MTA Twenty-Year Capital Needs Assessment 2015-2034

October 2013

MTA CAPITAL PROGRAM

Metropolitan Transportation Authority

New York City Transit
Long Island Rail Road
Metro-North Railroad
Bridges and Tunnels
Capital Construction
Bus Company

October 2013

On the cover:
An F train approaches New York City Transit's Smith-9th Sts. station in Brooklyn. These R-160 cars were part of an order for over 1,600 cars that was completed in 2010. Located on the Culver Line Viaduct, the station is the highest elevated station in NYCT's system. Originally opened in 1933, the station and viaduct have recently undergone a comprehensive rehabilitation to make structural repairs and modernize signals and other critical systems.

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Glossary

AC	Alternating current
ADA	Americans with Disabilities Act
ADEPT	Automated Decision Engine for Passenger Transportation System
AET	All electronic tolling
ATM	Asynchronous transfer mode
ATS	Automatic train supervision
B&T	Bridges and Tunnels
BMT	Brooklyn Manhattan Transit
BRT	Bus rapid transit
BPG	Battery Parking Garage
C&C	Command and control
C3	Command, control and communications
CBB	Cross Bay Bridge
CBD	Central business district
CBH	Circuit breaker houses
CBTC	Communications-based train control
CCTV	Closed circuit television
CDOT	Connecticut Department of Transportation
CIS	Customer information screen
C&S	Communications and signals
CNG	Compressed natural gas
CTC	Centralized train control
CWR	Continuous welded rail
DC	Direct current
DSSSD	Discreet solid state signal device
EAM	Enterprise asset management
EAU	Emergency alarm unit
EIS	Environmental impact statement
EoH	East of Hudson
ERTs	East River Tunnels
ESA	East Side Access
ESU	Emergency service unit

FTA	Federal Transit Administration
GCT	Grand Central Terminal
HVAC	Heating, ventilation, and air conditioning
HCT	Hugh L. Carey Tunnel
HOV	High-occupancy vehicle
IND	Independent Subway System
IRT	Interborough Rapid Transit
ISIM-B	Integrated service information & management - B Division
ITS	Intelligent transportation systems
JCC	Jamaica Central Control
LIRR	Long Island Rail Road
MDBF	Mean distance between failures
MNR	Metro-North Railroad
MOW	Maintenance of way
MTA	Metropolitan Transportation Authority
MTAPD	Metropolitan Transportation Authority Police Department
NFPS	New fare payment system
NJT	New Jersey Transit
NYC	New York City
NYCT	New York City Transit
NYCDOT	New York City Department of Transportation
NYSDOT	New York State Department of Transportation
OTP	On-time performance
PA/CIS	Public address / customer information signs
PBX	Private branch exchange
PSA	Penn station access
PTC	Positive train control

QMT	Queens Midtown Tunnel
RCC	Rail control center
ROW	Right-of-way
SAS	Second Avenue Subway
SBS	Select Bus Service
SIR	Staten Island Railway
SGR	State of good repair
SMS	Scheduled maintenance system
SONET	Synchronous optical network
TOD	Transit-oriented development
TOM	Ticket office machine
TVM	Ticket vending machine
TVRA	Threat vulnerability and risk assessment
VHF	Very high frequency
VIS	Visual information system
VNB	Verrazano Narrows Bridge
WoH	West of Hudson

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Prologue

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This needs assessment focuses on two areas of capital investment over the next 20 years. First is continuing to rebuild and replace the thousands of assets that comprise the MTA transportation network's vast infrastructure to ensure that the existing systems continue to deliver transportation services safely and reliably for the region. Second is enhancing and expanding the network to address critical transportation needs and to respond to the region's changing travel demands. These will require the MTA to take steps to prevent capacity and reliability backslide by continuing with needed state of good repair and normal replacement investments and to overcome long-standing limitations and shortfalls in the network. Though the MTA's network is robust, ongoing investment in it is essential to support the diverse and dynamic region now and in the future.

The strategic enhancements included in this assessment, highlighted on the following maps, provide a view of future planned transportation investments. Over the next 20 years, these will transform the MTA's network so that by 2035 customers will use an MTA system where customers can seamlessly travel throughout the region. These investments are critical to maintaining New York's standing as one of the world's preeminent economic centers.

Strategic Enhancements Delivered: 2015-2034

Citywide Improvements

New Payment Technology Systems

Improved Accessibility for Mobility-Challenged Riders

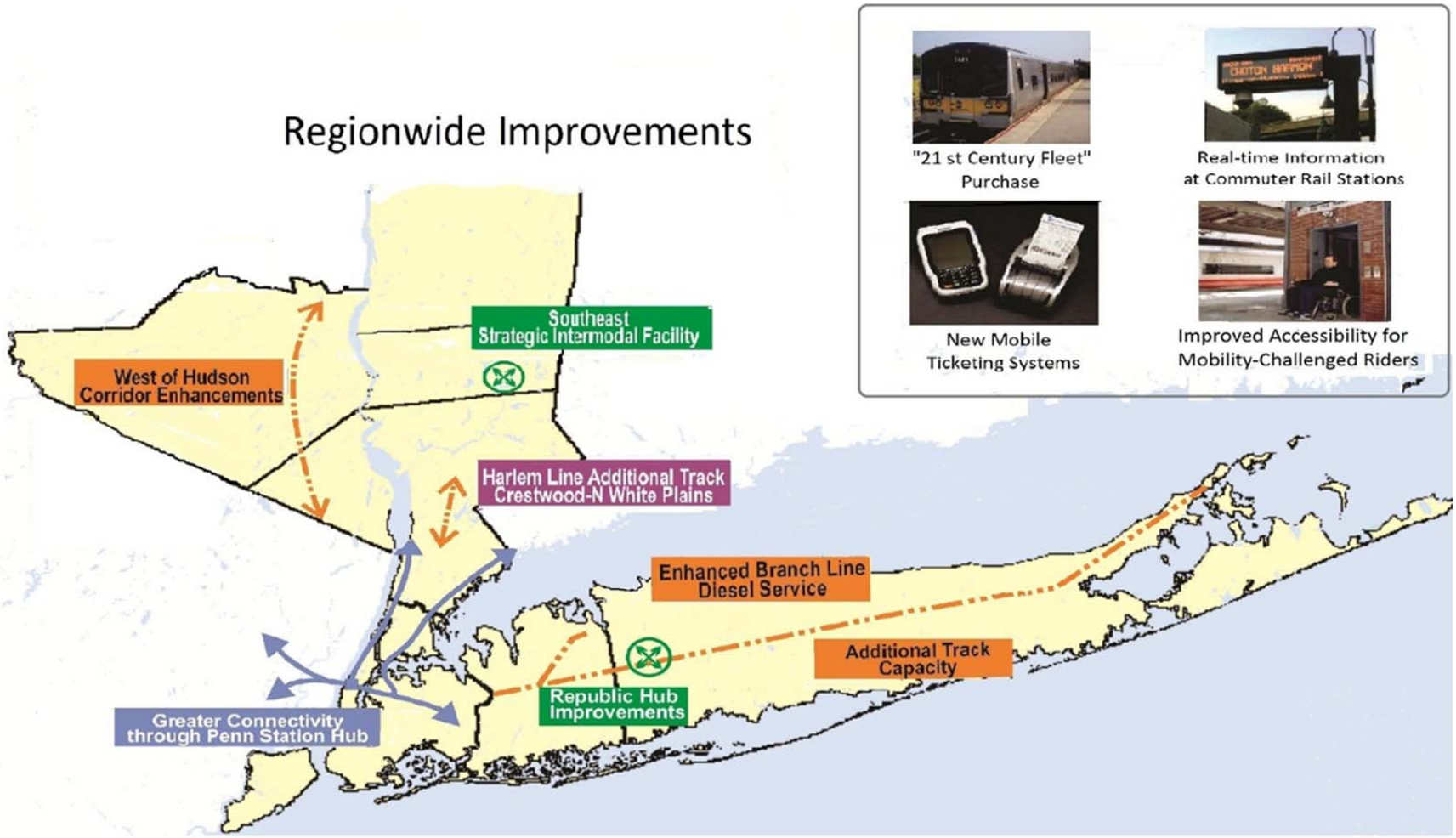
Replace Obsolete Signals with Communications -Based Train Control

City-Wide SBS Expansion

Provide Real-Time Information for Bus and Subway Service

"21st Century Fleet" Purchase

Strategic Enhancements Delivered: 2015-2034



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Introduction

Preserving the Transit System's Rich Heritage

The MTA's network of subways, buses and railroads move 2.6 billion New Yorkers a year, about one in every three users of mass transit in the United States and two-thirds of the nation's rail riders. MTA bridges and tunnels carry more than 280 million vehicles annually — more than any bridge and tunnel authority in the nation. This vast transportation network – North America's largest – serves a population of some 15 million people in the 5,000 square-mile area fanning out from New York City through Long Island, southeastern New York State and Connecticut.

Today's network reflects the rich heritage of the region's original transportation systems. When the **New York City Transit (NYCT) subway** opened in 1904, it launched an unprecedented era of growth and prosperity for the newly unified New York City. Nearly 110 years later, the City continues to rely on its rapid transit system. NYC Transit keeps New York moving 24 hours a day, seven days a week as

some 6,400 subway cars travel over nearly 700 track miles in underground tunnels and elevated structures throughout the boroughs of New York City.

Bus service on the streets of Manhattan began in 1905. Today, NYC Transit operates over 4,400 buses in all five boroughs on approximately 200 local and 30 express routes. **MTA Bus Company**, the newest member of the MTA family, was formed in 2004 to merge seven private operations. With nearly 1,300 buses, it provides service on some 80 local and express bus routes serving the Bronx, Brooklyn, Queens, and Manhattan.

The MTA operates the nation's two largest commuter railroads. The **Long Island Rail Road (LIRR)** was chartered in 1834, making it the oldest railroad in America operating under its original name. With 689 miles of track on eleven branches extending from three major New York City terminals — Penn Station, Atlantic Terminal, and Hunterspoint Ave. — through a major transfer hub at Jamaica to the easternmost tip of Long Island, the Long Island Rail Road transformed Long Island from farmland to economically vibrant communities with easy access to Manhattan jobs.

Proud old names in the history of railroading — New York Central and New York, New Haven & Hartford among them — are the lineage of **Metro-North Railroad (MNR)**. Metro-North's main lines — the Hudson, Harlem and New Haven — run northward out of Grand Central Terminal (GCT), the now 100 year old Beaux-Arts Manhattan landmark, on nearly 800 miles of track into suburban New York and Connecticut. West of the Hudson River, Metro-North's Port Jervis and Pascack Valley lines run northward out of Hoboken, New Jersey, serving Orange and Rockland Counties in the State of New York.

Created in 1933, **MTA Bridges and Tunnels (B&T)** carries more traffic than any other bridge and tunnel authority in the nation over its seven bridges and through its two tunnels. These spans of steel, concrete and cabling are critical links in New York City's transportation infrastructure.

This remarkable transportation legacy, which underlies the economic success of the region and promises to do so for generations to come, depends on an ongoing commitment to protect this infrastructure and its thousands of visible and invisible components. This responsibility has been well recognized by the State through its continuing choice to invest in public transportation, beginning with the Legislature's

Infrastructure of the MTA Network

Track Length:	*2,078 miles—enough to reach from New York to Phoenix. AZ.*
Mainline Switches:	*3,538—supporting the complex network of rail service branches and express and local transit service*
Signalized Track Miles:	*14,850 controlling over 9,000 trains a day with nearly 6 million passengers*
Fiber Optic Cable:	*Over 1,425 miles—enough to reach from New York to Houston, TX.*
Power Substations:	*530—using more than enough power annually to light the city of Buffalo for a year*
Third Rail:	*1,322miles—enough to reach from New York to Oklahoma City, OK*
Pump Rooms:	*291—pumping 17 million gallons of water each day*
Ventilation (Fan) Plants:	*197—clearing air in tunnels during emergencies*
B&T Structures:	*368,940 tons of steel and 3.9 million cubic yards of concrete*
B&T Bridge Cables:	*49,368 feet, containing 181,900 miles of wire—enough to circle the Earth over 3½ times*

historic investment program in 1982 through to the current 2010-2014 Capital Plan, comprising the largest public investment program in the country's history. These investments – nearly $115 billion as of 2013 – have brought the MTA back from the brink of collapse. The most critical elements of MTA's core system – its rolling stock and tracks – have been rebuilt or replaced. As a result of these unprecedented improvements in the transit system, subway delays have fallen almost 92% and reliability has reached new heights with the distance between breakdowns increasing 2,200% on subways and 470% on the bus systems. As MTA has continued to rebuild, now completing its 2010-2014 Capital Plan, the public has returned to the system in record numbers. In 2012, ridership on the subway, bus and commuter rail system reached an all-time high with 2.6 billion people using the MTA system annually compared to 1.7 billion in 1995.

Twenty-Year Capital Needs Assessment

Recognizing that continuous investment is essential to ensure the viability of the transit system for generations to come, the New York State Legislature mandated in 1982 that the MTA prepare five-year capital plans to rebuild and improve the New

York region's transit network. To establish the planning context prior to the development of each of these five-year capital plans, the MTA prepares a 20-year capital needs assessment that sets forth the long-term capital investments that would be made in a program. These investments focus on two priorities: rebuilding the system and expanding the system.

Rebuilding the System. These investments embody the responsibility to continue to restore the massive, regional transit system to a state of good repair and to replace assets that reach the end of their useful lives before they fall into disrepair. While past investments have restored many of the system's assets, many more still require investment. And many of those that have been restored have reached the end of their useful lives and now require replacement. With an infrastructure valued in the trillions, this capital needs assessment identifies an investment level between $25-$30 billion (in 2012 dollars) in each five-year period over the next 20 years in order to accomplish both the repair and replacement needs of the system. These investments to rebuild and modernize the system, which comprise the overwhelming majority of investments in this assessment, promise to preserve the legacy of these systems and will serve the economic vitality of the region.

Expanding and Enhancing the System. The size of the MTA's rail network has not been significantly increased since its expansion in the first half of the 20th century. The ongoing commitment to maintain and rebuild core assets has enabled the MTA only recently to begin to address long-standing capacity limitations of the existing system through such initiatives as the Phase 1 of the Second Avenue Subway, East Side Access (ESA), and the #7 Line Extension. This assessment includes the next stages in the multi-year development of the network expansion projects currently underway (i.e. the Second Avenue Subway) – as well as the identification of future capital initiatives that address currently unmet and emerging transportation needs.

The following sections discuss in turn the capital investments proposed for rebuilding the system and for expanding and enhancing the system for the 20-year period from 2015 to 2034. The first five years will provide the basis for the next MTA five-year capital plan, to be proposed for the years 2015-2019.

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Rebuilding the System

2015-2034 Continuing Needs

This assessment identifies nearly $106 billion in core asset investment need over the next 20 years to protect the vast and rich heritage of New York's transportation infrastructure. Investments are focused on rebuilding the existing system, which includes replacing assets and maintaining those assets already repaired. While past investments have restored many of the system's assets, there is a significant backlog of assets that still require rehabilitation. And, many assets that have been restored in past plans will reach the end of their useful lives over this 20-year period and require replacement.

The MTA prepares capital needs assessments every five years. The process for this assessment began in 2011, and is based on the agencies' updated inventory of assets and evaluation of asset conditions. This effort accounts for addition, replacement, or removal of assets through the latest capital plan, and includes gathering key information for assets such as location, quantity, age, and useful life. The condition of each asset is rated to help identify and prioritize asset investment needs and general timeframes.

Next, agencies developed asset investment strategies to project their priority needs over the 20-year period. Importantly, the strategies reflect certain constraints. Chief among these are the system's ability to accommodate the work; agencies must be able to execute the capital work while minimizing adverse impacts on service. Also, they reflect the agencies' and the marketplace's ability to deliver the work. Last, financial constraints were exercised to ensure that the strategies address highest priority needs in the most efficient manner and to be consistent with funding that may reasonably be expected.

In October 2012, Superstorm Sandy and its tidal surge and high winds caused substantial damage to the MTA's infrastructure. Utilizing mainly anticipated federal funding, the MTA established programs in the 2010-2014 Capital Plan to repair assets damaged by the storm and to improve the system's resiliency to withstand similar storms or other disasters and resume service. Therefore, in general, recovery and resiliency work are not reflected in the assessment. However, the storm highlighted system vulnerabilities to such events, and agencies are incorporating lessons learned into project design guidelines and standards, project delivery processes, and prioritization and sequencing of work.

Looking forward, MTA agencies are taking steps to improve their asset management, and to better integrate capital investment and maintenance work. Incorporating industry best practices into the MTA enterprise asset management (EAM) approach will require changes in organizational and systems resources to help provide a consolidated, life-cycle based view of the assets. This in turn will help the MTA to refine its projections of capital needs. EAM will help to maximize asset useful lives and performance, and is expected to help minimize capital expenses.

Based on the existing process, each agency identified an investment level in each five-year period over the next 20 years (Table 1) to accomplish the repair and replacement needs of the system.

Table 1
MTA Summary of Continuing Needs: 2015-2034
By Agency
(2012 $ in millions)

Agency	2015-2019	2020-2024	2025-2029	2030-2034	Total
NYC Transit	$16,256	$16,703	$19,472	$15,807	$68,237
Long Island Rail Road	3,459	3,244	3,627	3,074	13,404
Metro-North Railroad	3,451	2,222	1,458	1,805	8,936
MTA Bus Company	832	523	690	462	2,507
MTA Bridges and Tunnels	2,410	2,771	3,187	3,665	12,033
MTA Police and Security	199	150	140	125	614
Total	$26,607	$25,613	$28,574	$24,938	$105,731

On a fully unconstrained basis, the agencies' needs are even greater than what is included in this assessment since more backlogged state of good repair needs exist than can be implemented. The "Rail Modernization Study," an April 2009 report to Congress by the Federal Transit Administration, found that more than one-third of the assets of the nation's seven largest transit agencies, including MTA, are near or have already exceeded their useful lives. These backlogged state of good repair needs total roughly $50 billion for the agencies. The FTA's expanded follow-up report in June 2010, "National State of Good Repair Assessment," estimated the national SGR backlog at $78 billion ($ 2009). It also estimated that over $14 billion would be needed annually to keep the backlog from growing larger. Recognizing the extraordinary needs inherent in the vast infrastructure of these large systems and their extraordinary value to the economic health of the nation, the report recommended

funding approaches designed to eliminate this existing SGR backlog. Given constraints on the ability to implement such extraordinary investments, the report suggested that it cover multiple reauthorization periods.

The significant investments identified in this assessment, constrained as noted above, are prioritized according to such factors as age, condition, performance, safety and reliability in order to provide the greatest service benefits and maintenance savings to the operating budget. These needs-based investments establish the long-term planning context for developing prioritized investments in each five-year capital plan. While funding for the upcoming 2015-2019 Capital Plan is expected to keep pace with past plans, it will likely not address the full backlog of needs identified in the first five years of this planning document. However, the most critical investment needs will be included; for those assets not proposed for repair or replacement, additional maintenance investment will ensure their ongoing safety and acceptable performance.

This assessment outlines smart investments in replacing obsolete assets and restoring assets at the end of their useful lives. This means that assets are not replaced in-kind where opportunities exist to make smarter investments that promise increased benefits, like introducing new technologies that enhance capacity and increase safety, such as computerized train control, or like implementing innovative ways to enhance transit services, such as Bus Rapid Transit. These "smart investments" described below are a key element of this assessment.

Replacing Obsolete Signals with New Technology

As the agencies replace their signal systems, smart investments will ensure that obsolete hand-thrown switches for which parts are no longer available on the open market are replaced by micro-processors with central control capabilities that offer greater system safety and enhance system capacity by providing more control over train movements. These next 20 years will see much of the subway signal system rebuilt with communications-based train control (CBTC), an advanced signal system that enables real-time centralized train supervision and monitoring, permitting trains to operate with shorter headways, thus increasing capacity. It also provides for automated train operation and information regarding the

exact location of trains, enhancing normal operations and emergency response. NYC Transit completed a CBTC installation on the Canarsie line L, is now installing it on the Flushing line 7, and is planning its use on additional lines.

The railroads will similarly replace aging signal infrastructure. In addition to targeted signal component and interlocking replacement and investment in positive train control (PTC), LIRR will continue development of centralized train control (CTC), a multi-phased effort to relocate the management of train dispatching, train supervision, and tower operations to the Jamaica Central Control (JCC). Metro-North will continue the multi-plan replacement of the aging signal system with the latest technology, including PTC, to accommodate current operations and ensure compatibility with future service needs.

Providing Innovative and Enhanced Bus Service

Long standing problems, including slow speeds, poor reliability and long travel times have plagued bus services and limited the efficiency and, therefore, the appeal of surface transit. Future investments in surface service will incorporate smart approaches to addressing these problems. This assessment, therefore, features the continued deployment of NYC Transit's Select Bus Service (SBS) to areas of long-standing need.

SBS is a type of bus rapid transit (BRT) service with innovative features, including street pavement treatments, dedicated bus lanes, signalized intersection strategies to speed buses through traffic choke points and fare payment innovations to speed boarding. Intelligent transportation system elements like "Bus Time" (a real-time bus information service now being deployed throughout the system) and off-board fare collection will further regional benefits.

NYC Transit and the City of New York are advancing initial SBS efforts. The MTA and NYCDOT have identified corridors where SBS service could supplement the reach of the subway network with rapid transit options. Further, because SBS can provide increased capacity and connectivity to areas of need at less cost and in a shorter development period, it is being integrated into the standard MTA planning process in all corridor studies seeking to expand capacity. This plan delivers

investments to expand the benefits of SBS to additional areas of the City, and promises improvements in capacity, travel times, and reliability.

Communicating Real-Time Information

Many of the communications investments in the core plans will replace the system's aged communication assets, garbled audio messages and largely static signage with smart communications that provide the information backbone to allow customers to make smart travel decisions, providing customers "real-time" information while they are planning a trip or en-route. Other investments will provide immediate communications for customer use in stations to respond to local emergency situations.

Investments over this assessment period include:

- Expansion of real-time transit information in subway and rail stations
- Installation of new communication systems and updated infrastructure to support operations and customer information
- Expansion of the Help Point intercom program to all subway stations to improve customer safety and information

These investments will, in turn, provide the opportunity in the future to communicate with customers through social media and new technologies, such as Twitter and "Instant Messaging" systems, to deliver targeted "just in time" information on transit services (arrival time, track number, etc.) over this assessment period.

Implementing New Fare and Toll Payment Options

The fare payment infrastructure currently in use at all MTA agencies — ticket machines, turnstiles, fare processing equipment —is approaching the end of their useful lives. Just as this infrastructure was transformative with its introduction in the 1990s enabling elimination of New York City Transit's two-fare

zones and implementation of fare discounts, the replacement of these assets with the next generation of fare payment technology promises a similar transformation.

This assessment includes investments to migrate to more advanced systems across the MTA family. MTA is evaluating new fare and toll payment methods for the transit, commuter rail and crossings network, including the use of contactless "smart chip" payment systems, such as standard bank and credit cards, pre-paid transit payment cards, key-tags and smart phones. The future promises the ability to use a single smart card or a cell phone with a smart chip — cell phones being nearly ubiquitous in the New York region — to ride any and all of the MTA region's transportation systems, from NYC Transit's subways and buses to the commuter railroads. This new approach could offer many benefits to the MTA, including increasing bus speeds by shortening the boarding process, reducing labor and cash handling expenses, supporting inter-modal fare payments options and improving customer service through simplified and expanded fare payment options.

Improving Access for the Elderly and Physically Challenged

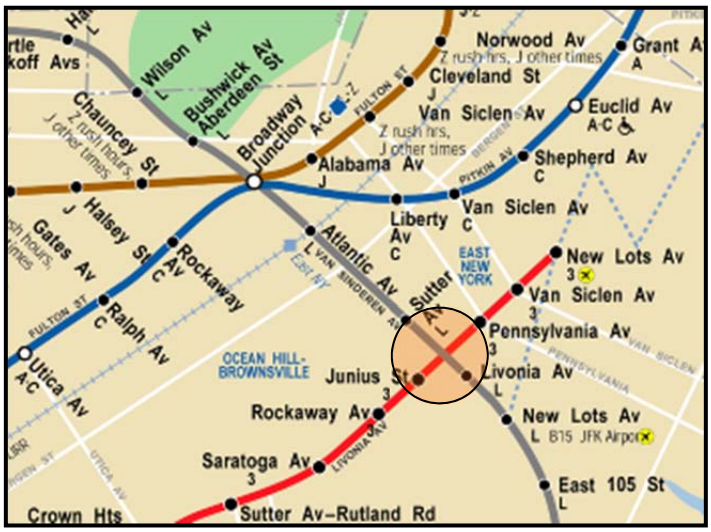
Surveys continue to show that people expect to remain in the workforce longer or remain in the New York area even if retired. Many of these individuals are or will become MTA customers, and investments will have to accommodate a wide range of new needs, from larger message text to innovative ways to site and maintain elevators and escalators throughout the transit system. To this end, this assessment continues investments in audio/visual screens, low-floor buses, elevators and paratransit vehicles among other core investments to serve an aging customer base as well as people with disabilities.

Optimizing System Links

As investments are made in stations and track on the rail system and enhancements to the bus system, opportunities exist to optimize service by adding new transfer points between intersecting subway lines and between bus and subway or bus and rail connections through intermodal terminals. These investments promise to expand travel choices and better exploit network capacity, especially when also informed by

the real-time information improvements described above. These smart investments have provided new subway transfers between the B D F M and uptown 6 lines at Bleecker St. in Manhattan, between the A C F and the R lines at Jay St. MetroTech in downtown Brooklyn, and at Court Square in Queens between the 7 and G lines.

Additional opportunities to create new transfers, add new station entrances, or reconfigure stations to better meet travel needs will be considered.



LIRR will undertake infrastructure investments in the vicinity of Jamaica Station to increase station capacity and throughput in conjunction with service expansion, including new Cross-Borough "Scoot" Service between Jamaica and Brooklyn. This critical link in LIRR's system will be modernized, through a new track layout, new signals, and new higher speed crossover switches. Metro-North's Strategic Intermodal Facilities and Parking Expansion project will implement strategic station and parking investments to construct key intermodal transportation hubs in the Metro-North region.

Smart investments such as these will allow customers to optimize travel by minimizing travel paths and seamlessly switching from one service to another.

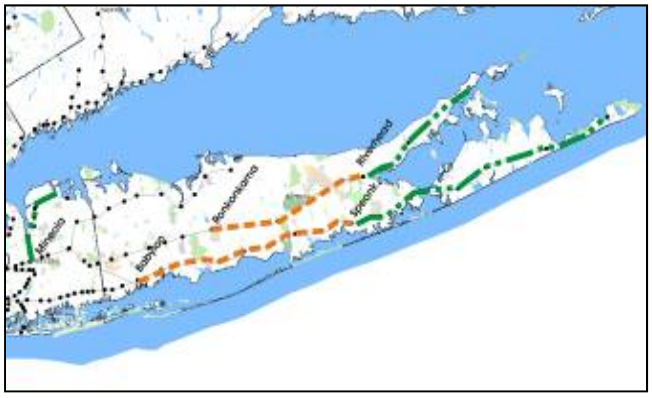
Maximizing Investments in Commuter Rail Stations in New York City

While Metro-North and LIRR services are primarily used by customers traveling to and from the suburban counties, the rail lines pass through parts of Manhattan and the outer boroughs and provide a number of city station locations. As part of investments in these stations over this plan period, opportunities may exist for pocket tracks, signal enhancements, and station platform extensions to create incremental throughput capacity. This would enable additional trains to stop at these stations, enhancing both CBD-bound service and reverse-commuter travel.

LIRR can also make investments to overcome infrastructure limitations at stations such as Kew Gardens and Forest Hills, whose platforms are only four car lengths. Lengthening the station platforms at these two stations would allow additional customers to utilize these stations without having to pass between train cars during a station stop in order to access a car which platforms at the station. Through the construction of lengthened platforms that accommodate more train cars, station dwell times at these stations will decrease, making for shorter travel times between Jamaica and Penn Station, while improving service to these Queens communities. This smart investment is particularly beneficial after East Side Access service opens, as LIRR service to two Manhattan terminals will help to decrease overcrowding on the Queens Blvd. subway line.

