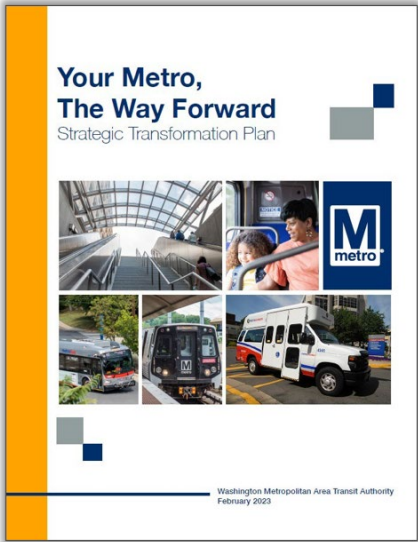


World Class Transit

Safety and Operations
Committee



Strategic Transformation Plan: Guides long term strategy and day-to-day decision making of Metro over the next five + years



Guiding



Day-to-day decisions

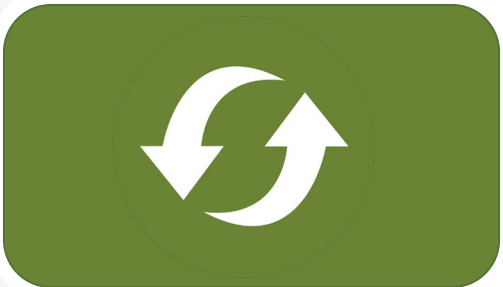
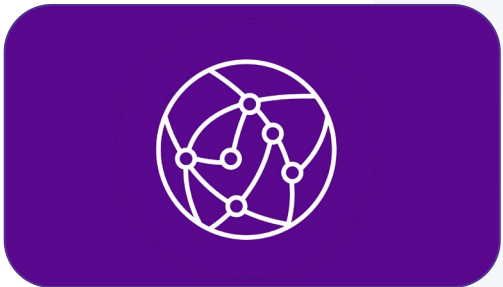
- Customer interactions
- Service schedules
- Communications



Long-term strategy

- Budget allocation
- Capital improvements
- Priority projects

Goals — Our priorities to achieve the vision



Purpose

- Define world class transit investments and Metro's activities to advance rail automation and frequent bus service with bus priority
- Highlight how these two activities, applied systemwide, can maximize the region's infrastructure investments, improve safety and reliability, grow ridership, and add service for low incremental costs
- Review experiences of peer cities/regions and transit agencies
- Establish next steps for:
 - *Rail Automation: Develop and adopt Rail Automation Vision, Program, and Phasing Plan*
 - *Bus Priority: Through DMVMoves, develop regional bus priority network and implementation framework*
 - *Blue/Orange/Silver Corridor: Apply world class transit investments to address capacity and reliability challenges*

Metro's vision for world-class transit

Deliver best-in-class service that maximizes transit ridership and supports a thriving economy

Investments



Fast, frequent service all day/ all week



Modern vehicles, infrastructure, and technology



Integrated customer-focused system

Benefits to Customers, Metro, and the Region



Safer and cleaner system, fewer incidents



Consistent and **reliable** service



Maximize system **capacity**



Deliver **more service with same resources**



Thriving economy



More access to jobs and activities



Enhance quality of life



Higher ridership

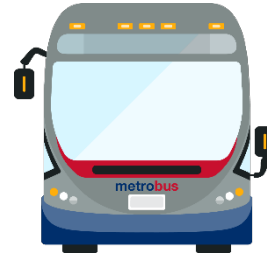


Cleaner air

Metro is leveraging its resources to improve safety, reliability, capacity, and efficiency



Automatic Train Operations (ATO) provides faster, more reliable service, and enables Metro to deliver more frequent service for the same cost.



The **Better Bus Network** provides more frequent and reliable service and connections to more destinations for the same resources.



More customers using the **Abilities Ride** alternative improves the customer experience while reducing costs per trip.

Metro will continue to improve service and grow ridership while modernizing to deliver efficiencies and reduce costs

Region can add capacity, improve reliability at low incremental cost with smart investments

More people and jobs mean more congestion. By investing in world class transit, the region can use the system we already have more effectively to deliver more service and grow ridership

Metrorail

By addressing bottlenecks, the system can run more and longer trains, better utilizing tracks and other infrastructure.



Fleet Size



Yard Storage



Core Throughput



Terminal Capacity

Metrobus

By addressing sources of delay, streets can more efficiently move more people with high-capacity transit.



Road Congestion



Traffic Signal Delay



High-Capacity Fleet



Bus Stops

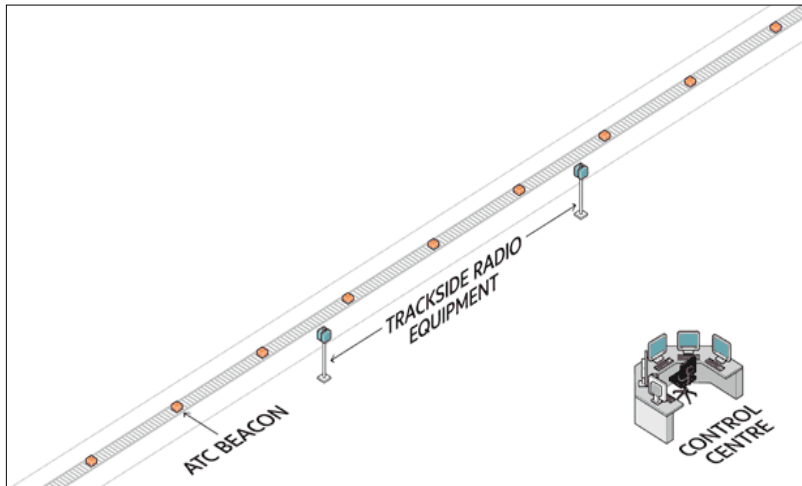
The alternative is to build more roads and extend and expand the transit system at great financial, environmental, and social cost

