FOCUS 40

The 2040 Investment Plan for the MBTA

STATE OF THE SYSTEM REPORT: RAPID TRANSIT

December 2015

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ABOUT THE STATE OF THE SYSTEM

These State of the System reports lay the foundation for the development of *Focus40*, a financially responsible 25-year capital plan for the MBTA, to be released in 2016. Planning for the future requires a clear understanding of the present. These reports describe that present: the condition, use, and performance of the MBTA bus, rapid transit, commuter rail, ferry, and paratransit systems. In addition, these reports describe how asset condition and age influence service performance and customer experience.

The next phase of *Focus40* will consider how a range of factors – including technological innovation, demographic shifts, and climate change – will require the MBTA to operate differently in 2040 than it does today. With the benefit of the information provided in these State of the Systems reports, the *Focus40* team will work with the general public and transportation stakeholders to develop and evaluate various strategies for investing in and improving the MBTA system in order to prepare it for the future.

SUMMARY OF THE STATE OF THE SYSTEM: RAPID TRANSIT

Carrying 60 percent of total MBTA ridership, the rapid transit system plays a critical role as the region's primary mover of people into Boston's central business district. However, the aging system and its infrastructure are not able to fully meet the current, let alone future, needs of its customers for reliability, efficiency, and carrying capacity.

RAPID TRANSIT OVERVIEW

Rapid transit service is the MBTA's high-capacity backbone, connecting downtown Boston with the rest of the urban core.

OVERVIEW OF MBTA RAPID TRANSIT SYSTEM

The MBTA's rapid transit system operates high-frequency service in densely populated urban and suburban areas of the Boston region.

For purposes of this report, the term 'rapid transit' comprises the MBTA's heavy rail system (Red, Orange, and Blue Lines), the entire Green Line, and the Mattapan high-speed trolley service. The rapid transit mode provides the most passenger trips and accounts for the most passenger miles of all MBTA modes; it also generates the most fare revenue.

MBTA Annual Metrics by Mode - 2013

	Operating Expenses (%)	Fare Revenues (%)	Passenger Miles (%)	Passenger Trips (%)
Bus	29.8	17.8	15.4	29.8
Commuter Rail	26.4	29.9	40.4	8.9
Rapid Transit	**35.1**	**49.9**	**42.8**	**60.4**
Ferry	0.8	1.1	0.6	0.3
Paratransit	7.9	1.3	0.8	0.5

Source: 2013 NTD Transit Profile

RAPID TRANSIT DEFINITIONS

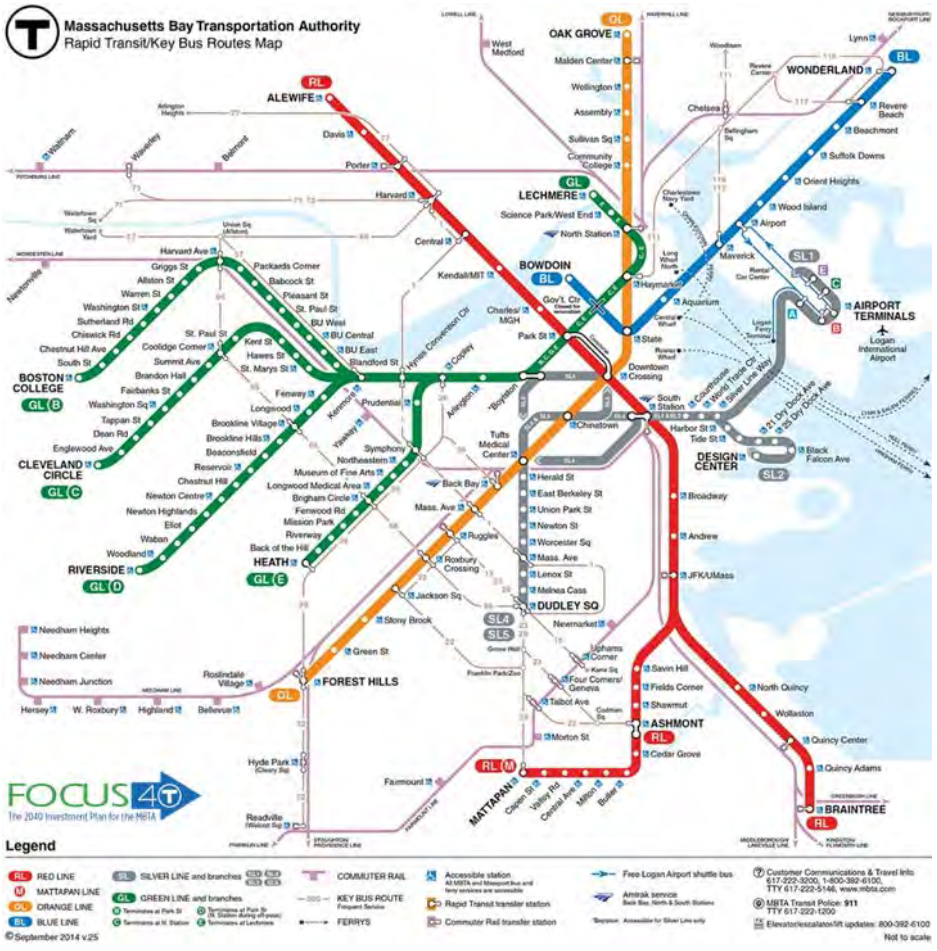
- **Rapid Transit:** Steel-wheeled vehicles operating on a fixed guideway consisting of track (rail, ties, ballast and traction power). Two types of rapid transit service exist within the MBTA system:
  - **Heavy Rail:** Rapid transit service that operates in a dedicated right of way (ROW) with surface and subway stations that have platforms approximately four feet above rail to provide level boarding onto the train, with fare payment occurring at fare gates, not on the vehicle.
  - **Light Rail:** Green Line and Mattapan service that operate in a variety of conditions – as rapid transit with an exclusive ROW and pre-paid boarding, with an exclusive ROW and on-board fare collection, with a semi-exclusive ROW featuring at-grade intersections with vehicular traffic and on-board fare collection, and without any dedicated ROW.

- **Accessible:** Rapid transit stations that are generally accessible in accordance with most MBTA, Massachusetts Architectural Access Board, United States Department of Transportation, Federal Transit Administration, and Building Code requirements. 89 rapid transit stations are accessible.

- **Non-accessible:** Non-accessible: rapid transit stations that do not have an accessible means of entering or exiting the station and vehicle. 38 rapid transit stations are non-accessible.

- **Traction Power:** Power required to move trains along the ROW. This power is provided by either third rail (an additional rail that runs parallel to the running rail on which the train travels) or an overhead catenary system (a system of poles and wires along the ROW providing power from above). The Green Line and Mattapan Trolley are all overhead catenary; Red and Orange lines are all third rail, while the Blue Line is a mix of catenary and third rail.

SERVICE MAP



Rapid transit service consists of five lines, 127 stations, and 64 route miles across 11 cities and towns.

- **Blue Line –** Heavy rail between Bowdoin and Wonderland
- **Green Line –** Light rail between Lechmere and BC/Cleveland Circle/Riverside/Heath
- **Orange Line –** Heavy rail between Forest Hills and Oak Grove
- **Red Line –** Heavy rail between Alewife and Ashmont/Braintree
- **Mattapan Trolley –** Light rail between Ashmont and Mattapan

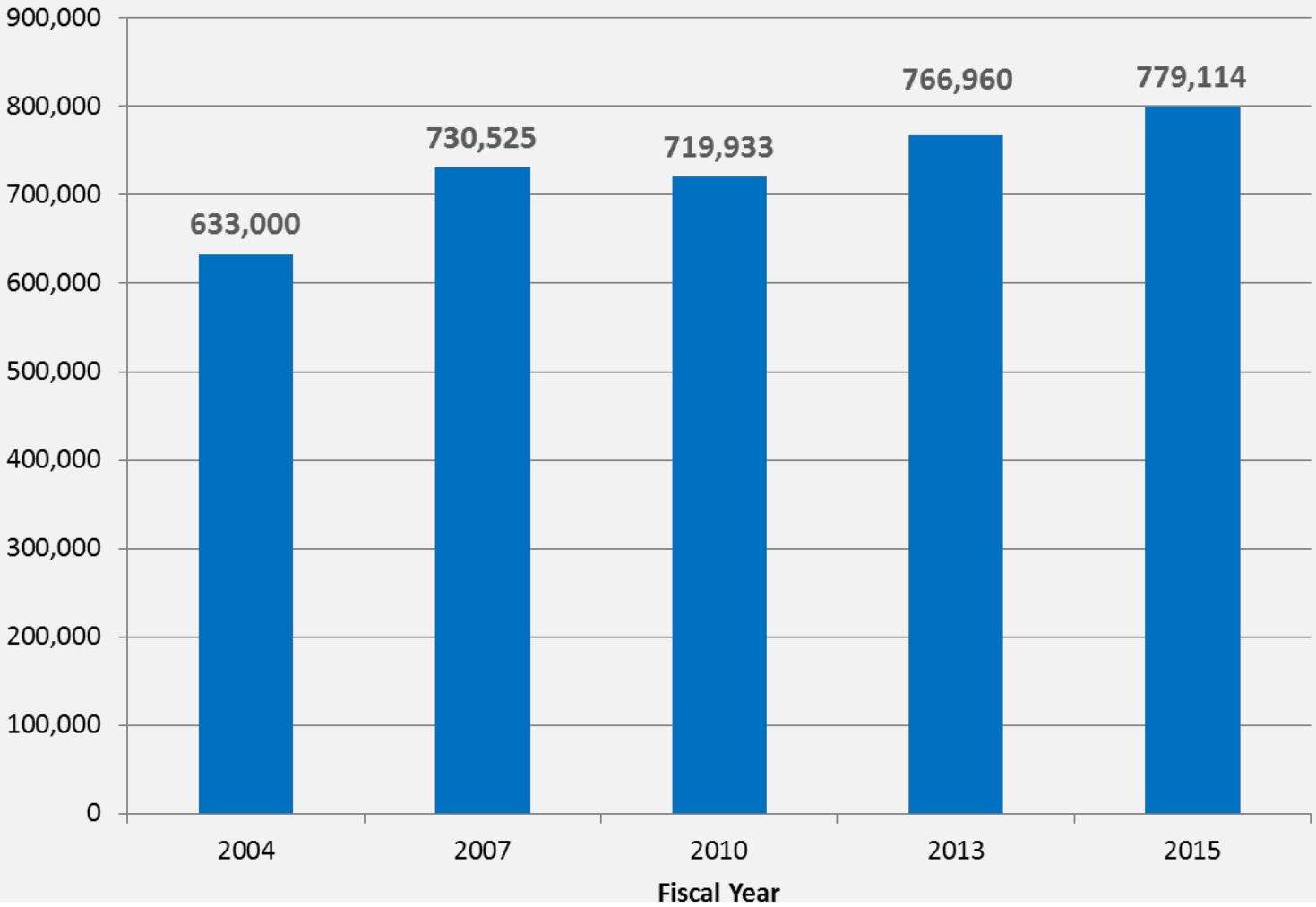
SERVICE AND RIDERSHIP

Line	# of Stations	Route Miles*	Fleet Size	WEEKDAY RIDERSHIP FY 15
Blue	12	6	94	66,265
Green	66	23	209	219,741
Orange	19	11	120	209,057
Red	22	21	218	280,851
Mattapan Trolley	8	3	10	3,200
TOTAL	**127**	**64**	**651**	**779,114**