Implementing Strategic Corridor Improvements to Improve Service

As the railroads invest in track, signals and power, additional targeted investments in strategic corridors promise significant opportunities to increase capacity and enhance service. For LIRR, these investments in their core program complement the East Side Access network expansion project currently underway, putting in place the infrastructure necessary to maximize the increase in capacity that Long Islanders will receive. For Metro-North, similar improvements will facilitate additional service on the Hudson and Harlem Lines.



Long Island Rail Road's Strategic Improvements represent core program investments to increase railroad capacity. For instance, as the LIRR modernizes the aging signal system in Jamaica, it is reconfiguring the existing track layout, which has not changed significantly since the complex opened in 1913, to allow for increased throughput. Other strategic corridor investments in LIRR's program include: expanding Main Line

track capacity, including a complete double track between Farmingdale and Ronkonkoma, constructing the Republic Hub Intermodal Station, enhancing/establishing "Scoot" Services on diesel branches (Oyster Bay and East of Ronkonkoma), and building additional electric train storage capacity on multiple branches in Suffolk County.

Metro-North Railroad's core program investments also include strategic corridor improvements aimed at increasing capacity on the busy Harlem, Hudson and New Haven Lines of Metro-North's East of Hudson (EoH) River services in conjunction with general track, signal and power improvements intended along the corridors. These investments include the initial effort to expand the Harlem line between Crestwood and North White Plains and design of a new Woodlawn flyover at the junction of the Harlem and New Haven lines in the Bronx.

These smart investments in track, signal and power help to remove critical existing operational constraints, improve service flexibility and improve train performance.

Making Investments Sustainable and Resilient

The MTA has made a concerted effort in this 20-year needs assessment to incorporate smart "sustainability" in its many definitions into the planning and construction of proposed infrastructure investments. Building sustainable features into core investments will further enhance transit's role in the overall sustainability of the region, which already has one of the lowest carbon footprints in the nation largely due to transit use. This 20-year period will also see the growth in smart station access programs and transit-oriented development (TOD). The MTA and the communities it serves will continue to work collaboratively to cluster commercial and residential development around MTA stations and MTA right-of-way.

The MTA is incorporating the hard lessons learned from Superstorm Sandy into future core capital work. Our network is robust, but the storm exploited its vulnerabilities in our most basic infrastructure. The repair and mitigation programs established after the storm are a good first response to the disaster, particularly for those assets in the most prone areas. Over the long-term, other assets will be better

protected and hardened from storms, critical systems reconfigured, elevated or relocated, and new assets deployed to help allow the network to recover more quickly from such major events. A more resilient transportation infrastructure translates into a more resilient New York region.

The core agency investment needs which follow focus on repairing and replacing obsolete assets in these smart ways, to ensure the legacy of the system for generations to come.

MTA Agencies' Twenty-Year Capital Needs: 2015-2034

The following sections describe the investments identified by each agency as necessary to continue restoring the regional transit system to a state of good repair and replacing assets that reach the end of their useful lives before they fall into disrepair. These needs, constrained as described in a previous section, are prioritized according to asset condition and performance in order to provide the greatest service benefits and maintenance savings to the operating budget. While all of the identified needs may not be included in subsequent five-year plans, additional maintenance investment will ensure assets' ongoing safety and acceptable performance.

New York City Transit
Capital Needs 2015-2034

NYC Transit has experienced near-record annual subway ridership – 1.65 billion in 2012, a total not seen since 1950. With the bus system included as well, total ridership exceeded 2.3 billion. This high level of usage is, in part, a reflection of three decades of prior capital investment, which has made the system far more reliable and attractive than it once was. Nevertheless, portions of the system are nearly 110 years old, and a significant portion of its asset base remains overdue for attention. The system also suffered a devastating blow in 2012, in the form of Superstorm Sandy, and the post-storm service shutdown highlighted both the critical importance of NYC Transit service to the city and region, as well as the remaining fragility of the system's infrastructure.

In this context, NYC Transit must continue to invest in its vast infrastructure, fleets, and facilities to sustain and build upon the progress that has been made to date. This investment is separate from the extensive post-Sandy recovery and resiliency efforts that will be occurring over the next several years, but is no less vital to the transit system's future. Implementing this work concurrently, all while continuing to provide the 24/7 service upon which New Yorkers rely, is a significant challenge that NYC Transit is prepared and equipped to face. In light of implementation and financial constraints, this 20-year needs assessment includes the most critical investment needs.

Investment Needs

NYC Transit forecasts a need of nearly $68 billion through 2034 to continue to maintain, replace, and upgrade its capital assets (Table 2). This excludes investments in new routes and extensions, as well as investments in security, which are funded through other MTA agencies and discussed elsewhere.

More than half of all needs, $39 billion, are concentrated in the following areas: signal systems, passenger stations, subway cars, and bus/paratransit fleets. Signal systems, at $15.6 billion, constitute the single largest category of needs.

The pace of investment across the upcoming four capital plans is somewhat uneven, ranging from $15 billion to $19 billion per period, largely due to the "lumpiness" of subway car purchases. At the extremes, there is a $3.8 billion need for new cars in the 2020-2029 period, but zero need in the following five years.

Table 2
MTA NYC Transit Summary of Continuing Needs: 2015-2034
By Investment Category
(2012 $ in millions)

Investment Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
Subway Cars	$2,717	$1,920	$3,789	$0	$8,426
Buses	1,150	1,661	1,841	1,538	6,191
Passenger Stations	2,256	2,350	2,443	2,400	9,449
Track	1,450	1,426	1,406	1,390	5,671
Line Equipment	882	765	835	957	3,439
Line Structures	792	767	640	816	3,015
Signals	3,050	3,837	4,366	4,357	15,610
Communications	944	365	765	570	2,644
Traction Power	681	914	854	651	3,100
Shops & Yards	396	847	606	624	2,473
Depots	669	597	448	558	2,271
Service Vehicles	409	102	93	110	714
Passenger Security	19	29	4	4	56
Added Capacity	0	0	500	1,000	1,500
Miscellaneous/Emergency	730	892	734	712	3,068
Staten Island Railway	111	231	147	120	609
Total	$16,256	$16,703	$19,472	$15,807	$68,237

(numbers may not total due to rounding)

$68 billion represents a reduction in stated needs for NYC Transit compared with prior needs statements. Recognizing fiscal realities, the strategies by which assets are repaired and modernized have been revamped across the board, placing much greater emphasis on lower-cost component reinvestment rather than complete reconstruction of facilities. This shift is an outgrowth of the component investment strategy that was successfully introduced for passenger stations in the 2010-2014 Capital Plan. The old strategy for stations – comprehensive rehabilitation projects, with a stated useful life of 35 years – had become unsustainable in terms of pace and cost. Under the new strategy, investment is targeted to address the most critical deficient *components* (such as stairs and platform edges) at stations systemwide, with the expectation that each station will receive reinvestment on a more frequent cycle. For the 2015-2034 period, similar component-based strategies have been developed for a number of other asset

groups, including line structures, power substations, subway shops, and bus depots. Investments will be targeted to address the specific deficient components of these assets – such as specific structural members, equipment items, or building subsystems – based on the best available systemwide condition data. (Component investment in line structures is discussed further as a "Highlighted Investment Category," below).

System Investment Status

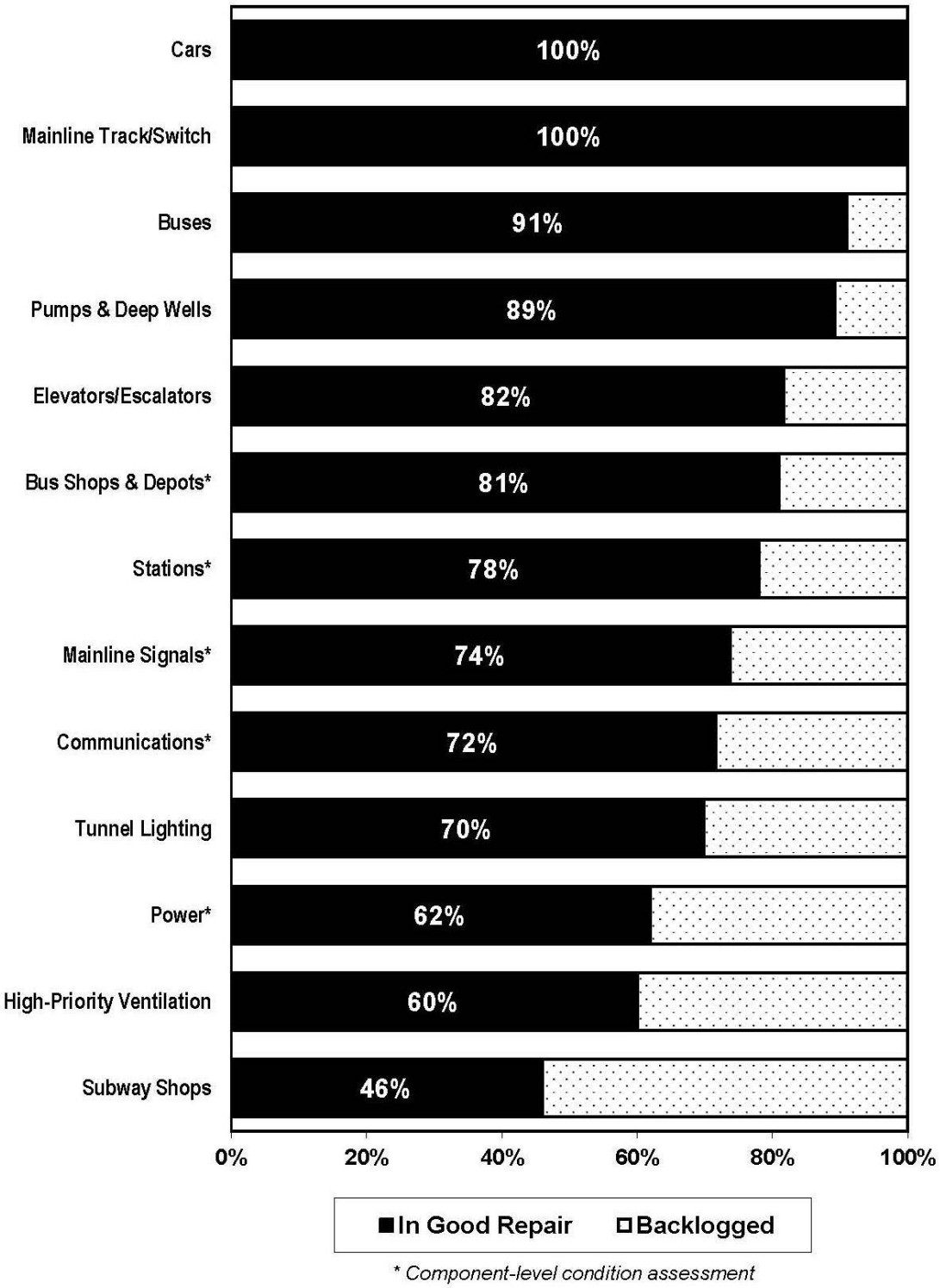
In this 20-year needs assessment, NYC Transit has evaluated the assets that comprise its vast infrastructure based on one or more of three attributes:

- asset condition;
- asset age vs. useful life;
- asset performance vs. an identifiable performance standard (including safety and reliability).

The measuring stick is customized by asset type, based on the best available data. This approach is the same as what was presented in the previous 20-year needs assessment (2010-2029); when it was introduced at that time, it was a departure from previous reporting of "state of good repair" status.

The *System Investment Status* exhibit (Chart 1) presents, by investment category, the measure of whether an asset is considered in good repair or whether it is backlogged and already past due for investment. Subway cars and mainline track – assets that are fundamental to safe and reliable service delivery – are both fully in good repair, but will require significant normal replacement investment throughout the 2015-2034 period to maintain that status. All other major asset categories have some degree of investment backlog.

Chart 1
System Investment Status
MTA NYC Transit Major Investment Categories



** Component-level condition assessment*

Note: A revised component based strategy for investment in Structures is being implemented and is therefore not included above.

This chart does not include the new assets that are being constructed under the Second Avenue Subway and 7 West Extension projects. Such assets will be placed in service during the 2015-2034 period, but it is expected that they will not need major capital reinvestment in that timeframe. The capital reinvestment needs of these assets will be evaluated and incorporated into future needs assessments.

Highlighted Investment Categories

Below are five "signature" investment categories that have the most significant needs over the coming 20 years. Each is a major capital initiative in its own right, and each reflects unique challenges in execution to achieve the aggressive investment goals over this horizon.

The following sections provide the highlights of these categories. Later in this document is a comprehensive presentation of all NYC Transit investment categories.

Signals

Signal systems are the single largest need, representing 23% of NYC Transit's 20-year total. A well-functioning signal system is critical for reliable service; currently, signal failure is a leading cause of train service delays. Many of the B Division's IND lines still depend on antiquated signal technology that dates from the original construction of the subway system. The previous 20-year needs assessment (2010-2029) included an accelerated pace of signal investment, and such a plan continues to be a centerpiece of the current assessment. Previous projections indicated the interlockings would reach state of good repair earlier in the 20-year period. However, NYCT has updated the definition of good repair for interlockings to match the definition used for line signals, resulting in an increase in the number of backlogged locations. Assuming the appropriate level of funding, a combination of backlog and normal replacement investments will be made in each program through 2034, with backlog investments dropping off at the end of the 20-year period. Achieving this pace of investment will require not only adequate funding, but also a scaling-up of NYC Transit's design and construction expertise, and qualification of additional vendors to supply state-of-the-art communications-based train control systems. The investment plan for 2015-2034 includes modernization of interlockings and the continuing rollout of CBTC, as well as installation of new Discrete Solid State Signal Devices (currently in a pilot/development phase) to extend the life of existing conventional signals on some lines.

Subway and Bus Fleets

Cars and buses are fundamental to service delivery, and normal replacement of these assets continues apace. Collectively, these fleet needs represent 21% of NYC Transit's 20-year total. Subway cars have a projected 40-year useful life. Buses have a 12-year useful life, so the fleet is replaced nearly twice-over in a 20-year period. Replacement of subway cars by fleet class results in uneven distribution of investment needs, so much so that the 2030-2034 period does not require purchase of new cars. NYC Transit is exploring the most efficient means of phasing and packaging these car investments. Bus purchases are also uneven to some degree, largely due to extraordinary fleet growth that occurred in the 1998-2000 period.

Passenger Stations

Stations are a major need, representing 14% of NYC Transit's 20-year total. Beginning in the 2010-2014 Capital Plan, NYC Transit adopted a new strategy for capital investment in stations, to focus on addressing specific deficient components rather than costly full rehabilitations of entire stations. In addition, a number of comprehensive station "renewal" projects are performed at stations with high concentrations of deficient components. This overall strategy enables NYC Transit to address prioritized needs more quickly, and reinvest at a sustainable pace that recognizes the varying useful life of various components. To date, the strategy has proved successful, with data from a new 2012 systemwide Station Condition Survey showing a significant reduction in component defects compared to the prior 2007 survey – for example, there is a 37% reduction in the number of components rated 3.5 or worse (on a condition rating scale of 1.0 to 5.0), reflecting the completion of all programmed 2010-2014 work. This strategy will continue throughout the 2015-2034 period, which will allow continual improvements to be made at funding levels equivalent to 2010-2014.

Structure Component Repairs

NYC Transit is striving to improve how it addresses the critical repair needs of its right-of-way structures. Although line structure needs represent only 4% of NYC Transit's 20-year total, this category is highlighted because of its fundamental importance to service delivery. Based on an in-depth re-evaluation of its past investment strategy, NYC Transit is now adopting a component repair program – similar to what is in place for passenger stations – that will focus on specific known high-priority defects tracked through the continual inspection of all structures. Previously, these spot defects were incorporated into extensive line rehabilitations

addressing all level of defects, but such jobs proved unaffordable under current funding levels and did not address all priority defects systemwide.

Communications Technology Enhancements

Complementing the investment in NYC Transit's core infrastructure, several high-profile initiatives are planned for the 2015-2019 period, which reflect a corporate strategy to implement new technology that will enhance the customer experience. These initiatives include completion of the new fare payment system (NFPS), which will replace MetroCard technology with contactless "tap and go" fare payment; completion of the Integrated Service and Information Management – B Division (ISIM-B) project, which will enable real-time train arrival information; and rollout of Help Points to all remaining stations systemwide. These types of technology assets have short reinvestment cycles, so reinvestment in these assets is included in the latter half of the 2015-2034 period.

Investment Category Summaries

Railcars

As of the conclusion of the 2010-2014 Capital Plan, NYC Transit's railcar fleet has 2,905 cars in the A Division (numbered subway - also referred to as IRT - lines) and 3,560 cars in the B Division (lettered routes, sometimes referred to as IND or BMT lines) for a combined fleet of 6,465 cars. The railcar fleet has been in a normal replacement cycle since 1992, and recent railcar purchases have also included some fleet growth to meet service needs.

Railcars are a critical service delivery asset and, as such, make up 12% of the total 20-year capital needs investments. This level of investment is needed to maintain the high service level that NYC Transit has achieved through past railcar purchases and a comprehensive railcar maintenance program. Past investments have increased reliability from an average of 7,000 miles between breakdowns in 1982 to more than 160,000 miles today.

NYC Transit's strategy for the 2015-2034 period is to continue the normal replacement of railcars as they reach the end of their 40-year useful lives, with additional cars purchased as necessary to support ridership growth that is expected based on modeling and forecasting. Highlights for the A Division include a large normal replacement of the R-62/R-62A fleet (1,140 cars), phased across the 2020-

2024 and 2025-2029 periods. In the B Division, the R-46 car class (752 cars) will be replaced in the 2015-2019 period and the R-68/R-68A car classes (625 cars) will be replaced in the 2025-2029 period. For the purposes of this plan, it is assumed that the B Division will continue to operate a mixed fleet of 60 foot and 75 foot cars; and the cars to be purchased in the 2015-2034 period will be 75 foot cars, based on the length of the existing R-46 and R-68/R-68A fleets. In addition, a total of 168 cars will be purchased for fleet growth. Growth cars for the B Division are scheduled for purchase in the 2015-2019 and 2025-2029 periods, and for the A Division in 2025-2029. The 2015-2019 growth cars are expected to be used for additional service on the E, G, L, and N lines, although these service plans remain subject to change.

Buses

The NYC Transit bus fleet currently has 4,428 buses (as of the conclusion of the 2010-2014 Capital Plan), including 3,169 standard, 493 express, and 766 articulated buses. The number of buses in the fleet, and mix of bus types, are continually reevaluated – and changes may be implemented via successive bus purchase projects – to ensure that the fleet is appropriate to meet service needs. All express and articulated buses are in a normal replacement cycle, but 387 standard buses have remained in service beyond their stated useful lives of 12 years. Prior purchases coupled with NYC Transit's service program, including preventative maintenance and general overhauls, have resulted in fleet reliability improving from less than 1,000 miles between breakdowns in 1982 to more than 4,000 miles today. They have also made NYC Transit's fleet the greenest large bus fleet in the nation; the entire bus fleet is now composed of either clean diesel, hybrid diesel-electric, or CNG-fueled buses. And, the fleet is one that is fully accessible to the disabled.

NYC Transit remains committed over the next 20 years to the normal replacement of buses with purchases planned to coincide with the retirement of all buses at the end of their useful lives. Overall, 4,290 standard, 2,060 articulated, and 658 express buses will be purchased by 2034. These purchases will shift the composition of the bus fleet to include more articulated buses and fewer standard buses, as selected high-volume routes are converted to articulated operation, and as articulated buses are deployed on new "Select Bus Service" routes (discussed in the Bus Depots section, below). The plan also includes modest fleet growth over the 20-year period – 24 additional articulated buses and 26 additional express buses – to handle increased ridership that is projected based on demographic forecasts. In addition, development of advanced bus technologies, such as automatic passenger counters, is expected to occur throughout the 20-year period.

NYC Transit's paratransit fleet provides point-to-point trips for qualifying customers. As of 2012, the fleet consists of 1,458 lift-equipped vans, purchased through the capital program; plus over 600 sedans, which are purchased through the operating budget. All paratransit vehicles are currently within their useful lives, but their short lifecycle (seven years) necessitates frequent normal replacement. In the 2010-2014 Capital Plan, much of the van fleet will be retired; only 657 existing vans will remain in the fleet by end of 2014, and new lift-equipped vans will not be purchased in the future. Instead, beginning in 2010-2014 and going forward, all capital purchases will be smaller wheelchair-accessible vehicles that have a lower unit cost. Paratransit ridership has grown rapidly since the service's inception, in part due to a growing and aging population. Despite recent policy changes, which have mitigated growth to some extent, the paratransit fleet is still expected to grow substantially over 20 years; based on an average growth rate of approximately 4% per year over the next 20 years, the capital fleet will more than double by 2034.

Stations

NYC Transit currently operates 468 passenger stations: 277 subway, 142 elevated, and 49 on viaduct, fill, or open cut structures. Beginning in the 2010-2014 Capital Plan, NYC Transit adopted a new strategy for capital investment in stations, to focus on eliminating the most deficient conditions systemwide. This strategy emphasizes projects targeted to specific station components, such as stairs, platform components, mezzanine components, windscreens, and canopies. The strategy also includes a number of broader station "renewal" projects, at stations with high concentrations of deficient components. This overall strategy enables NYC Transit to quickly address prioritized needs, and reinvest at a sustainable pace that also recognizes the varying useful life of station subcomponents.

Underpinning this strategy is a comprehensive condition survey of all stations, to be updated every five years, which rates over 14,000 station components. Each component's structural and architectural condition is rated on a scale of 1.0 (best) to 5.0 (worst). The most recent survey was completed in 2012, and found that 22% of station components have structural conditions rated 3.0 or worse.

In the 2015-2034 period, NYC Transit's objective is to gradually reduce the number and severity of component defects systemwide. In each successive capital plan, the deficiency threshold used to determine which station components should be

addressed will be lowered. As an example of the success that has been achieved to date, the 2012 condition survey shows a 37% reduction in the number of components rated 3.5 or worse, as compared to the 2007 survey, reflecting the completion of all programmed 2010-2014 work. Based on the 2012 survey results, it is expected that the 2015-2019 period will eliminate all deficiencies rated 4.0 or worse, and at least half of all deficiencies rated 3.5. Successive plans will eliminate the remaining defects rated 3.5, and make continuous progress toward the long-term goal of eliminating all defects rated 3.0 or worse.

NYC Transit is committed to making the subway system increasingly accessible to customers with disabilities, including a mandate to upgrade 100 stations ("Key Stations") to become fully ADA-accessible by 2020 (including three Staten Island Railway stations). 89 stations will be complete by the end of the 2010-2014 Capital Plan, and the remaining 11 stations will be included in the 2015-2019 period. (In addition, 25 stations beyond these Key Stations are also wholly or partially accessible, as of 2014.) Beyond 2019, it is assumed that accessibility upgrades will continue, at locations to be determined, with the same pace of investment that was required to complete the 100 Key Stations.

With investments through 2010-2014, there are 231 elevators, 179 escalators, and two moving walkways in NYC Transit stations. The number of elevators has increased over time due to the completion of ADA projects. Over the 20-year period, investments in escalators and elevators are planned to replace these assets at the conclusion of their useful lives, with an average pace of roughly 45 elevators and 45 escalators per five-year period. Replacement of traction elevators, which serve the deepest stations in the system (such as in Upper Manhattan), will be a particular focus of the 2015-2019 period, based on current conditions.

Fare collection equipment will be replaced over the 20-year period. Phase 1 of the NFPS is funded in the 2010-2014 Capital Plan. This next generation of fare equipment will involve contactless "tap and go" technology, and promises to transform access to the region's transportation systems much like MetroCard did years ago. Phase 2 of NFPS implementation is planned for the 2015-2019 period. Subsequent normal replacement reinvestment is planned in 2030-2034.

A major reconfiguration project is planned at NYC Transit's busiest station complex, 42 St.-Times Square, in the 2015-2019 period. Work will include renewal and reconfiguration of the Shuttle station, both to improve passenger circulation and to

make the station ADA-accessible. The existing Shuttle station has various deficiencies, including circuitous customer paths, platform edge gap fillers and other components that are not in good repair, and a general station appearance that does not match the standard achieved through the rest of the Times Square complex. The work is also essential to comply with ADA mandates. Other system improvement projects – such as passenger circulation improvements, new passenger transfer facilities, and/or new intermodal facilities – are planned in each period beginning in 2020-2024. Among the possible system improvement projects is the installation of platform edge doors, to enhance safety and security by preventing customer access to tracks. Installing platform edge doors in NYC Transit stations may involve structural retrofits and other technical challenges; feasibility is currently being studied.

Mainline Track and Switches

The NYC Transit system contains 633 miles of mainline track and 1,758 switches. Including switch length, the total system length is 660 miles. As track and switches are two of the most critical assets for safe, efficient, and reliable service delivery, every segment of track is assessed several times each month on a scheduled basis. Switches are inspected jointly by track and signal maintainers. These efforts have yielded up-to-date condition information that has enabled a track and switch replacement program that has placed all track and switches in good repair since 1991 and 1997, respectively.

An estimated 229 miles of mainline track is planned for replacement between 2015 and 2034, or approximately 57 miles per capital program. The investment pace is informed by the quadrennial track condition survey, with appropriate adjustments to actual 5-year plans. As part of the mainline track replacement program, traditional bolted rail will be replaced with continuously welded rail (CWR) at critical locations, to prevent the occurrence of broken rails. This is a key investment strategy for the continued safety of the rail system. Other benefits of CWR are reduced damage to rolling stock and better ride quality. As appropriate, new investments in CWR will be made to address critical rail breaks throughout the 20-year period.

Approximately 540 switch replacements are planned over the next 20 years, which is suitable to maintain a normal replacement pace. New strategies that were introduced in the 2010-2014 Capital Plan, including a Scheduled Component Replacement program and use of solid-cast polymer tie blocks, will enable a faster pace of investment at lower cost, compared to prior periods.

Line Equipment

Line equipment refers to the array of equipment distributed along the right-of-way. Broadly, there are four distinct types of line equipment: tunnel lighting, ventilation plants, pump rooms, and deep wells.

There are approximately 432 track miles of tunnel lighting in the NYC Transit system, covering all subway tunnels, including 130 miles of incandescent lighting. All incandescent tunnel lighting will be replaced with compact fluorescent lighting by 2034. To accomplish this goal, tunnel lighting awards will proceed at an average pace of 32 track miles per capital program. This pace is nearly double what was achieved in the 2010-2014 program (18 miles) but similar to what was achieved in other prior capital plans.

There are currently 195 ventilation plants (or "fan plants") in the NYC Transit system protecting all under-river tubes and a share of the rest of the system. In an emergency, they are used to direct heat and noxious fumes away from passengers and evacuation routes. NYC Transit proposes to construct 26 new or expanded fan plants by 2034 to achieve modern ventilation standards at the next group of high-priority tunnel segments. The number of plants built in each successive five-year period will ramp up over the next 20 years to help mitigate the challenge of achieving this increased pace of construction. Plants will be built based on a priority ranking and other site considerations. In addition, smaller-scale investment is programmed to extend the useful life of existing fan plants that are in poor condition.

There are 230 pump rooms to expel the ground water that naturally infiltrates the subway tunnels and other runoff that enters the system. While all pump rooms will have been modernized by the end of the 2010-2014 plan, 26 pump rooms currently exhibit conditions that are sufficiently deficient that they are considered out of good repair and therefore necessitate investment; these rooms will be addressed by 2024. After 2024, investment in pump rooms will shift to normal replacement, and NYCT will address an additional 38 pump rooms by 2034. Replacement investment is assumed to be less intensive than initial modernizations. Cyclical investments to back-flush deep wells (pumps that lower the water table in the vicinity of a subway structure to prevent water infiltration) to ensure they will not become clogged will continue throughout the 2015-2034 period. One new deep well location is planned for construction in the 2020-2024 period.

