

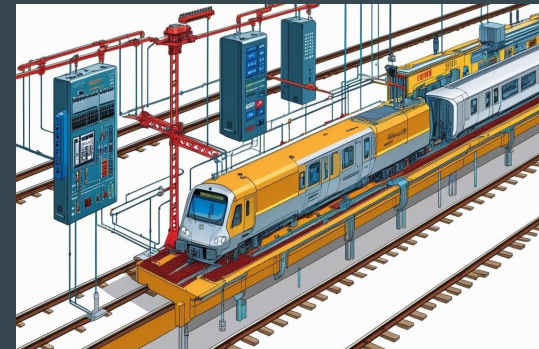
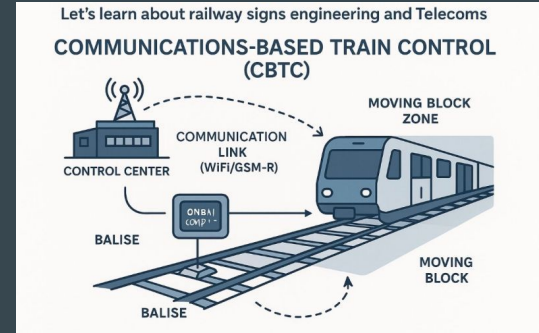
Communications-Based Train Control



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Intro / Problem

- Train system is very slow
- Light system and communications fails a lot
- We wanted to make a system that is more reliable and faster for users
- Lack of a reliable and advanced subway system.



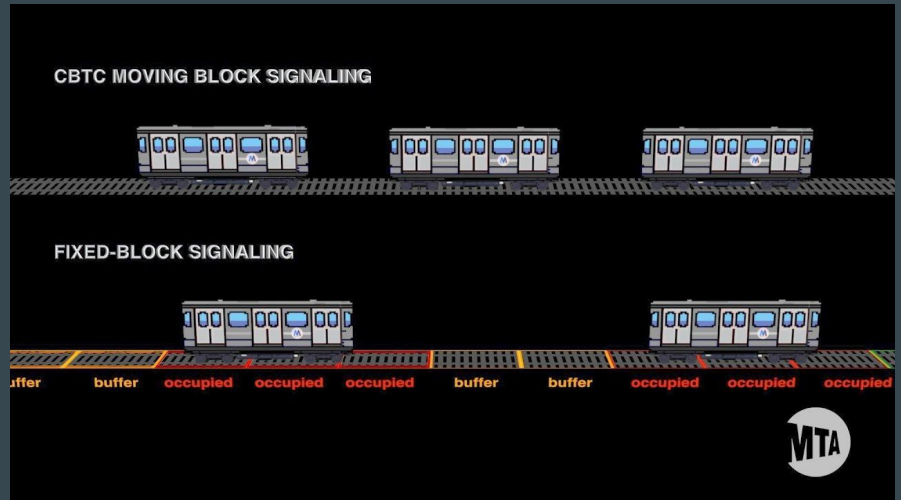
Previous Attempts and Our Solution

Enhanced Subway Program of 2016:

- Focused on Cosmetic Upgrades
- Did Not Address Train coordination and Signalling
- Extensive Infrastructure Decay Delayed the Project

CBTC:

- Utilises Live Wireless Communication Between Trains
- Fixed “Blocks” Are Replaced with Dynamic “Blocks”
- Maintains Consistent Spacing Between Trains



Costs

Cost of Fixing Subway Delays (CBTC System):

- \$25 Million per mile (signal)
- \$12-15M per train car
- 50 miles = \$1.25 Billion
- Station: \$28M-\$43M each

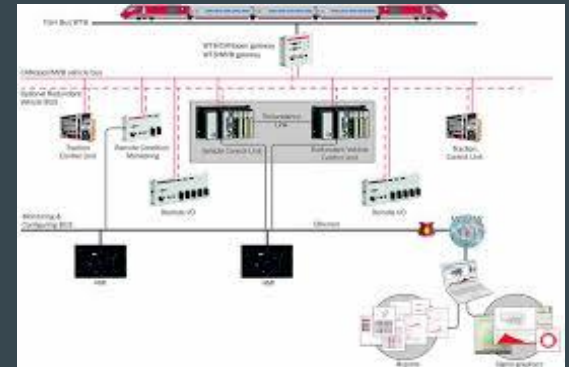
Why so expensive:

- New digital System (CBTC)
- Removing old signals
- Complex underground work
- Advanced tech + high labor costs