* Route miles are one-way, non-duplicative

AVERAGE WEEKDAY RIDERSHIP ON RAPID TRANSIT

(total number of boardings, inbound and outbound)

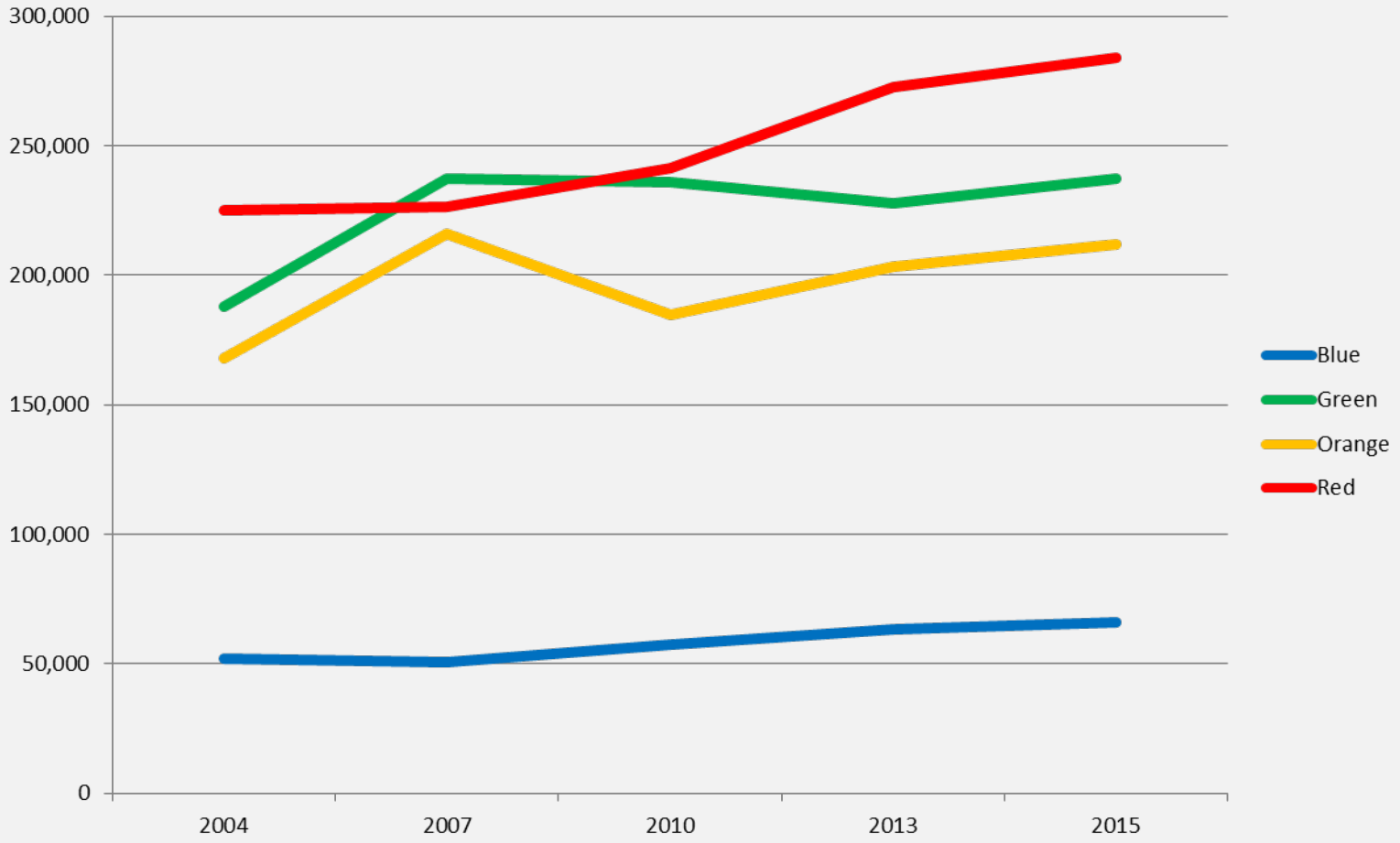


With the exception of the 2008-09 recession, ridership has been growing steadily.

Source: MBTA 2014 Blue Book

Prior to the Automated Fare Collection system coming on line in 2007, ridership counts were conducted using manual methods which may explain the size of the increase between 2004 and 2007

AVERAGE WEEKDAY RIDERSHIP BY LINE



With the exception of the 2008-09 recession, ridership has been growing steadily on all lines.

Source: MBTA 2014 Blue Book

HIGHEST WEEKDAY STATION ENTRIES

Blue Line	Ridership
Maverick	10,106
Airport	7,429
Wonderland	6,105
State	4,993
Aquarium	4,776

Green Line*	Ridership
Copley	14,021
Kenmore	9,503
Hynes	8,946
Arlington	8,519
Park Street	8,119

Orange Line	Ridership
Back Bay	18,100
Forest Hills	15,150
Malden	12,686
North Station	10,831
Downtown Crossing	10,588

Red Line	Ridership
South Station	23,703
Harvard	23,199
Central	16,525
Kendall/MIT	15,433
Davis	12,857

Source: 2013 data from MBTA 2014 Blue Book

* Green Line Station entries only include subway stations with automatic fare collection; they do not take into account Green line boardings at surface stations.

HIGHEST AND LOWEST RIDERSHIP SURFACE LIGHT RAIL/TROLLEY STATIONS

Station (Line)	Ridership
Longwood M.A. (E)	3,813
Harvard Ave (B)	3,602
Fenway (D)	3,488
Coolidge Corner (C)	3,440
Reservoir (D)	3,404
Brookline Vil. (D)	3,230
Longwood (D)	2,719
Packard's Corner (B)	2,654
Northeastern (E)	2,650
Brigham Cir (E)	2,547

Station (Line)	Ridership
Back of the Hill (E)	35
Valley Road (M)*	42
Capen Street (M)	57
Cedar Grove (M)	81
Butler Street (M)	137
Milton (M)	206
South Street (B)	214
Fenwood Road (E)	221
Central Ave (M)	329
Hawes Street (C)	339

As a comparison, only 200 MBTA bus stops have more than 350 boardings per day.

Source: 2013 data from MBTA 2014 Blue Book

* (M) = Mattapan Trolley

RIDERSHIP DEMOGRAPHICS

Of all MBTA modes, rapid transit ridership demographics most closely reflect those of the region.

	Minority	Low-income
RAPID TRANSIT	**27.5%**	**24.1%**
Bus	46.5%	41.5%
Commuter Rail	13.9%	7.2%
Ferry	5.7%	4.5%
Total	33.0%	28.5%

Source: 2008-2009 MBTA Systemwide Passenger Survey (the MBTA is currently updating its systemwide survey)

RAPID TRANSIT FARES AND PARKING FEES

Get a CharlieCard and Save!
Then upgrade your CharlieCard with MyCharlie

CharlieCard	**$2.10** FREE transfer to Local Bus DISCOUNTED transfer to Express Bus One Transfer valid within two hours of paying your fare.
CharlieTicket/ Cash-on-board	**$2.65**
Monthly LinkPass	**$75**/month Valid on Subway plus Local Bus.
Day/Week LinkPass	**$12.00** for 1 day **$19.00** for 7 days Valid on Subway, Local Bus, Commuter Rail Zone 1A, and Inner-Harbor Ferry and only if purchased on a CharlieTicket.
Seniors and Persons with Disabilities (Blind persons ride for free)	**$1.05**/ride **$29**/month Valid on Local Bus and Subway. Requires a Senior/TAP ID or Blind Access Card.
Students (Junior High and High School)	**$1.05**/ride **$26**/month for 7-day validity **$26**/month for 5-day (Monday-Friday) only Valid on Bus, Subway, Express Bus, and Commuter Rail Zones 1, 1A, and 2. Requires Student ID Badge.
Children 11 years old and under	**Free** Children under the age of twelve ride free when accompanied by an adult, with a limit of two children for each adult.

The MBTA offers a variety of discounted fares.

Parking Payment:

- Most rapid transit lots have cashiers; garages have pay stations.
- Unattended lots transitioned from an honor box payment system to PayByPhone in June 2015.
- Garage rates are $4-$7, while some increase to $14 after 14 hours of parking.
- Garages accept cash or credit at pay stations.
- Attendant lots accept cash, while some also accept credit.