Line Structures

There are 228 miles of line structures on the NYC Transit system. There are 136 miles of underground subway structures, including 13 miles of under-river tubes and 123 miles of land-based tunnels. There are 70 miles of elevated structures, of which nine miles are viaducts, which include ferro-concrete or concrete-encased steel elevated structures. At-grade structures make up 22 total miles, which consist of right-of-way built on earthwork at-grade, in open-cut, or on embankments.

A component approach, similar to the process developed for stations, is currently under development to address defects for both elevated and subway line structures. It is expected that this approach will address the highest-priority defects faster and more efficiently than the previous investment strategy, which was based on line segment rehabilitations. Through an in-house NYCT structural inspection program, defects on subway and elevated structures are tracked in a database and assigned ratings based on criticality. This database will be used to target areas for component investment, such as specific locations on the right-of-way or specific types of steel structural members. Because structures are inspected on a continuous cycle and the condition database is routinely revised to reflect new findings, additional high-priority defects may be identified in the future that will take precedence over currently-identified work.

For subway structures, the backlog of all known defects will be addressed by 2024. In subsequent periods, investment will continue at a pace sufficient to address anticipated new defects.

Elevated structures will follow a similar component approach and will be closely coordinated with line structure painting work. There are currently 65 miles of painted steel structure. This includes virtually all steel elevated structures, plus steel bridges that are part of certain at-grade structures. Performing this work together is intended to increase efficiency and prolong structural life. Line structure painting will proceed at an average pace of 22 miles per capital program, which is necessary to reestablish a regular repainting cycle based on the 15-year useful life of overcoat paint. In tandem, the backlog of highest-priority structural defects will be addressed by 2034.

Complementing these investments, funding for special structural repairs is included in every five-year period, to address structures not easily addressed through the component program. These may include structures with unique physical

characteristics (such as concrete-encased viaduct structures, retaining walls and bridges found on at-grade right-of-way), as well as segments of subway and elevated structures with unique concentrations of defects.

Subway structures include 542 emergency exits, which are located at regular intervals along the right-of-way. An in-house initiative to rehabilitate these exits began in the 2005-2009 plan. This initiative will continue through 2034, at a pace of 75 emergency exits per five-year period.

Signal Systems

Signals govern the movement of trains along the right-of-way to ensure that trains operate at safe speeds and to prevent collisions. There are 727 track miles of mainline signals. Most of the NYC Transit system relies on conventional "fixed block" signal systems, but the agency is beginning to transition to communications-based train control signals.

Currently, 74% of the signal system is in good repair. For line signals, 267 track miles are in need of modernization. Portions of the signal system were modernized in the 1960s and are just now reaching replacement age. The B Division (primarily the IND lines) contains the majority of backlogged mileage, with some installations dating to the 1930s. A number of interlockings have been modernized in advance of the full modernization of signals along a line; currently, 40 interlockings are backlogged.

An ambitious program is planned for signals through 2034 that will continue interlocking modernizations and line-based signal modernization including CBTC deployment. This plan represents a major increase in investment pace compared to recent capital plans, averaging nearly $4 billion per five-year period, compared to less than $2.3 billion in the 2010-2014 Capital Plan.

When antiquated fixed-block signals are due for replacement, NYCT's strategy is to modernize each line with CBTC signals. In contrast to trains operating on lines with traditional fixed-block signals, each train on CBTC-equipped lines has an on-board computer that is in constant radio communication with wayside devices. Train speeds and positions are measured precisely, not based on fixed blocks, and are communicated to the centralized Rail Control Center (RCC). Instructions regarding allowable train speed are then transmitted back to the on-board computers. CBTC provides a variety of benefits, providing enhanced safety, capacity, operations, and customer information. Installation of CBTC will entail the modernization of each

individual interlocking along the line, the subsequent "overlay" of CBTC technology along the entire line, and outfitting all railcars that operate on the line with CBTC carborne equipment. CBTC installation is now complete on the Canarsie Line and in construction on the Flushing Line. Over the next 20 years, the rollout of CBTC signals will continue with installation on 322.5 miles of track, including the western portion of the Queens Blvd. Line and major Manhattan trunk lines: 8th Ave. Line (2015-2019), 6th Ave. Line (2020-2024), Broadway and Lexington Ave. lines (2025-2029), and Broadway-7 Ave. Line (2030-2034). Installation on the remaining lines in the NYCT system will continue for several capital plans after 2034.

This plan requires an intense focus on project implementation. Interlocking modernizations are planned to occur in advance of CBTC deployment, and all cars operating in CBTC territory must be equipped with specialized equipment. Since CBTC equipment can only be installed on new-technology cars (the R142-class cars and newer), the pace of CBTC equipment installation is coordinated with the planned schedule for delivery of new cars. By 2027, all revenue cars in the NYC Transit system will be CBTC-equipped.

The largest investment area in the signals category is the modernization of interlockings. Signal interlockings ensure the safe movement of trains at locations where tracks cross or merge/diverge. There are 183 interlockings in the mainline NYC Transit system. Interlockings are controlled from signal towers, where NYC Transit personnel can monitor the position of trains and specify the route for each train to take. The backlog of interlockings will be addressed by the 2025-29 program. An additional 34 interlockings will undergo normal replacement upgrades, which are necessary for compatibility with CBTC. Interlocking investments begin with 13 in the 2015-2019 period and then ramp up to approximately 20 in each period within the 2020-2034 window.

On several lines, the automatic signaling will reach the end of its useful life before it is scheduled to be modernized according to the CBTC rollout plan. In anticipation of this, a new technology is being investigated that potentially can extend the useful lives of these signals until a full CBTC upgrade is awarded. Known as Discrete Solid State Signal Device (DSSSD), this technology uses solid state equipment to handle some of the logic processing normally handled by older electromechanical relays and utilizes fiber optic cables to network the signals together. Beyond extending the useful life of the automatic signals, this technology has the potential to significantly reduce cabling, relays, and field maintenance compared to a typical automatic signal installation. A

pilot of this technology is currently being planned, and mainline applications are already being considered.

NYC Transit will also continue several initiatives to enhance the safety and operational efficiency of existing conventional signals. These projects include circuit and line control modifications and stop machine cable replacements at locations throughout the system. These initiatives are expected to conclude by the 2025-2029 period. Lastly, the cyclical normal replacement of ATS-A technology is expected to occur every 10 years, with the next replacement in the 2020-2024 plan.

Communications Systems

NYC Transit has an extensive carrier-grade communications network. The network is supported by 472 miles of fiber optic cable, extensive copper telephone cable installations, eight major PBX sites, wireless radio systems for use in the subways by NYC Transit and the New York City Police and Fire Departments, 190 miles of subway antenna cable, and one or more communications rooms located in every station. Communication assets also include in-station communications applications such as public address / customer information signs (PA/CIS) and Help Points (customer intercom devices). Collectively, these assets are critical to providing voice and data communications for NYC Transit personnel, as well as customer communications. A major challenge in this area is the short useful life of electronic equipment, which necessitates a frequent normal replacement cycle for many assets. The strategy over the 20-year period is primarily to focus on normal replacement work, as well as to complete two ongoing system improvement initiatives related to in-station applications.

A major focus of normal replacement investment will be NYC Transit's main fiber optic data network, known as SONET/ATM; it will receive upgrades of selected equipment in the 2015-2019 and 2020-2024 periods to extend the life of the network, followed by phased replacement of the network in the 2025-2029 and 2030-2034 periods. The subway VHF radio system will also require normal replacement in the 2025-2029 period, along with more frequent replacement for related portable radio units. PBX switches will require normal replacement in 2015-2019, as the second phase of work that began in 2010-2014.

To support the functionality of the network, infrastructure investments in 2015-2034 include continuous investment to replace degraded fiber optic cable, antenna cable, and copper cable as needed. Upgrades and expansions of communications rooms are

required as more electronic equipment is placed in them; air conditioning/ventilation upgrades for the rooms and expansions continue through 2034.

In addition to normal replacement investment, two major ongoing system improvement initiatives will be completed in the 2015-2019 period. First, by the end of the 2015-2019 period, Help Points will be installed at all remaining stations systemwide. Help Points at 138 stations are being installed through ongoing projects, leaving 330 stations to be addressed in the 2015-2019 period. Second is the completion of the Integrated Service and Information Management – B Division (ISIM-B) project, the first phase of which is funded in the 2010-2014 plan. ISIM-B will enable real-time train arrival information to be provided to NYC Transit customers and personnel, including train arrival "countdown clocks" in B Division stations.

Complementing ISIM-B, nearly 200 B Division stations will need upgraded PA/CIS in order to provide real-time train arrival information. While all subway stations will have some capacity for public address by the end of the 2010-2014 Capital Plan, there remain a variety of older systems in place that will be upgraded to modern standards in the 2015-2019 period, including installation of text-based CIS at stations that currently have audio PA only. Subsequent investments include normal replacement of selected Help Point, PA/CIS and ISIM-B components.

Traction Power

NYC Transit operates 216 substations throughout the subway system. Substations receive high-voltage alternating current (AC) power and convert it into 600-volt direct current (DC) power for use in train propulsion. To accomplish this conversion, each substation includes a transformer, which reduces the voltage of the AC power, and a rectifier which converts the power from AC to DC. Substations also include switchgear to isolate equipment and protect against overloads or short circuits. DC power output from a substation is transmitted to the third rail by means of the power distribution system, which includes traction power cables and circuit breaker houses (CBHs). For emergency removal of power, emergency alarm units (EAUs) are placed throughout the NYC Transit system.

With investments through the end of 2014, 100 substations will exhibit conditions requiring capital investment. These locations have at least one of the above-mentioned components or its enclosure out of good repair; these locations will be addressed by 2034. In general, substations with multiple backlogged components will

receive a more comprehensive "renewal" type project, while substations with only one or two backlogged components will receive component-only investment. Sixteen substations are planned for renewals; the remaining 84 locations will have varying degrees of component rehabilitation.

On lines that will be upgraded with CBTC signals (as discussed above), it is expected that additional power will be required to support the higher train throughput enabled by CBTC. Providing this power will require new substations at key locations, as well as enhancements to other power infrastructure. The assessment reflects new substations on the 8th Ave. and Queens Blvd. lines, along with other investments (at locations to be determined) beginning in the 2015-2019 period and continuing through 2025-2029. These system improvement projects will ensure that the full customer benefits of CBTC can be achieved – specifically, more frequent, higher-capacity train service – and will also allow for improved reliability.

There are 304 CBHs systemwide. Investment in CBHs will increase compared to recent plans, with an average of 17 locations in each five-year period, up from seven in 2010-2014. At this increased pace all 66 CBHs that need rehabilitation will be addressed by 2034.

Known deficiencies in power cables and ducts will be addressed in the 2015-2019 and 2020-2024 periods. Additional power cable and duct needs are expected to emerge and will be addressed in later periods. Emergency alarm units will also be invested in systemwide during the 2020-2034 period.

Subway Shops and Yards

NYC Transit's system of railcar shops keeps the subway fleet in good working order. The 14 railcar maintenance facilities handle daily maintenance and cleaning tasks along with the Scheduled Maintenance System (SMS) component change-outs. NYC Transit's two overhaul shops house the six- and twelve-year SMS program and any repairs that are too intensive to be completed at the maintenance facilities. In addition, NYC Transit's 26 Maintenance of Way (MOW) shops are critical to maintaining the track, signals, and electrical infrastructure of the subway system.

Investment in shops primarily focuses on addressing deficient components, such as architectural and structural elements, heating/ventilation, lighting, electrical systems, and facilities. Such component repairs are planned at the two overhaul shops and 12 of the railcar maintenance shops. Two railcar maintenance shops (Livonia and 240th

St.) need larger-scale rehabilitation because they exhibit a high concentration of defects and their physical configurations (such as aisle widths) are ill-configured for current industrial practices. Besides the needs of shop buildings, initiatives are also planned for replacement of heavy shop equipment and repair of car washers. Similarly, 20 MOW shops will each receive investment for component rehabilitation work; and one MOW shop, the Atlantic Ave. Cable Shop, will be fully reconstructed. Lastly, a new facility will be created to service track geometry cars and other work trains, which will enhance NYC Transit's ability to maintain these vehicles and keep them available for productive operation.

The 24 yards used for the storage of railcars and work trains are spread out across the NYC Transit system, generally located near the end of subway lines. Several components make up NYC Transit's yard facilities, including 118 miles of yard track (including track occupied by switches), 895 yard switches, signal systems, perimeter fencing, and yard lighting. In addition to the tracks located at the yards, there are also some unsecured layup areas at various locations throughout the system that are used for off-peak train storage.

With investments through 2014, 93% of all yard track, 90% of non-revenue track and 94% of yard switches are in good condition. The most backlogged element of yards is their lighting; 38% of yards have lighting that is in poor condition and does not meet current standards.

Yard and non-revenue track replacement is planned to eliminate delayed investment needs by 2034 and keep pace with normal replacement needs. Yard switch replacement over the 20-year period will continue at a pace of 35 switches per period. Yard signals need substantial investment throughout the 2015-2034 period, complementing the accelerated pace investment in mainline signals (discussed in the Signals section, above). The signal systems at four yards will be replaced by 2034, starting with Jamaica Yard in 2020-2024.

Train storage capacity, security, and other yard needs are also identified. Jamaica Yard is planned to undergo an expansion that will double its storage capacity and greatly reduce the need to store trains along the mainline during off-peak hours; this will be implemented in phases in the 2020-2024 and 2025-2029 periods. To improve the security at the yards, the installation of CCTV at all locations will continue through the 2015-2019 plan, followed by normal replacement in subsequent plans. The last group of yards will receive fencing upgrades in the 2015-2019 plan. Similarly, in order

to eliminate the investment needs for yard lighting, a total of nine yards will be addressed in the 2015-2019 and 2020-2024 periods, followed by normal replacement of other locations in the 2025-2029 period.

Bus Depots and Shops

NYC Transit's 21 bus depots support bus service throughout the five boroughs of New York City by fueling, servicing, maintaining and storing buses as required. As the bus fleet diversifies, so do the facilities that support it. Two of the bus depots, West Farms in the Bronx and Jackie Gleason in Brooklyn, are equipped to service buses that run on compressed natural gas (CNG). Other depots have been modified to house articulated buses, which are a growing portion of the fleet. Supporting the maintenance functions at depots are two base shops, which handle heavier work such as major bus chassis and engine repairs, as well as smaller support shops at various locations.

About half of the 21 depots are relatively new, built within the last 30 years. Based on age and condition, it is expected that nearly all depots will require some level of capital investment in the 2015-2034 period. Projects will be targeted to address specific deficient components at each depot (such as roofs, heating/ventilation systems, lighting, and facilities). A recurring investment cycle is planned for each depot, with an initial investment followed by a second, smaller investment after 10 years. Base shops will also receive component repairs.

Complementing this component repair program, three depots will undergo complete reconstruction and/or replacement – beginning with Jamaica Depot in 2015-2019 – to address numerous functional deficiencies such as poor layout, inadequate work areas, and insufficient capacity. Among other benefits, these projects will help NYC Transit to reduce its reliance on outdoor street parking for buses. Likewise, four depots will be modified to accommodate an increase in the articulated bus fleet, and one additional depot will be expanded to add capacity. Historically, the identification and acquisition of suitable property for relocations/expansions has proven difficult, given the real estate and community pressures across NYC. Early identification and resolution of real estate needs will be a key factor in project delivery.

Besides the needs of depot buildings, important facility and communication equipment needs must be addressed. Over 40 bus washers and 20 bus paint booths are to be upgraded or replaced on a campaign basis by 2034. Likewise, there is a need

for replacement of portable radios, depot elevators, bus lifts, storage tanks, and paratransit scheduling/vehicle location systems.

Finally, a major priority investment in this category is the future deployment of Select Bus Service, in partnership with the NYC Department of Transportation. SBS is NYC Transit's innovative bus service designed to reduce travel time and increase the level of comfort for customers. First introduced on the Bx12 route in the Bronx in 2008, SBS has subsequently been implemented on several additional routes citywide. SBS includes a package of enhancements (which may vary by route), including limited stops, off-board fare payment, high-capacity articulated buses with boarding at all three doors, dedicated bus lanes, traffic signal priority, and distinctive branding. Investments over 20 years, on par with current spending, will allow for continued development and implementation of SBS on additional routes (to be determined) throughout the five boroughs. Lastly, in the 2015-2019 period, the assessment includes construction of a new off-street busway in Ridgewood, Queens that will reduce travel times and reduce operating costs for several bus routes.

Service Vehicles

NYC Transit maintains a fleet of 496 specialized railcars (i.e., work trains) and 640 heavy-duty rubber-tire vehicles (such as trucks and vans) used to support capital construction projects, operations and emergency situations.

NYC Transit proposes to purchase 211 new work train cars by 2034, in order to ensure that operations and capital construction projects are properly supported. This includes fleet growth of 10 additional locomotives in the 2015-2019 period for capital and maintenance workload needs. Otherwise, the investments in 2015-2034 are limited to replacement of the existing work train fleet. For rubber-tire vehicles, NYC Transit's goal over the 20-year period is to eliminate a small backlog of vehicles not in good repair and to be maintain a normal replacement cycle as vehicles reach the end of their useful lives.

Passenger Security / Police

NYC Transit is responsible for improvement of police facilities that serve the system. The Transit Bureau of the New York City Police Department operates out of 12 district offices and seven support facilities. In accordance with the merger agreement with the City of New York, NYC Transit will continue to consider specific capital needs of the Transit Bureau related to these facilities. Two district offices, at Union Square and East New York, are identified for rehabilitation or replacement in the 20-

year period. There is also a continuing need for component repairs at other district offices and support facilities, consistent with the component-based investment strategy that is being pursued for many asset categories. Other investments to ensure a secure customer environment are addressed through the MTA Security program.

Expanded Capacity / Major System Improvement

In the 2015-2034 period, there is a need for major reconstruction of NYC Transit's Rockaway Line. While this investment is driven by state of good repair needs, not capacity needs, it falls into this "Major System Improvement" category because of the comprehensive and cross-cutting nature of the work.

The Rockaway Line carries A train service in Queens. It includes a bridge/viaduct segment that traverses Jamaica Bay over water, and a concrete viaduct that runs overland along the Rockaway peninsula between Far Rockaway and Rockaway Park. Structural repair projects were completed in recent capital plans, which stabilized deterioration and extended the life of the structures. However, major reconstruction and/or full replacement will be required within the 2015-2034 period. Alternative alignments and/or alternative technologies may be considered, to better meet the needs of Rockaway customers and their communities. Depending on the alternative selected, work may not be limited to structural reconstruction, but may also include installation of all applicable supporting infrastructure (e.g., track, signals, communications, power). The over-water segment would be addressed in the 2025-2029 period and the overland segment in the 2030-2034 period.

NYC Transit Miscellaneous

This category has varied investments to support the work of the capital program. These include environmental improvements, such as asbestos abatement, groundwater/soil remediation, and underground storage tank remediation. Specialty consulting services are provided for as well; NYC Transit utilizes consultants for specialized engineering services to support ongoing and planned capital work, such as borings, test pits, concrete testing, environmental monitoring, value engineering, administration of the Small Business Mentoring Program, and other engineering support. Additionally, this category includes funding for program-wide insurance, as well as scope development and design for future projects. In all cases, investment needs over the 20-year period are similar to what has been programmed in this category in recent capital plans.

This category also addresses significant investments in facilities not addressed in other categories. Planned investments include repair and, in some cases, consolidation of in-station employee facilities. There is also a need for continuing improvements at NYC Transit's major administrative facilities – including Livingston Plaza, the Rail Control Center, and Power Control Center – and at various facilities related to fare collection. Most significantly, expansion of the central warehouse at Tiffany St. is planned for the 2020-2024 period, complemented by investments in other storeroom facilities, to improve industrial efficiency. Elevators in various facilities will be replaced at a pace of 10 per five-year period. There will also be continuing investments in fire alarm and sprinkler systems, in order to achieve or maintain code compliance, and these investments will be in keeping with broader plans for the uses and conditions of each facility. Finally, this category includes investments in computer networks and other information technology systems.

Staten Island Railway

The Staten Island Railway (SIR) offers 24-hour rail transit service to over 25,000 daily riders on a single line consisting of 21 stations from Tottenville at the southern end of the island to St. George Terminal in the north. (The count of stations reflects the consolidation of Atlantic and Nassau stations into the new Arthur Kill station, which is being constructed in the 2010-2014 Capital Plan). The capital needs of SIR are diverse; the railway purchases and maintains most of the same types of assets and infrastructure as NYC Transit.

Compared to the previous needs assessment, there is an increase to the number of assets that are considered backlogged. This is mainly due to increased age, changing conditions, and the adoption of new evaluation criteria for some assets to be more consistent with the criteria used for similar NYC Transit assets. Important categories exhibiting such a shift include railcars, power infrastructure, and stations. With targeted investments, however, many of these backlogs are will be eliminated by the end of the 2015-2034 period.

In the 2015-2019 and 2020-2024 periods, investment in SIR primarily focuses on addressing service-critical assets that are backlogged, such as mainline track and switches, CBHs, and ROW structures. In the latter two five-year periods, investments shift predominantly towards normal replacement. A component investment approach will be adopted for stations and shops to bring those assets into good repair, mirroring the investment strategy used on the mainline. Major investments include the continuation of the project to rehabilitate St. George terminal that began in the

2010-2014 plan that will bring backlogged signals, switches, and track at the terminal into good repair.

A study is currently underway to evaluate the structural condition of SIR's railcars, which are more than 40 years old, and fleet strategies will depend on the results of this study. Options under consideration may include near-term investments to extend the service life of the existing cars, and/or migration of NYC Transit cars to SIR (which would require car modifications). SIR car investments are planned in the 2020-2024 period as a follow-up to investments funded in the 2010-2014 Capital Plan.

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Long Island Rail Road
Capital Needs 2015-2034

For over 179 years, the Long Island Rail Road has served as an engine of regional mobility, a force for economic growth and catalyst for transit oriented development. Long Island Rail Road has played a crucial role in the history and development of Long Island and New York City, with many communities literally growing up around the LIRR. Today, the LIRR is one of the biggest and busiest commuter railroads in North America and the oldest in the US continuing to operate under its original charter name. The LIRR network includes 11 branches serving 124 stations, with an average weekday ridership of 285,082. Just recently, in March 2013, the LIRR celebrated the centennial anniversary of its Jamaica Station hub in Queens. For over 100 years, Jamaica has truly been the heart of the LIRR, including the Jamaica Station Building, the elevated tracks/station, three major interlockings, and the yard complexes.

Following 30 years of MTA Capital Program investments, the LIRR has made tremendous progress towards improvements to rolling stock and infrastructure, as demonstrated by improved on-time performance and fleet mean distance between failures (MDBF), which has increased from 16,168 miles in 1982, to 169,724 miles in 2012. With its new M-7 cars, the LIRR now has the youngest rail fleet in the MTA family - over 70% of the fleet is less than 15 years old.

This rich history and vital role in the railroad industry and the life of the New York region continues today, with the LIRR remaining extremely focused on maintaining and modernizing its infrastructure and preparing for future service enhancements, particularly East Side Access service, while continuing to provide vital regional mobility with access to high-skilled, high-paid jobs in Manhattan. Another aspect of this infrastructure investment and modernization is preparing for future extreme weather events, particularly in light of the recent experiences with Tropical Storm Irene and Superstorm Sandy. As capital projects are planned and undertaken, the LIRR will look at ways to design and construct infrastructure with storm resiliency aspects in mind. This will be particularly true for parts of the system which have been shown to be prone to flooding/storm surge, particularly assets near the East River and Hudson River and along the LIRR South Shore.

Planned Long Island Rail Road investments through 2034 total over $13 billion (Table 3). This proposed level of investment, developed through an extensive, integrated staff effort, will continue the normal replacement of assets and ensure that line structures, the only asset category currently not in a state of good repair, will be brought into a state of good repair by 2024 (Chart 2). The largest investments

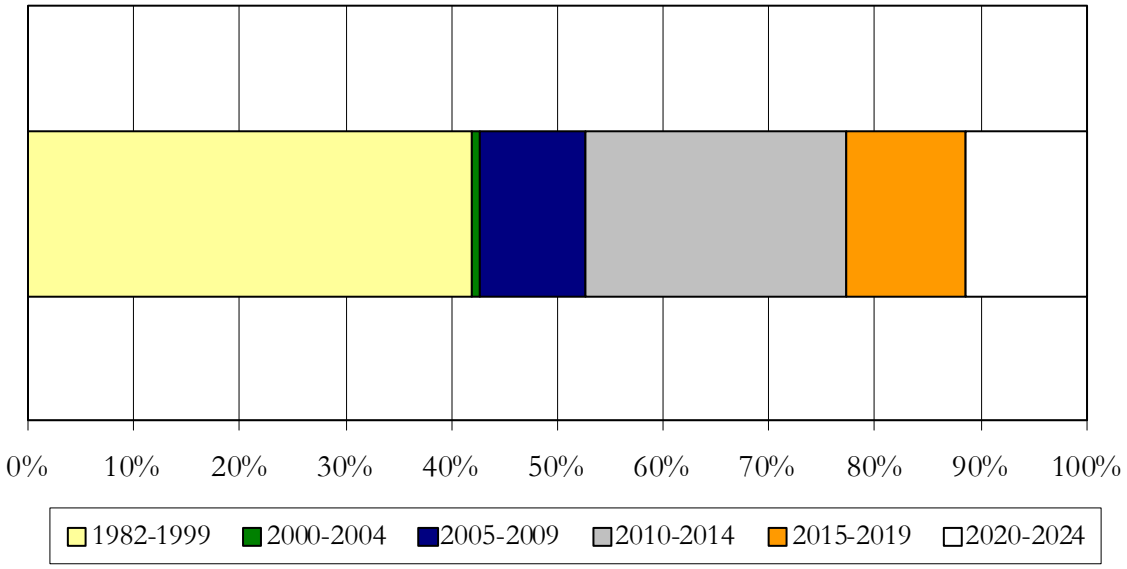
identified for this 20-year period are in the Rolling Stock and Track categories, reflecting both cyclical replacement of fleet and track components, as well as expansion initiatives to grow the fleet size and increase track / station capacity in strategic locations, including Jamaica. Over the next 20 years, critical infrastructure renewal / modernization will be enhanced by expansion investments which allow the maximum benefits of East Side Access to be realized. Manhattan travel will be further supported as the Penn Station Visioning investments commence, following integrated planning with all Penn Station service providers - an effort currently underway. LIRR continues to move forward with projects to modernize its signal system and migrate towards centralized train control, invest in infrastructure to provide service reliability, and work to serve the New York region's transportation needs in the 21st century. Infrastructure investment and modernization will continue to be a central focus of the LIRR, particularly as it moves towards its Bicentennial Anniversary at the end of this 20-year needs period (2034).

Table 3
MTA LIRR Summary of Continuing Needs: 2015-2034
By Investment Category
(2012 $ in millions)

Investment Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
Rolling Stock	$945	$400	$670	$303	$2,318
Stations	519	429	531	474	1,953
Track	872	946	945	590	3,353
Line Structures	160	338	305	320	1,123
Communications and Signals	394	376	393	268	1,432
Shops and Yards	203	127	190	40	560
Power	181	427	375	835	1,818
Miscellaneous	184	202	218	244	848
Total	$3,459	$3,244	$3,627	$3,074	$13,404

(numbers may not total due to rounding)

Chart 2
MTA LIRR – Line Structures
Progress Toward State of Good Repair



Investment Strategy Overview

The LIRR core investment strategy includes a profile of investments along the Main Line which will enable LIRR to maximize the benefits of East Side Access Service by implementing the infrastructure necessary to support it. The initiation of East Side Access Service will be the most dramatic transformation for LIRR riders in over a century. Creating a one-seat LIRR ride from Long Island/Queens to the east side of Manhattan will save up to 40 minutes of daily travel time for many commuters, improving access to jobs and quality of life for both LIRR commuters and those who utilize LIRR service for non-commutation trips (including leisure and recreational trips). Linking Long Island with Grand Central Terminal will also create new opportunities for reverse-commute as well as access to JFK International Airport (via the Port Authority's Air Train). This new transit service will encourage more trips in the New York region via public transportation instead of by automobile, helping reduce roadway congestion and improving regional air quality.

