

# 03 Metro-North Railroad

Passenger vehicles  
and yards

Passenger stations

Grand Central Terminal  
and Grand Central Artery

Right-of-way

Signals, power,  
and communications

## Overview of agency and assets

Metro-North Railroad (Metro-North) provides service into and out of Grand Central Terminal in New York City on our Hudson, Harlem, and New Haven lines, which extend as far north as Dutchess County in New York and as far east as Fairfield and New Haven counties in Connecticut, forming our East-of-Hudson service territory. West of the Hudson River, riders travel on our Port Jervis and Pascack Valley lines. This West-of-Hudson service—provided under an agreement with New Jersey Transit—serves Rockland and Orange counties in New York.<sup>4</sup>

We need to invest in and properly maintain our aging infrastructure to successfully support current and future operations and ensure the delivery of safe and reliable service that meets the growing and changing demands of Metro-North's riders.

### Metro-North by the Numbers:

- **Weekday ridership: Approximately 210,000 trips**
- **912 railcars**
- **39 shops and 11 yards**
- **85 passenger stations**
- **513 miles of track (254 track miles of third rail power)**
- **331 overhead bridges, 201 undergrade bridges, 9 tunnels, 4 viaducts**
- **571 mainline switches**
- **67 power substations**

4. This plan reflects Metro-North's New York state assets. The New Haven Line assets operated by Metro-North in Connecticut are the responsibility of Connecticut Department of Transportation and certain assets of the Port Jervis and Pascack Valley Lines are the responsibility of NJ Transit.



EMU trains on the Park Avenue Viaduct

## Investment needs highlights

Over the next 20 years, our priority investment needs include:

- **Passenger vehicles and yards**
  - Purchasing over 750 new railcars, including 15 new locomotives for West-of-Hudson service, to replace aging cars and improve reliability, accessibility, and passenger experience.
  - Expanding railcar maintenance facilities and train storage yards, and replacing outdated and temporary shops with modern workshops for our Maintenance of Way teams.
- **Passenger stations**
  - Rehabilitating stations to address high priority structural issues, particularly at Harlem Line stations with deteriorating platforms.
  - Improving the customer experience for all of our riders by replacing station elevators and by installing upgraded public address (PA) systems, real-time train information screens, and security cameras at over 50 stations.
- **Grand Central Terminal and Grand Central Artery**
  - Upgrading and modernizing the structure and support systems of the historic Grand Central Terminal Building and connecting infrastructure.
  - Reconstructing deteriorated structural elements of the 110-year-old Grand Central Train Shed, the massive, bi-level structure underneath Park Avenue.
  - Continuing to reconstruct deteriorated structural elements and make improvements to the Park Avenue Viaduct and the Park Avenue Tunnel.
- **Right-of-way**
  - Doubling the pace of the current track replacement program.
  - Replacing and rehabilitating bridges and drainage systems, focusing on over 100 bridges and existing poor drainage areas.
  - Implementing the climate resilience measures needed to protect Metro-North assets from the effects of climate change, such as stormwater flooding, extreme heat, and sea level rise.
- **Signals, power, and communications**
  - Upgrading our traction power system with new power substations which will improve reliability and allow us to run more trains across the Metro-North network.
  - Replacing over 150 miles of Harlem and Hudson line legacy, relay-based signal systems with new, updated signaling technology and improving our ability to monitor and regulate train service by installing a next generation, modernized Operations Control Center.



Harrison Station on the New Haven Line

## Metro-North Railroad appendix structure

The Metro-North appendix provides an overview of the agency's assets, their current condition, and expected investment actions to maintain and improve them over the next 20 years. This appendix is divided into asset groupings, based on how the categories function together. For example, our passenger vehicles are supported by our shops, yards, and facilities, so together they form an asset grouping. We provide a summary of each asset grouping, describe how the asset categories support each other, and then provide a 20-year vision for their maintenance and enhancement. Each asset category section then provides a more detailed description, an inventory showing their ages or the percentage of assets in poor or marginal condition, followed by the agency's investment needs and priorities for the next 20 years.

## Our asset rating methodology

We perform regular and comprehensive inspections of all of our assets. Through these inspections, all assets are given a condition rating on a scale of 1 to 5, based on various factors, including age, condition assessment, performance, reliability, safety history, and location. Assets with a rating of 1 (poor) or 2 (marginal) help us identify where we need to focus investment needs the most. This rating scale is consistent with the Federal Transit Administration's Transit Economic Requirements Model scale. A brief description of the rating scale is provided below.



**1. Poor (Deteriorated):** Critically damaged or in need of immediate repair, well past useful life. Assets are operable with extraordinary maintenance, but have serious functional deficiencies and/or can be expected to experience potentially unacceptable stoppages over the next five years, which could have serious negative impacts on service within the existing maintenance framework. Assets require operating-funded interventions, which may include more frequent inspections and/or repairs that may include removing the asset from service until repairs can be performed. Capital investment in these assets is needed on a priority basis.



**2. Marginal (Deficient):** Deteriorated, in need of replacement, and may have exceeded useful life. Assets have functional deficiencies and/or can be expected to experience above-normal stoppages over the next five years, but severity of customer impacts or changes to operational practices can be held within acceptable bounds for a time within the existing maintenance framework. If capital investment is/was deferred for these assets, added maintenance and operating expenses would be expected.



**3. Adequate (Acceptable):** Moderately deteriorated, but has not exceeded its useful life. Assets that are not necessarily meeting all current technical and functional standards, but are considered adequate for service and can be expected to experience normal stoppages that can be fully accommodated within the existing maintenance framework. These assets may require cyclical replacement in the next five years.



**4. Good:** No longer new, but in good condition and still within its useful life. Assets may be slightly deteriorated, but are overall functional within the normal maintenance practices.



**5. Excellent (Modernized):** No visible defects, new or near new condition and may still be under warranty (if applicable). Considered to meet most or all important technical and functional standards.

It is important to note that an asset condition rating is not an indicator of safety. Safety and risk assessments are performed separately from asset condition ratings and are addressed on an ongoing basis.

# PASSENGER VEHICLES AND YARDS

## → Passenger vehicles and yards

### Passenger stations

**Grand Central Terminal  
and Grand Central Artery**

**Right-of-way**

**Signals, power,  
and communications**

**Our trains provide approximately 200,000 passenger trips every weekday, with most arriving in Manhattan from points north in New York and east in Connecticut. When trains are not in service, our shops, yards, and facilities allow for fleet storage, maintenance, and inspection services, and play an important role in our continuing ability to provide safe and consistent service.**

**Metro-North owns a fleet of over 900 passenger vehicles, ranging in age from new to over 50 years old. To ensure passenger safety, federal regulations and Metro-North procedures require testing and inspections of railcars and locomotive components and systems each day they are in service. This includes inspecting braking and power systems, lights, wires, cables, doors, air conditioning, radios, and more. These basic inspections take place at our yards before trains are put into service. Yards are also used to stage repair materials for assets across our network. More extensive work is performed at our shops, where railcars undergo regular interior and exterior cleaning, as well as more comprehensive inspections and scheduled maintenance at recurring intervals to ensure reliability.**

**As demand for Metro-North service has grown over the years, so too has the size of the fleet, resulting in inadequate shops and yard space in certain locations. Our vision for shops and yards includes new and upgraded facilities configured to better support railroad operations for today and into the future. By providing specialized facilities for different types of railcars, we can better ensure the reliability of our entire fleet. Building new shops for our Maintenance of Way (MOW) crews will provide the space needed to address repairs more rapidly throughout our system.**

**Our investment needs over the next 20 years include:**

- **Purchase over 750 new vehicles, including 15 new locomotives for West-of-Hudson service, which will allow us to retire aging railcars in our fleet.**
  - **The new fleet will be accessible, energy-efficient, utilize environmentally friendly technologies, and will incorporate modern amenities such as charging ports, digital screens, and communication systems to improve the rider experience.**
- **Replace inadequate, outdated facilities and temporary buildings with modern shops to properly support our MOW teams.**
- **Expand railcar maintenance facilities and train storage yards at key locations so more trains can be inspected, repaired, and returned to service quickly and efficiently.**
- **Build resilience against the effects of climate change. We must ensure new facilities account for the impacts of increased flooding and heat by including elements such as enhanced drainage systems, perimeter walls for floodproofing, and elevated assets.**
- **Continue to support MTA-wide sustainability efforts and reduce greenhouse gas emissions by capitalizing on opportunities to implement technologies that conserve energy, reduce fossil fuel use, and generate renewable energy on-site.**

# Passenger vehicles

**Keeping our passenger vehicles in good condition is vital to ensuring safe and reliable service, making the maintenance and upkeep of these assets critical to providing the riding experience our customers expect. Our passenger vehicle fleet includes:**



**Coaches**

A railcar that carries passengers; one or more coaches make up a train that is pushed or pulled by a locomotive.