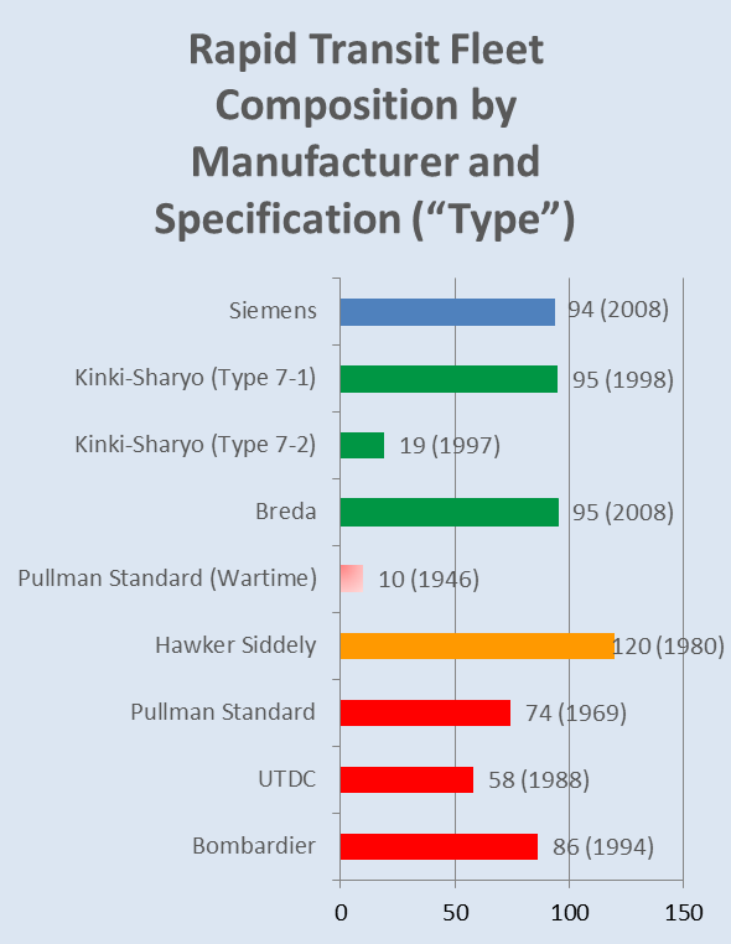
RAPID TRANSIT ASSETS

More than 650 rail cars serving 127 stations are the most visible rapid transit assets.

RAPID TRANSIT FLEET

Service is provided using a fleet of 651 vehicles, consisting of heavy rail, trolley, and light rail vehicles.

- The fleet is a mix of rail vehicles from a wide array of manufacturers, with different specifications for different lines and uses.
- 55% of Green Line fleet (all Type 7 cars) and 100% of Mattapan fleet do not meet accessibility requirements.
- Green Line fleet consists of 195 functional vehicles; another 14 on property are not in operational condition.



* Green Line fleet consists of 195 functional vehicles; other 14 are on property but not in operational condition. Qty of each fleet is shown in above table (year of manufacturer provided in parenthesis)

RAPID TRANSIT STATIONS

The MBTA rapid transit system includes 127 stations:

- 34 are underground (subway) stations
- 32 are above-grade heavy rail stations
- 61 are surface Green Line or Mattapan light rail stations
- 31 stations include infrastructure for bus transfers
- 10 stations provide a connection to commuter rail

MBTA stations include circulation and accessibility elements:

- 70% are accessible
- 161 escalators
- 133 elevators

MBTA Rapid Transit Stations	
Rapid Transit Line	**# Stations**
Blue Line	12
Green Line (surface and subway)	66
Orange Line	19
Red Line	22
Mattapan	8
Total	**127**

RAPID TRANSIT FARE COLLECTION

Asset	Quantity
Fare Vending Machines	453
Gates	611
Transfer Machine and Validators*	30
Total Fare Equipment at Stations	**1,094**

All Blue, Orange and Red and Green Line subway stations have fare collection equipment consisting of gates and fare-vending machines.

61 Green Line Surface and Mattapan Trolley Stations have only on-board fare collection. This results in some of the same delays experienced on buses due to customers paying as they board.

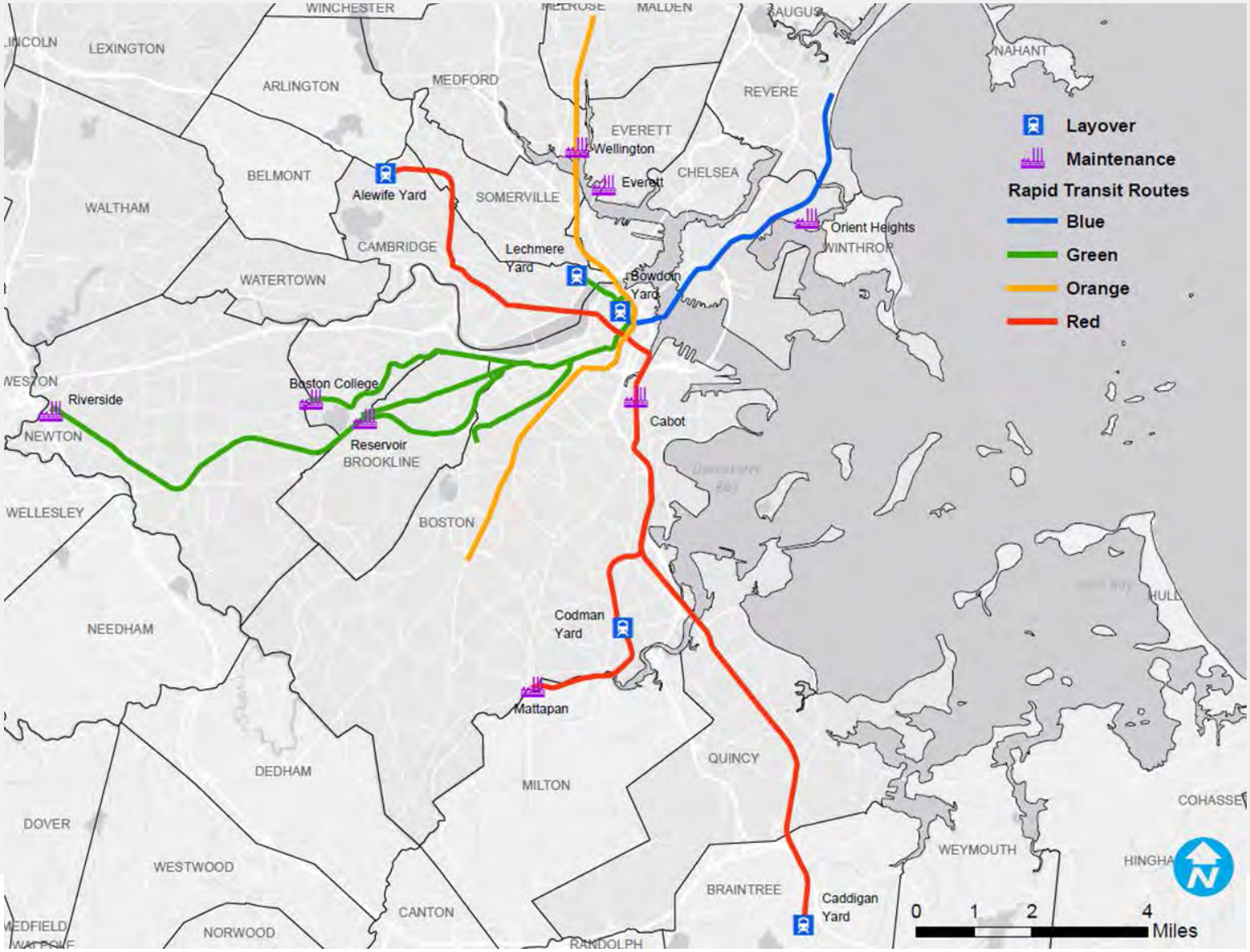
*One Transfer Machine at Ashmont Station to provide riders with free transfer to Mattapan Trolley when exiting Ashmont Station. Validators are utilized on the Green Line surface stations for customers with a CharlieCard to board the train more quickly.

RAPID TRANSIT FACILITIES

Besides stations, the MBTA has a variety of facilities throughout the rapid transit system, including:

- 8 maintenance facilities
  - Main function is daily heavy maintenance and repair of rapid transit vehicles; cleaning and washing; painting; maintenance employee locker facilities
- 5 layover facilities
  - Main function is vehicle storage and light maintenance.
- 46 traction power substations
  - Buildings house sensitive traction power equipment to provide power to the ROW for operation of vehicles.
- 62 signal bungalows along the ROW
  - Typically pre-fabricated buildings along the right-of-way that house signal control panels and equipment

MAINTENANCE AND LAYOVER FACILITIES



Source: Layover Facility Alternatives Analysis

RAPID TRANSIT TUNNELS

The MBTA system has more than 19 miles of tunnels:

- Light rail system contains 5 miles of tunnels.
- Heavy rail system contains 14 miles of tunnels.
- 16 culverts are located throughout the rapid transit system to convey storm water or bodies of water under the track and ROW.

The Blue Line tunnel from Aquarium to Maverick was the first underwater transit tunnel built in America and the Park Street to Boylston section of the Green Line is the oldest subway in the nation.

RAPID TRANSIT BRIDGES

The MBTA owns and maintains 157 bridges within the rapid transit system:

- 74 highway bridges
  - Private vehicles traveling over MBTA tracks or right-of-way
- 58 transit bridges
  - MBTA vehicles traveling over waterways or roadways
  - Elevated viaduct structures (Red Line, Mattapan Trolley loop at Ashmont)
- 25 pedestrian bridges
  - Pedestrian walkways over MBTA tracks, ROW, or other roadways
  - Wonderland pedestrian bridge to Revere Beach Boulevard

MBTA Rapid Transit Bridges	
Rapid Transit Line	**# Bridges**
Blue Line	15
Green Line	32
Orange Line	37
Red Line	72
Mattapan	1
Total	**157**

TRACK AND TRACTION POWER

Rapid Transit Line	Track Mileage	Traction Power Asset
Blue Line	12	Overhead Catenary and Third Rail
Green Line	46	Overhead Catenary
Orange Line	22	Third Rail
Red Line	45	Third Rail
Mattapan	6	Overhead Catenary
Total	**131**	**Total**

Rail on rapid transit system can be expected to last up to 40 years but lifespan varies widely due to wear, curvature, location and other factors.

RAPID TRANSIT SIGNALS

The MBTA has a total of 1,907 signal-related assets throughout the rapid transit system.

- The signal system's primary responsibility is to control trains for safe and efficient operation by maintaining proper train separation and minimizing headways and run times.
- The balance of signal-related assets consists of switch heaters, bonds, train stops, signal masts, etc.