There are a number of initiatives which prepare the LIRR for this expansion of service and ensure that Long Islanders receive the full value of this important regional investment by putting in place the necessary supporting infrastructure. One critical element of this effort is the reconfiguration of the Jamaica complex, including a

redesigning of the track, signals and switches both east and west of Jamaica station, to allow increased train throughput. With a few exceptions, the existing track level layout of the Jamaica complex appears today as it did in 1913, when the complex opened. The design and construction of modernized track level infrastructure will streamline operations by eliminating conflicting routings and allow for train operation at higher speeds, through the utilization of higher speed switches. Work on this project also includes modernizing the aging signal system in Jamaica, and replacing signal components which are at the end of their useful life.

Additionally, infrastructure investments to the east of Jamaica are also critically important, particularly in the vicinity of the Main Line. The LIRR's Main Line between Jamaica and Ronkonkoma serves as a crucial "central artery" for Long Island, where the Port Jefferson, Oyster Bay, Hempstead, Ronkonkoma and selected Montauk Branch trains operate for all or a portion of their route, prior to these branches diverging at various locations. Stretching across the center of Long Island, the Main Line connects densely developed suburban population and employment centers, including the Nassau Hub / Mineola / Garden City, Hicksville, Route 110 and MacArthur Airport. The ability to accommodate a high volume of trains and density of customers along the Main Line is constrained by limited track capacity. Expanded track capacity on the Main Line includes a full second track from Farmingdale to Ronkonkoma. Independently, the Main Line double track and additional track capacity expansion would provide tremendous benefits. Additional track capacity would improve reliability and provide for improved access within their portion of the LIRR Main Line. This would also address the infrastructure constraints which limit more optimal operational conditions, opening the door for vastly improved service and flexibility, which results in improved train performance.

A collection of investments, including expanded Main Line track capacity, a new Republic Hub station, new intermodal parking facilities, improvements to track-level infrastructure in Jamaica, and increased train storage yard capacity, are envisioned to leverage economic growth and improve regional accessibility. These enhancements in transportation infrastructure will foster economic growth, both by making central Long Island more accessible for those who commute from points west, and also strengthening the connection between Long Island and Midtown Manhattan, assuring continued access to high-skilled, high-paid jobs in the nation's largest central business district.

In the 1980s, the LIRR electrified the Main Line from Hicksville to Ronkonkoma, greatly reducing travel time to New York City for thousands of Nassau and Suffolk County residents. When it was designed, this project was anticipated to include the construction of a full second track between Farmingdale and Ronkonkoma. However, due to funding challenges at that time, only selected passing sidings and double tracking at stations were constructed. Without a full second track, this section of the Main Line contains considerable stretches of single track territory which cause constrained, fragile operations, especially during peak travel periods. Although a full second track was not constructed as part of the electrification project, the supporting infrastructure, including bridges, substations, and most station platforms, were sized to accommodate a future second track. The Main Line between Farmingdale and Ronkonkoma has for decades been envisioned to contain a full second track, and it is important that this vision from the 1980s is realized in order to improve service reliability by enhancing operating flexibility and speeding recovery time following service disruptions, while also allowing for Off-Peak service at a half-hourly frequency, which is expected to increase travel demand and reliance on commuter railroad service.. In light of recent extreme weather events in the New York region which demonstrated the vulnerabilities of the transit network, a full Double Track is very much needed for network resiliency, as it would facilitate a transit alternative should a catastrophic event halt train operations on the LIRR's South Shore Service - the Babylon/Montauk, Far Rockaway, Long Beach, and West Hempstead Branches. With a full Double Track in place, more train service could be operated on the Main Line, which would thus provide a commuter rail alternative for displaced South Shore customers. As part of the 2010-2014 Capital Plan, Phase I of the Double Track is currently progressing, with Phase II – completing this effort – planned to take place in the next capital plan.

In order to improve on-time performance and to accommodate more service, both in the peak direction and to address gaps in reverse-peak trains, the LIRR needs to add track capacity to the Main Line. This will allow service reliability improvements and reduction in recovery time following service disruptions. With limited track capacity, a single incident can cripple rush hour service for thousands of commuters, creating ripple effects felt in offices throughout New York City or in households across Long Island, as employees are delayed getting to work or returning home, resulting in wasted work productivity and diminished quality of life.

As indicated in the "Planning for the Future" section of this document, Main Line infrastructure investments will allow for expanded service in the important intra-island

and reverse commute markets, providing more service to LIRR stations near employment centers in the Nassau Hub and Garden City, while supporting the local economy by providing access to labor resources and employment markets.

A key element of the economic development and regional mobility aspects of the Long Island Strategic Improvements is the construction of a Republic Hub station. This new hub station along with added Main Line track capacity will provide LIRR access to the Route 110 Corridor, linking with planned BRT initiatives by local governments to improve transit access, spur economic growth, and encourage more intermodal transit trips. Investments in Main Line track capacity will improve access from New York City / Nassau County to MacArthur Airport, which will help to relieve overburdened airports in Queens, improving regional mobility and quality of life. The construction of two new electric yards in Suffolk County over this 20-year period is also a key requirement in the LIRR's ability to expand service. The increase in rail service made possible by these infrastructure investments is expected to support transit oriented development, not only in economic activity centers like the Republic Hub, but also in downtowns across Long Island.

Strategic improvements along the Main Line will also help to facilitate the investigation of new "scoot" service within diesel territory. New "scoot" service could allow for more frequent connecting service into electric territory, including improved service east of Ronkonkoma and on the Oyster Bay Branch, upgrading commutation service for residents living outside of LIRR electric territory. This potential new service will serve Nassau County commuters on the Oyster Bay Branch as well as residents of eastern Long Island and recreational travelers.

Strategic improvements along the Main Line will serve to advance a number of goals which are important for the MTA: addressing current system constraints and expanding service delivery, establishing new connections with key regional economic activity centers, and improving the region's quality of life through expanded mobility and improved service reliability. These improvements will strengthen the economic competitiveness of Long Island's business centers and residential communities, while also improving access to jobs, recreation and airport travel for New York City and Long Island.

Investment Category Summaries

Rolling Stock

Presently, the Long Island Rail Road rolling stock fleet consists of 1,006 electric multiple unit cars and 134 locomotive hauled coaches. Also included are 23 diesel locomotives and 22 dual mode locomotives that can operate in electric territory, providing a one-seat ride service into Penn Station from diesel branches. The non-revenue portion of the LIRR's rolling stock consists of work locomotives utilized during track and infrastructure maintenance and during fall and winter weather conditions; protect locomotives to haul disabled trains; and track equipment to maintain various components of the track bed and track system components.

Over the next 20 years, the composition and size of the Long Island Rail Road's electric fleet will change dramatically. This includes fleet expansion of up to 318 new M-9/M-9A electric cars, based upon an initial procurement with contract options. The increase in the LIRR's fleet size will support ridership growth at the initiation of East Side Access, as well as robust growth in the years beyond. The 170 M-3 cars, which have been in service since the mid-1980s, will be replaced with modern M-9 cars. Additional M-9/M-9A cars will be purchased to support service expansion as part of LIRR East Side Access service to Grand Central Terminal. These investments in rolling stock will enable improvements in on-time performance and customer satisfaction, accommodate ridership growth, and expand service, and increase maintainability and reliability. The procurement of a new alternative diesel fleet will allow for potential additional "scoot service" between terminal stations for electric service and points east, enhancing access to electrified service for diesel territory customers. LIRR diesel locomotives, both revenue and non-revenue, will also be replaced, as will the diesel hauled passenger coaches. In addition to the fleet replacement benefits described above, replacing the aging diesel locomotives will also provide an important regional environmental benefit, as the new fleet of diesel locomotives will meet the latest U.S. Environmental Protection Agency (EPA) emission standards.

Stations

The Long Island Rail Road serves customers at 124 stations in Nassau and Suffolk counties and New York City. The long-term objective of investments in this asset category is to improve the appearance and utility of Long Island Rail Road stations thereby increasing the safety and satisfaction of current and future customers.

Investments proposed for this category will maintain station assets in a state of good repair and guard against increased maintenance and potentially unsafe conditions. Included in this area is the rehabilitation of station and parking facilities systemwide, as well as investments to expand parking and construct parking facilities. The LIRR aims to utilize component-based approaches to address station assets such as staircases, elevators, and escalators. However, at selected locations on the Babylon Branch, where busy mid-Twentieth century viaduct stations have numerous deteriorated station components, the LIRR has utilized a full platform replacement approach. Renewal and component-based investments will also address staircases, overpasses, platform canopies, platform edgeboards and station buildings systemwide. Ticket vending machines (TVMs) and ticket office machines (TOMs) will be replaced as well, in coordination with any MTA and regional fare technology initiatives. The 20-year capital needs assessment includes two normal replacement cycles for the ticket selling equipment, consistent with a 12-year useful life (which reflects associated life cycle maintenance of this equipment).

One of the largest station projects will rebuild the 1960s-era elevated Babylon station. This high volume transfer station will undergo complete replacement of both island platforms, providing new station components at platform level and creating a safer, more attractive and more accessible station for LIRR customers at this customer transfer point between diesel and electric service. Another focus of the LIRR's station program is to undertake the cyclical replacement of escalators and elevators, thereby modernizing these important vertical transportation elements within stations and incorporating the latest technology and safety features.

Penn Station has and will continue to be a defining aspect of the LIRR customer experience. In this regard, a Penn Station Vision has been under development – a collaborative effort between LIRR, New Jersey Transit, Amtrak and the MTA. This Vision Study will yield a collection of projects which have independent utility that will improve the customer experience over the 2015-2034 period. The focus of the Penn Station Vision includes widened and lengthened corridors, signage and lighting improvements, significant improvements to station entrances/exits, and enhanced ADA access and retail experiences.

LIRR also includes East Side Access station investments. System enhancements include added station entrances and crossovers between tracks. Later in the 20-year period, normal replacement of station elevators and escalators are planned as well.

In response to significant population increases in Queens, the LIRR would be in a position to serve a newly re-opened station in Elmhurst, on the Port Washington Branch. Should a travel survey, which is currently underway, demonstrate ridership demand, the LIRR would look to construct a new station in this vibrant area of Queens, taking advantage of extremely strong population growth, with an interest in regional access to both Manhattan and eastern Queens/Long Island. In addition, the 20-year capital needs reflects the need to design and construct a new LIRR Republic Hub station on the Main Line, to address planned smart growth development, both business and residential, along Suffolk County's vital Route 110 Corridor.

Track

The Long Island Rail Road has 689 miles of track, all of which are in a state of good repair. The ongoing maintenance of the system includes the replacement of component assets on a life-cycle basis. Included in this category are cyclical normal replacement projects to maintain the track infrastructure (wood ties, rail, track surface and turnouts). The cyclical replacement of track components is based on age, condition, and physical inspection. LIRR's long-term strategy in this area also includes the installation of concrete ties in place of wood ties in selected areas to maximize service life and ensure longer periods between track outages, thus minimizing the impact on customers. Concrete tie installation is planned on the busy Main Line west of Ronkonkoma, as well as portions of the Atlantic, Montauk, Port Jefferson, Oyster Bay and Port Washington Branches.

Other track initiatives will address State of good repair needs at selected locations, including yard track throughout the LIRR network and direct fixation track on the Wreck Lead Bridge in Long Beach.

Also included are significant System Improvements: multi-phased Jamaica Capacity Improvements which will reconfigure the track, switch and signal infrastructure in the vicinity of Jamaica Station to enhance the complex's capacity and modernize its operations. The completion of a full second electrified track on the Main Line from Farmingdale to Ronkonkoma will provide a substantial increase in train capacity and greatly improve service reliability and recovery time following incidents for this very busy and crowded railroad corridor.

A second track from Ronkonkoma to Yaphank has also been identified as a key investment, allowing LIRR to provide additional service to diesel territory customers, thereby addressing customer demand for enhanced service on the Main Line east of

Ronkonkoma, while also providing significant travel time savings via East Side Access service. This investment supports an area of Suffolk County which has been experiencing significant population growth, many of whom are attracted by favorable housing prices.

Line Structures

The Long Island Rail Road line structures category is made up of 490 bridges, 176 culverts, 29 viaducts, four tunnels and other structures within in the right-of-way. It is the only asset group not in a state of good repair. Investments planned over the 2015-2019 and 2020-2024 periods, combined with an ongoing Operating-budget-funded repair program, will bring the assets in this area into a state of good repair by 2024; thereafter they will be maintained under a cyclical normal replacement program.

In addition to the rehabilitation and replacement of railroad bridges, the LIRR will increase inspections, as needed along with continuing its bridge painting program and bridge waterproofing program, to protect structural steel and prevent rusting and corrosion, thus extending the life of the structures. The LIRR will continue its bridge component replacement program, which targets bridge elements like abutment walls, bridge seats and bridge bearings. Six LIRR-owned overgrade highway bridges, most of which date from the 19th century, are planned for replacement as well. It is also expected that rehabilitation of the East River tunnels (which are owned and maintained by Amtrak and connect Penn Station to the Queens portion of the Long Island Rail Road system) will continue over the next 20 years, with the participation of Amtrak.

Communications and Signals

Over the next 20 years, the communications and signal infrastructure will be upgraded and modernized to increase operational capacity and ensure the provision of cost-effective, safe and reliable rail service. Included in this category is the cyclical normal replacement of the communications and signals infrastructure to maintain past investments and lay the groundwork for improvement, modernization and expansion.

Planned investments in the communications infrastructure will enable the LIRR to meet ever-increasing voice, video and data requirements (both vital systems needed for safe railroad operations and non-vital systems for informational or financial purposes) while increasing reliability and reducing dependence on leased line services. Communications cables in the East River Tunnels (ERT) will be replaced, and a

program to replace deteriorated communication poles systemwide will continue. The program to replace outdated private branch exchange (PBX) and wayside phone systems will also continue, modernizing this infrastructure with a new vital voice telephone and wayside system.

The signal system will also be upgraded and modernized to continue the safe operation of trains. Despite ongoing signal modernization efforts, the railroad has the oldest cab signaling system in the country. The proposed replacement of these systems with modern, state-of-the-art equipment is critical to maintain prior investments and support the new rolling stock fleet. A key focus of the signal investments will be an enhanced signal state of good repair program, which will target selected signal system components. An upcoming systemwide assessment will inform this approach. Through the creation of programs to replace signal batteries, relays, cable, and other system components, the LIRR will progress a more targeted replacement effort to complement signal investments in major interlockings. Another major initiative in the signal category is the implementation of centralized train control (CTC), which will migrate train control from towers in outlying locations into the Jamaica Central Control. This effort will provide a centralized command center to coordinate, manage and dispatch LIRR trains, which will provide for quickened response and recovery to service conditions and faster implementation of operational decisions.

In addition, the federally mandated installation of positive train control for railroad safety requires PTC investments to continue in the 2015-2019 plan. Investments during the timeframe of this capital needs assessment include signalization efforts, wayside, rolling stock and other components for PTC.

Shops and Yards

Currently, the Long Island Rail Road operates 25 shops and yards for fleet storage, fleet maintenance and inspection services. The rolling stock fleet size will be increased to meet projected ridership growth and to begin LIRR service into Grand Central Terminal. In order to accommodate this expanded fleet, the LIRR will construct two new yard facilities in Suffolk County, in addition to the Mid-Suffolk Yard which is included in the 2010 – 2014 Capital Plan. These yards include one on the Huntington / Port Jefferson Branch, and one on the Babylon / Montauk Branch. New facilities will allow the LIRR to begin additional train starts in Suffolk County, providing enhanced service for some of the LIRR's busiest stations and adequate seating capacity systemwide.

In an effort to modernize its maintenance facilities, the LIRR will rehabilitate and upgrade facilities at select locations, which will accommodate the maintenance of the new electric and diesel fleets. Also included is the replacement of employee facilities, in order to enhance safety and improve employee productivity and efficiency.

Power

The long-term goal of asset investments in power is to replace equipment that has reached the end of its useful life and reduce equipment failures, continuing component replacements necessary to maintain the power infrastructure. Maintaining these assets ensures the safe, reliable operation of trains while containing the growth of operating costs.

In recent capital plans, the LIRR focused on full substation replacement in locations where the substations were deteriorated or undersized for current and future power demand, replacing five to six substations during a typical five-year capital plan. While full substation replacements will still be required in select locations which serve multiple branches or where legacy 1940s substations are still in service, the LIRR will be shifting to a component-based program for much of its substation investments. Informed by a recently completed assessment of all substations throughout the system, this component-based approach will enable the LIRR to address critical needs at over 50 substations within a 10- to 15-year period. This represents almost half of all substations systemwide, dating from the early 1970s, which were built to address the power demands of the now decommissioned M-1 fleet. Additional investments will address various other components of the traction power system, including third rail, protection board, third rail cable, negative reactor upgrades, third rail disconnect switches, and substation batteries. Investments will also be made in station and building electrical systems, station platform lighting, as well as yard and tunnel lighting. The LIRR's Traction Power Load Study identified areas where traction power supply needs to be increased in order to meet future service demands. One of the key aspects of this is the construction of three new substations in Queens, along the busy Main Line and Montauk Branches, to prepare for additional operational demand once LIRR service to both Penn Station and Grand Central is underway.

Electrification extensions are also a key element of LIRR's long-term needs. To address growing population and travel demand within more easterly parts of Suffolk County, the LIRR envisions future extensions of electrification on the Port Jefferson Branch, the Main Line, and the Montauk Branch. Completion of this effort would

bring electric train service to 16 stations in Suffolk County. Currently, 85 of the LIRR's 124 stations have electric train service. These electrification efforts are anticipated to be undertaken in conjunction with double tracking and construction of new electric train storage yards, as a phased effort over multiple capital plans, and will likely continue beyond this 20-year planning horizon.

Last, in support of MTA sustainability efforts, the LIRR will continue its transition from composite to aluminum third rail, as part of its cyclical replacement efforts. Utilization of aluminum third rail results in significant energy efficiencies.

Miscellaneous

Included in this area are investments to meet environmental remediation requirements at LIRR substations, yards and other locations, as well as insurance coverage, engineering and administrative needs, all of which support the LIRR's capital programs.

Metro-North Railroad
Capital Needs 2015-2034

Metro-North celebrated its 30th anniversary in 2013 – 30 years of historic accomplishments and improved performance. As one of the largest passenger railroads in the country, Metro-North carried an unprecedented 83 million riders in 2012 on the Hudson, Harlem and New Haven Lines east of the Hudson River, and on the Pascack Valley and Port Jervis Lines west of the Hudson River. In the last 30 years Metro-North has carried over two billion customers.

Over this same period, the number of trains Metro-North operates has increased by nearly 50%, the number of revenue passenger miles is up 111% and once Metro-North's M-8 railcars are fully commissioned, the fleet size will have increased by nearly 75%. On-time performance has improved dramatically from 80.5% in 1983 to 97.6% in 2012. Within its service territory, Metro-North's market share of weekday train commuter trips to Manhattan has increased from 70% in 1991 to 80% in 2010. Non-commutation ridership to/from Manhattan has increased by approximately 130% since 1984.

To facilitate this transformation, the past 30 years have seen major investments in rolling stock and infrastructure with the dedicated funding of the MTA Capital Program. This funding has allowed Metro-North to fulfill its primary mission to provide a safe, clean, comfortable ride to every customer – reliable and on-time nearly 98% of the time.

In its early years, Metro-North's focus was on large-scale reinvestment in a system in disrepair, restoring basic infrastructure to a reliable condition. This initial focus on infrastructure repair and in providing targeted improvements resulted in increased reliability, operational capacity, and ridership. While the normal replacement of assets is a vital component of Metro-North's strategy to provide exemplary customer service, significant repair work remains, particularly in Grand Central Terminal, bridge and structural assets, West of Hudson (WoH) infrastructure and in shops and yard facilities. Metro-North continues to invest its limited resources in state of good repair initiatives and normal replacement making large system improvement actions contingent on additional funding.

Planned Metro-North investments total nearly $9 billion through 2034 with the largest areas being the Track and Structures and Rolling Stock categories. Metro-North utilizes a balanced investment, replacement, and rehabilitation approach spread across multiple asset categories allowing for the greatest needs to be addressed. This level of

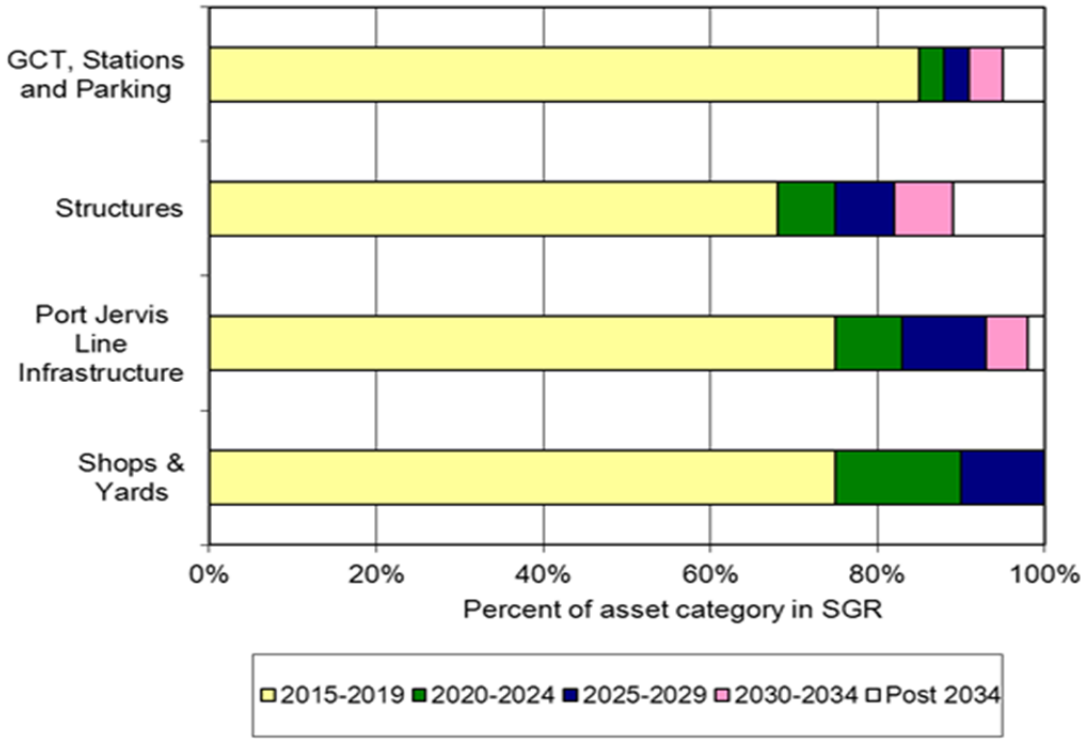
investment will ensure that the majority of the system is brought into a state of good repair by the end of this 20-year period

Table 4
MTA Metro-North Railroad Summary of Continuing Needs: 2015-2034
By Investment Category
(2012 $ in millions)

Investment Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
Rolling Stock	$1,017	$723	$0	$288	$2,027
Grand Central Terminal	215	154	126	117	611
Stations	336	242	117	287	982
Parking	50	50	29	27	156
Track and Structures	433	450	659	755	2,297
Communications and Signals	384	198	174	65	821
Power	237	158	165	134	694
Shops and Yards	657	122	64	17	859
Miscellaneous	123	123	123	123	490
Total	$3,451	$2,222	$1,458	$1,805	$8,936

(numbers may not total due to rounding)

Chart 3
MTA Metro-North Railroad
Progress Toward State of Good Repair



Investment Category Summaries

Rolling Stock

Over the next 20 years, Metro-North plans on spending 23% of its total core program on rolling stock replacement. Under recent capital plans Metro-North began a replacement cycle of aging equipment through the M-7 and M-8 purchases and this will continue through the replacement of its M-3 fleet. As of June 2013, the Metro-North East of Hudson rolling stock fleet consisted of 940 self-propelled electric multiple unit railcars (264 of which are owned by the Connecticut Department of Transportation or CDOT), 213 non-powered coaches (50 of which are owned by CDOT) and 55 locomotives (10 of which are owned by CDOT). In addition, 15 diesel locomotives and 65 coaches are currently supplied for service west of the Hudson River on the Port Jervis and Pascack Valley lines, operated by New Jersey Transit under an agreement with Metro-North.

Metro-North has a significant need to replace aging rolling stock over the next 20-year period as existing units reach the end of their useful life. In the 2010-2014 Capital Plan, Metro-North will complete the replacement of its M-2, M-4 and M-6 series electric car fleets with the delivery of 300 M-8 cars ordered in 2006, and 105 additional M-8 cars ordered in 2010-2011 for New Haven Line service. The 1984-built M-3 fleet comprises a third of the Hudson and Harlem fleet and will be 35 years old in 2019. Replacement of this fleet is planned to occur in the 2015-2019 period. By 2025, the locomotive hauled End-Door coach fleet will have an average age of 39 years, the Genesis dual-mode locomotive fleet will have an average age of 27 years, and the West of Hudson diesel locomotive fleet will have an average age of 40 years. These fleets are planned to be replaced in the 2020-2024 period. In addition, the East of Hudson Center Door coaches will be 40 years old near the end of this 20-year period, and are expected to be replaced in the 2030-2034 period.

With the replacement of the M-3, End-Door coach, and Genesis locomotive fleets in this 20-year period, Metro-North seeks to improve operational and maintenance efficiencies. One alternative being considered is the purchase of M-9s jointly with the LIRR to replace the M-3 fleet. This would consolidate Metro-North rolling stock to five major fleets (M-7, M-8, M-9, Coach and Locomotive). Another alternative combines all three planned fleet replacements in a single purchase of coaches and locomotives with potentially greater operating range and better internal efficiencies by reducing the number of fleets to maintain. Metro-North will complete its alternatives analysis and business case (including comparative efficiencies and life cycle costs of each strategy) and make a decision in support of the 2015-2019 Capital Plan.

Grand Central Terminal, Stations and Parking

Grand Central Terminal, Stations and Parking account for 20% of Metro-North's investments over the next 20 years. This strategy is focused on meeting the rehabilitation and repair needs of basic infrastructure within Grand Central Terminal, priority repairs and component replacement at outlying Stations, and continued work in Metro-North's Strategic Parking Expansion and Intermodal Facilities Program in key markets.

Grand Central Terminal: In February, 2013 Metro-North celebrated the 100th anniversary of the landmark Grand Central Terminal. Over the past 30 years, Metro-North has spent over half a billion dollars on improvements to the once neglected Terminal, transforming it into one of the world's most high-profile and magnificent transportation hubs and tourist destinations. However, Grand Central Terminal is

much more than a historic waiting room and Landmark building. The complex consists of the terminal building plus a multi-level, subsurface trainshed spread over approximately 75 acres, including 44 operating tracks, 47 platforms and a myriad of railroad, City, and privately owned utilities and buildings above the trainshed and above the Park Avenue Tunnel.

To preserve this landmark structure, Metro-North must continue investment to complete the repair of the deteriorating basic infrastructure – from the sprawling trainshed and tunnel structures to the extensive network of utilities. This work may not be highly visible to customers or visitors, but without it the building will not continue to function as it does now. The historic trainshed represents a critical need for substantial investment and rehabilitation to repair and help prevent further degradation of the trainshed structure Key utilities, including electrical, water conveyance systems (water, steam, sanitary and fire protection systems, track and storm drainage systems), as well as HVAC must be updated as well. In many cases these utilities have not been rehabilitated in 100 years. Interior and exterior architectural elements, rehabilitated in the revitalization of the Terminal, require continued investment in order to maintain their historical integrity. As Grand Central Terminal continues to age, this investment in restoration and revitalization work must be protected with the proper level of strategic investment and maintenance.

In addition, work to the communications backbone of the Terminal is critical. The current GCT Visual Information System (VIS) has reached the end of its useful life and Metro-North is seeking to replace this aged system with a modern, state-of-the-art, reliable, user-friendly, easily expandable VIS that will enhance the customer experience in GCT and will deliver real-time commuter information needed. The new system will replace and upgrade current displays and central control equipment and wiring required to control and drive the displays.