Materials and resources

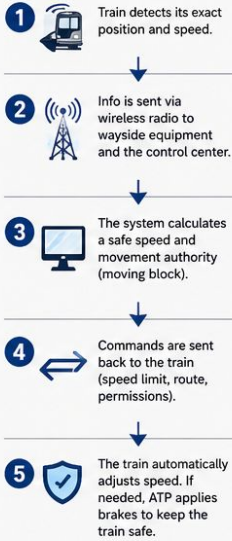
- Zone Controllers(Temp)
- Antennas (RF)
- Train Control Management System
- Radars
- Locking-systems
- Engineers/contractors



NYC SUBWAY CBTC TRAIN CONTROL SYSTEM

Communication-Based Train Control (CBTC) replaces fixed wayside signals with real-time communication to safely move trains more efficiently.

HOW CBTC WORKS (OVERVIEW)



CBTC = MOVING BLOCK

Trains are separated in real time based on their exact position, allowing closer headways and more service.

MAIN COMPONENTS & PARTS

1. ONBOARD TRAIN EQUIPMENT

Installed on each train.

- Onboard Computer (OBC)
- ATP (Automatic Train Protection)
- ATO (Automatic Train Operation) – where used
- DMI (Driver Machine Interface) / Cab display
- Radio (Wi-Fi)
- Speed & position sensors (odometer, accelerometer)



2. WAYSIDE EQUIPMENT

Located along the track.

- Wayside Radio Units (Wi-Fi)
- Zone Controllers (trackside computers)
- Transponders / Balises (position reference points)
- Axle Counters (train detection)
- Switch Controllers
- Power & equipment cabinets



3. COMMUNICATION NETWORK

Provides continuous two-way data.

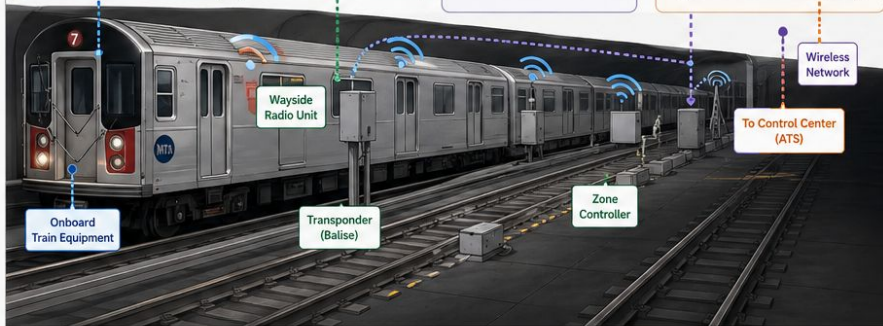
- Redundant Wi-Fi network (5 GHz)
- Leaky feeder / fiber backhaul
- Wayside to train and wayside to control center links



4. CENTRAL CONTROL (ATS – AUTOMATIC TRAIN SUPERVISION)

System that monitors and manages all train movements.

- Servers & applications
- Real-time train tracking
- Movement authority calculation
- Speed commands
- Route setting & interlocking
- Alarm monitoring & logging
- Operator workstation displays



CENTRAL CONTROL CENTER



KEY BENEFITS

-  **Higher Capacity**
Trains run closer together safely, reducing headways.
-  **Improved Reliability**
Fewer delays and more resilient operations.
-  **Enhanced Safety**
Continuous monitoring and automatic protection.
-  **Energy Efficiency**
Smoother operations reduce energy use.
-  **Better Customer Experience**
More service, less waiting.

CBTC (MOVING BLOCK)

Trains are separated by real-time continuous calculation.



Closer spacing = more trains = more capacity





TRADITIONAL SIGNALING (FIXED BLOCK)

Track is divided into fixed blocks with signals.



More spacing = fewer trains = less capacity

LEGEND

-  Onboard (train)
-  Wayside (trackside)
-  Communication (wireless)
-  Central Control (ATS)

Benefits of CBTC Implementation

- Improved reliability and train consistency.
- Reduced delays and wait times.
- Increased train capacity and efficiency.
- Enhanced passenger safety.



Challenges

- High installation and upgrade costs
- Temporary service disruptions during installation
- Complex coordination across subway lines
- Legal, safety, and regulatory requirements
- Long timeline for full system integration



Conclusion

- NYC subway delays are caused by outdated signaling systems
- CBTC provides a modern, data-driven solution
- Improves efficiency, safety, and reliability
- While costly, it is a long-term investment in infrastructure
- Partnership with the MTA allows realistic implementation
- Overall, CBTC can transform the subway into a faster, more dependable system

Thank You