RAPID TRANSIT PARKING

A significant amount of infrastructure is associated with parking at rapid transit stations:

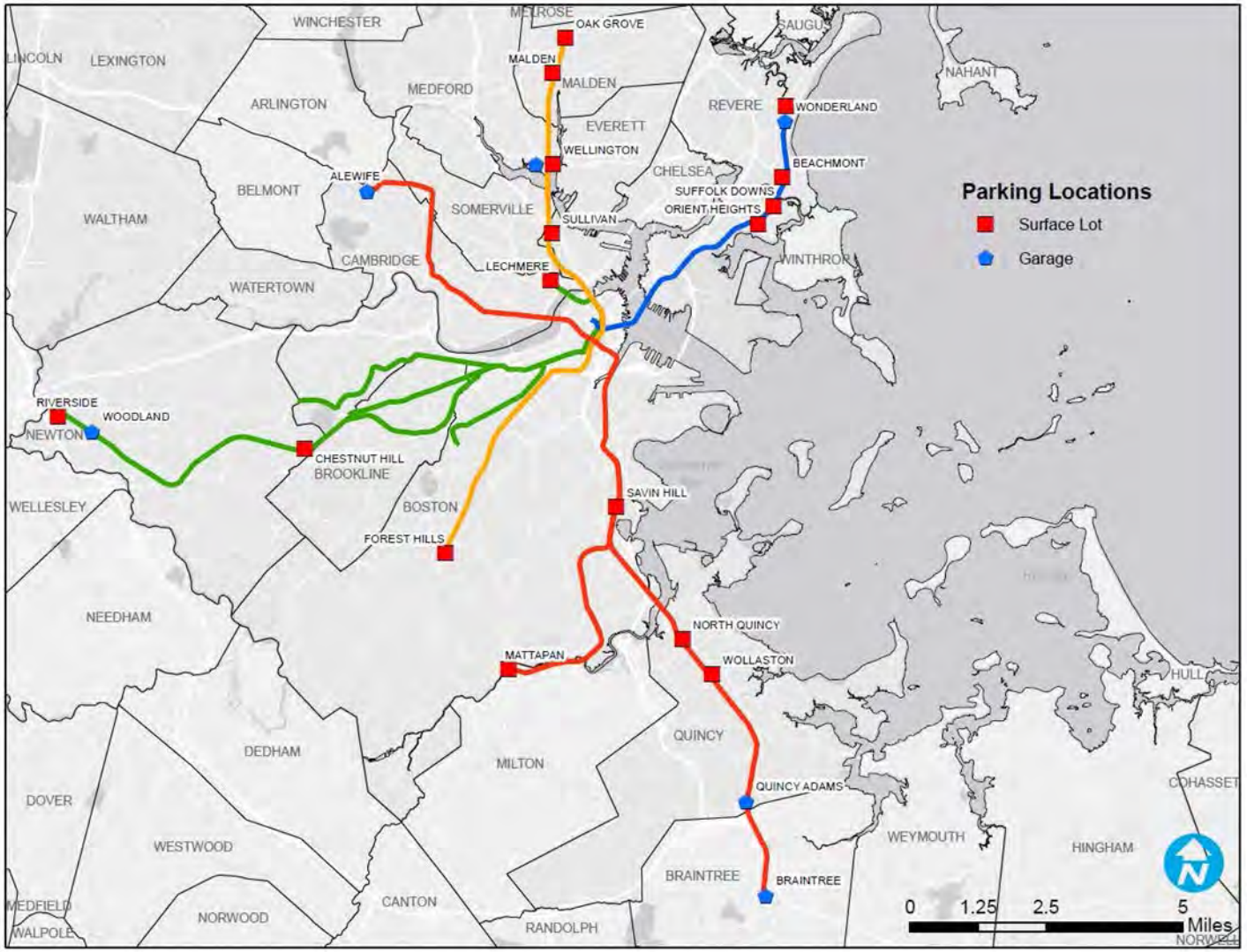
- 16,000 parking spaces in surface lots and garages
- 15 surface lots and six active* parking garages
- Parking is less common closer to the core of the system as station access is primarily by bus or on foot from densely populated adjacent neighborhoods and land is more expensive and less available.

Parking Garages:

- ✓ Alewife
- ✓ Braintree
- ✓ Quincy Adams*
- ✓ Wellington
- ✓ Wonderland
- ✓ Woodland

*Quincy Center Garage is currently closed due to significant structural deterioration, which makes it unsafe for vehicles to occupy the garage.

RAPID TRANSIT PARKING



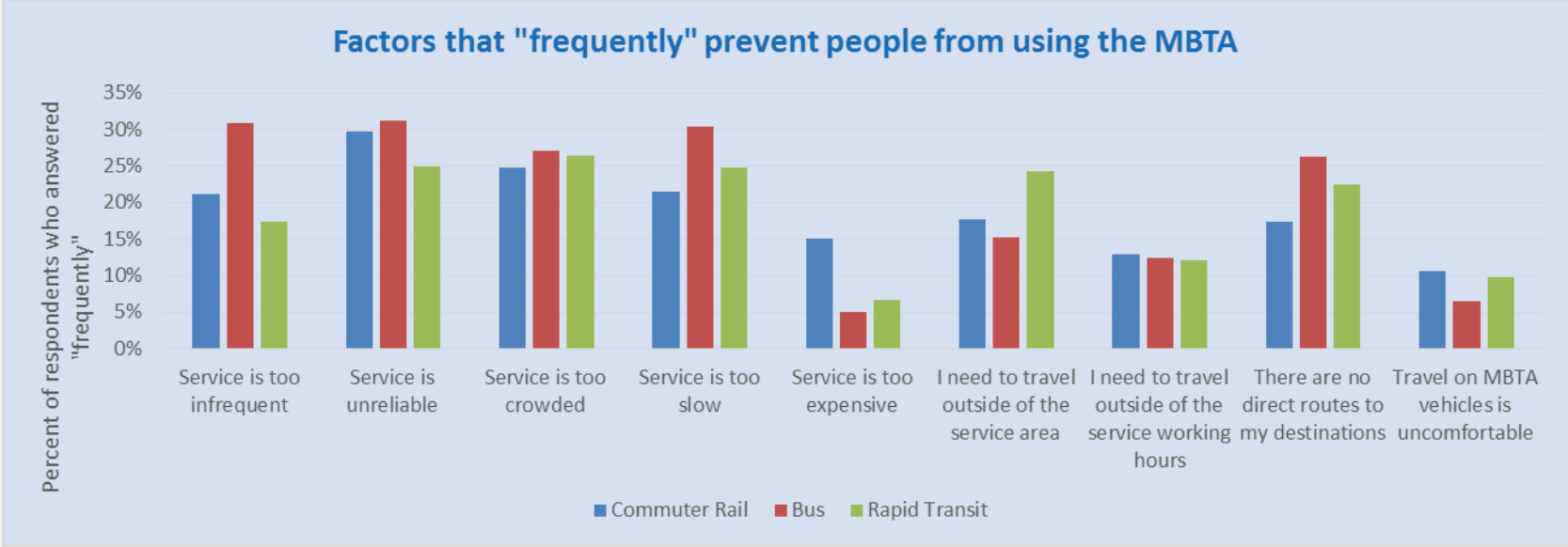
Parking capacity represents a barrier to accessing service.

RAPID TRANSIT SERVICE PERFORMANCE

While meeting some MBTA service standards, rapid transit experiences crowding and reliability issues.

CUSTOMER VOICE

The MBTA surveyed 6,000 customers across all modes in the summer of 2015. Rapid Transit customers cited crowding and the geographic limits of the system as barriers to using it more.



These service characteristics are affected by a combination of:

- Asset Condition: The condition of the revenue vehicles, stations, and right of way assets
- Internal Operations: Labor practices and budget constraints
- External factors: Real-world conditions that are beyond the control of the MBTA.

MBTA SERVICE GUIDELINES

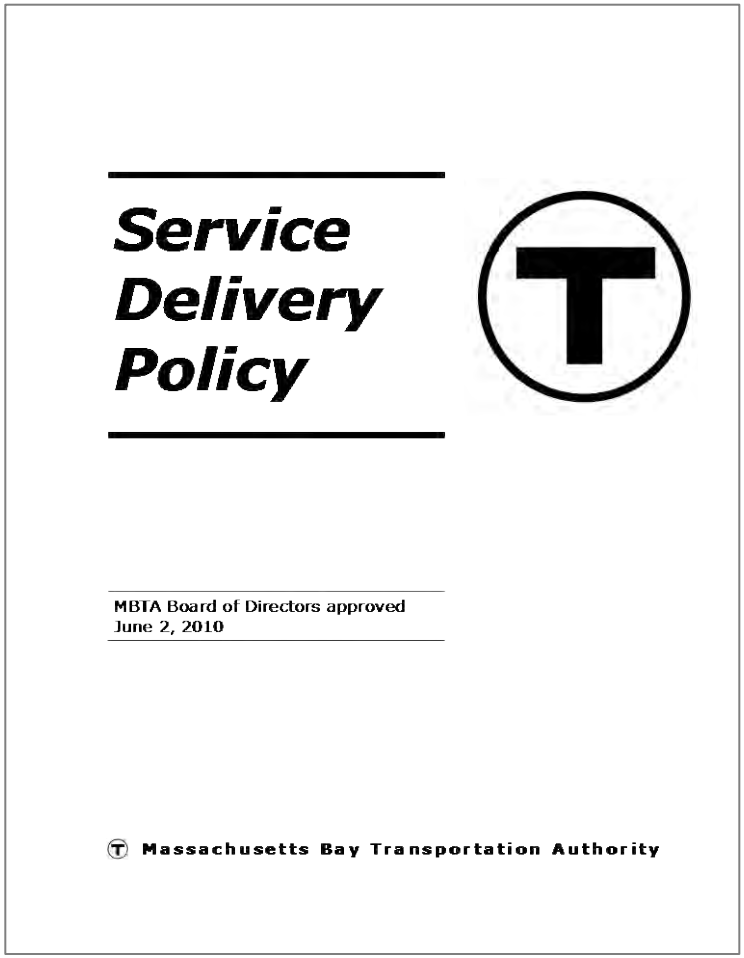
The MBTA's Service Delivery Policy* articulates the type of service it should provide in terms of:

- Minimum spans of service
- Minimum service frequencies
- On-time performance
- Passenger wait times
- Maximum crowding levels

Rapid transit service is meeting the standard for span of service and frequency.

The MBTA currently lacks a mechanism to quantitatively track crowding. But observationally, crowding standards are not met on certain services during peak periods.

**The MBTA is currently in the process of updating its service standards.*



SCHEDULED SERVICE FREQUENCY

Scheduled frequency varies by line and is dependent on fleet size, track and signal capacity, and other factors.