The MTA and Metro-North must also ensure that riders, both the growing Metro-North ridership base and the new surge of Long Island Rail Road passengers expected as a result of the East Side Access project, will continue to enjoy the benefits that the Terminal now offers; that the infrastructure can continue to support additional projected train service; and that the extraordinary building remains preserved for generations to come.

Stations: There are 74 Metro-North passenger stations in New York State east of the Hudson, with twelve more stations located in the railroad's territory west of the

Hudson. Metro-North owns and/or operates 26 station buildings, many of them historic. Over the past 20 years, the majority of stations in New York State have received substantial component-based investment for rehabilitation or replacement, and a number of new stations have been constructed with Yankee-153rd St. being the most recent. Metro-North has worked to enhance the customer environment and increase safety of the entire station area including station buildings, platforms, overpasses and underpasses, as well as provide ADA compliance and miscellaneous customer amenities. Metro-North must now continue investment in these facilities to address station elements to extend useful life and maintain these assets in good repair. This systematic component rehabilitation program is targeted for stations across the 20-year horizon. However, due to resource constraints, Upper Hudson and Mid Harlem Line Stations will continue to require priority repairs in early years to maintain safe and usable platforms until significant rehabilitation can be completed later in the 20-year period. Extensive investments at New Haven Line stations in New York State will begin towards the end of the 20 year cycle. Work must also continue to upgrade many of Metro-North's historic station buildings. Improvements are planned at outlying stations on all branch lines.

Additionally, by 2013, the current ticket selling system will be at or near the end of its useful life and a phased replacement program will begin in coordination with any MTA and regional fare technology initiatives.

Finally, Metro-North will improve customer communications services through a program to provide real time train information to customers, customer assistance telephones, expansion of CCTV installations, remote control and monitoring of security and elevator/escalator systems and fare collection improvements at all full time New York State stations both East of Hudson and West of Hudson. This comprehensive investment strategy crosses multiple asset categories including Stations, Grand Central Terminal, and Communications and Signals.

Parking: The parking inventory includes approximately 40,500 spaces of which over 14,500 are controlled by Metro-North. Rehabilitation of these spaces to maintain them in a state of good repair will continue in each five-year period. Metro-North's Strategic Parking Expansion and Intermodal Facilities Program provides for the creation of transportation hubs in key markets. These investments ensure station access and parking capacity is in place to promote the use of mass transit and accommodate anticipated ridership growth and customer demands, including regional station access. Parking work includes: new/expanded station facilities and intermodal

facilities; major access improvements from interstate highways, and major and local roads; expanded parking; and complementary right-of-way improvements such as track, interlockings, signal and yard work. New bicycle parking areas will be installed where appropriate. In addition, Metro-North will construct new facilities as needed to accommodate increased ridership and increase access and parking opportunities, supporting local development opportunities as well.

Track and Structures

Over the next 20 years, Metro-North plans on spending over 26% of its total core program on extensive track and structures assets. There are 385 route miles (115 miles of which are owned by CDOT) and 795 track miles (244 miles of which are owned by CDOT) that constitute the Metro-North system. This infrastructure includes nearly 1,000 turnouts on the right-of-way and in Grand Central Terminal. There are 432 vehicular, pedestrian and utility bridges which cross over Metro-North, 285 in New York State and 147 in Connecticut. Additionally, there are 435 railroad bridges in New York State and 198 in Connecticut which carry Metro-North, Amtrak and freight service. These structures include six moveable bridges, and the 104 year-old Moodna Viaduct. There are eight tunnels within the New York State territory allowing trains to go through rock slopes along the Hudson River, and through a mountain in Otisville, New York. Also included are the significant Manhattan structures of the Park Avenue Tunnel and Viaduct. The long-term objective of investments in this area is to maintain the condition of the existing assets and achieve a state of good repair in structures. The ongoing investment in track is essential to providing customers with a safe, reliable, and comfortable ride. To accomplish this, Metro-North has developed a cyclical program of track and turnout rehabilitation and replacement that maintains track structure components and switch facilities in proper operating condition without safety hazards or speed restrictions. To enhance the condition of the right-of-way, additional emphasis has been placed on track infrastructure improvements including mudspot repair, drainage, and rail and tie component replacement as needed.

Similarly, the continued investment in line structures along the railroad right-of-way is vital to its smooth and safe operation. This includes overhead and undergrade bridges, viaducts, tunnels, and retaining walls. Metro-North will continue work to maintain the bridges in safe, serviceable condition but progress to rehabilitate or replace the structures remains slow due to the volume of bridges, the level of investment for the required work, and the ability to schedule track outages for multiple bridge work locations around an operating railroad. The Park Avenue

Trainshed and Tunnel Structure remain two of the most significant elements identified for critical rehabilitation in the capital needs assessment.

In addition, capacity improvements to meet growing demand and service expansion will be required as Metro-North ridership continues to increase. Projects which would improve capacity include such elements as a third track from Crestwood to North White Plains and a flyover at Woodlawn, but funding for these projects is challenging to identify when balanced against the basic infrastructure needs.

Lastly, in 2003 Metro-North assumed responsibility for the Port Jervis Line under a lease agreement with Norfolk Southern. Capital investment in state of good repair began on the aging and degraded infrastructure in the 2000-2004 Capital Plan. Track will reach a state of good repair by the end of the 2010-2014 Capital Plan, with normal cyclical replacement beginning in 2015. In the 2010-2014 Capital Plan, Metro-North made key repairs to both the Moodna and Woodbury Viaducts. Even with these recent repairs, a significant need is the overall replacement of the Moodna Viaduct. The Viaduct spans a distance of 3,200 feet and is 193 feet high at its highest point, making it the highest and longest railroad trestle east of the Mississippi River. While structures work to date has been focused on keeping the structures safe and in a serviceable condition, these bridges must ultimately be replaced and a state of good repair will not be achieved until post 2034.

Communications and Signals

Communications and Signal (C&S) assets are essential elements of rail infrastructure and among its most safety-critical systems. Their impact on delivery of rail service is fundamental in meeting Metro-North's on-time performance goals and critical in providing improved customer service, information and security. Of the 795 track miles which constitute the Metro-North system in New York State and Connecticut, a total of 668 total track miles are signaled, an increase of 89 track miles as a result of the installation of a West of Hudson cab signaling system in the 2010-2014 Capital Plan. These assets are now on a normal replacement/ rehabilitation cycle, targeting specific components and/or segments in order to maintain the assets in good repair.

The primary long-term objective of C&S investments is to replace existing systems as they reach the end of their useful lives with the latest technology to accommodate current operations and provide compatibility for future needs. Signal system replacement for various line segments began in the 2005-2009 Capital Plan and has reached a state of good repair.

Hudson Line and Harlem Line signal and communication infrastructure, safely operating beyond its useful life cycle, requires replacement in the 2015-2019 timeframe. In addition, the federally mandated installation of positive train control for railroad safety requires PTC-readiness investments to continue in the 2015-2019 plan.

Metro-North also plans to implement a comprehensive systemwide Communications Infrastructure System improvements program in order to support applications at passenger stations, centralized traffic control, interlockings, substations, large facilities, yards and New York City offices and control centers. Fiber optic cables were installed in the 1980s and copper cables were installed decades earlier. This presents a significant need to replace the existing fiber optic and local copper cables on the Hudson and Harlem Lines as the current cable plant has reached the end of its useful life. This program will continue to keep all of Metro-North's customer service applications and other ancillary services working as intended. This program will also support the implementation of additional customer service initiatives including enhanced ticket selling capabilities, providing real time train information to customers, and improved CCTV monitoring and resolution.

Power

Metro-North's power infrastructure is comprised of traction power and auxiliary power systems. Of the 795 track miles in New York State and Connecticut, 545 miles are electrified, with 256 miles having DC third rail power and 289 miles having AC catenary power (185 miles of which are owned by CDOT). The power supply for these systems include a significant number of substations, distribution systems and signal power generating stations and supply stations. Sufficient traction power allows electric cars to operate at an optimal performance level, achieving maximum allowable speeds and contributing to meeting Metro-North's customer driven on-time performance goals.

The long-term objective of investments in this area is to maintain the condition of the existing assets and improve substation (third rail power) capacity, to support current train operation and expanded rail service as projected over the next 20 years. The majority of the components of Metro-North's traction power supply system are approaching the end of their useful life and require a normal replacement investment. Without reinvestment, inadequate traction power can result in reduced speeds and affect the operating and mechanical characteristics of electric cars. A comprehensive

systemwide Traction Power Study, completed in 2006, focused on traction power requirements for future service demand and new rolling stock electric cars. Critical traction power improvements to replace the aging assets and to meet future demand are now underway and will continue over multiple future capital plans. Work will continue to provide new substations on the Hudson and Harlem Lines.

Shops and Yards

Metro-North's long-term Shops and Yards strategy is to upgrade and adequately size its shops and yard facilities to accommodate new rolling stock, support Reliability Centered Maintenance, and improve on-time performance to ensure customers are provided with a safe, reliable and comfortable ride and the highest quality service. Currently, Metro-North operates 11 shops and/or yard facilities systemwide for fleet storage, maintenance and inspection services. Over the past 20 years, Shop and Yard facilities were constructed or modernized at Harmon, North White Plains, Brewster and Highbridge.

Harmon Shop which is Metro-North's oldest, largest, and most critical shop and yard complex supports 80% of the shop operations on the railroad. Approximately $690 million has been expended at this critical facility over the last three capital plans and the phased replacement of the 100 year old facility is estimated at approximately $500 million in the upcoming capital plan.

At the same time, the need for increased and improved overnight storage of rolling stock is becoming critical at several locations as ridership growth, fleet replacements, and related planned service expansions require streamlined operations and expanded capacity improvements at existing facilities. As a result, significant investments are needed at Brewster and Poughkeepsie Yards (West of Hudson Yards are included in Network Expansion), to support the new fleets and service expansion in all territories and other miscellaneous yard improvements.

Miscellaneous

Included in this area are investments to meet environmental remediation requirements at Metro-North substations, yards and other locations. Also included are engineering, security, insurance, and administrative needs.

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MTA Bus Company
Capital Needs 2015-2034

The MTA Bus Company was created in 2004 to assume the operations of seven private bus companies that had provided bus services under franchise agreements with the City of New York. MTA Bus operates 46 local and 35 express routes across Manhattan, the Bronx, Brooklyn, and Queens, serving approximately 400,000 riders daily. In fact, it is the seventh largest bus agency in the United States, as measured by ridership. It operates a fleet of 1,215 buses, including 646 standard buses, 72 articulated buses, and 497 over-the-road coach buses for express services. Operations are based out of eight depots – seven depots located throughout New York City plus one in Yonkers.

The MTA has implemented strategies to integrate management and coordinate operation of its two bus services (MTA Bus and New York City Transit); so from a customer perspective, the two services are seamless and largely indistinguishable. However, the agencies are still legally separate entities, and so their capital needs are outlined separately.

Investment Needs

MTA Bus forecasts a need of $2.5 billion through 2034 to maintain, replace, and upgrade its capital assets (Table 5). The bus fleet accounts for more than 70% of the needs ($1.8 billion), with the balance mainly attributable to depots and associated equipment. In order to protect the condition of the fleet, MTA Bus' needs challenge financial constraints.

Table 5
MTA Bus Summary of Continuing Needs: 2015-2034
By Investment Category
(2012 $ in millions)

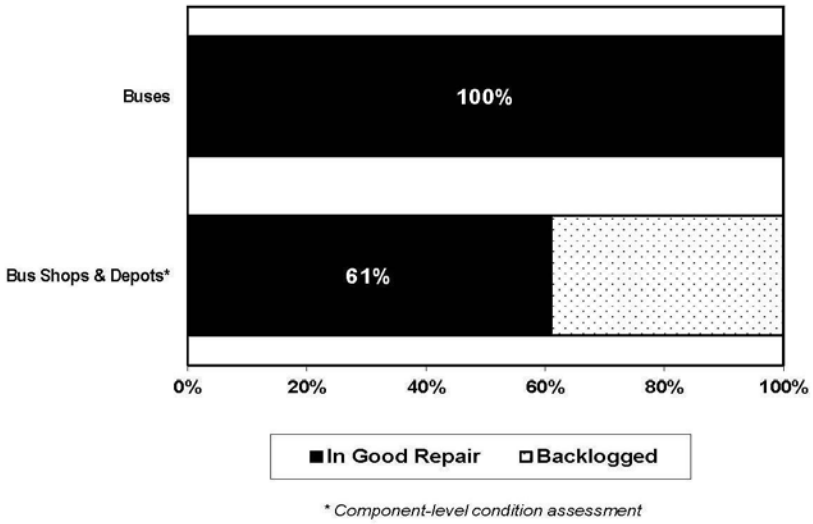
Investment Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
Buses	$640	$267	$553	332	$1,793
Depots and Equipment	155	219	100	93	566
Service Vehicles	2	2	2	2	8
Engineering	35	35	35	35	140
Total	$832	$523	$690	$462	$2,507

(numbers may not total due to rounding)

System Investment Status

To ensure consistent quality of service for customers, MTA Bus assets are evaluated using the same benchmarks as those used for New York City Transit – namely, a 12-year useful life for buses and component-based asset condition ratings for depots. The *System Investment Status* exhibit (Chart 4) presents, by investment category, the measure of whether an asset is considered in good repair or whether it is backlogged and already past due for investment.

Chart 4
System Investment Status
MTA Bus Major Asset Categories



Currently, the entire MTA Bus fleet is in good repair (i.e., not exceeding 12 years of age). However, a near-term challenge will be to keep pace with bus normal replacement needs. Sixty-two percent of the fleet (759 buses) was purchased between 2004 and 2006, immediately after the agency's formation, and these buses will come due for replacement in the 2015-2019 period.

In addition, seven out of eight depots exhibit deficient conditions and are due for investment. However, these deficiencies are limited to specific subcomponents of each depot – such as lighting systems, equipment, or employee facilities – not necessarily the overall structure and facility.

Investment Category Summaries

Buses

Thanks to prior investment, the MTA Bus fleet is highly reliable; on average, buses travel more than 5,000 miles between failures. It is also a green fleet – consisting of a mix of clean diesel, hybrid diesel-electric, and CNG-fueled buses. And, it is fully accessible to the customers with disabilities. To maintain these advantages, the fleet plan calls for the purchase of 2,150 new buses by 2034, including 874 standard, 264 articulated, and 1,012 express buses. Purchases are planned to coincide with the retirement of buses at the end of their 12-year useful lives.

These purchases will shift the composition of the bus fleet to include more articulated buses and fewer standard buses, as selected high-volume routes are converted to articulated bus operation. The plan also includes modest fleet growth over the 20-year period – 26 additional standard buses and nine additional express buses – to handle increased ridership that is projected based on demographic forecasts. Fareboxes and other bus systems, such as automatic passenger counters, will also be addressed. Note that the number of buses in the fleet, and mix of bus types, are continually reevaluated – and changes may be implemented via successive bus purchase projects – to ensure that the fleet is appropriate to meet service needs.

The agency's bus purchase needs are uneven across the 20-year period. More than 35% of the needs fall in the initial 2015-2019 period, while only 15% of the needs are in the subsequent 2020-2024 period. As discussed above, a large share of the fleet was purchased when the MTA Bus Company was initially formed, and these buses will reach the end of their useful lives in the 2015-2019 period.

Depots and Equipment

The MTA Bus Company's eight bus depots support bus service throughout its service area by fueling, servicing, maintaining and storing buses as required. Two of the bus depots, College Point in Queens and Spring Creek in Brooklyn, are equipped to service buses that run on compressed natural gas. Four of the depots are relatively new, built since 1980, while the other half were built in earlier decades. Based on age and condition, it is expected that nearly all depots will require some level of capital investment in the 2015-2034 period. Projects will be targeted to address specific deficient components at each depot (such as roofs, heating/ventilation systems, lighting, and facilities). A recurring investment cycle is planned, with each depot receiving investments every 10-15 years. The agency also anticipates the likelihood of a major facility investment in the 2020-2024 period to right-size maintenance and heavy repair capabilities.

Besides the needs of depot buildings, important facility and communication equipment needs must be addressed. Bus washers, bus paint booths, and bus lifts are to be upgraded or replaced on a campaign basis by 2034. Also, in the 2015-2019 period a new bus radio system will be coordinated with NYC Transit's ongoing project in the 2010-2014 Capital Plan to replace its bus radio system.

Service Vehicles

MTA Bus maintains a fleet of heavy-duty rubber-tire vehicles (such as trucks and vans) used to support operations. To maintain a normal replacement cycle as vehicles reach the end of their useful lives, 54 vehicles will be replaced over the 20-year period.

Engineering

To support the investments discussed above, the assessment reflects design and construction management services and associated project administration.

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MTA Bridges and Tunnels
Capital Needs 2015-2034

MTA Bridges & Tunnels (B&T) was established in 1933 as the Triborough Bridge Authority. Today, B&T operates seven bridges and two tunnels that form essential links for vehicular highway transportation in the New York City metropolitan area. It is the largest among the nation's bridge and tunnel toll authorities in terms of traffic volume, serving more than 800,000 vehicles that carry more than a million people daily in the New York Metropolitan area. In 2012, the nine B&T crossings carried approximately 282.6 million vehicle trips and generated $1.491 billion in toll revenue. With close to 60% of this toll revenue dedicated to mass transit operations, Bridges and Tunnels performs a unique and vital function in support of regional mobility.

MTA Bridges and Tunnels developed its first five-year capital plan in 1992. Since then, the agency has invested approximately $5.7 billion in capital funding for its infrastructure. However, more than half of B&T's facilities are over 70 years old and even with regular maintenance, the structures and mechanical components of the bridges and tunnels eventually deteriorate from the combined effects of traffic loads and environmental exposure and need replacement. By the end of this 20-year planning horizon (in 2034), some facilities will be almost 100 years old, a significant milestone that will require a new level of major investments. As bridge and tunnel components reach the end of their useful lives, they require a higher level of capital investment to keep them structurally sound.

Previous plans have invested heavily in the Authority's oldest facilities from the 1930s, such as the Robert F. Kennedy (RFK), Bronx-Whitestone, Henry Hudson, and Marine Parkway Bridges. But as the benefits of those previous investments accrue, the Authority now also needs to make large-scale investments in its two largest facilities from the 1960s--the Verrazano-Narrows (VNB) and the Throgs Neck (TNB) bridges. Over the 2015-2034 time frame, the largest investments will be made in the suspension bridges (Verrazano-Narrows, Robert F. Kennedy, Throgs Neck and Bronx-Whitestone Bridges). Table 6 outlines B&T's needs and investment summaries for each facility and by category of work.

The 20-year capital needs investments are derived from master plans developed for each facility. These address the on-going needs of the crossings, the timing and coordination of the improvements, opportunities to address functional obsolescence and aging structural components, and plan for future needs, while mitigating potentially significant burdens and constraints in maintaining efficient operations.

B&T's goal for the next 20 years is to carry out a fully funded capital plan that will keep the facilities in a state of good repair, ensure a high level of reliability, resiliency and redundancy and strategically improve facility operations and conditions, including the movement of traffic, wherever appropriate.

In regard to the type of work being carried out, B&T's traditional 20-year needs investment pattern has also been evolving since its first submission of a 20-year plan in 1992. During the 1990s, a relatively large proportion of the needs identified were in the structural category, but in the last two 20-year needs submissions (2005-2024 and 2010-2029) the most significant investment needs have been identified in the category of Roadways and Decks. Indeed, major deck replacement/rehabilitation programs at four facilities were continued or initiated in the 2010-2014 plan and will continue into the 2015-2034 period as well. However, once these decks are replaced (most of this work will be committed by the end of the 2020-2024 plan and the new decks will last approximately 50 to 60 years), it is anticipated that subsequent capital needs for this asset category will be reduced. The capital plans will once again show the highest investment levels in the structural category, which includes the rehabilitation of bridge substructures and main cables (Table 6).

Toll Plaza replacements are also a key capital need for B&T in the 2015-2034 timeframe. Under the 2010-2014 plan, B&T initiated a pilot program at the Henry Hudson Bridge that will help determine the feasibility of implementing All-Electronic Tolling at other facilities in later capital plans. The purpose of the pilot is to test new technologies required to collect video images from passing vehicles and the back-office systems needed to collect tolls from registered owners of vehicles without an E-ZPass tag. The pilot will also help identify the operational and financial issues in a cashless environment. The data collected from this pilot (the completion date of which has not yet been determined) will be used to evaluate and guide future toll collection and toll plaza reconstruction plans. In the first phase (implemented in January 2011) toll gates were removed at the facility enabling peak hour throughput to increase from approximately 800 to 1,000 vehicles per hour. The implementation of cashless tolling at the facility began on November 10, 2012. All motorists are now able to use any lane to drive through the toll plaza without stopping. There is no change for drivers who use E-ZPass. For customers without an E-ZPass tag, an image is taken of their license plate and the registered driver receives a bill in the mail. Year-to-date, approximately 94% of total crossings have been E-ZPass and 6% "Tolls By Mail" transactions.

Due to the age and structural needs of the toll plazas (which include portions of the roadway decks and the substructure along with the toll plaza equipment), replacements must begin to be programmed and B&T is therefore proceeding with a modular approach that can accommodate a wide variety of toll collection strategies. Under this approach, all toll plaza replacements, with the exception of the Henry Hudson Bridge (HHB), will be designed as traditional toll plazas with booths and islands in order to be conservative from a "need" standpoint; they will be flexible enough, however, to evolve over time as toll collection methods change.

For the first time, structural painting work is now being included in B&T's 20-year needs assessment, with an anticipated need of more than $1 billion over the 2015-2034 period. As part of a best value analysis carried out in 2010, major bridge painting projects that were capital eligible were incorporated into the 2010-2014 Capital Plan, reducing operating expenses by approximately $158 million over that time frame. This painting work is primarily associated with removal of lead paint and repainting of the bridge structures with new high performance coatings that have a useful life of 30 years and provides corrosion protection to maintain the structural integrity of all facilities.

Finally, it should be noted that this Assessment does not include any of the investments being made to restore B&T facilities affected by Superstorm Sandy. This assessment does, however, reflect master plan shifts at the facilities that will result from coordinating B&T's core normal replacement plans in the 2015-2034 period with ongoing and planned Sandy related investments in the 2010-2014 plan.

Table 6
MTA Bridges &Tunnels Summary of Continuing Needs: 2015-2034
By Facility
(2012 $ in millions)

Facility	Age	2015-2019	2020-2024	2025-2029	2030-2034	Total
Bronx-Whitestone Bridge	74	$250	$127	$350	$621	$1,348
Robert F. Kennedy Bridge	77	834	367	343	296	1,840
Throgs Neck Bridge	52	342	626	829	272	2,069
Verrazano-Narrows Bridge	49	317	894	701	531	2,443
Henry Hudson Bridge	77	176	41	91	171	479
Cross Bay Bridge	43	31	66	66	456	619
Marine Parkway Bridge	76	41	179	114	476	810
Hugh L Carey Tunnel	63	103	170	271	231	775
Queens Midtown Tunnel	73	107	150	164	221	642
Agency Wide		209	151	258	390	1,008
Total		$2,410	$2,771	$3,187	$3,665	$12,033

(numbers may not total due to rounding)

By Investment Category
(2012 $ in millions)

Asset Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
Structures	$841	$910	$1,563	$2,200	$5,514
Roadways and Decks	729	852	406	223	2,209
Toll Plaza	297	348	153	60	858
Utilities	286	291	419	577	1,574
Buildings and Sites	60	110	293	84	547
Painting	149	210	298	468	1,125
Miscellaneous	48	50	55	54	207
Total	$2,410	$2,771	$3,187	$3,665	$12,033

(numbers may not total due to rounding)

Facility Investment Summaries

Bronx-Whitestone Bridge

The Bronx-Whitestone Bridge (BWB), one of two B&T suspension bridges connecting upper Queens with the Bronx, carried approximately 39.5 million vehicles in 2012. The bridge carries a single deck of traffic supported by a pair of main cables.

In previous capital plans, investments at the BWB have focused on rehabilitation of the bridge's primary structural elements, including significantly reducing the dead load on the main cables by removing the truss, replacing the bridge decks with a lighter orthotropic deck and installing a lightweight wind fairing system. Most recently, in 2008, the Authority began reconstruction of the Bronx approach, which was completely replaced with a modern structure in 2012. And just last year (2012) the Authority initiated the reconstruction of the Queens Approach structure, with completion scheduled for 2015. Once the Queens Approach work is finished, all of the original 1930s era roadways will have been replaced.

Most proposed investments at the BWB over the next 20 years will continue to address other aging bridge structure elements while also upgrading the various components to meet current standards and to ensure that current and future traffic demands can be met with an acceptable level of service. More specifically, the structural needs of the main cables and the suspender ropes will continue to be addressed, and projects to widen the bridge structure on both the suspended spans and the approach viaducts to improve safety and traffic movement are planned. In addition, a new fender system will be installed and a new toll plaza will be constructed with standardized toll lane widths to enhance vehicular flow. Ninety-seven percent of the overall needs are for normal replacement, with the remaining 3% addressing system improvement.

Robert F. Kennedy Bridge

The Robert F. Kennedy Bridge (formerly known as the Triborough Bridge), the Authority's flagship facility, is comprised of three bridges, a viaduct and approach roads connecting Manhattan, Queens and the Bronx. The bridge's three branches meet on Randall's Island, where an interchange and two toll plazas sort out traffic flowing in 12 directions including access to the island itself. Approximately 57.3 million vehicles crossed the Robert F. Kennedy Bridge in 2012.

The overall rehabilitation program for this facility began in the mid-1990s, and will continue over the next 20 years. Projects already completed include the replacement of the Harlem River Lift Span deck and approaches, rehabilitation of the mechanical and electrical systems of the lift span, replacement of the decks of the Bronx approach, the Queens viaduct, Randall's Island and Wards Island Viaduct, and the Queens suspended span. In addition, the bridge cable and suspender ropes were rehabilitated, the Queens to Manhattan ramp widened, and a new pedestrian ramp from Queens to Wards Island and a new vehicular ramp from the Bronx to Wards Island were constructed. In the 2010-2014 Capital Plan, extensive deck replacement/rehabilitation of the Manhattan approach ramps and of the Bronx toll plaza is underway.

Over the 2015-34 period, B&T plans to complete replacement of the remaining original decks, continue investments in the main cables to address recurring structural needs, implement traffic throughput enhancements as part of the structural rehabilitation work, and complete upgrades to both the substructure and superstructure that will: a) meet today's load criteria for the most heavy trucks; b) meet today's seismic criteria; and c) eliminate wind vulnerabilities.

Specific work will include a full replacement of the Manhattan toll plaza and its associated components; replacement of the FDR Manhattan approach ramp; continuation of the main cable inspection program and the possible installation of a dehumidification system; and reconstruction of the Manhattan interchange, which will provide a direct connection from the west bound Harlem River Lift Span to the north bound Harlem River Drive, ensuring full redundancy of traffic movement (consistent with the NYS 2100 Commission report) and significantly reducing traffic on city streets. Ninety-five percent of the overall needs are for normal replacement, with the remaining 5% addressing system improvement.

Throgs Neck Bridge

The Throgs Neck Bridge (TNB) crosses the East River, connecting the boroughs of Queens and the Bronx via Route I-295. The bridge carries three lanes in each direction with the toll plaza located on the Bronx side. In 2012 the TNB carried approximately 39.4 million vehicles.

In previous capital plans, investments at the TNB have focused on rehabilitation of the superstructure (e.g. decks, stringers) and primary structural elements. For example, extensive steel repairs and drainage improvements have been carried out, the

complete superstructure of the Cross Island Parkway ramps has been cleaned and re-coated and parts of the Queens Approach span have been completely rehabilitated, including replacement of the deck and seismic retrofits. Additional deteriorated superstructure repairs on the suspended span are being performed in the current capital plan (2010-2014).

