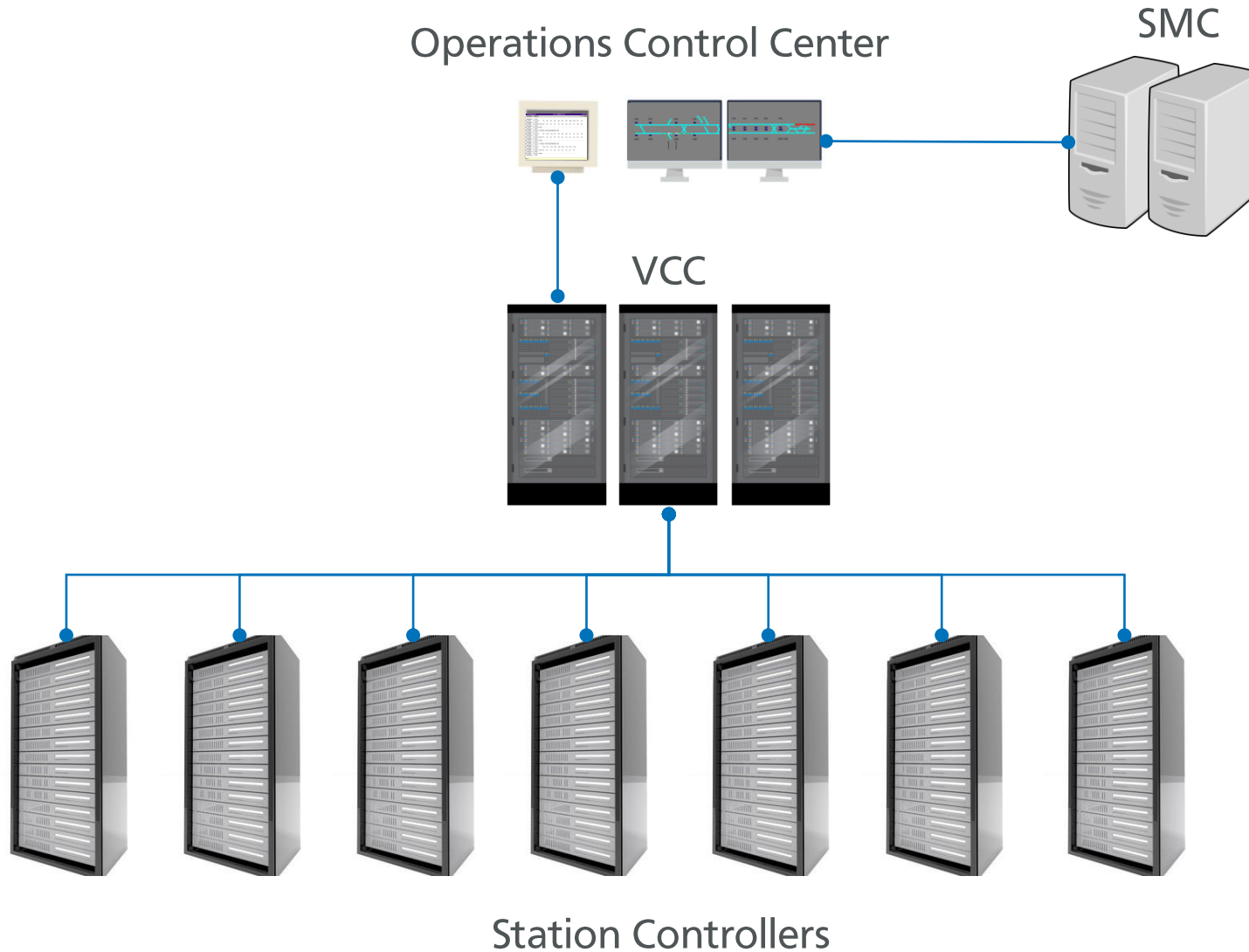


## Moving block

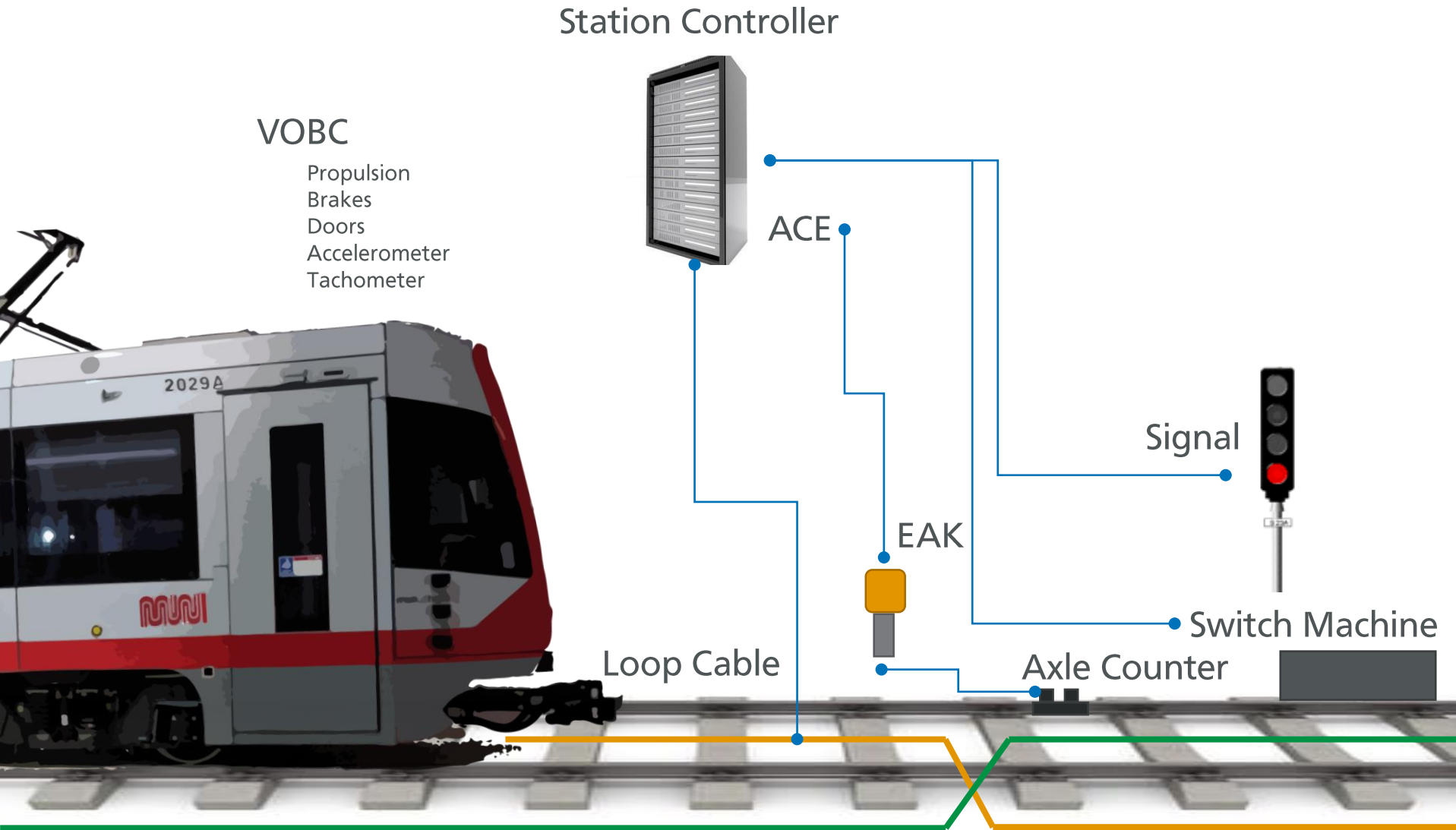




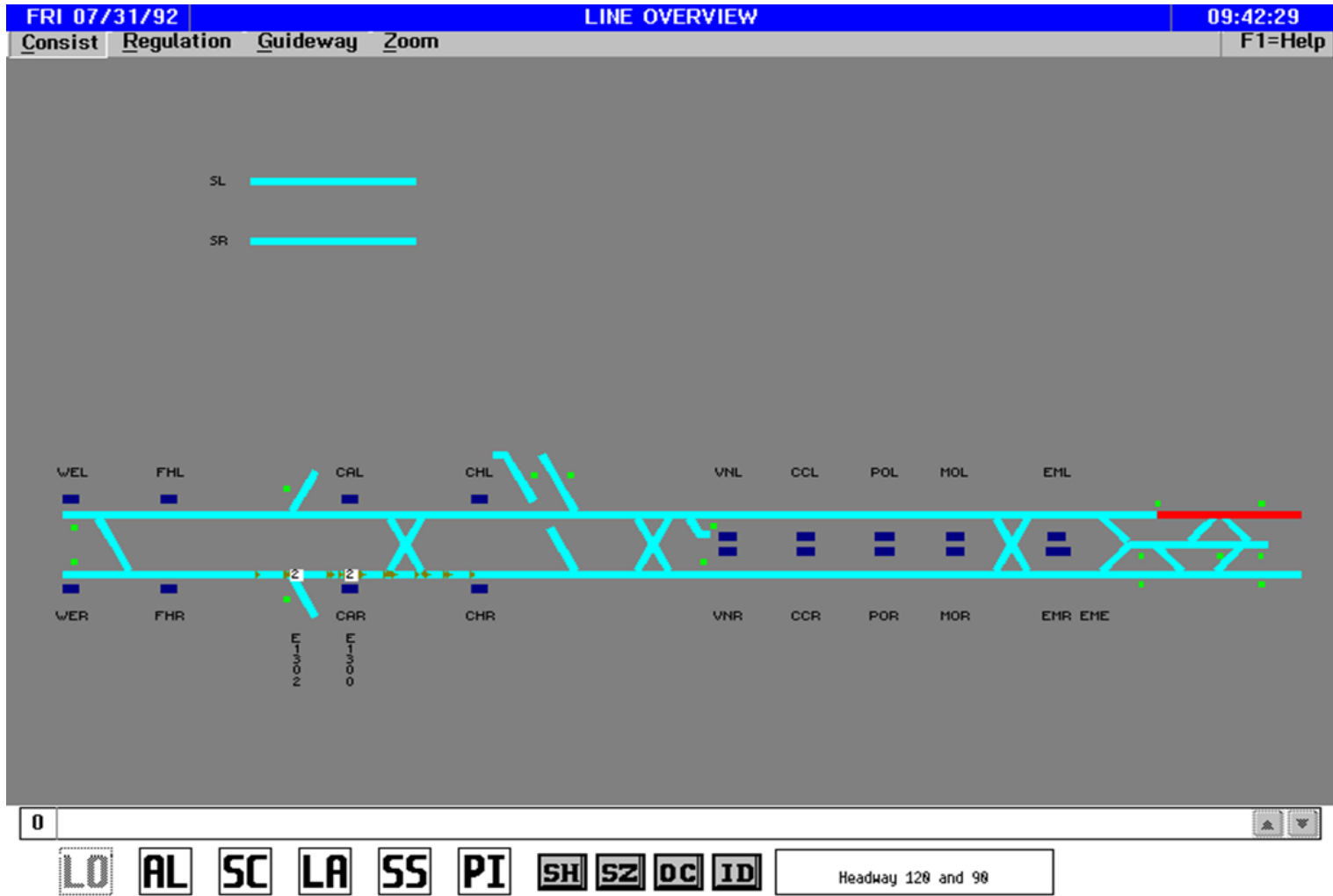
# ATCS System Overview



# ATCS System Overview



# SMC – System Management Center



# Why Are There So Many Subway Delays?

System delays can be categorized into two types: **acute delays** caused by some sort of emergent event, and **chronic congestion** where trains are “stuck in traffic.”



ACQUIRE  
ATCS  
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# Types of Subway Delays