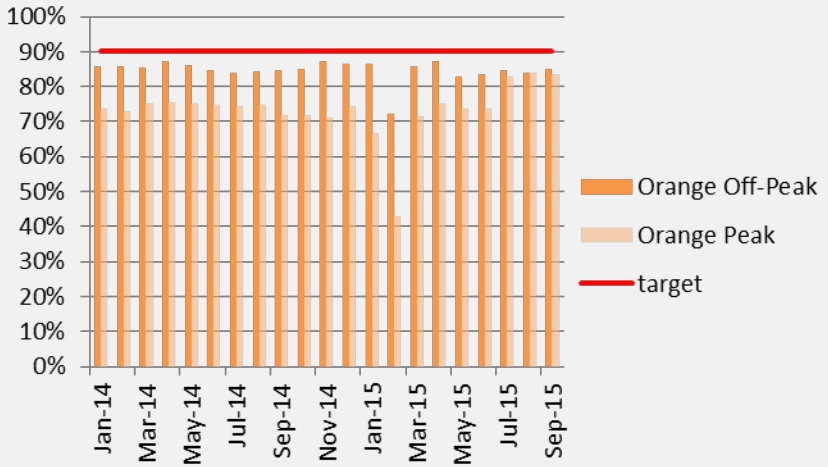
Line	Weekday Peak Headways* (minutes)	Midday Headways (minutes)	Weekend Headways (minutes)
Green (surface and subway)	6-7 branch, 1-2 trunk	8-10 branch, 2-3 trunk	7-12 branch, 2-3 trunk
Orange	6	8-10	9-13
Red	8-9 branch, 4-5 trunk	12-14 branch, 6-7 trunk	14-16 branch, 7-8 trunk
Blue	4-5	6-10	9-13
Mattapan	5	8-12	12-26

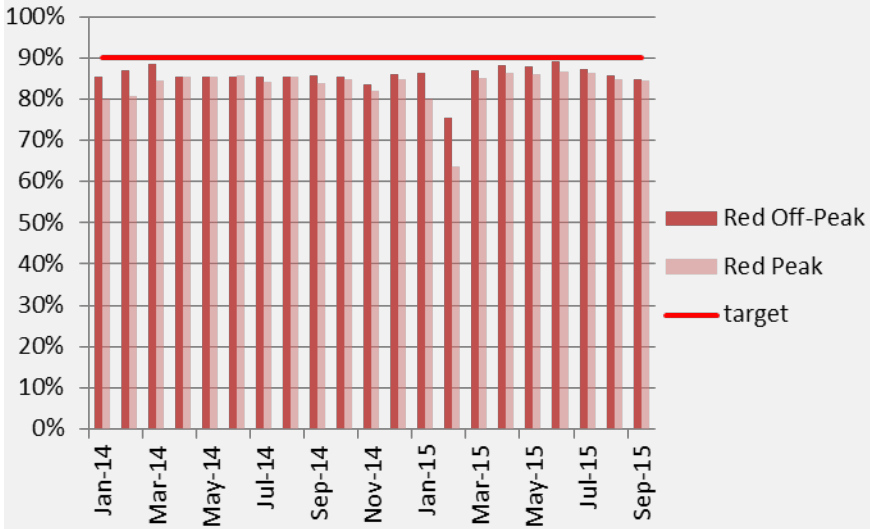
Source: MBTA Schedule, Fall 2015

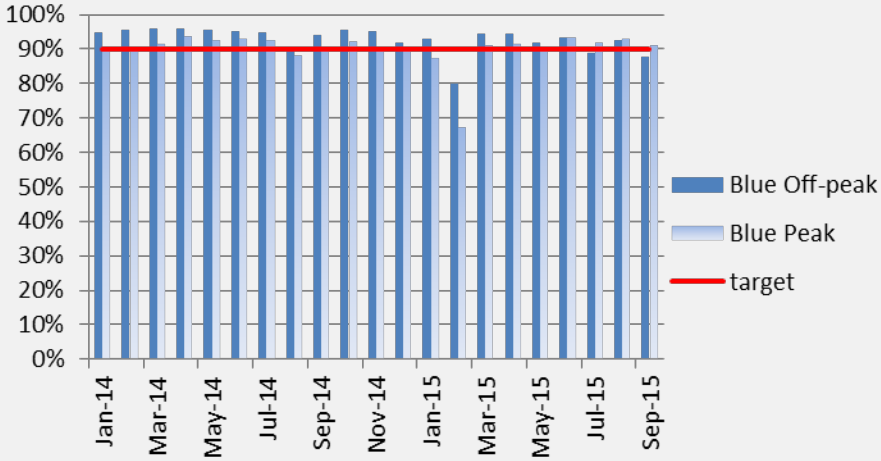
* Headway is the frequency of trains arriving at stations along a specific route

PASSENGER WAIT TIMES

The MBTA tracks passenger wait times for the three heavy rail lines. These charts show the % of passengers who waited less than the scheduled headway for that line. The MBTA target is for 90% of passengers to wait less than the scheduled headway.







RAPID TRANSIT SERVICE FREQUENCY/CROWDING

According to the MBTA FY 2014 scorecard, the rapid transit system lacks sufficient capacity to meet the established service standards for crowding and on-time performance.

System capacity is limited by:

- Platform lengths and configurations
- Track capacity (lack of sidings, express tracks, etc.)
- Traction power limitations
- Aging and outdated signal equipment
- Fleet size and condition

The significant capital cost associated with addressing many of these factors has resulted in the status quo of greater demand than availability of service.

RAPID TRANSIT ASSET PERFORMANCE

Service quantity and quality are heavily dependent on the condition and quantity of a wide range of interdependent assets.

ASSET PERFORMANCE

State of Good Repair (SGR):

The MBTA maintains a current inventory of capital assets in its State of Good Repair (SGR) Database.

The Database generates scores for each asset, based on **age, condition and performance.** 1 = low, 5 = high, >2.5 = SGR.

When referencing SGR scores, it is important to note:

- **Summary scores at the asset/modal level represent the average of all assets in the category**, and are a less precise tool for understanding condition of the individual assets within the category.
- Since SGR scores are blended evaluations of age and condition/performance, **relatively new assets that perform poorly may have better SGR scores than their condition alone would suggest.**
- **Assets that are within their useful life and performing as intended will have good SGR scores, even if the assets are inadequate to meet current or future needs of the system.**
- **The SGR backlog will continue to change** – as assets age and are replaced, the backlog decreases; conversely as assets age and do not get replaced, the backlog increases.

The MBTA has conducted extensive work to define the condition of its major capital assets through the SGR database, and will continue to update the SGR database each year. The next organizational step is to begin collecting data for the Maintenance Management System (MMS), a more granular asset management tool that will help the MBTA to implement lifecycle management processes and track asset condition down to the smallest replaceable component. The MBTA also needs to regularly update its existing asset management plan – a policy/strategy document for implementing asset management across the MBTA – for all asset classes. A continuous, predictable capital funding program, including funding for these tasks, is essential to maintaining an effective asset management program.

RAPID TRANSIT STATE OF GOOD REPAIR

Rapid transit assets have an SGR backlog of **$3.4 billion** and a replacement value of **$11.8 billion.**

Asset Category	Average SGR Rating (0 to 5 Scale)	Compared to Other MBTA Modes
Bridges	3.20	Similar
Communication	**3.61**	Above
Elevators /Escalators	**3.53**	Above
Facilities	2.78	**Below**
Fare Equipment	***3.99***	Similar
Parking	**2.32**	**Below**
Power	3.06	Above
Revenue vehicles	2.84	Similar
Blue Line	4.90	Above
Green Line	3.90	Above
Orange Line	1.19	Below
Red Line	2.11	Below
Mattapan Line	1.00	Below
Signals	3.3	Above
Stations	3.45	Above
Track/ROW	**2.32**	**Below**
Tunnels	2.64	**Below**

Source: : Draft SGR report 8/10/15; *Green = Excellent to Good; Yellow = Fair to Marginal; Red = Substandard to Poor*

RAPID TRANSIT FLEET

The Rapid Transit fleet is old.

651 total fleet:

- Average SGR Score: 2.84
- Average Age: 32 years
- Design lifespan: 25 years
- 55% are beyond useful life
- Desirable average age: 12.5 years

New Orange and Red Line vehicles will reduce average age of fleet and improve reliability of service. These vehicles begin to arrive in 2018.

	Quantity of Revenue Vehicles						
Age (years)	7	18	21	27	35	46	69
Blue	94						
Green	95	19		95			
Orange					120		
Red			86	58		74	
Mattapan							10
	294 vehicles within useful life			*357 vehicles beyond useful life*			

RAPID TRANSIT FLEET

— **Red, Orange, and Blue Line Vehicles**

- The biggest reliability challenge is the age of the Red and Orange Line cars, with the Orange Line cars experiencing the greatest number of failures.
- Red Line cars (Car Types 1 & 2) have frequent door problems impact service.
- New Orange and Red Line cars will start arriving in 2018 and 2019.
- The newest Red Line car (1994) is the workhorse of the system with very good mean miles between failure (MMBF), but the cars are five years overdue for a mid-life overhaul.
- Blue Line vehicles are only 6-7 years old and have a 30-year life, but will require diligent maintenance and overhauls.