The majority of the work planned over the next 20 years at the TNB will continue to focus on deficient bridge structure elements, in order to address the effects of age, corrosion, heavy truck traffic, increasing traffic volumes, and protection of the bridge structure. Investments will include replacing the structurally deficient hybrid concrete filled steel grid deck on the suspended spans, implementation of main cable protection systems, rehabilitation of the Bronx and Queens Approach viaducts, rehabilitation of the Cross Island Parkway substructures (e.g. structural supports), anchorage and tower protection systems, and replacement of the toll plaza. Major bridge painting needs will also continue to be addressed. Some of the above work may require extensive lane closures that will require careful coordination with work being planned at the nearby Bronx-Whitestone Bridge. All of the needs are categorized as normal replacement.

Verrazano-Narrows Bridge

The Verrazano-Narrows Bridge (VNB), connecting Brooklyn and Staten Island, is the newest of B&T's suspension bridges and the longest in North America. The VNB carried approximately 65.6 million vehicles in 2012.

In previous capital plans, investments at the VNB focused on rehabilitation of the bridge's decks, Brooklyn approaches, painting, electrical work and toll plaza improvements. Painting of the main cables has been performed on a regular cycle in an effort to maintain them in good condition, as the main cables are the primary structural element supporting the suspension bridge and are the most difficult and costly element to replace.

The 2010-2014 Capital Plan continues to progress major projects initiated in the previous capital plans. Ongoing projects include the reconstruction the eastbound toll plaza section and eastbound ramps (which will provide direct access to the lower level from the Staten Island Expressway and improve access to the upper level for express buses and all traffic accessing the bridge from the local ramps on Staten Island) and the reconfiguration of the upper level of the bridge to provide a reversible bus/high occupancy vehicle (HOV) peak travel lane. Construction of a new bus/HOV ramp is

planned and will soon be underway, eventually connecting the new HOV/bus lane on the upper level suspended span to NYSDOT's bus/HOV lane on the Gowanus Expressway. Once these projects are complete, the VNB will meet regional traffic capacity needs for the foreseeable future.

The majority of the work identified for the next 20 years will address deficient bridge structure elements. Specific investments will include replacing the west bound toll plaza (which is substandard for today's traffic volumes) and its associated components; replacing and upgrading to current design load criteria the remaining original concrete decks, including the Belt Parkway ramp, the upper level approach ramps and the lower level suspended span; addressing seismic vulnerabilities on the ramps and wind vulnerabilities on the suspended span; establishment of a regular cable monitoring program; repairs to the Staten Island and Brooklyn Anchorage Structures, including sealing them to protect the concrete from the weather and prevent water infiltration into the anchorage chambers; and rehabilitation of the suspender ropes and main cables. Nearly all of the overall needs are for normal replacement, with system improvement comprising just over 1%.

Henry Hudson Bridge

The Henry Hudson Bridge connects the northern tip of Manhattan with the Bronx and points north across the Harlem River. Approximately 22 million vehicles crossed this bridge in 2012.

In previous capital plans, B&T replaced the majority of the decks on both the original upper level (excluding the outer portions over the curb stringers and the toll plaza area spans) and the lower level (excluding the south approach spans). Currently in progress is the replacement of the outer portions of the upper level deck not addressed in earlier plans, as well as replacement of the original curb stringers with a new improved design intended to prevent water ingress.

With both the upper and lower level roadway decks now replaced, the last remaining original 1930s era portions of the superstructure are the upper and lower level toll plaza areas, and the south approach area, which includes the maintenance garage. Early in the 2015-2034 plan period, the toll plazas and the garage will be replaced in a phased approach by initially providing satellite toll plaza locations and relocation of existing utilities, followed by replacement of existing toll plaza structures. The new plazas will be fully flexible so that they can be converted in the future if the Authority migrates to a different toll collection method. Other key investments over the next 20

years include rehabilitation or replacement of the skewbacks (a critical substructure component), rehabilitation of the retaining wall and rock face adjacent to the parkway, replacement of the Dyckman St. abutment and resurfacing of the lower level roadway. Nearly all of the overall needs are for normal replacement, with system improvement comprising less than 1%.

Cross Bay Bridge

The Cross Bay Veterans Memorial Bridge (CBB) spans Beach Channel in Jamaica Bay, providing access from Brooklyn and Queens to the Rockaways and the beaches in the area. It was completely reconstructed in 1970 as a high-level fixed bridge with a wide main channel for marine passage. Approximately 7.5 million vehicles crossed the bridge in 2012.

In previous capital plans, investments at the CBB focused primarily on structural rehabilitation work. This included, major rehabilitation of the drainage system, structural rehabilitation of the ramps, and a major reconstruction of the deck, including substructure work recently completed.

During the 2015-2034 period, investments will be made to rehabilitate both the superstructure and sub-structure, and the pier fender system will be rehabilitated or replaced. In addition, an engineering study and conceptual designs for various alternative capital investment strategies for the reconstruction of both Rockaway crossings (Marine Parkway and Cross Bay) will be undertaken. This study will provide an understanding of the inherent issues associated with these bridges due to their original construction, their location and the prospective need for continued recurring high levels of investment to maintain a state of good repair. Superstorm Sandy brought to light a number of vulnerabilities of the Rockaway crossings considering their location and the potential climate changes, and such issues will be analyzed and incorporated into the ongoing long term master plan for each bridge. Significant funding is included in the latter part of this 20-year assessment to address these potential needs. All of the needs are categorized as normal replacement.

Marine Parkway Bridge

The Marine Parkway Gil Hodges Memorial Bridge Facility consists of three bridges – the main bridge, the Rockaway Point Boulevard Overpass and the Jacob Riis Park Pedestrian Bridge. Approximately 7.8 million vehicle trips crossed the bridge in 2012.

Under previous capital plans, original functional deficiencies of the bridge were addressed, particularly through a major deck replacement project. The 2010-2014 capital plan includes substructure investments, electrical and mechanical repairs and the rehabilitation of the Rockaway Point and Jacob Riis overpasses.

The investments planned over the next 20 years will largely focus on structural steel repairs, replacement or rehabilitation of the fender system and large scale zone painting. As discussed in the Cross Bay Bridge summary, an engineering study and conceptual design for various alternative capital investment strategies for the reconstruction of both Rockaway crossings will be undertaken in order to provide an understanding of the inherent issues associated with these bridges due to their original construction, their location and the prospective need for continued recurring high levels of investment. The vulnerabilities brought to light by Superstorm Sandy will be incorporated into the study. As with the CBB, significant funding is included in the latter part of this 20-year assessment to address the potential long term needs. All of the needs are categorized as normal replacement.

Hugh L Carey Tunnel

The Hugh L. Carey Tunnel (HCT) (formerly known as the Brooklyn-Battery Tunnel) is a twin tube four lane vehicular tunnel, the longest in North America, connecting lower Manhattan and Brooklyn. The facility includes two ventilation buildings located in lower Manhattan, a third near the Brooklyn portal, and a fourth adjacent to Governors Island. In addition, the Battery Parking Garage (BPG), located just north of the Manhattan portal, is part of the original tunnel structure. Approximately 15.9 million vehicles traveled through the tunnel in 2012.

Previous capital investments in the tunnel have been extensive and include replacement of the tunnel ceiling slab, the original ceiling tiles, the exhaust fans, the traffic signal controls and the top layer of the concrete roadway slab, followed by the addition of a cathodic protection system. Major work to overhaul and modernize facility power distribution systems has also been undertaken.

The tunnel has been significantly affected by Sandy and most of the in-tunnel assets impacted by the storm are now not in a state of good repair. As a result, the HCT's long term needs have dramatically changed and are now largely driven by the recommendations presented in Post-Sandy Damage Assessment Reports. Some of the assets that would have been due for a rehabilitation cycle during the plan period as

part of B&T's normal replacement program were severely damaged or destroyed by the storm and must now be replaced with funding from the 2010-2014 Capital Plan.

Beyond the work to recover from Sandy, however, significant work remains to be done, including rehabilitation of the structural slabs in the entrance and exit plaza roadways; replacement of fan motors; rehabilitation of the deteriorated drainage systems, curbs, sidewalks, traffic barriers, and retaining walls; and rehabilitation or repair of various buildings that support tunnel operations. Ninety-seven percent of the overall needs are for normal replacement, with the remaining 3% addressing system improvement.

Queens Midtown Tunnel

The Queens Midtown Tunnel (QMT) is a twin tube four lane vehicular tunnel opened to traffic in 1940. The tunnel connects the Long Island Expressway and midtown Manhattan. Related structures in this facility include two ventilation buildings, one in Queens and one in Manhattan. The Queens Midtown Tunnel facility also includes three Manhattan Overpasses at 2nd Ave., 36th St., and 37th St., along with approach and exit marginal streets between 34th and 41st Sts. Approximately 27.8 million vehicles traveled through the tunnel in 2012.

Previous capital investments in the tunnel go back to the mid-1990s and include replacement of the traffic control wiring, replacement of the ceiling slab, tiles and lighting, rehabilitation of the ventilation and portal pump rooms, replacement of the tunnel exhaust fans, and modernization of the facility power distribution systems.

As with the Hugh L Carey Tunnel, the QMT's needs for the 2015-2034 period have been significantly affected by Superstorm Sandy and most of the in-tunnel assets impacted by the storm are now not in a state of good repair. As a result, the master plan for the facility has dramatically changed and is now largely driven by the recommendations presented in Post-Sandy Damage Assessment Reports. Some of the assets that would have been due for a rehabilitation cycle during the plan period as part of B&T's normal replacement program were severely damaged or destroyed by the storm and must now be replaced with funding from the 2010-2014 Capital Plan.

Beyond the work to recover from Sandy, significant other needs remain to be addressed. Work will include rehabilitation of the bathtub structure of the plaza, rehabilitation of the plaza roadways, as necessary, using high performance asphalt and concrete, replacement or rehabilitation of the plaza's concrete base slabs, including

repairs to roadway joints and perimeter drainage channels, repair or replacement of the plaza sidewalks and gutters, and replacement of the remaining original parts of the control and communication systems. All of the needs are categorized as normal replacement.

Agency-Wide Projects

The bulk of the needs in the agency-wide category address B&T's program for Intelligent Transportation Systems (ITS). MTA Bridges & Tunnels has been at the forefront of ITS technology implementation since the comprehensive national ITS program was established approximately 20 years ago. B&T is currently in the process of updating its ITS implementation plan, which was developed over 10 years ago and has been used as a framework for developing the ITS projects in the capital program. The new ITS plan, which should be completed by the end of 2013, will be used to assist in prioritizing needs and planning projects over the next 20 years.

Systems being evaluated in the implementation plan include closed circuit television traffic cameras, which monitor incident management activities across the facilities; variable message signs, which disseminate traffic information to motorists, including real time traffic conditions; travel time information systems such as TRANSMIT, which utilizes E-ZPass readers and transponders to estimate travel time between destination points, and other travel time technologies that utilize vehicle installed devices; vehicle traffic detectors, which can measure speed, volume, occupancy and vehicle classification, allowing for quicker detection and clearance of incidents; over-height vehicle detection systems, which enable B&T staff to re-route over height vehicle before they enter a tunnel and disrupt traffic or damage the facility; and roadway weather systems, which utilize roadway sensors to facilitate planning and resource allocation for weather events, particularly during the winter months. Sixty-three percent of the overall needs are for system improvement, with the remaining 37% addressing normal replacement of existing ITS assets.

This assessment also addresses program-wide needs associated with the support and administration of capital work, including protective liability coverage, independent engineering services, value engineering services, scope development, etc.

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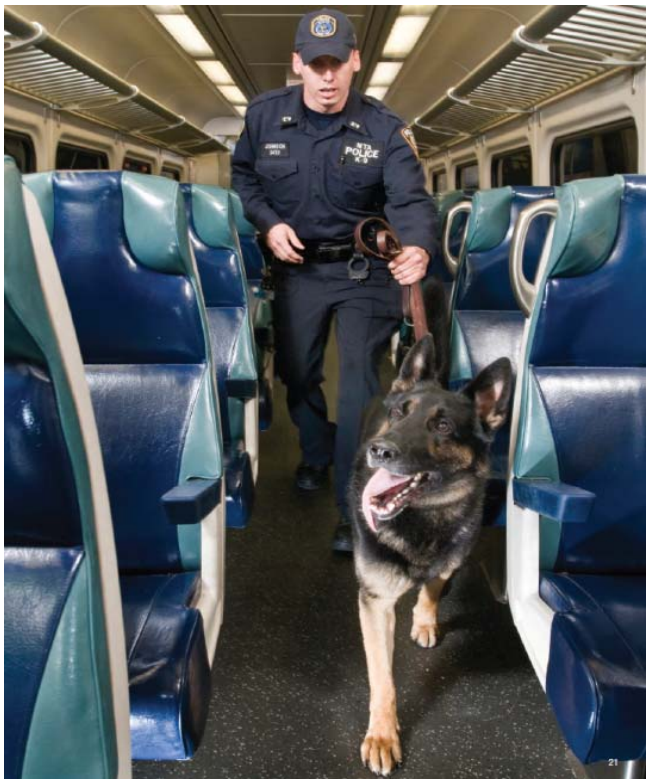
MTA Police Department/Security
Capital Needs 2015-2034



The MTA and other national transit agencies has been the target of constant threats and specific assaults from terrorist groups and individuals who advance their agendas through attacks on the target rich, mass transport environment. In the time from the attack on the World Trade Center to the present day, New York City metropolitan transit systems have been subjected to no less than seventeen actual or planned terrorist scenarios. Consistent with the MTA's high risk, high density, and high consequence operating and capital venues, terrorists have targeted our agency's ridership and asset base.

The primary objective of the MTA's layered security strategy is to provide an in depth defense designed to deflect, interrupt and interdict the capabilities and potential activities of terrorist and individual aggressors. The effective application of such strategies will reduce our vulnerabilities, diminish risk and consequence, and through proactive law enforcement strategies prevent crime. Both operating and capital tactics are employed to achieve these goals. Some operating initiatives include: Enhanced training of police officers – in explosive trace detection skills, command incident management, and detection of chemical and biological attacks. Another focus is on Security awareness – training for front line operating personnel and public "See Something, Say Something" campaigns.

The capital initiatives remain focused on mitigation efforts to preserve MTA assets throughout the system at key locations, including: electronic security systems, structural/perimeter protection and hardening measures, and consequence management mitigations.

The MTA plans to sustain this program throughout the 2015-2034 period, after which time it is anticipated that future security investments will be advanced by the MTA Operating Agency which owns the asset.

Forecasts for MTA Police and Security investments total $614 million through 2034 (Table 7).

Table 7
MTA Police / Security Summary of Continuing Needs: 2015-2034
By Investment Category
(2012 $ in millions)

Investment Category	2015-2019	2020-2024	2025-2029	2030-2034	Total
MTA Police Communications	$52	$2	$2	$0	$56
MTA Police Facilities	21	21	12	0	54
MTA Police Vehicles	1	2	1	0	4
MTA Security	125	125	125	125	500
Total	$199	$150	$140	$125	$614

(numbers may not total due to rounding)

Asset Investment Summaries

MTA Police Communications

The MTA Police Communication's Division is a support unit of the Department whose core mission is the assignment of police officers, supervisors and Command level members to both routine and emergency conditions impacting on transit operations. Equipment facilitating this function consists of interoperable portable handheld radios, base station equipment, transmitter sites, Command and Control Communications (C3) infrastructure, inclusive of redundant emergency backup locations, and ancillary equipment required for the support of police communication operations.

In the 2010-2014 Capital Plan the Department's communication function was vastly improved through the completion of a technologically advanced Command and Control (C&C) C3 center. A paramount need for a secondary C&C location is still existent. The ability to optimize this system is constrained by an existing radio system with coverage gaps negatively impacting on the clarity of radio communications. MTA Police projects to remedy this challenge in the 2015-2019 period by upgrading the system with a reliable public safety grade interoperable communications system for its police officers throughout the region. This new system is also partially funded in both the 2005-2009 and 2010-2014 Capital Plans. Other related needs include replacement of communications base station equipment and enhancement of transmitter sites.

MTA Police Facilities

MTA Police facilities are established throughout the commuter rail service area for a variety of police functions, including Patrol, Detective Division, Internal Affairs, Highway, K-9, Emergency Services, Training, T.R.A.C.K.S., Right-Of-Way Task Force, Fleet, Property and Evidence, Records, Supply, Communications and Integrated Electronic Security System monitoring and Counter Terrorism. The MTAPD currently operates from 26 facilities throughout the 12 counties of New York State in which it has jurisdiction. In addition to the 26 existing facilities, three new facilities will replace existing facilities (K-9, Nassau District Headquarters, District 9), as a result of prior and current capital plans. In the future, MTAPD plans to establish a new headquarters as a result of the move out of the MTA's Madison Avenue complex, a permanent facility for its Northern Headquarters in Mount Vernon, resulting in cost efficiencies, and is also planning to establish a new facility in Dutchess County to better serve Metro-North's expanding market.

These facilities are acquired through a variety of methods: via leased office space and temporary structures, shared space in existing MTA commuter railroad structures such as station buildings and power substations, and permanent, dedicated facilities. Several of these locations are insufficient to support operational needs. The overarching goal of the MTA police, in this venue, is to eliminate inefficient and costly temporary housing with permanent facilities that maximize the Department's capabilities and provides an expense reduction benefit to the MTA.

MTA Police Vehicles

This category is comprised primarily of rubber tire vehicles: Five emergency service units (ESUs) and two mobile command buses. These units are used in various emergency response situations, as well as for routine ESU patrols. Officers assigned to these units utilize specialized training and expertise to support the patrol function by handling major incidents beyond the scope of the uniform patrol officer. These efforts require the use of various types of emergency equipment from Medical Supplies to Hazardous Material mitigation gear to meters for monitoring chemical and radiological levels in the air, all of which are equipped in the vehicles.

The units are deployed throughout the MTA service region, which includes the Metro-North Railroad, the Long Island Rail Road and the Staten Island Railway. The long term goal for this category is to maintain the specialized equipment and replace

them at the end of their useful life, providing for technological upgrades where appropriate.

MTA Security

The MTA employs a risk-based approach, in terms of an all Threat Vulnerability and Risk Assessment (TVRA) as a guide path, for the investment of local and federal funds to support risk/consequence reduction security mitigations for its capital program. The TVRA defines the measurable risk reduction benefit in terms of cost outlays; aligns and prioritizes by risk the MTA's capital asset base; advances the utilization of the most cost effective and technologically adept security measures; projects the future maintenance costs of the security mitigation; and provides a transparent process for all agency's to utilize the TVRA for future capital security projects. To ensure mitigation strategies remain aligned with emerging risks, the MTA Office of Security conducts periodic updates to the TVRA, encompassing the entire MTA network, most recently done in May 2013. Capital security measures are designed to reduce such vulnerabilities to the agency's infrastructure.

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Planning for the Future

Introduction

The MTA's system has played an indisputable role in the revival of New York City and the New York region since the 1980s, and supports New York's role as the world's second largest business center (Gross Regional Product of more than $1.27 trillion[1]). Investments by the MTA in rebuilding and maintaining the system over the past 30 years have not only resulted in improved reliability and more convenient travel, but have also provided the foundation for the region's vigorous economic growth over the past 20 years. Overall, use of MTA's transit services and river crossings remains strong in the face of the economic turmoil of the past few years. In fact, the total daily usage of MTA's facilities and services exceeds the combined population of the cities of Los Angeles, Houston and Chicago.

Recent analysis of economic trends suggests that while the region's economy still faces challenges, recovery and job growth are underway, with growth industries such as health care, education and technology leading the way. In addition, there continues to be a broad consensus that double digit population and employment growth can be expected in the next 20 years, provided that a financially stable and efficiently-run transit system exists to help move the region's population. New York City is still on track to grow by one million people to over nine million by 2040[2] – the equivalent of another large American city. Many urban neighborhoods that experienced population declines in the 1970s and 1980s have rebounded as new residents take advantage of renewed housing stock and good access to an efficient public transportation system.

In the past, this type of economic growth would have resulted in ridership gains that were primarily focused on travel to the Manhattan central business district in the peak of the morning rush hour. However, there is mounting evidence that the nature of work and how people access their jobs is changing significantly. Over the past decade, the pattern of where and when people travel (in general, and to work specifically) has been undergoing a profound transformation. Manufacturing jobs have virtually disappeared, and "pink collar" office jobs (file clerks, secretaries, typing pools) have been largely replaced by smaller staffs utilizing information technology networks. New non-Manhattan CBD economic hubs (such as Long Island City and Downtown Brooklyn in NYC, and suburban hubs such as White Plains, Stamford and Suffolk County's Route 110 corridor) have emerged to attract workers. A seven day per week service economy, led by the retail, health care, education and travel fields

[1] Bureau of Economic Analysis, *Economic Growth Continues Across Metropolitan Areas in 2011*, Feb 2013
[2] MTA "Blended Forecast" (NYMTC/Moody's/Global Insight)

(New York's vigorous and growing tourism industry is attracting more than 52 million visitors per year[3]) is now becoming the norm.

Consequently, while overall ridership is up in the past thirty years, the patterns of when and where people travel have been undergoing a dramatic change. While the traditional peak periods continue to be the MTA's largest travel market, future travel growth is expected to be less peak- and Manhattan CBD-centric, largely reflecting the growth in non-CBD destinations and non-peak period travel markets. Going forward, travel will become more complex and diverse, mirroring the changes in the broader economy. As a result, while the MTA's transit infrastructure can generally handle the still-busy peak hour loads into the CBD (with the exception of some critical "hot spot" corridors discussed below), it faces the challenge of making the most of the existing network to accommodate changing travel patterns that are no longer exclusively CBD-oriented.

Additionally, MTA must consider the region's potential future in a period of more erratic environmental conditions: two hurricanes in the past two years, more than three tornadoes in the past five, and increasingly volatile rain and snow conditions, which exacerbate flood damage and impact vital roadways and rail lines critical to supporting the growing region's travel needs. The MTA faces the daunting task of building a resilient transportation infrastructure and identifying methods to more quickly recover from or offer alternatives to, damaged and flooded transportation resources.

Finally, this new travel complexity, combined with more austere government spending plans, present the MTA with challenges not encountered in its 45-year history: how to meet the needs of existing and new travel markets in a continually growing region, while "making every dollar count" from constrained capital program budgets. These new economic and travel realities may not necessarily require MTA to pursue additional multi-billion dollar megaproject solutions to boost capacity. Instead, they call for new, market-driven "network-strategic" investments that target specific problems in specific locations that can be achieved "in our commuting lifetimes."

The purpose of the "Planning for the Future" section of the Capital Needs Assessment is to describe these trends in detail and identify the new investment areas that can address them and help the MTA maintain the New York region's position as

[3] MikeBloomberg.com, *NYC's Tech and Tourism Industries Spurs Economic Growth,* May 2013

the nation's preeminent local economy by providing for the mobility needs of a changing ridership.

Current Trends

The population growth that occurred in the New York City and in the 12 county MTA region since 1990 has been unlike anything experienced since the 1920s for the City and the 1950s for the rest of the region.

In 2012 transit ridership was higher than at any time in the past 45 years; and for the subway alone, higher than any year since 1950. The growth in ridership has been most pronounced since the introduction free intermodal transfers and volume pricing through New York City Transit's MetroCard fare collection system, and supported by more than thirty years of MTA capital investment. This growth has occurred throughout the day, (extending to the overnight hours as the New York economy has become more closely linked to international markets in different time zones) and has grown most heavily on the weekends, reflecting the choice of New Yorkers to make the use of the bus and subway system as a "way of life" for all trip purposes.

Public transportation's competition – the automobile – is not enjoying the same growth. While auto usage remains predominant for intra-suburban travel, the overall rise in auto trips and miles traveled has been leveling in off since 2001[4], due to the rise in fuel prices, which spiked in 2007, as well as the impact of the recent economic downturn. The lack of any new highway construction in past decades, and recurring highway reconstruction, which removes many lane miles from service nights, weekends and often during daylight hours region-wide, is increasingly limiting capacity. Traffic congestion continues to grow throughout the region as the highway network is under perpetual repair.

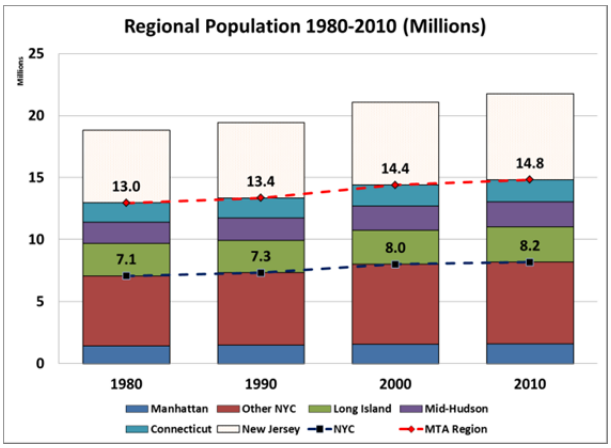
Population and Age

Population

New York City and the MTA region's population have reached record levels after the economic downturn and sluggish growth of the 1970s. Continuous growth in international immigration has largely offset domestic outmigration, allowing natural increases (births minus deaths) to expand the population.

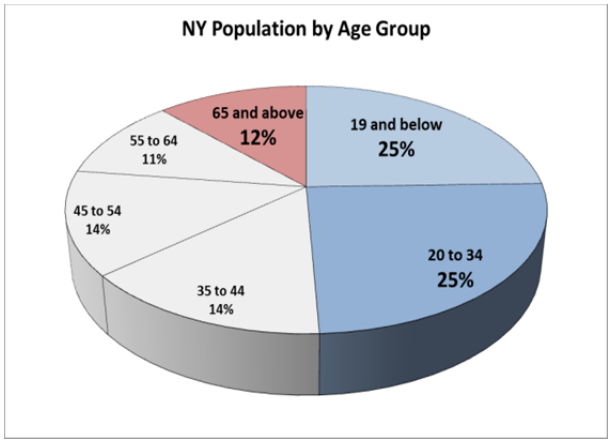
[4] Brookings Institution, *The Road…Less Traveled*, December 2008

Between 1980 and 2010, New York City's population grew by 16% from 7.1 million to 8.2 million—an increase equivalent to the entire population of San Diego, CA. The strongest growth (946,000, +19%) occurred in the outer boroughs.



Today, 12% of the US population is foreign born, the highest level since 1930, and according to the 2009 American Community Survey, more than 37% of New York City residents report foreign birth (Brookings Institute and Pew Institute). While population in many other older US cities peaked between 1950-1970 (after which those cities lost population to suburbanization), New York City has continued to grow due to immigrant arrivals from Latin America, Asia, the Caribbean and the former Soviet bloc area, replacing those who moved to suburban areas.

Regional population has also grown, from 12.9 million in 1980 to 14.8 million in 2010, an increase of 1.9 million, which exceeds the population of Philadelphia, PA. The most robust suburban growth has been in the Mid-Hudson region where population grew by 323,000 (+19% from a base of 1.78 million), while SW Connecticut (Fairfield and New Haven) grew by 210,000 (+13.4% from a base of 1.57 million). By comparison, Long Island has grown at a lower rate of 9% or 227,000 residents from a base of 2.6 million. Outside the MTA region, the northern and central New Jersey counties are also exhibiting robust population growth, increasing by 1.1 million (+19%).



Millennials and Boomers

One challenge the MTA faces in addressing the region's growth and changing travel needs is the divergence of age cohorts in the population. First and foremost is the growth

"Millennials own fewer cars and drive less than their predecessors. They'd rather walk, bike, car-share, and use public transportation — and want to live where that's all easy."
National Association of Realtors

of the Gen Y population ("Millennials"). This age group, born in the 1980s and 1990s, is becoming a growing segment of the region's workforce. Today adults under the age of 35 represent 47% of the regional population, and 49% of people in New York City. Millennials show a growing predisposition to live in urbanized areas, and to forego auto ownership and driving in favor of walking and public transportation. They also have strong awareness of and comfort with modern information technology, and an expectation that public transportation service will be state of the art in terms of functionality, information delivery, fare collection and comfort.