**Locomotives**

A vehicle that pulls and pushes passenger coaches. Locomotives are powered by both diesel and electricity.



**Electric Multiple Units (EMU):**

These passenger railcars, which include our M3, M7, and M8 models, are self-propelled coaches that draw electric power from a third rail or overhead wires, and do not require a locomotive.

We will continue replacing passenger vehicles as they reach the end of their useful life and we plan to procure locomotives that can use electric power more extensively and efficiently, resulting in reduced greenhouse gas emissions and fossil fuel dependence.

## Asset inventory and status

We use two primary indicators to assess the condition and performance of our fleet, which together guide decisions on when further investment or replacement is warranted. For example, for our EMU railcars, the condition and performance indicators are as follows.

- **Useful life:** Older railcars are more prone to break down, generally require more extensive and costly maintenance to keep in service, and are less comfortable for our passengers due to worn interiors. They also sometimes lack modern amenities or do not meet the accessibility standards we have for new railcars. Any railcar over the age of 40 is considered past its useful life. We plan to continue replacing railcars before they reach the end of their useful life.
- **Mean Distance Between Failures (MDBF):** This is a measure of reliability that expresses the railcar's mean (average) operating distance mileage traveled between all train delay failures. The MDBF measure is used to inform decisions about how and when perform maintenance, as newer cars perform much better than cars slated for replacement. In 2022, the MDBF of the M8 EMUs was approximately 802,000 miles compared to about 93,000 miles for the M3 EMUs

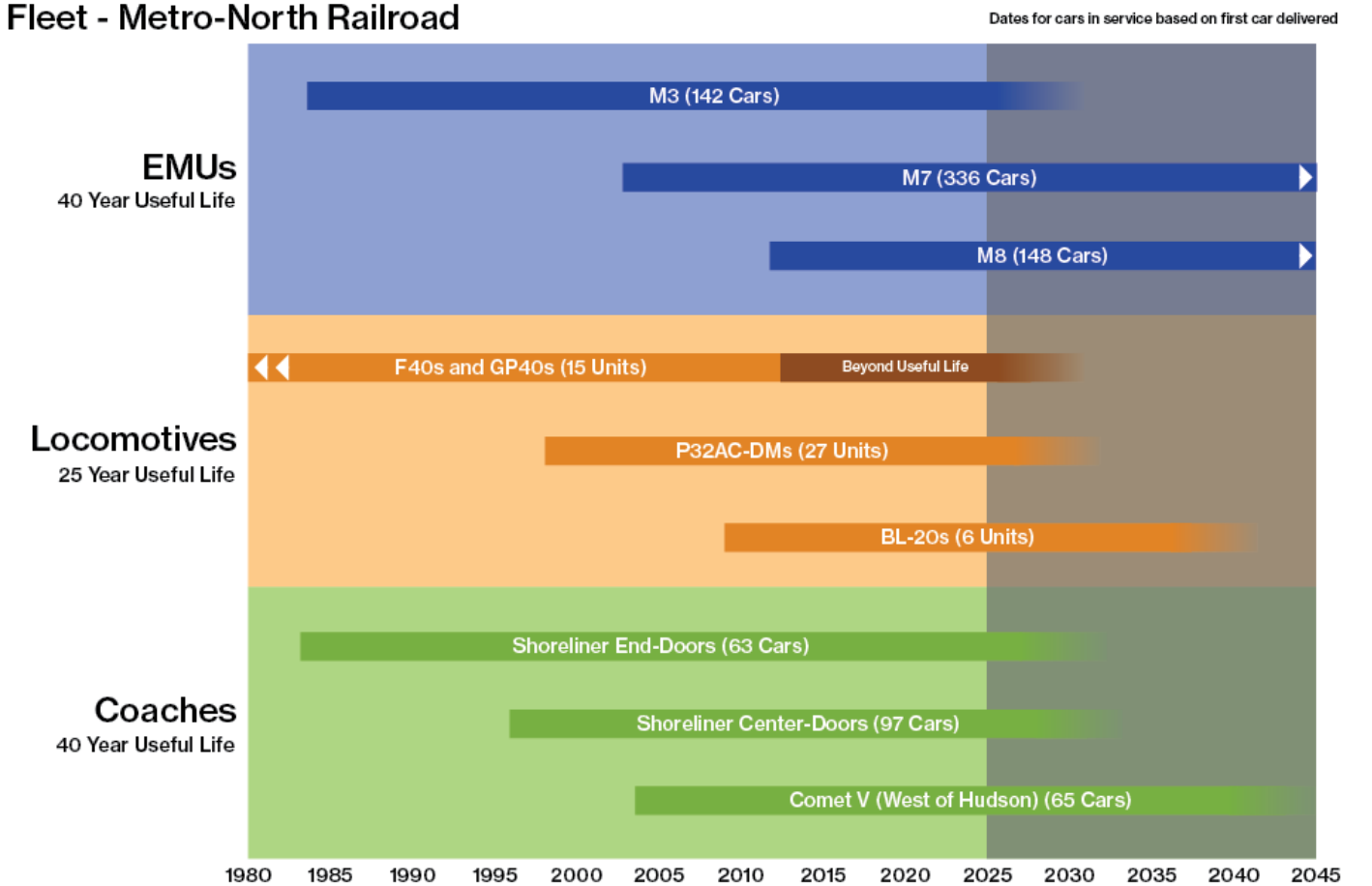
## Investment needs

To keep all EMU railcars within their useful life of 40 years, we will need to replace over half the fleet in the next 20 years. We plan to purchase new locomotives for increased reliability and lower emissions; replace our older M3 EMUs with new, modern M9A EMUs; replace the East-of-Hudson coach fleet; and begin the replacement of our M7 EMUs when they reach the end of their useful life.

Over the next 20 years, we need to:

- Upgrade the passenger fleet through the continued replacement of the M3 EMUs that have been in service on the Hudson and Harlem lines since the 1980s and are past their useful life. These will be replaced with new M9As that are a next generation railcar equipped with multiple amenities to improve customer experience, including better accessibility, wider seats, electrical outlets, and multimedia screens.
- Begin the planning process needed to replace the M7 fleet. MNR's M7 fleet (36% of MNR's total fleet), will reach the end of its useful life at the end of the 20-year period. A failure to commence the replacement of the M7 cars by the end of their useful life will potentially cause greater frequency of breakdowns, increased operating costs, and trains not offering the quality and customer experience that our passengers deserve.
- Upgrade our locomotive fleets, including replacing locomotives in service in Metro-North's West-of-Hudson territory and diesel locomotives used in East-of-Hudson service.
  - Upgraded "dual-mode" engine technology will be employed for locomotive procurements. This maximizes the potential to use electricity from the third rail or overhead catenary, greatly reducing the use of diesel, and together with Tier IV engines, will reduce the production of both greenhouse gas emissions and local air quality pollutants, such as particulate matter and nitrous oxide.
- Upgrade our coach fleet through the replacement of the Shoreliner coaches used on our East-of-Hudson services. The oldest cars are nearing the end of their useful life and not up to current accessibility standards. The new fleet will be compliant with the Americans with Disabilities Act (ADA).