— **Mattapan Line Vehicles**

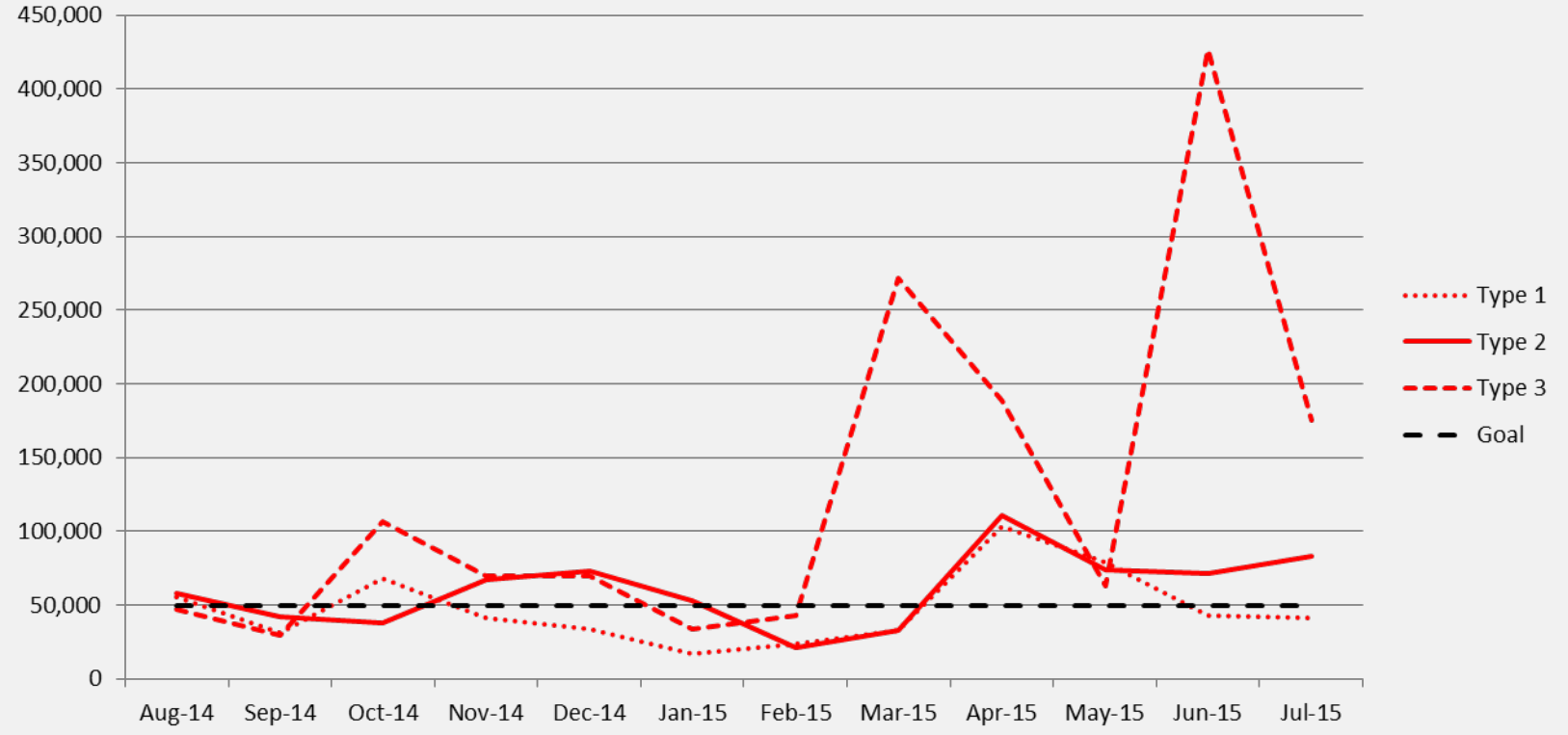
- Vehicles are almost 70 years old and replacement parts and components are no longer available. Of the 10 vehicles on the property, only eight are in service with no plan to replace them. An alternative will need to be found.

RAPID TRANSIT FLEET

— Green Line Vehicles

- The biggest reliability challenge comes from the Type 8 Breda vehicles. Breakdowns are more frequent than on the other types of Green Line cares and take longer to fix.
- The Type 7 Kinkisharyo vehicles are older but significantly more reliable than the Type 8 vehicles.
- A program is underway to overhaul 86 of the Type 7 3600 series vehicles, of which the first 17 are in process.
- 24 Type 9 vehicles are ordered, not enough to replace the Type 8.
- Long-term goal is to replace all the Type 7 and 8 with Type 10.

RED LINE MEAN MILES BETWEEN FAILURE



Red Line goal = 50,000 miles between failure

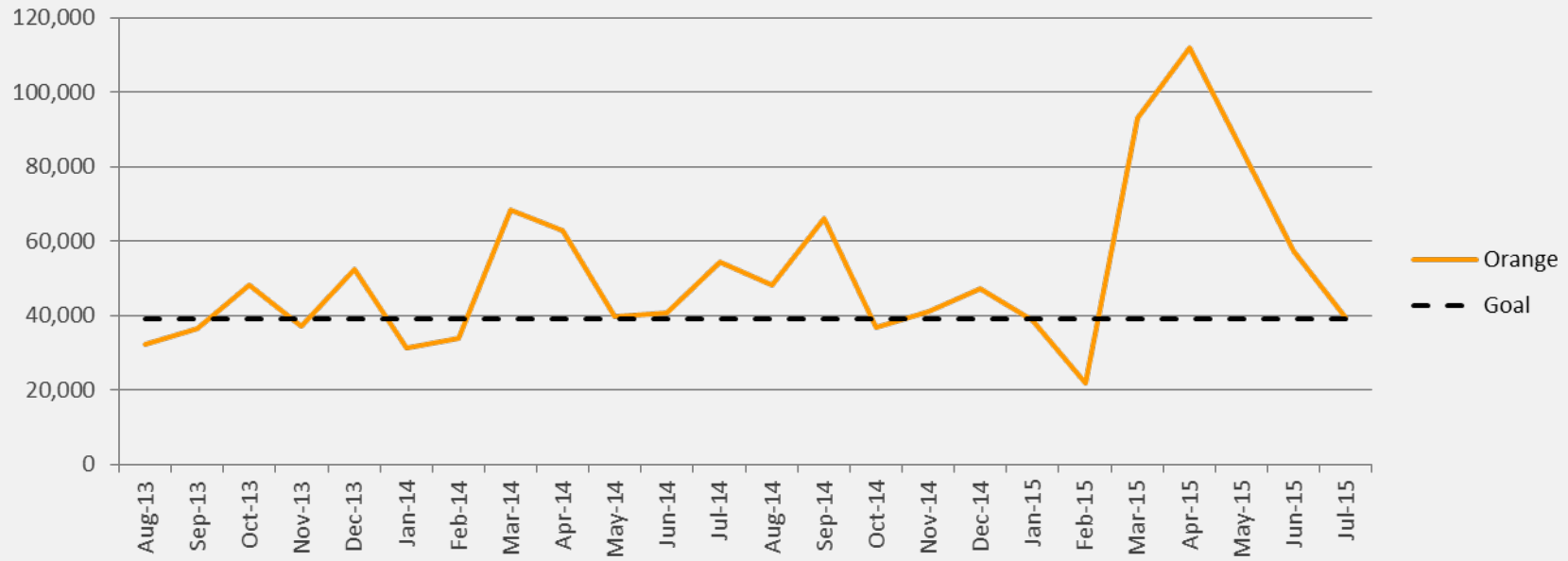
Top Type 1 failure causes:
- ✓ Engine/Propulsion
- ✓ Electrical & Lighting
- ✓ A.T.O.*

Top Type 2 failure causes:
- ✓ Air Supply
- ✓ Doors
- ✓ Engine/Propulsion

Top Type 3 failure causes:
- ✓ Air Supply
- ✓ Engine/Propulsion

* A.T.O. – Automatic Train Operation

ORANGE LINE MEAN MILES BETWEEN FAILURE



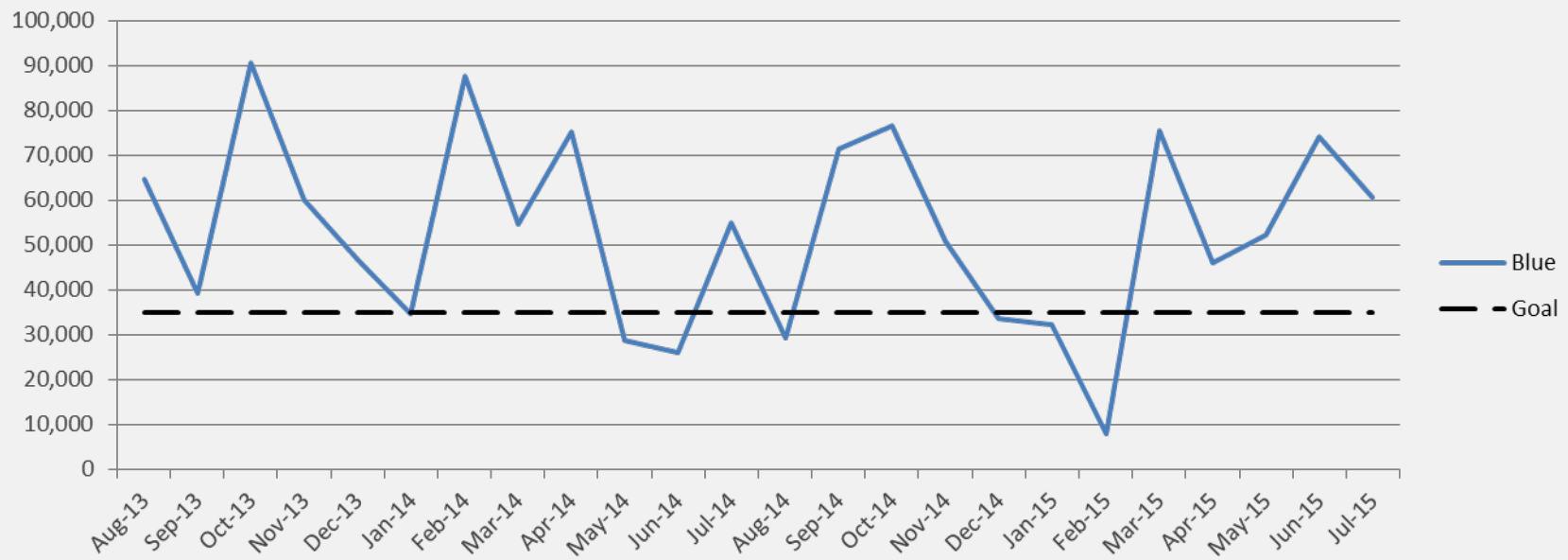
Orange Line:

- Goal of 37,000 miles between failures is a lower goal than the Red Line.
- The Orange Line has been above the goal since March 2015, but reliability has been declining in recent months due to increased failures across the fleet, primarily due to problems with the air supply and propulsion systems.