...in 2011, health care continued to expand at a moderate pace (+1.7%). The strong performers in health care industries were ambulatory care services (+4.4%) and its sub-component -- home health care (+8.4%).
Focus on New York City
NYC Dept. of Labor, March 2012

Conversely, a growing share of the older population is at or approaching retirement age, and many are choosing to "retire in place," rather than move out of the New York region; in fact; many are relocating from suburban areas to more developed communities where shopping and resources are accessible by walking or public transportation. This "Boomer" age group is dependent on public transportation, and requires accessibility features such as elevators and escalators in stations, bus lifts, and information services design for riders with impaired hearing and vision.

Labor Force and Employment

Labor Force

The region's economic challenge is finding enough qualified adult workers to fill available employer needs, and to move them between residences and workplaces. Fortunately, regional labor force has continued to grow in line with regional population growth over the past 30 years. Total regional labor force has grown by 1.1 million, a 15% increase. In NYC, employed labor force in Manhattan has grown by 24%, while the outer boroughs have also grown robustly (up 27% since 1980). In the suburbs, employed labor force has grown by 20% in Long Island, 23% in the Mid—Hudson region, and 19% in southwest Connecticut, while in northern New Jersey, the growth rate has been a robust 25%.

A challenge in supporting the match of the labor force and available jobs (and the corresponding need for transportation services between them) is a notable decline in the labor force participation rate as older workers who have been laid off find it increasingly difficult to re-enter the work force, or find themselves working fewer or

shorter hours. This results in less travel during traditional commuting hours, and an increasing volatility in the number of workers looking for work, affecting the MTA's ability to accurately forecast future ridership and mobility needs. Continual monitoring of both labor force participation rates and labor force levels is necessary to accurately gauge where and when MTA's customers will be traveling.

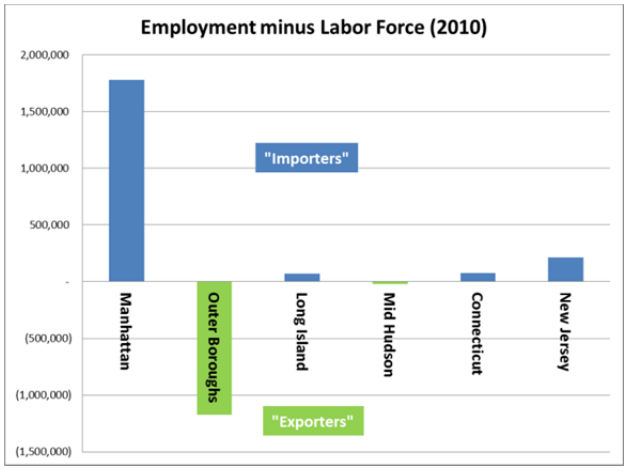
Public transportation makes New York's city jobs accessible to nearly 60 percent of the region's working-age labor.
Missed Opportunity: Transit and Jobs in Metropolitan America
Brookings Institution, May 2011

Employment

Regional employment has continued its upward trend since the 1950s, reaching in 2007 its highest levels since the economic downturn of the 1970s. Employment for the MTA region increased by 1.5 million (+22%) between 1980 and 2010, with immigration playing an important role in filling many of these jobs (the immigrant share of the work force has doubled from 15.8% in 1970 to 34% in 2000).

New York City employment grew by 12% (+497,000) between 1980 and 2010. The Manhattan CBD still predominates as the region's employment center, but since 1980, the greatest growth has occurred in the outer boroughs (561,000, +42%). In the same time period, regional employment grew by a robust 22% (+1.48 million), and the suburbs (776,000), with a 41% growth rate for Long Island and 44% increase in Mid-Hudson.

However, there continues to be a divide between where jobs are and where employed labor force is. Manhattan is still the region's primary job attractor, with 1.7 million more jobs than workers, while the outer boroughs have 1.2 million more workers than jobs, sending them both into Manhattan and reverse commuting to Long Island, the Mid-Hudson region and Connecticut, which both require employees from the city or adjacent suburban counties.



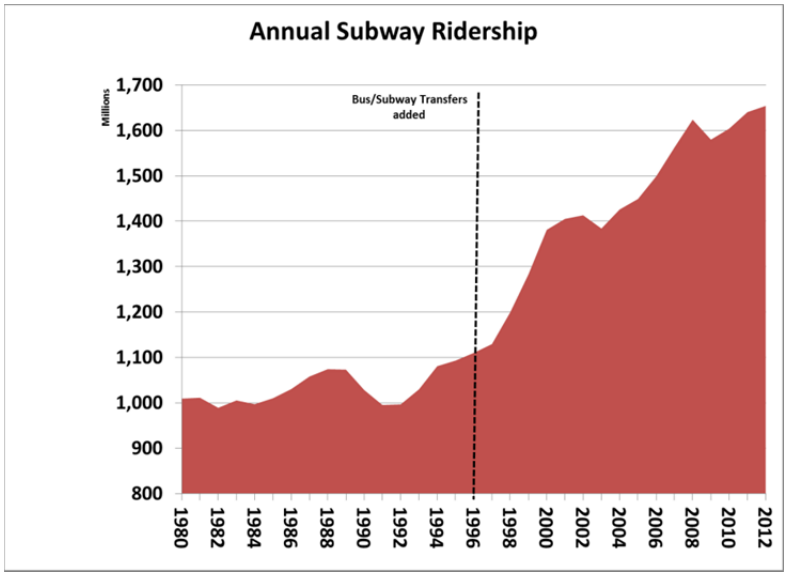
The raw numbers don't tell the entire story, however. New jobs, particularly in the growing technology and medical service industries, are less likely to have "traditional" working (and hence commuting) hours, and employees in these fields may be working at home or at client addresses; in addition, a growing number of workers are holding two or more jobs requiring intermediate commutation trips.

Travel

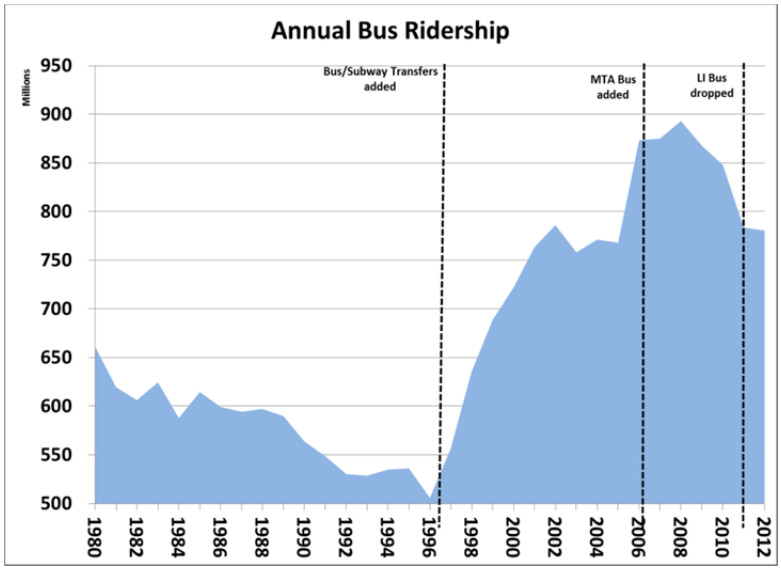
Regional work travel has grown in proportion to the growth in population and employment. In 2011 subway and railroad ridership began to rebound from the effects of the recession and are approaching or exceeding historic highs. Every business day, about 2.0 million daily work trips from the MTA region are destined to Manhattan, approximately a third of all work trips generated in the MTA region. However, the City's outer boroughs and the suburban counties are also major destinations for work travel. The outer boroughs generate approximately 2.9 million work trips and retain 56% of their work trips. The seven suburban counties in the MTA region generate 3.1 million trips and retain 69% of their work trips. The suburban counties are also becoming a significant destination for NYC workers; daily reverse commutation on both commuter railroads grew by 14,231 trips (+82%) from 1990 to 2010, with Metro-North experiencing a 140% growth rate (+6,951 trips).

MTA Ridership

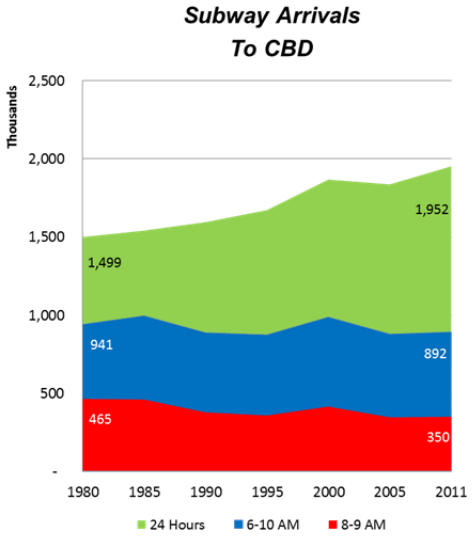
From 1995-2012, ridership on the MTA system (bus, subway and commuter rail) grew by 49% to 2.6 billion rides per year. Most of this growth is attributable to the new fare and transfer options made available by the introduction of MetroCard, as well as the over thirty years of capital reinvestment MTA undertook to restore the bus and subway system to a safe, comfortable and reliable resource for travel in NYC.



The largest segment of MTA ridership (those using the buses and subways operated by New York City Transit) has grown by 689 million trips since 1996 when MetroCard transfers and unlimited ride passes were introduced. Subway ridership has grown to 1.65 billion annual trips, the highest level since 1946. The subway has particularly experienced growth in non-traditional neighborhoods as city residents settle previously non-residential or lower-income areas. For example, between 2006 and 2010, the Bedford Ave. station in Williamsburg, Brooklyn grew by 2.4 million trips, (+48%); the Court St/Borough Hall/Jay St stations in Downtown Brooklyn grew by 3.1 million (+17%). In Queens, the Myrtle-Wyckoff in Ridgewood grew by 1.0 million (+23%); while the Vernon-Jackson Aves, adjacent to the new development sites in Long Island City grew by 1.1 million (+54%).



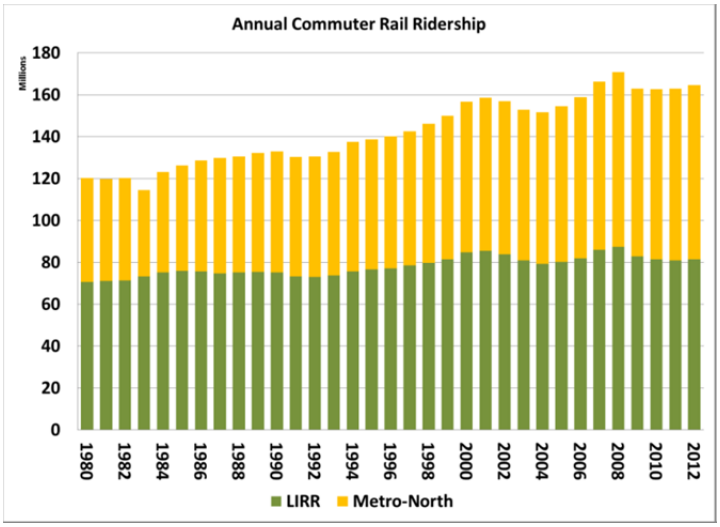
Bus ridership, on the other hand, has declined or been flat since its high point in 2008, after prior years of growth following the introduction of bus-subway transfers through the MetroCard fare system. Current conditions influencing poor bus performance include traffic congestion resulting in slow travel speeds, delays in customers boarding and unloading, and frequent stopping patterns.

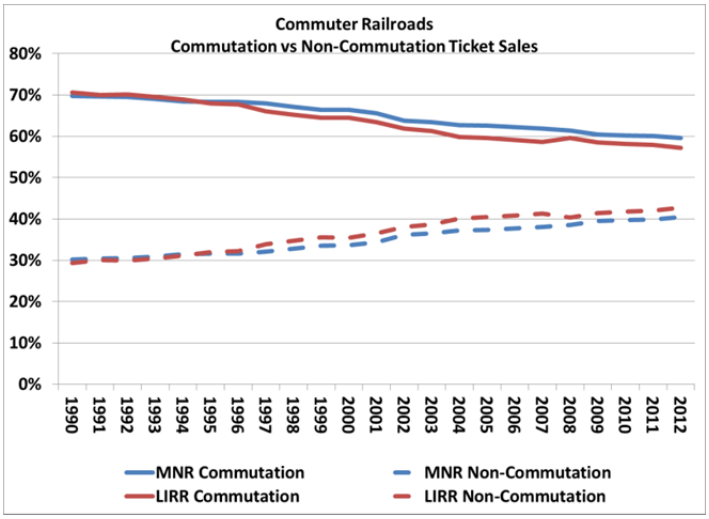


Ridership figures for both subway and bus show a "flattening of the peak" with the proportion of "traditional" work trips entering the Manhattan CBD during the peak morning hour steadily declining in many areas, reflecting changes in the types of jobs held by New Yorkers, working hours, employment locations and worker demographics such as age and ethnicity. As a

result, the largely radial network of bus and subway lines designed decades ago to feed customers into and out of the CBD is being challenged to meet the needs of intra-borough travelers and reverse commute customers using the transit system to access trains to the suburbs.

MTA's commuter rail system has also seen robust growth, with annual ridership up by more than 32 million (24%) since 1990. The most significant gains were experienced on Metro-North Railroad (+25 million or 44% above its 1990 ridership of 57.6 million); the LIRR by comparison has experienced a lower growth rate (+6.2 million or 8% above its 1990 base of 75.3 million) reflecting in part, a flattening of the population growth in Nassau County and a decline in the number of Nassau residents working in the Lower Manhattan financial sector. Particularly strong ridership growth was also experienced in the outer ring counties (Dutchess, Putnam and Suffolk) as a result of regional population shifts outward in search for more affordable suburban housing.





As with the NYC Transit network, commuter rail travel has exhibited significant changes from the traditional rush hour commute; there has been growing travel in the non-peak hours and significant growth in reverse commuter travel from the City to suburban work sites like Stamford (Connecticut) and Mineola (Nassau County), and well as intra-suburban travel by commuters who live and work in the same county or suburban area.

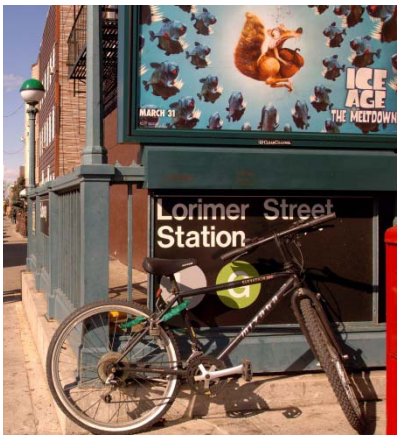
Vehicular Travel

There has been a 10.5% increase in citywide bus and subway ridership, and 1.5% decline in citywide weekday traffic volumes since 2000
2011 Sustainable Streets Index

Vehicular traffic growth is lagging behind transit ridership increases. Within the City limits, after growing in the 1990s, traffic volumes have been flat since 2003. Crossings at the MTA and the Port Authority's bridges and tunnels have also experienced stagnation, particularly for travel across the East River, where hub bound vehicle accumulation (the net difference between entries and exits) has dropped by 15% between 1990 and 2009.

Bicycles

One non-MTA travel market that has the potential to impact the agency's stations and vehicles is the use of bicycles. Partly due to the growth of the Millennials, and partly due to New York City's investment in bike-supportive infrastructure, use of bicycles for commuting increased by 13% in 2010, and an additional 7% in 2011. CBD-bound bike commuting growth has been particularly vigorous, growing by 289% since 2000[5]. Further growth is expected with the rollout of the first phase of the Bike Share network.



The increase in bike use for both commuting and recreational travel is likely to bring with it greater demands for accessibility to and use of MTA facilities. In addition, MTA's Smart Growth Advisory Commission has recommended facilitating the use of bikes as a means of travel to or from transit services. Particular areas where MTA needs to consider bike accommodation include:

- Greater bike accessibility on MTA Bridges & Tunnels crossings, including the Verrazano-Narrows Bridge (MTA has announced plan to evaluate the feasibility of installing a bike lane)
- Bike storage on MTA buses.
- Bike storage at rail and subway stations.

[5] NYCDOT, *Sustainable Streets Index*, 2011

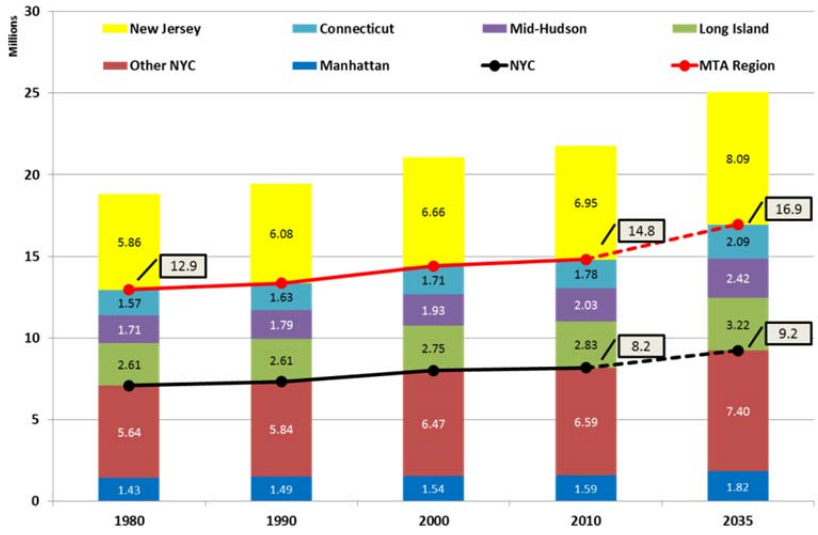
Projected Future Trends

Despite the recent economic recession and the rise in gasoline prices, the external forces that have induced the growth in population and employment are anticipated to continue for the foreseeable future, if perhaps at a lower rate of increase. New York's potential to grow remains significant but is dependent on key infrastructure investment that makes economic and population density possible. These factors will help generate increased ridership on MTA services: annual travel throughout the MTA system could reach close to 3.1 billion trips by 2030 up from 2.7 billion today.

Population, Labor Force and Employment

Population

The MTA region's population is projected to continue to grow, reaching 16 million in 2035 (a 10.0% gain from 2010). Much of this growth will be in New York City, where the population is forecasted to reach almost nine million people by 2035 (10.0%), adding 816,600 people, the equivalent population of the entire City of San Francisco. Foreign immigration is expected to remain an important factor in these growth levels, with in-migration from abroad offsetting declining birth rates and out-migration to other parts of the country.



Suburban regions of the NYC metropolitan area will also continue to grow, with geographic differences. The highest projected regional growth is in the Mid-Hudson counties, where population is projected to grow by 256,000 (+12.7% from a 2010 base of 2 million). Long Island counties will grow by 250,000, (a more modest increase of 8.8% from a base of 2.9 million), with the heaviest growth in Suffolk County (+179,000) and Nassau County growing more slowly (+71,300).

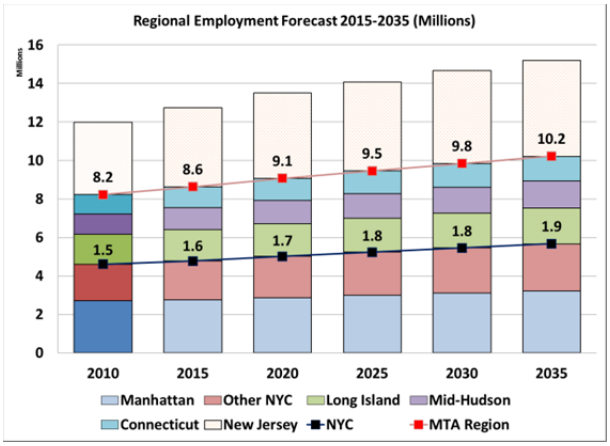
Labor Force

Regional labor force is also projected to show healthy growth, with an increase of 816,000 new potential employees (an 11% increase) by 2035. NYC labor force is projected to generate most of the regional growth, increasing by 480,000 or 12%.

One challenge facing the MTA is the projected growth of population and labor force in New Jersey, a region the MTA does not serve, but which can have a significant impact on work travel when NYC employment growth exceeds that of the City's population and labor force growth, and thus businesses seek more workers from the adjacent suburbs. The northern and central New Jersey counties are projected to experience a 13% growth rate in population and a 12.2% increase in labor force through 2035. New Jersey workers coming into the City thus have an impact on Penn Station and bus and subway lines in Midtown Manhattan.

Employment

Regional employment is also forecasted to continue to grow, increasing to an estimated 10.2 million (+20.9%), while New York City employment is projected to grow by 22% to 5.6 million. The largest growth is projected to be in the outermost counties of the region, where Suffolk County employment is projected to grow by 23.1%, while Westchester employment will increase by only 13.5%. Within NYC, employment growth is also expected to occur in outer borough "hubs." For example, a "technology triangle" is being developed in Downtown Brooklyn / DUMBO, while hospital centers in the Bronx and Queens are expected to be the focal point of a growing medical employment sector responding to the needs of the aging Baby Boomer demographic. In addition, the City is promoting future growth in the educational industry, with a new science and technology graduate school on Roosevelt Island, and an expansion of New York University in Downtown Brooklyn.



Trends in Regional Travel

The projected growth in regional and city-wide population and employment is expected to induce additional growth in both work and non-work travel, placing heavier demands on MTA's already crowded transit system. Travel patterns will become more complex. While travel to the Manhattan CBD is projected to continue to grow (increasing approximately 21%), travel to the outer boroughs for work is also expected to grow (+23%) as will work trips exclusively in the outer boroughs (+24%) and the Mid-Hudson region (+24%). There is also robust growth projected for reverse commute travel from the outer boroughs of NYC to Long Island (+22%), with projected employment growth in Suffolk County generating the heaviest travel increase (+31%). There is also expected to be continued growth outside of the traditional peak hours, and well as continued growth in off-peak (midday, evening and weekend) travel.

Environmental Challenges

The next 20 years are expected to be marked by dramatic environmental challenges and opportunities for the MTA that will be driven by both short-term weather-related events, like localized heavy downpours, and long-term climate-related impacts, longer heat waves, more frequent extreme storms, and sea level rise. Adapting to climate change will require resources over and above what would have been required in a climate-stable world. Adaptation will, equally, generate employment, economic activity and will give the region resilience that it currently lacks. Monetizing the large environmental benefit that the MTA generates through the avoidance of greenhouse gas emissions could provide some of the resources required.

As severe weather events begin to occur with a higher frequency and intensity, the MTA can no longer afford to react to individual storms and rely solely on insurance or emergency reimbursements to recover our costs. A proactive approach includes both protecting existing assets from severe weather events and ensuring that new or renovated infrastructure is designed to be resilient to future natural hazards and climate change.

Frequent and repeated storm preparations can become costly and time-consuming. Emergency shut downs result in increased operational costs, as well as business interruption costs to the MTA and economic losses to the City of New York. The MTA incurred $110 million in expenses and lost revenue from Tropical Storm Irene in August 2011 and nearly $5 billion due to Superstorm Sandy in October 2012. Advance preparations protected passengers, employees and rolling stock was

protected, but the financial impact on the region and the MTA specifically were unprecedented. The New York City subway system is nearly 110 years old, but it had never faced a disaster as devastating as this. As with Irene the year before, MTA activated its Hurricane Plan and deployed temporary protective measures throughout the system. But Sandy wreaked havoc on the entire transportation system, in every borough and county of the region. It brought down trees, ripped out power and inundated tunnels, rail yards and bus depots with corrosive sea water.

The MTA's legacy system requires substantial and continual investment to provide safe and reliable service and maintain it in a state of good repair. At the same time, the region is experiencing longer heat waves and more frequent and intense storms and flooding – events which result in significant unplanned operational and capital costs and can shorten the useful life of our assets. These changing patterns are indicative of the "new normal" and have added a new layer of complexity to defining and achieving a "state of good repair."

Climate change represents an "intervention" that will impact the economic and travel demand forecasts presented earlier. It is not yet clear how this intervention – the first ever in the NY region – will affect New York's ability to realize its potential growth.

Implications for the MTA Network

The forecasts discussed above are measures of potential growth and change, which assume that key elements of the region's infrastructure are rebuilt, regularly maintained to ensure reliability, and modernized to meet the demands of a larger and more mobile population and work force. By and large, if all planned megaprojects and systems enhancements are implemented, the existing transit network can accommodate the bulk of peak-hour, CBD-bound travel, which still constitutes a major share of MTA's travel market. However, several key subway lines will still experience capacity limitations, requiring further strategic investments at key points in the network to meet the growing passenger demand. In addition, the forecasted travel trends described above will place new demands on the MTA's ability to provide service to the region's changing markets with a network built largely for travel patterns in the early 20th Century. Given the fiscal constraints of the current economy, the MTA will need to respond with new strategies to boost capacity and accessibility, and which are more strategic in scale and location and are accomplished "within customers' commuting lifetimes."

Consequently, the investments discussed below employ six interrelated strategies:

1. Completing the remaining phases of the Second Avenue Subway, to respond to the long-established need for greater capacity and service flexibility on the East Side of Manhattan.

2. Identifying and applying strategic approaches to address existing and projected "hot-spots" and station crowding in the existing transit network by utilizing targeted system enhancements and corridor analyses to maximize customer mobility in congested corridors.

3. Addressing growing demand for non hub-based and "anytime" travel patterns through strategic investments in bus services, subway stations and infrastructure and the commuter rail network.

4. Building a "21st Century transit system" by implementing state-of-the-art technology and business methods to enhance customer convenience and enhance the ease of use of the MTA's transit resources.

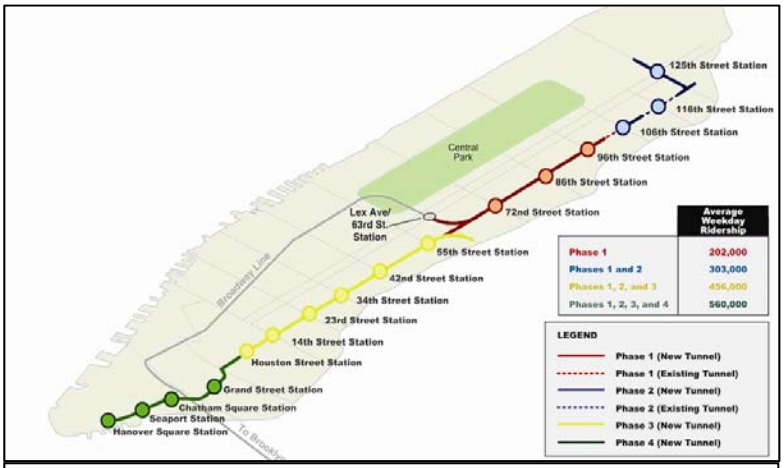
5. Rationalizing future railcar (subway and commuter rail) and bus purchases going forward to reflect revised customer demand levels and "flattening of the peak" conditions.

6. Preparing for the next catastrophic climate change "event" by hardening existing transit infrastructure and building resiliency into MTA's network

MTA's ability to meet the needs of its future ridership will depend on successfully implementing capital strategies in each of these areas.

1. Completing the Second Avenue Subway (SAS)

While Phase One of the SAS will help reduce much of the overcrowding on the Lexington Ave. Line, the maximum extent of crowding reduction will not be achieved until the full length subway line (from 125th St in Harlem to Hanover Square in Lower Manhattan) is completed.

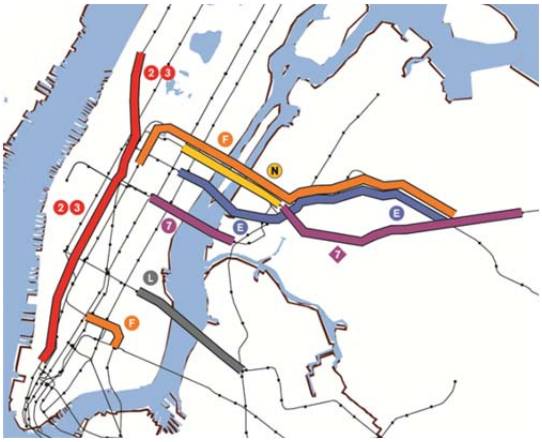


Second Avenue Subway Phasing Plan

Phase One will bring customer demand on the Lexington Ave. line down to just below peak capacity. Completion of the full-length SAS route will further reduce demand for the Lexington line to 80% available capacity. At that point, ridership on the SAS will reach 560,000 per day.