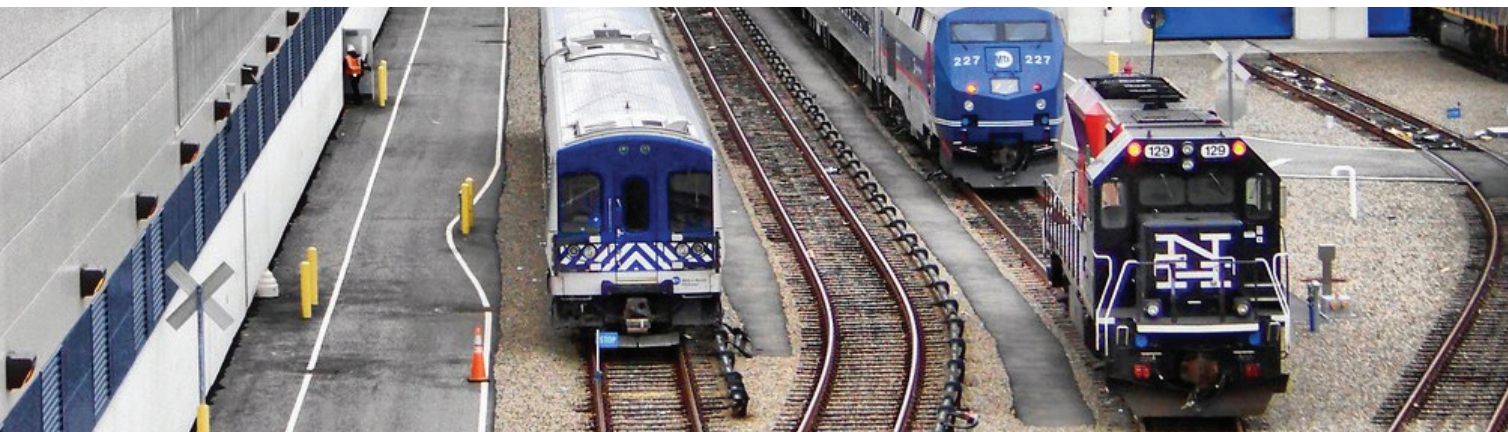
## Rail Fleet - Metro-North Railroad



# Shops, yards, and facilities

**Yards are used for the staging, inspecting, servicing, and storage of our passenger vehicle fleets. The yards are also home to many of our shops, which fall into two categories based on function.**

- **Maintenance of Equipment (MOE) shops, which are found exclusively in our yards, are where our workers perform inspections, repairs, retrofits, and overhauls of passenger vehicles.**
- **Maintenance of Way (MOW) shops are where we store or maintain equipment and materials needed for maintaining and improving the rail system and right-of-way infrastructure. Most MOW shops are located in our yards, but they also exist throughout the railroad territory.**



Harmon Shop

## Asset inventory and status

Shops and yards assets are evaluated based on their condition, age, and performance, as well as if sufficient space is available to meet the needs of the railroad. Asset performance considers the ability of the shops and yards to support the fleet and meet maintenance needs. Facilities that are unable to meet these fleet and maintenance needs will be upgraded and reconfigured or replaced. Replacement will be targeted toward poor performing components that are likely to impact fleet reliability or operations.

Inventory and status			
	Asset	Total	Percent in Poor/Marginal Condition
Yards and Yard Assets	Employee Facilities	9	13%
	Utilities	8	38%
	Yard Utilities	36	42%
	Plumbing and Drainage	37	41%
	Fire Protection	2	50%
	Yard Substation	4	0%

Inventory and status			
	Asset	Total	Percent in Poor/Marginal Condition
MOE Shops	Employee Facilities	12	17%
	Air Curtain Doors	6	0%
	Building Exterior	19	21%
	Building Utilities	16	6%
	HVAC	19	11%
	Roofs	19	16%
	Walls	27	11%
	Windows	15	7%
	Equipment (e.g., car cranes, equipment lifts, wheel true)	235	89%
MOW Shops	Air Curtain Doors	1	0%
	Building Exterior	60	72%
	Building Utilities	65	68%
	Employee Facilities	14	50%
	HVAC	16	44%
	Roofs	59	71%
	Walls	96	75%
	Windows	48	67%

## Investment needs

We continuously review the significant interrelated investment needs supporting our shops, yards, and related facilities, including plans supporting new railcars and other yard improvements needed for future needs and fleet growth. To ensure our facilities can meet future operational requirements, we are taking a systemwide planning approach with a focus on reconfiguration, reconstruction, and modernization.

Over the next 20 years, we need to:

- Replace outdated, deteriorated, and temporary shops with new, permanent facilities to support our MOW workforce, providing them with sufficient facilities needed for the ongoing maintenance of the railroad. This includes new facilities at Harmon, North White Plains, Brewster, and in the Bronx.
- Upgrade, reconfigure, and expand MOE shops and yards to better serve the current and future fleet, including the arrival of the M9As, the Shoreliner coach replacements, and new locomotives. We will replace our existing train washing facilities, which have exceeded their useful life.
  - We will reconfigure and expand Brewster Yard to meet our growing fleet needs and improve service operations for the Harlem Line. We will add repair tracks and train servicing locations at our MOE shops and yards.
- Construct a new warehouse to relieve insufficient storage space at existing facilities.
- Make facilities located in coastal flood zones, near streams and rivers, and/or in areas with insufficient local drainage that are prone to flooding, more resilient with investments such as backflow valves and pumping mechanisms.
- Seek to use component replacement opportunities to implement new technologies that can conserve energy, reduce fossil fuel use, and reduce demand for grid electricity. By integrating these practices into normal investment cycles, we will maximize the long-term operational cost savings that are generated through updated building systems.
- Install electric vehicle charging equipment dedicated for MNR use in appropriate locations to meet MTA goals of transitioning to 100% zero-emissions light-duty non-revenue vehicles by 2035 and medium/heavy-duty non-revenue vehicles by 2040.

# PASSENGER STATIONS

## Passenger vehicles and yards

### → Passenger stations

#### Grand Central Terminal and Grand Central Artery

#### Right-of-way

#### Signals, power, and communications

We have 85 passenger stations across five lines in New York state. Passenger stations contain many interrelated systems and individual components, all of which must be maintained so that customers can safely access trains. Station buildings and canopies provide passengers areas to wait for trains; overpasses and underpasses provide access between platforms and other station areas; and platforms allow for safe boarding of our trains. Elevators and escalators provide critical accessibility for our riders, and public communication systems provide key information and audio/visual messages to inform riders of important service updates.

Our investment needs over the next 20 years include:

- Rehabilitate stations to replace dated structures and aging assets, and provide the communities we serve with modern, comfortable stations.
  - Replace deteriorating platforms and other major components at 19 stations on the Harlem Line.
  - Improve station access by constructing new elevators and overpasses and replacing all 105 existing elevators.
- Improve customer experience by enhancing communication systems at over 50 stations, including new PA systems, real-time train information screens, and security cameras. Once completed, all of our customers would use stations with upgraded communication amenities.
- Replace and enhance our aging communication system and network infrastructure with the latest technology to accommodate current operations, address critical obsolescence issues, and provide compatibility and capacity for future needs. This includes:
  - Cyclical upkeep of short-lived technology assets to maintain existing communication and security services.
  - Upgrading and enhancing network infrastructure and obsolete communication systems to provide for updated PA/real-time train information, security cameras with remote monitoring/video management capability, elevator/escalator control and monitoring capabilities, and station intercoms at passenger stations.