Top 3 failure causes:

- ✓ Air Supply
- ✓ Engine/Propulsion
- ✓ Electrical & Lighting

BLUE LINE MEAN MILES BETWEEN FAILURE



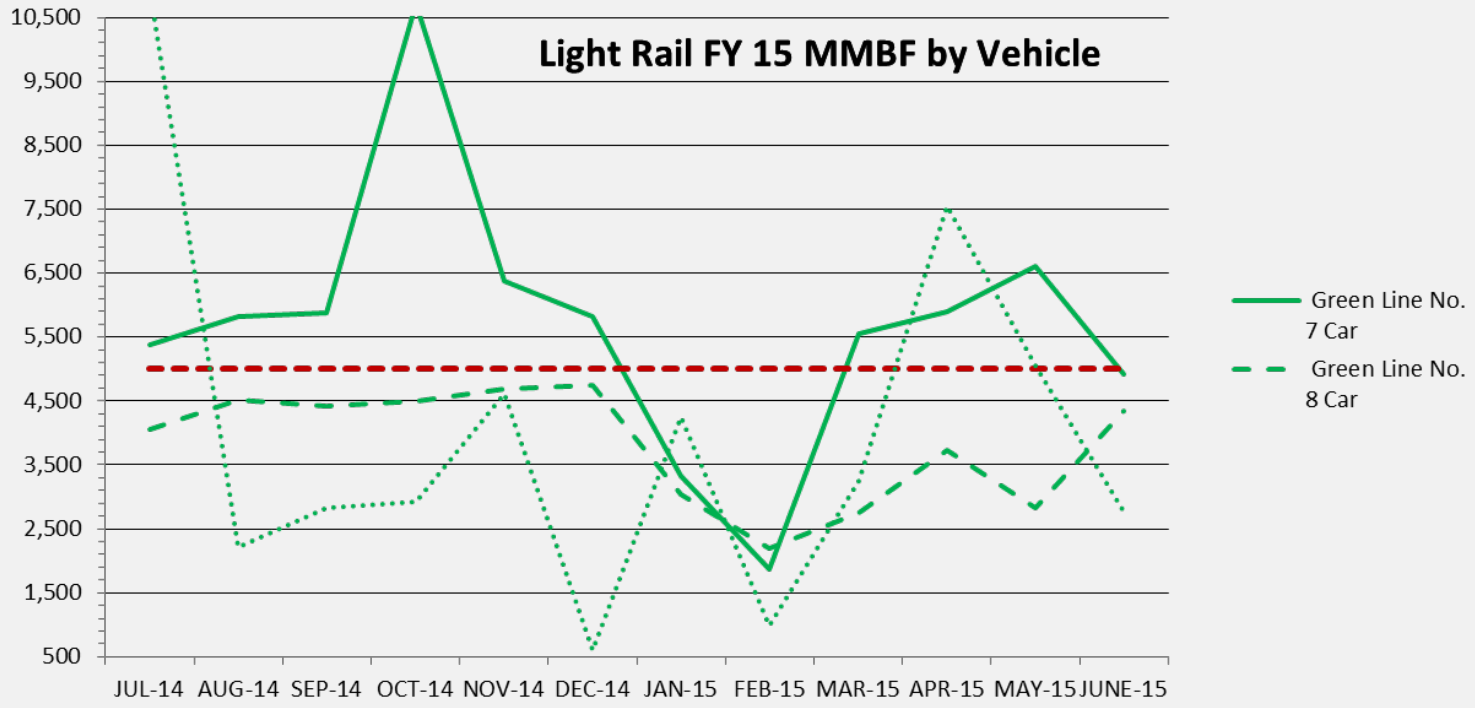
Blue Line:

- The Blue Line goal = 35,000 miles between failures
- The Blue Line, over the past 24 months, has surpassed its goal in all but five months.

Top 3 failure causes:

- ✓ Air Supply
- ✓ Doors
- ✓ Engine/Propulsion

LIGHT RAIL MEAN MILES BETWEEN FAILURE



Green Line goal = 5,000 miles between failure

Top PCC failure causes:

- ✓ Brake System
- ✓ Propulsion System

Top Green Line failure causes:

- ✓ Brake System
- ✓ Air Supply System
- ✓ Doors

RAPID TRANSIT STATIONS

MBTA stations are among the most visible components of the system and require ongoing capital investment and maintenance to ensure that the anticipated design life of all building components and systems are met or exceeded.

Station structures within the rapid transit system have a wide range of age, condition, and performance rankings:

- Average SGR Score: 3.45
- Average age of all stations: 36 years
- 50-year useful life
- Oldest Station: Boylston Station, 1897
- Newest Station: Assembly Station, 2014
- More than 75% of stations on Mattapan Line and Orange Line are beyond mid-life.

NOTE: Station age refers to the years since initial construction or the most recent major station reconstruction, whichever was more recent.

STATIONS: ELEVATORS & ESCALATORS

Elevators and escalators impact the customer experience and affect accessibility compliance.

Average SGR Score: 3.53

Elevators in the system:

- Average age: 21 years; 28-year useful life
- 38% are past useful life.
- An elevator is out of service for an average of 31 hours annually, or 0.4% of its revenue service operating time.

Escalators in the system:

- Average age: 27 years; 28-year useful life
- 64% are past useful life.
- Escalators experience outages at nearly five times the rate of elevators. An escalator is out of service for an average of 138 hours annually, or 1.9% of its revenue service operating time.

STATIONS: ACCESSIBILITY

The MBTA has made progress with improving accessibility at rapid transit stations. 79 of the 80 key stations* are fully accessible; the last key station (Government Center) is currently under construction.

38 rapid transit stations remain non-accessible:

- 31 surface and four subway stations on Green Line
- Wollaston Station on Red Line
- Bowdoin Station on Blue Line
- Valley Road Station on Mattapan Line

Rail is susceptible to movement from loose fasteners or expansion and contraction resulting from ambient temperatures. Without ongoing maintenance, this track movement can create large gaps between platform and train, requiring the use of bridge plates for customers:

- Between January and August 2015, bridge plates were used 883 times.
- Red Line has highest usage of bridge plates: 501 times, 57% of total usage.

Accessibility regulations require that stations be made accessible when certain alterations are made (e.g., resurfacing platform, stairs). As with legacy rail systems across the country, alterations that would trigger major accessibility improvements are often deferred due to budget constraints.

*Designations required by the federal government to prioritize accessibility improvements for important subway and commuter rail stations. Stations with above-average ridership, those at the end of a line, intermodal stations, and those located near business and retail centers, and others, were designated as key stations by the MBTA.

GREEN LINE SURFACE STOPS: ACCESSIBILITY

31 Green Line surface stations are non-accessible. These stations represent 23% of total Green Line ridership.

- Cost to make Green Line surface stations accessible, along with the necessary roadwork, is between $3m-$5m per station.
- Stop consolidation along the B Line would help reduce the cost.

MAINTANCE & STORAGE FACILITIES

Red Line – Cabot

- Facility dates to mid-1970s, with inadequate replacement and rehabilitation of major capital assets within the facility
- Some hoists with expected life of 25 years are now 40 years old.
- Only 50% of lifts are operational, which impacts ability to repair vehicles and return to revenue service.
- Overhead cranes often fail and diminish ability to move heavy equipment/vehicle parts efficiently around the facility.
- Other needs include an overhaul of the wheel truing machine, roof replacement, replace heating system and a test track for new vehicles.

Orange Line – Wellington

- Additional storage will be needed to handle the new fleet when it arrives. Capacity will increase from 120 to 152 vehicles.
- Renovation and yard storage improvement is currently funded under the Red & Orange Line procurement.

Blue Line – Orient Heights

- The relatively new facility is a model for improvements at other facilities.

MAINTANCE AND STORAGE FACILITIES

Green Line – Riverside

- Heavy maintenance and storage facility dates to the mid-1970s, with little work done since built.
- Flat roof has major leaks impacting operations within the building and puts large areas of already constrained space “off limits.”
- Two of the four hoists are 40 years old and are often out of service.
- One of the two cranes has been out of service since January 2015.
- Facility lacks work platforms and capital storage area, constraining productivity.

Other Facilities

- Roofing systems and water infiltration are a major problem at many equipment buildings where communications gear, electronics and other critical components are housed. This shortens the useful life of equipment and ties up crews with corrective maintenance who should be doing preventive maintenance.

RIGHTS OF WAY: TRACK

Much of the MBTA's rapid transit track is beyond its useful life (average SGR score is 2.32). Aside from cost considerations, a number of other issues factor into repair decisions. These include limited overnight hours and other extended repair windows and the size of the bus fleet available for substitute service.

- Track along the Southwest Corridor portion of the Orange Line is deteriorated and expensive to repair.
- The MBTA has in-house capacity for small capital repair jobs, but such work takes away from preventive maintenance.
- Special alignments (curves and turnouts, especially on the Green Line) cause track to wear out faster than straight rail. Replacing such special track requires longer lead times to plan for and procure materials.

RIGHTS OF WAY: TUNNELS

- Various MBTA tunnels require concrete repairs and have water infiltration issues.
- Reconstruction is impractical due to cost and operational interruptions unless part of major station projects (e.g. Maverick, Government Center, Copley, Haymarket).
- Leaking causes damage to sensitive signal, communication and power cables, and track infrastructure.

SGR score: 2.64

- 50% of tunnel exhaust fans are beyond useful life.
- Another 25% of tunnel exhaust fans are due for replacement in two years.
- $54 million total asset value of tunnel exhaust fans
- $5 million of leak repair projects are backlog

RIGHTS OF WAY: TUNNELS

Line	Tunnel Segments	Year of Construction
Blue	State to Maverick	1904
	State to Bowdoin	1916
Green	Boylston to North Station	1897
	Boylston to Kenmore	1912
	Kenmore to B-line portal	1931
	Kenmore to C-line portal	1932
	Kenmore to D-line portal	1959
	Copley to E-line portal	1941
Orange	North Station to Chinatown	1908
	Chinatown to Back Bay	1987
Red	Park Street to Harvard	1912
	Park Street to South Station	1915
	Harvard to Alewife	1983
	Andrew to South Station	1917/1918

RIGHT OF WAY: BRIDGE

According to bridge condition ratings maintained by the MBTA, 86% of bridges are in GOOD or SATISFACTORY condition. Only 3% are structurally deficient.*

- Average SGR score of all bridges in transit system: 3.20
- Average age: 64 years (useful life = 43 to 75 years)
- Useful life of bridges near roads is 38% less than non-highway bridges, due to damage caused by salt usage and spray.

Average age of culverts (included in the bridge SGR score) is 50 years (useful life is 75 years)

*By comparison, approximately 8% of MassDOT highway bridges are structurally deficient.