Implementation of future SAS phases will need to take into account MTA's ability to fund and plan each functional incremental stage, as well as the community growth subsequent to the completion of the project's planning phase. Most recently, medical industry growth on the Upper East Side and new residential growth in eastern Lower Manhattan are creating new trip generators that promise to grow travel even further in the Second Avenue corridor.

2. Strategic Approaches to Address Remaining "Hot Spots" and Crowding



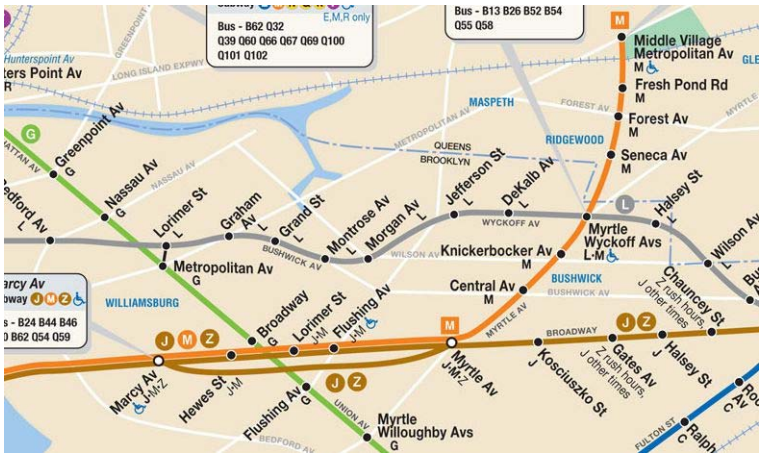
Over 75% of New York's subway lines could meet projected peak-hour CBD-bound travel needs in 2035 (assuming completion of planned Megaprojects and system improvements). However, there will still be several "hot spots" where growth in customer demand will exceed operating capacity:

Northern Queens Corridor: The northern Queens corridor encompasses the Queens Blvd. line (E F M R trains), the subway system's most congested corridor after the Lexington Ave. line, and the 7 express along Northern Blvd., which is projected to experience significant growth at its eastern end (Flushing/Main St and Willets Point stations) due to planned development. In addition, a series of recent rezoning actions by the City of New York focus future development in the Long Island City and Jamaica business centers where there is existing public transit infrastructure to reduce

the emphasis on the "auto-only" areas of the borough. However, continued growth may lead to crowding on subway lines that provide access to these business centers. Many riders may have destinations within the borough that could be better served by enhanced bus services, (see "Bus Strategies" below) augmenting capacity on clogged subway lines.

Manhattan West Side Corridor: MTA's and NYC Transit's analysis of future population and employment growth suggests that the 7th Ave.-Broadway corridor (1 2 3 lines) will require additional capacity given the heavy peak use that will continue along that corridor. The population within the 7th Ave. line commuter shed is expected to grow during the next 25 years; and the desire of residents to reach jobs and other destinations in Midtown Manhattan will result in greater ridership and congested conditions in the corridor. Some of the potential capacity of the line is restricted by capacity limits at key junctions and switching locations at the south end of the line in Brooklyn.

Northern Brooklyn Corridor: The L train through Williamsburg and Bushwick has experienced a pronounced increase in ridership. L train service has grown by over 300% since the 1970s, with artists and young professionals first moving into northern Williamsburg, and now migrating eastward to Bushwick. L train service has already been enhanced by installation of CBTC signaling along its entire route.



Lower East Side: Growth in F ridership in Downtown Brooklyn and the Lower East Side, combined with the replacement of V service by the M train (bypassing the 2nd Ave. station) has increased ridership, with limited capacity for increased service without CBTC implementation.

In identifying solutions for these choke points in the subway system the MTA needs to be cognizant of the long time horizon that "megaproject"-type solutions require. For example, the currently under-construction Second Avenue Subway took nearly 10 years to go through planning, engineering and required environmental analyses,

and will take nearly the same amount of time for construction of its first phase. This schedule makes it difficult for megaproject-sized strategies to address current or anticipated transportation needs in a timely manner. Therefore, the MTA needs to evaluate additional strategic solutions that make the greatest possible use of existing bus and subway lines to meet the evolving needs of an ever more mobile population.

In addition to regular state of good repair maintenance and regular replacement of power, signals and track, there are needed upgrades to the existing subway system to support additional system capacity. Critical among these is expansion of Communications-Based Train Control. Currently available on the L line and being installed on the 7 line, CBTC will allow more frequent train service on crowded corridors such as the Queens Blvd. line.

Maximizing the benefits of CBTC, however, may require fleet expansion to provide more frequent train service, which in turn may require more yard space for train storage and maintenance, as well as increased power generation capacity for the busier subway lines.

Other strategies which may alleviate hotspots may include:

- Corridor analysis studies to better analyze specific travel trends and identify cost- and time-effective capacity improvement efforts.
- Rebuilding critical subway junctions where lines merge and separate (such as Nostrand Junction on the 2 3 4 5 lines) to maximize train throughput and reduce delays
- Rebuilding constrained terminals stations (such as Brooklyn College/Flatbush Terminal) to address capacity choke points.
- Restructuring existing service to maximize throughput.
- Expanded Select Bus Service utilizing dedicated bus stops, off-board fare collection and limited stops to provide alternative travel routes in congested corridors.

Station Crowding

Subway Station Improvements: Just as some subway lines have hot-spots where demand exceeds the capacity of train service, some subway stations cannot accommodate the flow of a growing number of customers entering, leaving and waiting for trains. For example, ridership at the Bedford Ave. station on the L train

has grown by 80% in the last 10 years, and the platform areas can be crowded as late as 2:30 in the morning. A single stair at each end of the platform causes congestion and delays for customers boarding and alighting from increasingly crowded trains. Another key station access issue exists at 42 St.-Grand Central, where station usage is increasing as the result of growing subway and railroad ridership and changing travel patterns.

Approaches to improve station access and passenger flow could include:

- New station entry points at stations with single or limited entry
- points, or where changes in passenger flow create pressure on existing station facilities (an example of such a modification is the recently added subway entrance at Atlantic Avenue – Barclays Center, adjacent to the new Barclays Center arena)

New Station Entrance – Bleecker St.

- Restoration of former station entrances that were closed for safety or maintenance reasons when ridership dropped in the 1970s but which might accommodate growing and changing passenger flow today.
- Implementation of platform doors at key stations (where feasible and appropriate) where platform crowding creates a potential safety risk.
- The MTA has identified a series of improvements to Grand Central that will significantly improve pedestrian movement. These improvements include additional stairs between the platforms and mezzanine as well as to the street or terminal. To meet future growth in the area and the City as a whole, the MTA can build new passageways between the passenger rail areas of the Grand Central Terminal and the Lexington and Flushing subway lines. The proposed Midtown rezoning presents an opportunity for development to fund investment in the transit improvements.

Commuter Rail Station crowding: On Metro-North, overcrowding is noticeable at several stations including Fordham, White Plains and Harlem – 125th St. Metro-North

is investigating methods to better utilize the existing space at these stations to serve its customers while also working to consider future needs of possibly expanded facilities. Metro-North is currently working with the City of New York with planning efforts and improved platform access at Harlem-125th St. Station. Metro-North is also currently completing design for a project to significantly widen the outbound platform and improve access to both platforms at the Bronx Fordham Station.

3. Addressing growing demand for non hub-based travel patterns

In addition to addressing the problem of the existing congested segments of the subway system, MTA has the opportunity to craft cost-effective and timely strategies to meet the growth in non-CBD and non-peak travel patterns being forecast. Strategies that can be considered include restructuring and enhancing the bus network, and making better use of the commuter rail system to address intra-suburban and reverse commuting needs.

Subway Strategies

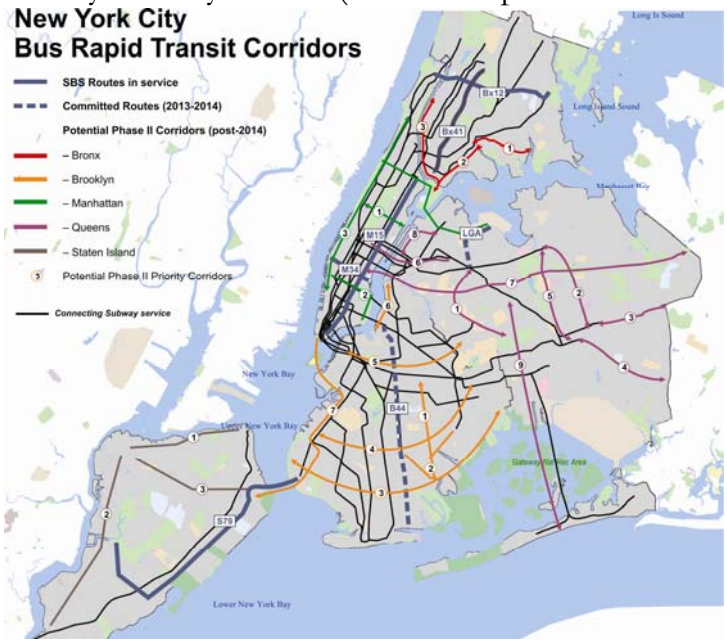
Flushing Line 10th Avenue Station: The Flushing Line, with funding support from New York City, is being extended to serve the last major redevelopment area in the Manhattan core, the far West Side. This extension from Times Square to West 34th St. at 11th Ave. uses the "best practice" approach of leveraging revenues from large land use redevelopment to fund greater transit capacity. This "value capture" approach is one of the largest ever undertaken, and will help create a thriving West Midtown district of up to 34 million square feet of new residential, commercial and retail development. Construction of this intermediate station could provide better transit access to the north edge of the Hudson Yards Development area and the growing "West Midtown" residential district.

Utilizing Available Rail Rights-of-Way: One challenge in providing for non-core based travel is the availability of travel corridors supporting radial routes linking existing subway, bus and rail lines. A possible option is the utilization of abandoned or underutilized Rights of Way such as the LIRR Bay Ridge Branch (linking southern and eastern Brooklyn with Central and northern Queens) or the abandoned Rockaway Beach Branch (linking Howard Beach and Ozone Park with Woodhaven) as transverse routes linking radial subway lines. Conversion of existing ROWs, where a solution to an identified travel need can be defined, could help reduce land acquisition and construction costs, and facilitate construction time in densely developed areas.

Bus Strategies

Many improvements put in bus service have been made in recent years. However, a significant portion of the bus route system has not kept pace with the seismic shifts in development and travel behavior, such as new business centers in areas such as Long Island City and downtown Brooklyn, and new residential neighborhoods that have emerged in the outer boroughs. The resulting changes in travel demand and trip destinations, especially within and between the outer boroughs, are not well served by the largely radial, Manhattan-oriented subway network and the bus system that feeds it. Consequently, many riders making intra-outer borough trips take a subway through Manhattan and double back to their outer borough destination, increasing travel time and adding demand to already crowded subway lines.

Local Bus Strategies: An examination of changing non-CBD travel trends and how they mesh with the existing bus network could identify new travel corridors for local bus services. New York City Transit has begun to address these new travel markets by developing new routes into previously un- or under-served markets, such as at the industrial site developed at the Brooklyn Navy Yard (which is planned to be incorporated into a new "Brooklyn technology corridor"), Spring Creek in Brooklyn and western Hunts Point in the Bronx.



Select Bus Service Expansion: Additional opportunities exist in enhancing existing bus routes to increase capacity and reduce travel times. Service on many NYC bus routes involves frequent stops and delays from slow street traffic and parking, even where designated bus lanes are available. NYCT is now in the fifth year of a campaign to address these service deficiencies with Select Bus Service routes, utilizing limited-stop service, multi-door articulated vehicles, off-board fare collection, enforced travel lanes and signal prioritization at key intersections. Existing SBS routes have saved as much as 20% of

previously scheduled travel times. MTA and the NYCDOT have developed a "Phase II" plan of identified corridors where SBS service on local street or in dedicated busways could supplement the reach of the subway network with rapid transit options. An expanded Select Bus Service network could provide redundancies to the transit network by offering perpendicular links between multiple subway lines and outer borough business hubs, to address the needs of non-CBD and inter-borough tripmakers. Continued City support and investments in needed physical improvements to streets to support SBS is critical to the continued growth and success of the program.

Exclusive Busways: In Staten Island, the Governor's 2100 Commission on resiliency for potential future flood events has identified development of Bus Rapid Transit operating on a dedicated busway on the right-of-way of the abandoned north shore rail line as a strategy to boost the resiliency of the Staten Island bus network. This bus corridor, built with multiple entry/exit points will allow the Borough's population, which is heavily dependent on express bus services to Manhattan for commuting, to access ferry service to Lower Manhattan, providing valuable travel route redundancy in the event of highway congestion or tunnel closings due to coastal flooding, electrical blackout or other emergency conditions. Construction of the busway, requiring shore line stabilization and raising of the right-of-way, will also provide a barrier against potential flooding in the Kill Van Kull. With post-Sandy travel times to and from Staten Island approaching three hours, this transit resiliency is essential.

New Bus Features: As fleet purchases are advanced, more consideration should be given as to how buses should be designed to both meet the needs of existing customers and provide a more attractive travel mode for those who see bus service as slow, uncomfortable and unreliable. MTA has and is introducing new bus features, like low floors and on board audio-visual displays, but more can be done, including larger entry/exit doors, onboard stopping maps (similar to those on subway trains) and announcements of upcoming stops, and interiors designed to mimic railcars, in order to make buses more appealing to a rail-oriented Millennial ridership.

Commuter Rail Strategies

Additional Rail Capacity: In order to maximize the utilization of the LIRR's East Side Access connection, as well as to expand capacity for peak hour reverse commute service to Long Island, a further phase of infrastructure enhancements is necessary. These include completion of additional tracks within the LIRR right-of-way, such as a

second track from Farmingdale to Ronkonkoma and completion of Jamaica Capacity Improvements, including universal 12-car platforms, new higher speed switches, track reconfiguration and signal modernization. Also included are new power substations in Queens, additional track capacity to support reverse commute service on the LIRR Main Line, and expanded yard capacity on Suffolk County's Huntington/Port Jefferson and Montauk Branches. Undertaking these infrastructure investments would enable LIRR to run additional trains in both peak and reverse-peak directions at strategic points in the network to better address new travel demand in the peak period and intermediate markets.

On Metro-North, additional capacity is needed on the West of Hudson lines to serve some of the fastest growing counties in the MTA region. Strategies to be considered include additional track and yard facilities on the Port Jervis line.

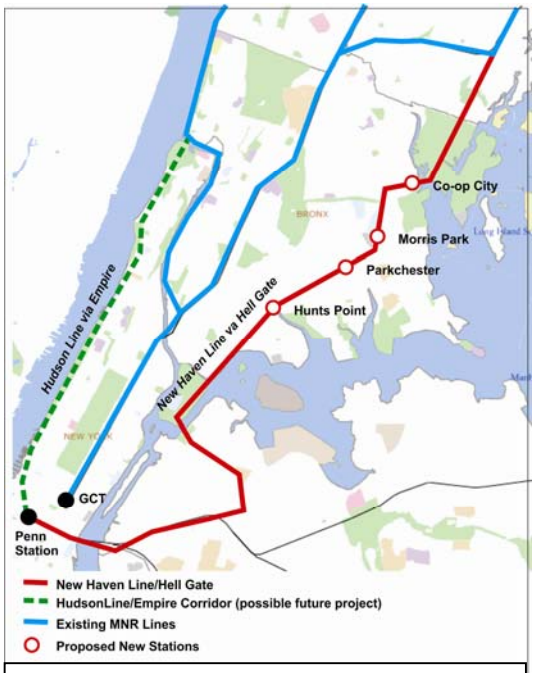
New Access to Suburban Employment Centers: Meeting the demands of reverse commute customers depends both on accessibility of transit from residential locations and connectivity to suburban job sites or employment-based transportation links. In conjunction with rezoning, the area around the LIRR's former Republic train station is expected to see significant new development and economic activity. Along with continuing development of office/commercial space in the nearby Route 110 corridor, this could create prime conditions for the LIRR to construct a new Republic Hub station, following the completion of the double track from Farmingdale to Ronkonkoma. This strategically located Republic Hub would facilitate access to the NYC-based labor force for new businesses setting up in the area.

Enhancing Service in Diesel Territory: In order to maximize the utility of new LIRR rail service to GCT associated with East Side Access, train slots on the Main Line should be targeted to serve the busiest lines and stations. In diesel territory, "scoot" services, utilizing new diesel-powered train equipment, can operate between interchange/transfer points with the electrified lines and local stations on the more lightly-used branch lines. This would enable enhanced service availability and would better address service demand within diesel territory. The Oyster Bay Branch and service between Ronkonkoma and Greenport are two areas where this type of service could be beneficial.

Developing a Regional Rail Network: The commuter rail system in the New York City area has been plagued by two long-standing problems: limited Manhattan destination choices and constrained CBD terminal capacity. In addition, demand on large portions of the rail system has been growing. Metro-North has overtaken LIRR as the nation's largest commuter railroad, and ridership on service provided by New Jersey Transit and Amtrak are at record levels, increasing the pressure on an already constrained regional rail system. As a result, by 2030, peak capacity on the regional rail network will be strained by growth already underway. Left unaddressed, this obstacle could stifle economic growth. The MTA in cooperation with the New York City area's other commuter and long-haul railroads, are investigating several possible short- and medium-term initiatives to both expand destination choices and increase capacity. These initiatives include: implementing Penn Station Access for Metro-North's New Haven Line; developing a strategy for thru-running of trains between different rail networks; and improving the functionality and capacity of Penn Station.

Modern Diesel Multiple Unit Vehicle

<u>Penn Station Access (PSA)</u>: MNR Access to Penn Station (would extend the reach of Metro-North's commuter shed and enhance Metro-North's CBD terminal capacity similar to LIRR's Access to GCT. The PSA project, currently in development, would provide regular MNR service between the New Haven Line and Penn Station via Amtrak's Hell Gate Line and add four new stations in the Bronx. A future phase could add a new link via the Amtrak Empire line for Hudson Line trains and



Metro-North Penn Station Access

provide potential new intermediate Manhattan west side stations. The new service would provide critical resiliency to the MNR network which today relies on a single link to Manhattan, the Harlem River Lift Bridge. MNR access to Penn Station would decrease travel times for Metro-North customers traveling to the West Midtown Manhattan area by up to 21 minutes and provide greater mobility to residents and employees of underserved communities in eastern Bronx.

Thru-Running: Completion of a Metro-North link to Penn Station would also facilitate shorter term operating strategies to enhance commuter rail capacity and optimize train movements and storage through the congested Penn Station. Today, arriving LIRR trains either have to quickly "reverse move" out the way they came into the station, or lay up in a storage yard with limited capacity for growth, while NJ Transit trains terminate at a handful of stub-end tracks or take up limited tunnel space under the East River en-route to Sunnyside Yard in Queens. Thru running agreements and compatible rolling stock would enable LIRR, MNR and New Jersey Transit trains to pass through Penn Station and continue in service on another rail system's tracks, thus providing additional capacity and congestion relief. It also promises to improve reliability and enable the region's employers to tap into new and more distant labor force pools using a more extensive rail system that spans three states. A pilot service linking the New Haven line through Penn and the Northeast Corridor to the NJT network and the Meadowlands Sports Complex is underway, provided in the Fall of each year.

Maximizing the opportunities presented by thru-running will call for addressing the variations in power systems (e.g. overhead catenary and different formats of third rail) used by the region's separate rail systems. Future plans for rolling stock purchases should take into account design needs for possible future regional rail operations.

Penn Station Enhancements: Even with completion of the LIRR East Side Access link to Grand Central, Penn Station will continue to be the primary destination hub for LIRR customers with 75,000 arrivals during the AM peak period. The current station complex, shared with Amtrak and New Jersey Transit, and potentially with Metro-North in the future, is a cramped maze of passageways and links to the street and connecting subway lines.

MTA railroads, in cooperation with Amtrak and New Jersey Transit, have embarked on a landmark study of transforming Penn Station into a world-class rail facility with improved functionality, customer amenities and convenience. By 2035, the railroads foresee a revised station design that is passenger-friendly, easy to traverse, iconic in appearance, and meets the future needs of the region for additional passenger capacity while accommodating the influx of new visitors, employees, and residents to midtown Manhattan. The goal of this effort is to develop a master plan for improvements and provide a clear, predictable and systematic process and schedule to transform the Penn Station through a set of interim, medium, and longer term enhancements to implement the 2035 Vision. This incremental approach will ultimately serve as building blocks to create a renewed, world-class Penn Station complex.

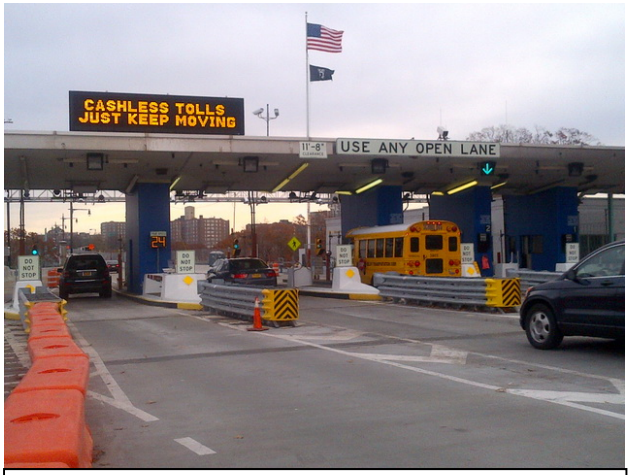
4. Implementing a "21st Century Transit System"

The MTA must continue to focus on fully achieving the promise of modern technology solutions for the MTA network – signal and track capacity improvements, new methods of communicating with customers and innovative fare payment and access networks. The ability to provide real time information to customers about best routes, introduce faster and more convenient ways to pay fares and tolls and promote more effective use of available network capacity all require world class technological innovations. The MTA must now deliver these innovations to be able to respond to the growing demand to use its network, particularly the "Millennials" who represent a transit-friendly generation not seen in the NY region in many decades.

MTA Smart Card Pilot Test

New Fare and Toll Payment Technology: The current "MetroCard" fare payment infrastructure (mag-strip cards, turnstiles, fare vending equipment),

which was designed in the 1980s and introduced in the early 1990s, continues to age and will reach the end of its useful life in the near future. MTA has an opportunity to migrate to more advanced fare and toll collection and payment systems across the MTA family. NYC Transit has completed two pilot tests utilizing contactless "smart chip" payment systems, such as chip-enabled standard bank and credit cards, pre-paid transit payment cards, key-tags and smart phones. This new approach will result in many benefits to the MTA, including increasing bus speeds by shortening the boarding process, reducing labor and cash handling expenses, supporting inter-modal fare payments options and improving customer service through simplified and expanded fare payment options. MTA's commuter railroads are working together on the procurement of a mobile ticketing systems that will allow customers to use a mobile app to purchase tickets for visual display to the conductor on the mobile device's screen.



Henry Hudson Bridge AET Pilot Test

The most potentially far-reaching B&T initiative is the pilot project at the Henry Hudson Bridge to test all electronic toll (AET) collection. In the first phase (implemented in January 2011) toll gates at the bridge were removed, enabling peak hour throughput to increase from approximately 800 to 1,000 vehicles per hour. For customers without an E-ZPass tag, an image is taken of their license plate and the registered driver receives a bill in the mail. ("Tolls By Mail" transactions.) The purpose of the pilot is to test both the new technologies required to collect video images from passing vehicles and the back-office systems to collect tolls from registered owners of vehicles without an E-ZPass tag. The pilot will also help determine the operational and financial issues in a cashless environment. The data collected from this pilot will be used to evaluate and guide future toll collection and toll plaza reconstruction plans.

"Real-time" Train Information: The rollout of countdown clocks on the 1 2 3 4 5 6 and L lines, showing the arrival and destination of subway trains in real time, has been a broadly-held success. NYCT is now rebuilding the signal system on the 7 line to support both CBTC and train status reporting, and is planning to upgrade technology on the lettered lines to bring real-time train information to all subway customers.

State of the Art Rolling Stock: As the MTA continues to purchase new buses and subway and commuter rail fleets, it must incorporate state-of-the-art design concepts and technologies to minimize energy consumption, maximize carrying capacity, reduce loading times, and meet the expectation of a tech-savvy generation of new travelers. In particular, consideration should be given to:

- Trainsets with open gangways between cars, similar to the design of articulated buses. This will both maximize carrying capacity, and allow passenger to move to less-crowded areas of the train, balancing loading and unloading times at all doors.

- Buses with more "train-like" features (including wider, more numerous bus doors to facilitate loading/unloading, and onboard "next stop" and route information.

- New diesel fleet railcars designed for "scoot" service along non-electrified branch line services.

- Vehicles with features to minimize energy consumption, such as reduced weight.

Bus "Next Stop" Display (Seattle)

Open-Gangway subway train

5. Rationalizing Future Bus and Railcar fleet procurements

Subway and commuter rail fleet and bus needs have traditionally been calculated based on the MTA's need to move customers during the "peak of the peak," and fleet sizes have grown as ridership has. With new ridership trends showing a "flattening" of peak ridership as more travel occurs during all hours of the day and evening, the maximum peak hour need for bus and rail vehicles may change. Future vehicle orders

should be sized to reflect the projected changes in peak demand as well as new demand in the off-peak over the vehicles' expected lifespans.

6. Promoting Environmental Resiliency

Climate change is perhaps the most significant "intervention" to affect the region's prosperity potential since World War Two. MTA's goal is to maintain a transportation system that is resilient to future natural hazards and the impacts of possible climate change. This can be achieved by integrating climate change considerations into the design, implementation, monitoring and evaluation of policies and programs at all levels of the MTA. An MTA Climate Adaptation Task Force, with representatives from all parts of the MTA and outside experts to advise on climate science, is becoming a fundamental element of capital planning and risk management processes. A coordinated and integrated climate adaptation effort aligns with multiple MTA program areas and can provide additional benefits to the units responsible for capital planning, emergency preparedness and response, state of good repair, asset management and risk management.

Steps to mainstream adaptation planning should include:

- Compiling agency-wide vulnerability assessments of MTA physical assets and operations followed by an engineering-based feasibility assessment of risk reduction measures.
- Integrating adaptation plans into the fiscal planning process including preparation of capital spending plans.

A coordinated strategy that considers these new environmental challenges can provide a decision support tool for future capital investments.

<u>Smart Growth</u>

Smart Growth, generally defined as a way to prevent or mitigate the unnecessary costs of sprawl development, is an important goal for New York State. Consistent with New York's 2010 Smart Growth Public Infrastructure Policy Act, MTA supports Smart Growth investments by improving public transportation and reducing automobile dependency, especially in and around municipal centers. MTA has incorporated smart growth consideration into its capital planning process; capital

work emphasizes improvement of existing infrastructure, often in coordination with local governments and community groups. As an example, LIRR is working to promote "Wyandanch Rising," an effort to encourage development around the Wyandanch Station on the railroad's Ronkonkoma Branch and that includes a parking structure at the station. Similarly, MTA is establishing a partnership and package of incentives with New York State to support TOD development throughout the MTA service area. As capital plans are developed and services designed, MTA will support Smart Growth where practical.

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Conclusion

Protecting and enhancing this region's remarkable transportation legacy depends on an ongoing commitment to rebuild its infrastructure with its thousands of visible and invisible components and to expand or enhance the system to meet the future growth needs of the region. The investment needed to accomplish this task includes addressing backlogged state of good repair, ongoing rehabilitation and replacement and future system growth needs. While this investment is massive, its importance is one that has long been recognized by the federal, state and local funding partners in their ongoing choice to invest in public transportation, beginning with the MTA's first five-year capital plan in 1982. And there is a heightened recognition at the Federal Transit Administration and among regional funding partners on the need to address the backlogged state of good repair of transit systems so critical to the economic wellbeing of the nation. As solutions for this need are sought, one thing is certain: this region will continue to invest in its transportation system. It is this commitment that brought the MTA back from the brink of collapse; the continuation of this commitment promises to ensure a well-run system that secures the economic health of the region for generations to come

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MTA
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