# Passenger stations

## Asset inventory and status

Comprehensive inspections of station assets are performed on a regular basis. During inspection, a rating is assigned to all components of the station assets such as elevators, platforms, station buildings, stairs, and ramps. Based on these component ratings, a prioritization list is analyzed to understand the trends and the progress toward getting all assets into good or better condition, as well as to schedule the required capital investments to preserve and maintain their integrity.

An example of an age-based assessment for stations is:

- **Condition:** Most station component replacement needs are determined primarily by component condition. The amount of deterioration in each component of the station is assessed during inspection and assigned a numerical rating.
- **Useful Life:** Some station assets or components such as elevators, which are generally replaced on a cyclical basis, are tracked based on their useful life. For example, the useful life of a station elevator is typically 20 years. Older elevators are more prone to break down and generally require more extensive and costly maintenance to keep in service.

The results of a condition-based assessment of station assets and components are shown in the inventory and status table.

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Platforms	134	19%
Canopies	113	2%
Shelters	124	2%
Elevators	105	89%
Escalators	2	0%
Stairs	340	7%
ADA Ramps	83	2%
Overpass	50	0%
Underpass	12	33%
Station Building	34	3%
Parking Lot	72	17%
Parking Garage	4	25%

Harlem-125th St Station



North White Plains Station with station components

## Investment needs

Our investment strategies focus on station assets in need of rebuilding and replacement, such as platforms, station access, building structures, and parking facilities identified as in poor or marginal condition. Where feasible, we also seek to construct new elevators, crossovers, and ramps to make stations more accessible for our riders.

Over the next 20 years, we need to:

- Address the deteriorated platforms at 19 stations on the Harlem Line that currently require additional structural support and maintenance.
  - We are proposing an accelerated pace to replace platforms at these stations, as well as other critical station components. We aim to minimize disruption to passengers by planning station work in tandem with other rehabilitation work along the right-of-way.
- Accelerate the pace of repairing and replacing station assets. This effort will focus on station access (stairs, ramps, overpasses, and underpasses), station parking facilities (lots and garages), and station buildings.
- Focus first on our oldest elevators and those with the greatest reliability issues. Establish a program to ensure all 105 existing station elevators are replaced over 20 years, as they reach the end of their useful life.
- Continue to add elevators, ramps, and create accessible routes between platforms to make full-service stations in Metro-North-operated territory fully accessible, where feasible.
- Identify opportunities for flood protection and other climate resilience improvements to ensure station components are protected from extreme weather.
- When upgrading stations, maximize opportunities to conserve energy and reduce fossil fuel use, such as exploring the feasibility to deploy solar photovoltaics for on-site renewable energy generation.

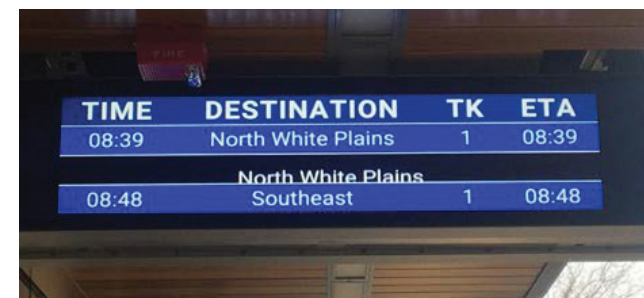


# Public communications and security

**Metro-North’s communication information system supports customer service applications including telephone, PA system, visual information display, closed circuit television (CCTV), and fare collection, which includes ticket vending machines, customer communication intercoms, and numerous other functions. Together, these technologies provide key service updates to passengers, increase security within our stations, and facilitate efficient fare payments**

## Asset inventory and status

Several prioritization factors are considered for communication investments and are evaluated in concert with a paced, continuous replacement cycle. Asset age compares the actual age of the communication equipment to its lifespan; when the equipment is close to exceeding its maximum age, it is prioritized for replacement. Asset obsolescence prioritizes installing new technologies; as communication technology changes, obsolete technology becomes more difficult to maintain and parts are harder and more expensive to acquire. Asset condition defines the physical state of the communication equipment, based on number and frequency of repairs and tickets. Asset criticality includes factors such as a role in maintaining safety, sustaining Metro-North operations, and supporting data needs.



Above, Hanging Digital Sign  
Right page, Grand Central Terminal

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Office (head end) Public Address/Visual Information System (PA/VIS)	2	100%
Grand Central Terminal Big Board	1	0%
Grand Central Terminal Arrival/Departure Boards	72	0%
Grand Central Terminal Gate Boards	96	0%
Grand Central Terminal Employee Displays	17	0%
Grand Central Terminal Station PA (speakers, ambient sensing microphones)	600	0%
Grand Central Terminal Customer Communications Network/Cable Plant	1	0%
PA/VIS - Ticket Office	30	100%
Station Digital Displays	827	40%
Station PA (speakers, ambient sensing microphones)	2,293	0%
Station Intercoms	87	10%
Station Communications Network/Cable Plant	10	100%
Station Equipment (controllers, digital signal processors, amplifiers)	87	80%
Security Head End, Workstations, Servers	96	76%
Security Cameras, Recorders and Server	2,743	52%
Security Switches (field data transfer links to head end security system)	382	32%

## Investment needs

Our top priority in this category is to improve the customer communication, safety, and security systems for Grand Central Terminal and passenger stations. Over the next 20 years, we need to:

- Advance our Project Customer Service Initiatives (CSI) program, which focuses on improvements to both communication and security assets. Over the next 20 years, we will complete Project CSI at all remaining Metro-North passenger stations in New York. The program includes the following:
  - An integrated PA/video system with voice and video messaging.
  - Real-time train information displays.
  - Elevator and escalator control and monitoring capabilities with the ability to communicate with customers needing elevator service, as well as control of elevators at select stations.
  - Security cameras with remote monitoring/video management capabilities.
  - Station intercoms.
- Upgrade and expand the existing Grand Central Terminal security system including hardware/software platforms, networks and technologies, and camera coverage.
- Replace/upgrade the Grand Central Terminal PA System assets including speakers and amplifiers.
- Replace the Grand Central Terminal LED digital display technology in historic areas, and provide upgrades for interoperability with Grand Central Madison.
- Replace aging and obsolete passenger station communication and security assets on a cyclical basis, as well as upgrade obsolete systems to new technologies, in particular older generation station displays, security cameras, security data transfer switches, and video recorders.
- Upgrade the office control systems for all Grand Central Terminal and station audio/visual communication and security systems with modern systems.



**Passenger vehicles  
and yards**

**Passenger stations**

**→ Grand Central Terminal  
and Grand Central Artery**

**Right-of-way**

**Signals, power,  
and communications**

# GRAND CENTRAL TERMINAL AND GRAND CENTRAL ARTERY

**Grand Central Terminal is one of New York’s most iconic buildings and the heart of the Metro-North network. The southern terminus of our Harlem, Hudson, and New Haven lines, many Metro-North journeys begin or end at Grand Central, while others continue from Grand Central—which connects to five subway lines and the Long Island Rail Road—across the city and region.**

**Many visitors only see the terminal building itself, but for the terminal to fulfill its intended purpose, there is substantial adjacent infrastructure that must also be maintained. All Metro-North trains must first traverse the Grand Central Artery, which is comprised of three other structures: the Park Avenue Viaduct, Park Avenue Tunnel, and the Grand Central Train Shed. Used by four out of every five Metro-North customers each day, the artery is crucial to Metro-North’s service.**

**Our investment needs over the next 20 years include:**

- **Investing in the Grand Central Terminal and Grand Central Artery so Metro-North continues to serve the region, bringing nearly 40 million annual riders to New York City on its three East-of-Hudson rail lines.**
  - **Grand Central Terminal: Renovating public areas such as restrooms, elevators and escalators, stairs, and ramps, as well as non-public areas for utilities and employee facilities within the terminal; addressing needed improvements to structural support, passenger platforms, and leak remediation; investing in security and ventilation systems and complete fire and life safety improvements; and performing comprehensive preservation work to the historical landmark building.**
  - **Grand Central Artery - Train Shed: Reconstructing deteriorated structural elements of the 110-year-old Train Shed, the massive, bi-level structure underneath Park Avenue, including the vital Train Shed roof replacement project, as well as other structural repairs, and making improvements to the Train Shed’s ventilation and other safety systems.**
  - **Grand Central Artery: Park Avenue Viaduct: Continuing to reconstruct deteriorated structural elements of this critical section of elevated railroad.**
  - **Grand Central Artery - Park Avenue Tunnel: Improving tunnel ventilation and safety systems and emergency egress capabilities, while also completing priority structural repairs needed in the Park Avenue Tunnel.**

# Grand Central Terminal

Midtown Manhattan was shaped by Grand Central Terminal. When railroads first arrived on East 42nd Street in the 1830s, much of Midtown was undeveloped. The current terminal building opened in 1913, as Midtown grew into the busy core of New York City. Today, Grand Central receives over 750,000 daily visitors, and it is vital that we invest in this landmark terminal building now in order to keep it running for decades to come.