## Acute Delays

Vehicle Breakdowns

Infrastructure Failures

Intruders/Falls/Dogs

Medical/Police Emergencies

Communication Failures

Failed Entries

ATCS Computer Failures

ATCS Infrastructure Failures

## Chronic Congestion

Subway congestion

Bunching

Non-Communicating  
Trains

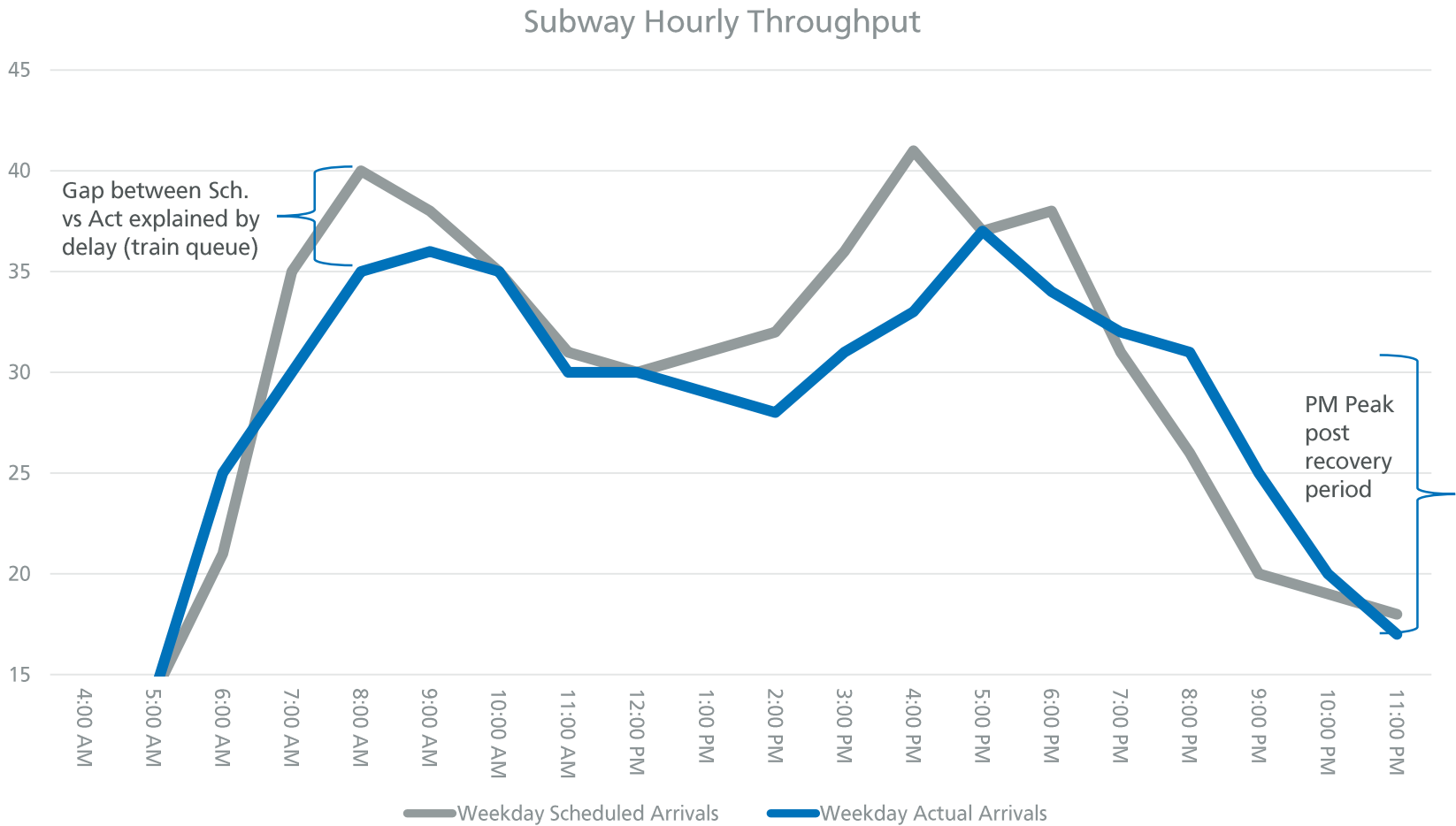
Street congestion

Green: Train control related

Gold: Maintenance related

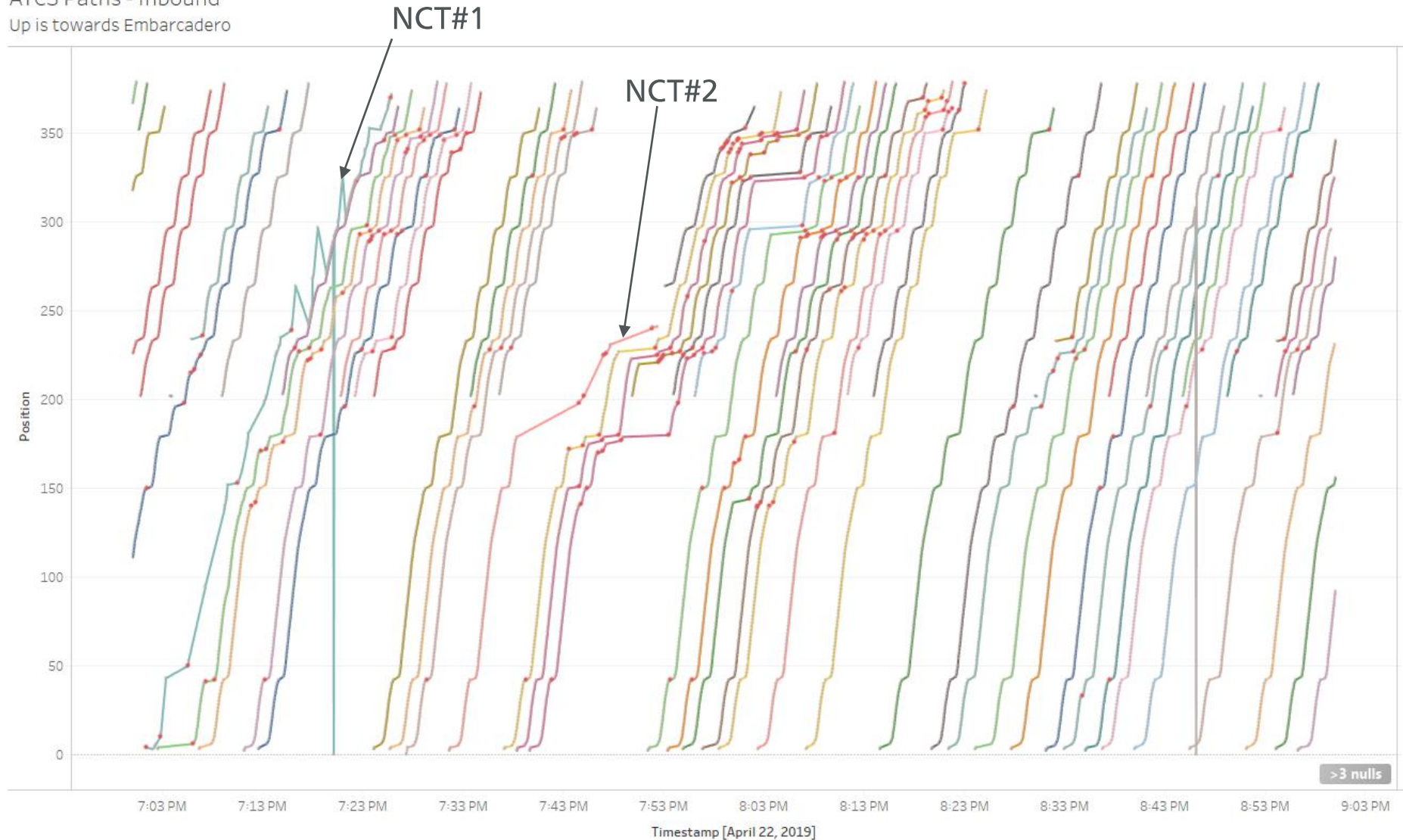
Gray: Outside of Muni control

# Weekday Actual vs Scheduled Subway Throughput



# Non-Communicating Trains

ATCS Paths - Inbound  
Up is towards Embarcadero





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

The present system 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



# Improving Subway Performance

- 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

# Embarcadero Crossover

- Turnbacks on mainline reduce subway capacity because they block train movements in both directions for 3 to 4 min
- Embarcadero crossover is critical for managing incidents and gaps in service (similar to Castro)
- Current functionality of crossover limited, but will be enhanced as part of upcoming 90 day plan



# Major Capital Investments

## **New Train Control System**

Replacement of the over 20 year old ATCS with a modern communications-based train control system, and expansion of that system to include both surface and subway operations.

## **Harrison Pocket Track**

Construction of a pocket track on the Embarcadero provides an additional location to turnback trains outside of the MMT

# New Train Control System

## Modern Equipment

New systems use modern standards like WiFi and cellular, provide redundant communication to keep trains connected. New equipment is less failure-prone than today.

## Better Software

Better software will allow for increases in capacity through more efficient operations. Software can also predict faults to reduce delay-causing failures in service.

## Traffic Signal Coordination

Train control system communicates with traffic signals so trains don't get stopped by red lights.

## Supervision Everywhere

A system-wide train control allows trains to enter system at yards, cutting out portal entry delays. It also permits better sequencing on the surface to avoid bunches/gaps.



Thank You