POWER

Overhead catenary system is in satisfactory condition.

- The average SGR score for catenary is 2.58 (for hardware, poles, and wire).
- Catenary infrastructure is in good condition. Wire failures are more often the result of the interaction of the vehicles' pantograph with the overhead wire when operating at maximum allowable speed, especially on curves and grades.
- **Although infrastructure is in good condition, additional power is needed to expand capacity and support 3-car train sets on the Green Line.**

Direct Current (DC) cables on the Red and Orange Line are in poor condition.

- The average SGR score for DC cables across lines is 3.22.
- While the SGR score for Red and Orange line DC cables is 3.15 due to the expected useful life, the condition and performance score is 2.4, meaning that the cables have deteriorated faster than would be expected based on their age.
- Cables exposed in tunnels deteriorate faster due to water infiltration and exposure to elements.
- Lack of negative return cables along some portions of the Orange Line cause faster decay of DC cable.
- Long lead time with short overnight work windows and cost to replace poses a challenge for bringing to a state of good repair.

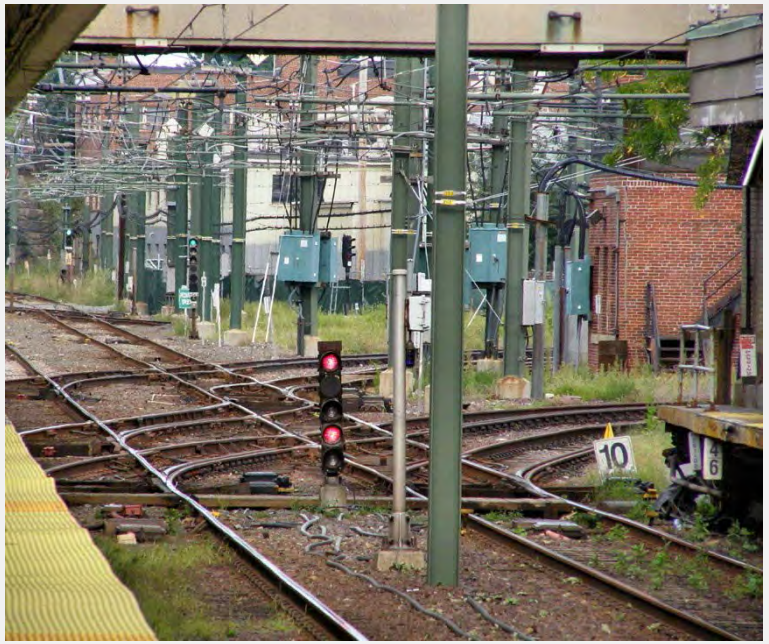
SIGNAL

The SGR backlog only assumes a replacement in kind. To meet desired service levels, a more significant investment in signal technology will be needed.

Average SGR Score: 3.30

Despite the satisfactory SGR score, many signals and supporting equipment* are at the end of their useful life.

- Best to replace signals with newest generation
- Unlike stations or bridges, signal upgrades require a systemwide investment to address interoperability issues with outdated and unsupported signal hardware and software presently in place.



* Current signal inventory in SGR database does not include individual switches, switch heaters, interlocking, turnouts, masts, signal heads and other individual components that make up the entire signal system

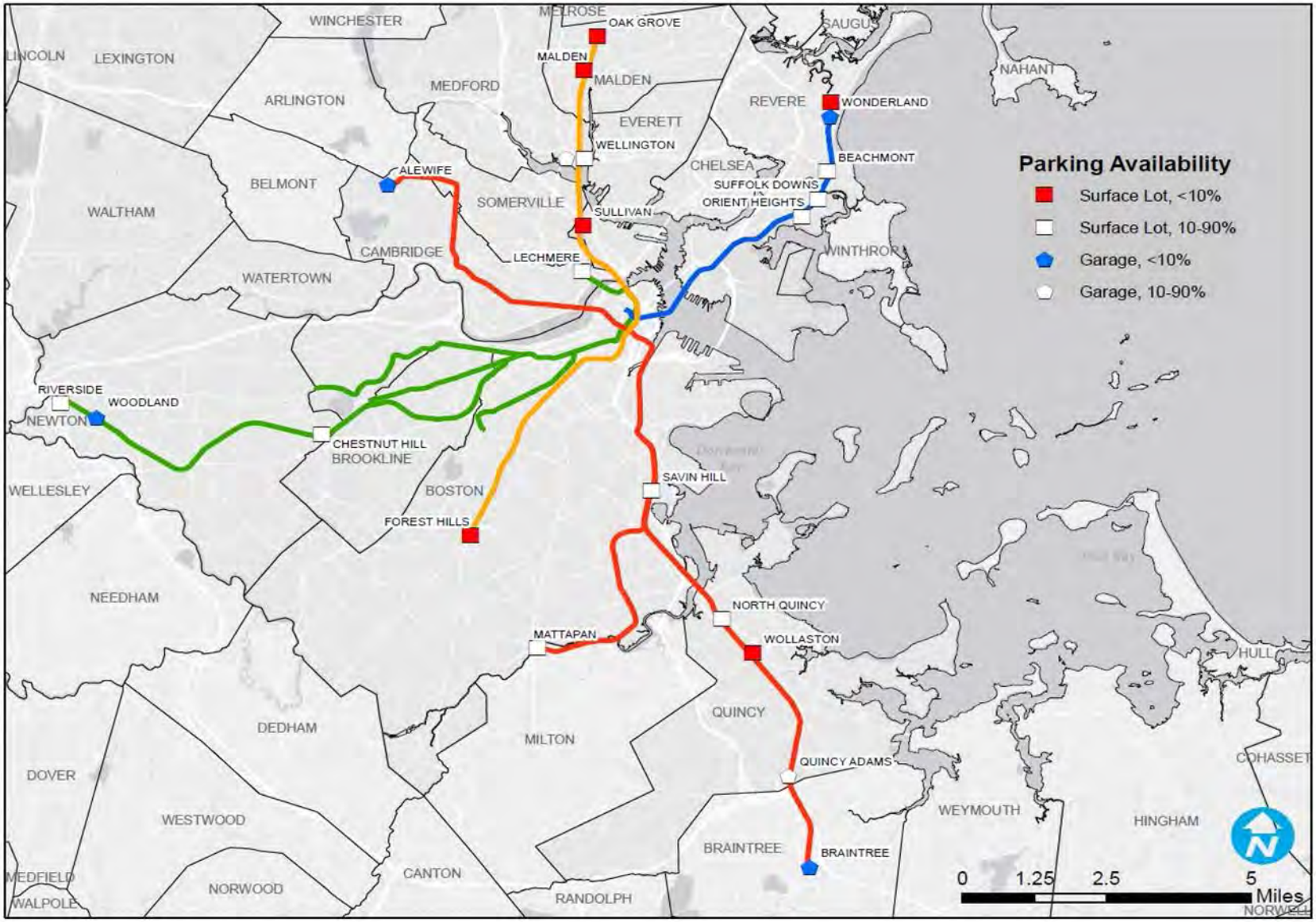
SIGNALS

MBTA rapid transit signal assets on the Red, Orange and Green Lines include numerous legacy components and systems and should be examined for major upgrades or replacements in order to improve reliability and maximize the capacity of track and vehicle assets.

Critical examples of needed major investment programs include:

- Green Line signal system overlay to enable Automatic Train Protection
- Green Line 25Hz power frequency track circuits should be replaced with contemporary-standard 100Hz equipment
- Red and Orange Line Analog Audio Frequency track circuits from the 1970s should be replaced with modern digital circuits to improve maintainability, reliability and enable capacity improvements.
- Red and Orange Line Power Frequency (PF) Track Circuits: Should be replaced with contemporary-standard 100Hz equipment to improve maintainability, reliability and enable capacity improvements.

PARKING AVAILABILITY



PARKING

Average SGR score: 2.32

Total SGR backlog for all rapid transit parking structures is $66M with a replacement value of $136M.

- Quincy Center garage is CLOSED due to condition; no funding currently in place for renovations or rehabilitation.
- Garages in worst condition with funding for concrete deck, waterproofing and other repairs in FY16 CIP:
  - Alewife
  - Braintree
  - Quincy Adams

SUMMARY

SUMMARY: MAJOR INVESTMENTS UNDERWAY BUT SIGNIFICANT SGR AND OTHER ISSUES REMAIN

Some pressing Rapid Transit system needs are being addressed:

- **Government Center reconstruction** will improve transfers at one of the busiest hubs in the network and make the last key station accessible.
- **New Red and Orange Line cars** will address some fleet-related reliability issues with both lines, while adding capacity to the Orange Line.
- **Facility improvements at Wellington and Cabot** will support the new vehicle procurement.

SUMMARY: ACCESSIBILITY

Many surface Green Line and two heavy rail stations are inaccessible.

- Accessibility improvements require significant capital investments.
- Maintenance options are limited at these locations because accessibility would be triggered.

More than half of all Green Line vehicles and all Mattapan trolleys are inaccessible.

Long-term plans for elevator replacement and redundant elevators are needed but not yet developed.

- Plan for Accessible Transit Infrastructure (PATI) under way – aimed at prioritizing barriers to access and developing long-term plan

SUMMARY: POWER NEEDS

Upgrades to the Rapid Transit power system can reduce delays and increase capacity:

- Upgrades to AC/DC Cable and the Catenary System are necessary to allow for consistent use of 3-car trains on Green Line.
- AC/DC Cable and their associated duct banks are aging and frequently collapse, causing service disruptions.
- Systemwide upgrades to traction power substations are necessary to provide more power then is now provided.

SUMMARY: MAJOR CHALLENGES TO MEET CURRENT AND FUTURE DEMAND

Providing additional capacity on rapid transit – by increasing size of vehicle consists or frequency of service – requires systemwide upgrades to many asset classes, including stations, tunnels, facilities, power and signals.

- Platform lengths prevent move to longer trains (even 3-car trains on Green Line would require longer surface platforms in many places).
- Because of station designs, passengers loads are often not evenly distributed by car, exacerbating capacity issues.
- Constraints with signals, fleet size and associated maintenance capacity prevent more frequent service.
- Track conditions and geometry limit speed in some locations.

Development near transit has been on the rise and is expected to continue, necessitating additional capacity and modernization in the system.