Biltmore Room at Grand Central Terminal

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
GCT Building and Structures (building and block area structural supports and roof, elevated Park Avenue roadway)	5	60%
Platforms, Platform Edges, Platform Expansion Joints	113	77%
Interior/Exterior Architecture Systems	146	47%
Electrical Systems	13	38%
Fire/Life Safety Systems (fire alarm, standpipe, sprinkler)	10	27%
HVAC Systems	25	48%
Plumbing Systems (domestic hot and cold water, sanitary, sewerage, drainage, steam)	16	75%
Elevators (passenger, freight)	32	19%
Escalators (passenger)	14	7%



Main Concourse, Grand Central Terminal

## Investment needs

Continued planned investments in the terminal building are needed to keep Grand Central Terminal in good condition for years to come. Asset replacement/restoration will help ensure the structural and aesthetic integrity of this major transportation hub and preserve its historical importance to New York City. Over the next 20 years, we need to:

- Make needed structural improvements to the terminal building, including:
  - Improve the terminal's structural support system and roof, and rehabilitate the block area and the roadway viaduct around the terminal.
  - Make repairs to the terminal platforms, platform edges, and expansion joints.
  - Continue to repair leak infiltration from surrounding buildings, streets, and sidewalks into the Grand Central Terminal complex.

- Make timely repairs to the architectural features of the historic terminal building, such as walls, floors, ceilings, doors, canopies, and ramps to ensure the landmark Grand Central Terminal remains in first-class condition.
- Prioritize fire protection improvements, guided by a recently completed systemwide utilities study. This includes improvements to sprinkler systems, and the terminal's ventilation, security, and safety systems, as well as carry out plumbing, electrical, and HVAC infrastructure replacements throughout the terminal.
- Improve the customer experience by adding new Biltmore Room restrooms, make repairs to the Roosevelt Passageway, improve elevators and escalators, and install more accessibility and safety signage.

While we work to preserve this landmark structure, we will strive to ensure that operations can continue during updates. Properly planning the investments and funding will be important in minimizing these disruptions given the large number of daily Grand Central Terminal passengers, as well as visitors and tourists.

# Grand Central Artery

Over the next 20 years, it is critical that we invest in the Grand Central Artery. Each of the artery's three structures is over 100 years old and must be rebuilt, improved, or significantly repaired to keep Metro-North service safe and reliable—all while trains continue to operate. As we work on the artery, we will coordinate closely with the community as work takes place along Park Avenue and surrounding streets.

## Grand Central Artery: Train Shed

Grand Central's 44 platforms and 67 operating tracks are housed in the Train Shed, a 110-year-old, two-level structure under Park Avenue that stretches from the terminal building to East 57th Street. Since this is where most Metro-North trips begin or end, the Train Shed is crucial to Metro-North service. In addition to rail infrastructure, the Train Shed hosts a myriad of utility cables, pipes, and structures that support a variety of city services. A century ago, over a dozen city blocks were built directly on top of the Train Shed. Today, the Train Shed holds up several of Midtown's largest skyscrapers, as well as Park Avenue itself. Over time, weather, salt, and water have damaged and deteriorated the roof, making it crucial that we replace the roof as we rehabilitate the Train Shed.

### Investment needs

Our priority investment in the Train Shed is roof replacement. This will address water infiltration, corrosion, and structural deficiencies, and make safety improvements. Metro-North recently completed installation of a new fire standpipe system in the Lower Level of Grand Central Terminal and is ready to begin installing a new fire standpipe system for the Upper Level. We are also implementing priority repairs to address the most urgent locations. To save time and money as we reconstruct the Train Shed roof, we are using innovative strategies, for example, our current public-private partnership with JP Morgan Chase for the redevelopment of 270 Park Avenue. The remaining work needed to complete the Train Shed rehabilitation project will continue over the next 15 years, and this work will ensure that the Train Shed is in good condition and able to hold up Park Avenue for decades to come.



Grand Central Train Shed Roof

Inventory and status			
Asset	Total	Units	Percent in Poor/Marginal Condition
Train Shed Main Bridge Structural Framing	6	Structure	83%
Train Shed Structural Supports and Roof Slab	4	Structure	100%
Train Shed Expansion Joints	19,045	Feet	12%
Train Shed Drainage System	5	Systems	100%
Train Shed Waterproofing System	5	Systems	80%
Train Shed Misc. Steel (gratings, drip pans, utility service carriers and supports)	5	Systems	80%
Train Shed HVAC System	1	Systems	100%
Train Shed Electrical Systems	3	Systems	33%
Train Shed Fire Standpipe Systems (Upper/Lower Levels)	2	Systems	50%
Train Shed Architectural	15	Structure	60%

Rendering of Train Shed and Park Avenue



# Grand Central Artery: Park Avenue Tunnel

Our trains approach or leave the Grand Central Train Shed via the Park Avenue Tunnel. This tunnel carries thousands of Metro-North customers every day under 40 blocks of Park Avenue in Manhattan, between East 57th Street and East 97th Street. Nearly 150 years old, the Park Avenue Tunnel is in need of improvements that will strengthen its structure and safety.

Inventory and status			
Asset	Total	Units	Percent in Poor/Marginal Condition
Park Ave Tunnel Electrical Systems (tunnel lighting, tunnel alarm, third rail traction power)	3	Systems	100%
Park Avenue Tunnel Main Structural Framing (brick walls, arches, steel framing)	1	Systems	100%
Park Avenue Tunnel Utility Bays (steel supports, concrete walls, infill)	1	Systems	100%
Park Avenue Tunnel Ventilation Shafts and Gratings	80	Each	100%
Park Ave Tunnel Structures (existing emergency stairs and exits at 59th, 72nd and 86th streets)	3	Sets	83%

## Investment needs

The Park Avenue Tunnel investment needs focus on priority structural repairs and safety improvements. Over the next 20 years, we need to:

- Construct two additional emergency exits at 65th Street and 79th Street, supplementing existing exits in the tunnel, as well as completing the following tunnel projects:
  - Replacement of the tunnel lighting.
  - Replacement of the steel conductor third rail with aluminum.
  - Upgrades to the tunnel alarm and tunnel fire standpipe systems.
- Upgrade ventilation and supplement critical infrastructure that provides ventilation for the tunnel.
- Undertake much needed priority structural repairs in the tunnel and, where possible, bundle communication improvements with planned work to take advantage of cost and time savings opportunities.



Right, Park Avenue Tunnel



Park Avenue Viaduct (at East 122nd Street)

# Grand Central Artery: Park Avenue Viaduct

The Park Avenue Viaduct is Metro-North's elevated gateway to Manhattan, carrying approximately 750 trains every weekday between the Harlem River and the entrance of the Park Avenue Tunnel at East 97th Street. Much of the aging viaduct's infrastructure dates from the 1890s, and we are focusing on the replacement of the elevated steel structure that carries four tracks between East 110th Street and the Harlem River Lift Bridge

Inventory and status			
Asset	Total	Units	Percent in Poor/Marginal Condition
Viaduct Structure	104	Spans	77%
Viaduct Deck	6,346	Linear Feet	77%

## Investment needs

After a fire beneath the Park Avenue Viaduct disrupted service for thousands of Metro-North passengers in 2016, the public was reminded of the operational importance and vulnerability of the then 125-year-old structure. With in-depth, hands-on inspections occurring since 2016, there have been numerous structural deficiencies identified. Fatigue-related defects in the steel girders and connections were appearing more frequently, growing each year, and repairs were not keeping up. To address the root causes of these defects, Metro-North has begun a comprehensive rehabilitation of the viaduct. This effort began in the 2020-2024 Capital Program, which planned for the complete replacement of the viaduct between East 115th and East 120th Streets. In 2022 and in 2023, we made arrangements to extend work up to East 123rd Street and began advanced planning work on the next segment planned to be replaced, between East 127th and East 132nd Streets. Future phases, which will focus on replacing other segments and rehabilitating the viaduct deck, are currently planned for inclusion in the 2025-29 Capital Program.

**Passenger vehicles  
and yards**

**Passenger stations**

**Grand Central Terminal  
and Grand Central Artery**

→ **Right-of-way**

**Signals, power,  
and communications**

# RIGHT-OF-WAY

**Right-of-way infrastructure is a grouping of asset categories that make up the physical space used by the railroad and include line structures and track. Line structures is a category of assets that includes bridges, viaducts, tunnels, culverts, and retaining walls, as well as various sub-components within each asset that requires continuous maintenance to guarantee their reliability and the safety of our riders. Track assets include rails, ties, switches, grade crossings and ballast. These assets, which also support the freight operations that transport goods throughout the region, are subject to heavy use and continuously exposed to harsh and changing weather conditions.**

**Our investment needs over the next 20 years include:**

- **Increasing our pace of rehabilitating and replacing our track and structures to provide safe and reliable service. We will also increase our use of preservation methods, such as bridge painting, that will extend the lifespan of our existing structures and decrease structural deterioration.**
- **Purchasing equipment such as track laying machines that will allow us to implement construction and track replacement methods that are faster and more cost-effective.**
- **Addressing the threats of climate change by:**
  - **Protecting the Hudson Line from flooding due to rising sea levels.**
  - **Implementing a long-term resilience strategy to protect our right-of-way assets from extreme rainfall and prolonged heat waves.**

# Line structures

Our line structures are crucial for the proper functioning of our system through, over, or under obstacles like roadways, water bodies, or along varying terrain. Line structures include undergrade bridges, overhead bridges, tunnels, culverts, and retaining walls. Undergrade bridges allow trains to pass over an obstacle (i.e., the obstacle is under the tracks), and overhead bridges allow trains to pass under an obstacle (i.e., the obstacle is above the tracks). Tunnels are underground passages or channels that provide the means for our rail to traverse underneath highly developed neighborhoods or difficult topography. Culverts are designed to allow water to flow underneath tracks to manage drainage and prevent flooding. Retaining walls are built to hold back soil and provide support for our elevated structures.



**Undergrade bridges**  
Allow an obstacle to pass under the railroad (i.e., the tracks are on the bridge structure).



**Culverts**  
Are designed to allow water to flow underneath tracks to manage drainage and prevent flooding.



**Overhead bridges**  
Allow the obstacle to pass over the railroad (i.e., a roadway on a bridge structure).



**Tunnels**  
Underground passages or channels that provide the means for our rail to traverse underneath difficult topography or highly developed neighborhoods.



**Retaining walls**  
Built to hold back soil and provide support for our elevated structures.



Willet Ave undergrade bridge

## Asset inventory and status

To keep all of our structures in a safe and reliable condition, we conduct regular inspections to determine the overall asset condition and to determine priority locations for rehabilitation and replacement. The many components related to structure, for example steel girders and abutments, are comprehensively assessed through our bridge inspection program. The results from our condition-based assessment of line structure assets and components are shown in the inventory and status table.

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Undergrade Bridge	181	46%
Culvert - Undergrade	189	65%
Overhead Bridge	313	23%
Retaining Wall	707	27%
Tunnels	9	11%

## Investment needs

Our Metro-North Bridge Management Program and inspection manual establishes standards to which bridge assets must be maintained. We monitor assets such as bridges, culverts, tunnels and retaining walls on an individual level and determine the overall rating for each structure to prioritize work throughout the system. Assets are selected for rehabilitation or repair work based on condition rating and other critical factors, including but not limited to inadequate load ratings (the weight of trains that bridges are capable of carrying), fracture critical construction (if a structure has single points of failure), and current operating restrictions (speed or carrying capacity). Once priorities are identified, our MOW team evaluates other structural assets surrounding the prioritized bridge for repairs or rehabilitation to maximize the reach of our work and minimize service disruptions. Over the next 20 years, we aim to bring all line structures into good condition.

Over the next 20 years, we need to:

- Address the backlog of bridges, culverts and retaining walls in poor and marginal condition by increasing the pace of our work and addressing multiple structures in close proximity at one time. Rehabilitate and replace assets, some over 100 years old with major fatigued components, with new assets to ensure optimal and safe railroad operations.
- Accelerate repair and preventative work, such as removing corroded beams and painting and waterproofing structures to preserve them against further corrosion and extend their lifespan.
- Retrofit line structures for climate resilience. Strategies for achieving this include appropriately sizing culverts for future storm events and stabilizing retaining walls in vulnerable areas. Incorporating these strategies provides better protection to our track, as well as structures.
- Plan structure work in tandem with work on other assets, such as track and stations, to ensure service disruptions to our customers are as minimal as possible.

# Track

Our track system is made up of several elements:

- **Ties:** Wood or concrete cross-members that hold the rails at a fixed width to form the track structure.
- **Rail:** Provides a running surface for the train wheels. Together with the ties, they form the track structure.
- **Switches (turnouts):** Arrangements of ties and rails that allow trains to move from one track to another.
- **Crossings:** Concrete or rubber pads installed to allow vehicles to travel over streets.
- **Equipment:** On-track machinery and rolling stock supporting track maintenance and construction.



Harlem Line intersection with Virginia Road (White Plains), Source: Google Streetview

## Asset inventory and status

Our track assets are assessed by age, condition of the asset, and based on operating conditions. When prioritizing track assets for replacement or improvement, we consider different factors by component. Track assets are generally replaced on a cyclical basis based on age or remaining lifespan. This includes replacing ties, rail, and turnouts, undercutting of ballast, as well as rail grinding and resurfacing, all of which help to ensure our rail components are meeting our high standards. We conduct regular inspections to determine the need for track resurfacing and ultrasonic testing to detect internal defects in the rail.

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Grade Crossing	49	35%
Hi-Rail Work Equipment	607	27%
Non-Revenue Rolling Stock	202	36%
Rail	1,004 rail miles	39%
Ties - Concrete	468,174	39%
Ties - Wood	1,090,507	34%
Turnouts (switches)	838	45%

## Investment needs

Our annual cyclical track program rehabilitates and replaces track and turnouts to provide a safe operating condition throughout our network. We are committed to continuously improving our methods of construction and replacement so that our track program can replace these components more efficiently.

Over the next 20 years, we need to:

- Accelerate the pace of investments to get to a more regular track replacement schedule. We are exploring opportunities to complement our cyclical track program with a third-party contractor utilizing a track-laying machine to efficiently replace tracks, ties, ballast, and third rail, where applicable.
- Address drainage and water inundation issues on tracks. Much of this is due to the topography that we traverse and is of particular focus as climate change puts these locations at further risk of coastal flooding, washouts, saltwater corrosion, and storm exposure.
- Continue investing in our high-rail work equipment, which allows us to replace track components and support right-of-way work and our fleet of service vehicles for maintenance needs that include railcar support equipment, rubber-tire vehicles, and steel wheel vehicles..



**Passenger vehicles  
and yards**

**Passenger stations**

**Grand Central Terminal  
and Grand Central Artery**

**Right-of-way**

**→ Signals, power,  
and communications**

# SIGNALS, POWER AND COMMUNICATIONS

**Signals govern the safe movement of trains as they travel along the line to their destinations. Our power system supports 490 track miles of electrified third rail and overhead catenary, which provide traction power to keep our electric trains moving. Our communication systems enable constant communication between customers, on-train staff, and rail controllers. Communication equipment also supports a myriad of other systems—including train control, radios, power, PA systems, and visual displays. Many of our existing legacy systems are aging and technologically obsolete, making them increasingly difficult to maintain. To support future needs, vital upgrades to these systems must be made.**

**Our investment needs over the next 20 years include:**

- **Prioritizing safety and reliability as we improve our signal system, replacing obsolete systems and technology.**
- **Upgrading our traction power system with new power substations, which will improve reliability and allow us to run more trains across the Metro-North network.**
- **Expanding a new, ethernet-based communications system to replace obsolete technology currently in use. This new system will better support the needs of other vital systems, such as signals, security, and radio communications, and improve customer communications through our public address system and informational displays.**

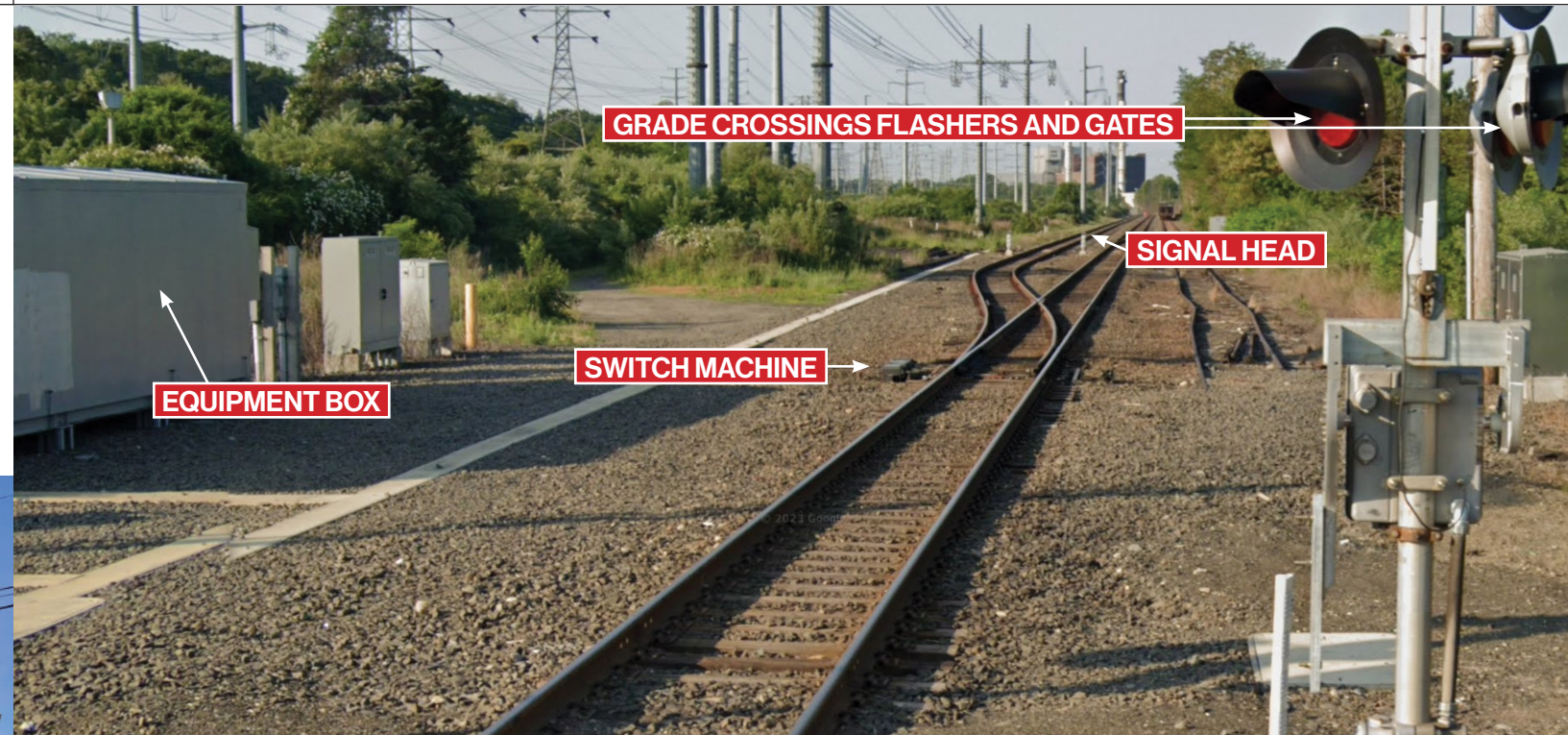
# Signals

Our signal system ensures that our trains operate safely, at the correct speeds, and at a safe distance from one another. This system encompasses many kinds of equipment — from the signals themselves that provide instructions to train operators whether to proceed and at what speed, to the switch machines that guide trains onto the correct routes, to the many miles of cables and relays that keep the system running. In addition to the core signal infrastructure, our signal system also includes the flashers and gates at grade crossings and other field infrastructure that alert train crews to potential problems.

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Signal Systems - Hudson Line	76 miles	93%
Signal Systems - Harlem Line	81 miles	52%
Signal Systems - New Haven Line (NYS only)	14 miles	0%
Signal Systems - Port Jervis Line	60 miles	0%
Signal CTC <sup>6</sup> Office and SCADA <sup>7</sup> Power Control Centers assets	1,445	78%
PTC <sup>8</sup> (office systems, onboard systems, field systems)	3,825	0%
Grade Crossing Flashers and Gates	37	0%
Signal Field Infrastructure (hot box detectors, dragging equipment detectors, block carries, overlay equipment, etc.)	1,821	49%
Switch Machines	930	46%



Signalized crossing near Manitou Station



New Haven Line Intersection Bic Drive and Danbury Branch, Source: Google Streetview

The nerve center of the Metro-North train control network is the Operations Control Center (OCC) at Grand Central Terminal. Rail traffic controllers at the OCC dispatch Metro-North's trains, guiding them efficiently through Metro-North's complex track network and ensuring they interact safely with dozens of other trains operating along their route. The current OCC is located within an aging facility packed with utilities of various ages and conditions that frequently cause interruptions to operations. To keep Metro-North service secure, safe, reliable, and resilient, we need a new, modernized OCC.

Over the next 20 years, we need to:

- Construct a new OCC at a secure, modern facility, replacing obsolete technology, and preparing us to meet the needs of current and future Metro-North service.
- Replace old signal systems with modern systems that use microprocessors instead of the older signal relay system technology still in use.
  - Microprocessors are designed to be safer, easier to maintain, more reliable, and allow for better train control. We plan to focus signal upgrades on the Hudson and Harlem lines over the next 20 years.
- Replace outdated components of our Centralized Train Control (CTC) and Supervisory Control and Data Acquisition (SCADA) systems, of which over 80% are beyond their typical lifespan.
- Begin upgrades to the oldest components of the Positive Train Control system. This includes office control systems, wayside signal equipment, and wayside radio office/field equipment that will need to be replaced over the 20-year period due to end of life, technological obsolescence, codes and regulatory compliance, and expansions for redundancy and systems integrity.
- Continue to keep grade crossings safe by normal cyclical replacement of obsolete components.
- Replace obsolete components with new technology that will use ethernet and fiber optic connectivity. For example, office and field components of the signals, PA/VIS, SCADA, radio systems, and ticket vending machines will be upgraded to be ethernet/IP capable, which will provide more reliability and capacity, faster data transfers, and vendor support.
- Continue the normal cyclical replacement of end-of-life signal field infrastructure (e.g., hot box detectors, dragging equipment detectors, block carries, and overlay equipment) that are always on and exposed to the elements.
- Replace end-of-life switches through the track replacement program, signal system replacements, and dedicated switch replacement programs.
- Prioritize signals that are in particularly critical locations—such as those exposed to flooding, extreme temperatures, wind, and erosion—for resilience upgrades such as asset elevation and/or hardening.

## Investment needs

Most of our signal systems were installed in the 1980s and early 1990s. These systems have exceeded their typical lifespan of 30 years and are obsolete, with many replacement parts no longer available from manufacturers. On the Hudson Line, 93% of the signal system is in need of replacement, and on the Harlem Line, 52% needs replacement.

6. Centralized Train Control (CTC) allows us to monitor and control the movement of trains across our network from one central location.  
 7. The Supervisory Control and Data Acquisition (SCADA) system controls the flow of power from substations to the third rail and overhead lines on the Harlem, Hudson, and New Haven lines.  
 8. Positive Train Control (PTC) is an integrated command, control, and communication system that adds an additional layer of safety protection for trains and workers on our tracks

Metro-North was formed through the consolidation of different railroads that have different systems to power their trains. As a result, we must maintain two power systems, each with their own track infrastructure, substations, transformers and other system specific assets.

Right, New Haven Line power changeover



# Power

Traction power provides the electricity required to propel trains. It is delivered through a complex network consisting of substations—which convert electricity from the power grid into the appropriate voltage and current for our trains—distribution systems, and the DC third rail and overhead AC catenary wire from which the trains draw power. Some of our equipment, such as the signal system and the Harlem River Lift Bridge, require additional power and substations.

Inventory and status					
Asset	Total	Percent in Poor/Marginal Condition	Asset	Total	Percent in Poor/Marginal Condition
Third Rail Components (brackets, connectors, insulators, snow melters, etc.)	291,065	100%	DC Circuit Breaker Houses	3	33%
Third Rail Linear Assets (rail)	308 miles	100%	DC Substation Auxiliary	50 sets	0%
DC Substations	55	89%	AC Substations	6	83%

Inventory and status					
Asset	Total	Percent in Poor/Marginal Condition	Asset	Total	Percent in Poor/Marginal Condition
AC Substation Assets (switches, transformers, supply stations)	20	95%	Catenary Plant Assets (pulleys, balance assemblies, etc.)	1,935	100%
Signal Power Substations	6	83%	Transmission Assets	692	95%
Signal Power Assets (transformers, switches, back-up generators)	301	100%	Transmission Bare Overhead Feeders (15kV)	18 miles	100%
Signal Power Cable	186 miles	100%	Transmission Wood Poles	1,400	79%
Cable Linear Assets	567 miles	100%	Harlem River Lift Bridge Plant (control systems, motors, drives)	17	0%
Catenary	36 miles	100%	Stand-by Power Assets	66	100%
Cable Plant Catenary Poles	245	100%	Passenger Station Lighting Assets	1,500	100%

## Investment needs

Our traction power system is critical to Metro-North service, but many assets of our traction power supply system are approaching or have passed their maximum age and require replacement. For example, 88% of our substations have exceeded their expected life. Much of our third rail has not been significantly upgraded since their original installation in the 1980s, and on portions of the New Haven Line, the catenary system is 25-30 years old. New substations are necessary not only to cope with the low-voltage occurrences on the Harlem Line today, but to prepare for greater power needs of newer trains expected in the years to come. Other improvements, such as the electrification of Track 1 on the lower Hudson Line, will focus on operational flexibility to help ensure service recovery is expedited when outages occur.

Over the next 20 years, we need to:

- Improve the Harlem Line traction power supply network with the addition of new substations at eight Upper Harlem locations and at Claremont in the Bronx, one of our most critical locations in need of improvements to properly support all three Metro-North lines.
- Replace temporary substations with permanent ones on the Harlem Line at Mt. Vernon West and Bronxville.
  - New substations will be more reliable and weather-resistant, with up-to-date equipment and technology.
- Improve the power supply capacity and resilience of the AC traction power supply system on the New York state portion of the New Haven Line, with the replacement of two AC traction substations (61 at Shell and 193 at Rye).
- Replace aging power substation feeder distribution systems between certain substations to reliably support current and future operations.
- Commence a replacement program to replace existing steel rail with aluminum third rail, which provides better electrical conductivity and performance. The DC third rail system is over 300 miles long and has not been significantly upgraded since installation in the 1980s.
- Improve service reliability through the replacement of deteriorating Harlem Line Transmission Wood Poles.
- Continue substation major component replacement program to extend life of aged substations until their replacement.
- Make signal power improvements to include replacing transformers, replacing motor alternators in signal substations, and upgrading signal feeders including the installation of a second Upper Harlem signal feeder for redundancy.
- Replace contact wire and catenary components on the New Haven Line and lighting systems at eight passenger stations.
- Upgrade and replace assets to address climate resilience strategies, including hardening assets that are most prone to repeat climate hazard exposure and asset elevation for those that are susceptible to water inundation from storm events.

*Right, Harlem Line, White Plains*



*Overhead catenary power system, New Haven Line*

# Communication infrastructure

Metro-North’s communication systems play a vital role in the safe operation of our network. Our rail traffic controllers, train crews, and station personnel rely on a flow of information to keep the system moving—and to keep our customers informed. Our communication system supports several other systems that are critical to Metro-North’s operations, including the power system (e.g., remote control of power systems) and fare collection (e.g., data collection from TVMs). Major elements of the communication systems include radio and telephone systems, fire alarms, and security systems (e.g., CCTV cameras, access systems, and intrusion detection systems), all which are connected by approximately 300 linear miles of fiber optic cables. In addition to communication between controllers, train crews, and customers, these interconnected technologies ensure police, fire, and other emergency personnel can respond rapidly to incidents.



Metro-North’s SONET communications systems equipment

Inventory and status		
Asset	Total	Percent in Poor/Marginal Condition
Fiber Optic Transmission Equipment (node houses) and Local Fiber Connections to CILs, MLs, Substations, Passenger Stations	970	85%
Voice Radio Equipment	7,268	100%
Voice Radio Cable	100,000 feet	100%
Telephone Equipment	118	100%
Uninterruptible Power Supply System	1	0%
Wire/Fiber	376 miles	12%
GCT Wire/Fiber	208 segments	45%
Construction Equipment	10	50%
Employee Facilities	15	20%

## Investment needs

Our long-term objective is to replace aging systems with the latest technology to meet current and future operational and agency needs. Over the next 20 years, we need to:

- Continue to move our communication systems from the obsolete Synchronous Optical Network (SONET) to an Ethernet-based Dense Wave Division Multiplexing (DWDM) system. The systemwide ethernet migration includes ethernet/IP capable head-ends, ethernet/IP capable field assets, and new fiber optic links to field assets.
  - This new DWDM system will support a wide range of Metro-North infrastructure—including telephone services, radio systems, CTC/signal, SCADA, PA/VIS, fare collection, and enhanced security services.
  - This will support capacity demands for projects such as security system upgrades and passenger station information upgrades, including Project CSI.
  - This upgraded system will also help us provide improved customer communication, including real-time train information and better PA communication.
- Continue to replace communication elements beyond their typical lifespan on a cyclical basis.
- Replace our current radio and PA systems—whose age makes replacement parts difficult to find—with more reliable communications for our customers and employees, including rail traffic controllers.
  - In accordance with regulatory requirements, our telephone systems and voice recorders will need to be upgraded over the next 20 years.
- Prioritize investments that protect communication infrastructure assets from climate hazards, including flooding, which may include asset elevation and/or hardening, as well as future impacts and risks to communication assets from prolonged extreme heat.