Investments in Rail Automation and Bus Frequency and Priority are the way our region reaches World Class

World Class Transit

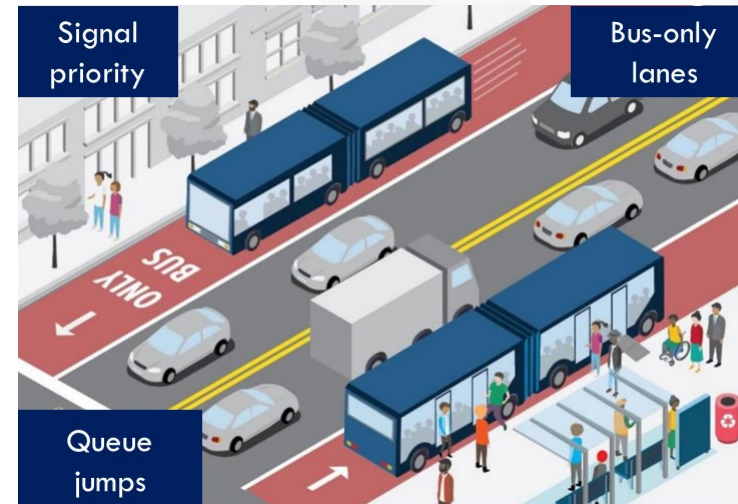
Metro continues to maintain assets, manage costs, and grow ridership, but the region needs to invest in modern technology and infrastructure to deliver world class safety, reliability, capacity, and efficiency.

Rail Automation



Deliver more service, improve the customer experience, and make the system safer and more reliable while reducing costs.

Bus Frequency and Priority



Move buses faster and more reliably on roads with priority treatments, enabling more service with the same bus fleet.



Use rail automation, rapid bus, and station investments to address long-standing capacity and reliability needs in the Blue/Orange/Silver corridor.

World Class Transit: Rail Automation

1. Automatic Train Operations compared to Rail Automation
2. Metrorail's Opportunities and Challenges
3. What is Rail Automation
4. Benefits and Outcomes of Rail Automation
5. Approach to Implementation and Phasing
6. Return on Investment
7. Next Steps

Metro's history of automated operations

Rail Automation

Increasing automation

Grades of Automation

Scale from 1-4 describing increasing levels of automation



Manual operation
Driver stops/starts the train

GoA 1

Operator controls train acceleration, braking, door operation, and monitoring the track

Metro designed for GoA 2 but operating in manual mode (**GoA 1**) since 2009



Semi-automated operation
Operator supervises train

GoA 2

Operator (in the cab) supervises the train, monitors track conditions, operates doors and train departure

We are Here: Metro returned to Automatic Train Operation (**ATO, GoA 2**) on the Red Line in Dec. 2024



Fully automated operation
No operator required

GoA 3

Train attendant (not in a cab) assists passengers and may operate the train if needed

GoA 4

No operator or attendant required for normal operation

Next Steps: Planned return to ATO (**GoA 2**) on all lines

Program Plan: Evaluate a **fully automated (GoA 4) system**

Current Metrorail challenges

Rail Automation

Safety



Ongoing trespassing incidents and on-track debris

- Trespassers, trash, and slips/trips/falls
- Human error in operation
- Challenging to mitigate with current system design

Reliability



Aging and unreliable infrastructure

- Human variability in operations and signal system failures cause delays
- Growing maintenance costs; replacement parts are difficult to source

Capacity



Insufficient room for long-term growth

- Bottlenecks at key locations limit service
- Expensive alternatives to adding capacity

Efficiency



Outdated concept of operations

- Rising operating expenses and inflexible service model

Components of fully automated transit

Rail Automation

1. Signaling Systems



Metro Integrated Command & Communications Center (MICC)

Communications-Based Train Control (CBTC) that can control all aspects of train operations.

Adjust train movements in real-time for smooth traffic flow based on crowding levels, weather, incident recovery, and work zones.

2. Vehicles



Paris Metro: MP05 rolling stock

Railcars equipped with CBTC technology located onboard with less wayside infrastructure.

Precise, automated operations reduce variability – same operation every time.

3. Platform Doors



Honolulu Skyline: Hālawā station

Protect customers on the platform with physical barriers, such as platform screen doors.

Platform screen doors keep people and objects off the tracks.

Full automation is now the global standard

Rail Automation

New Lines & Systems



Copenhagen Metro

Designing for driverless operation is the global standard for newly built rail transit lines

Airports



Washington Dulles AeroTrain

25+ fully automated systems operate in US airports; some since the 1970s. These are often “must-ride” systems with no alternative, demanding high reliability 24/7

Retrofits

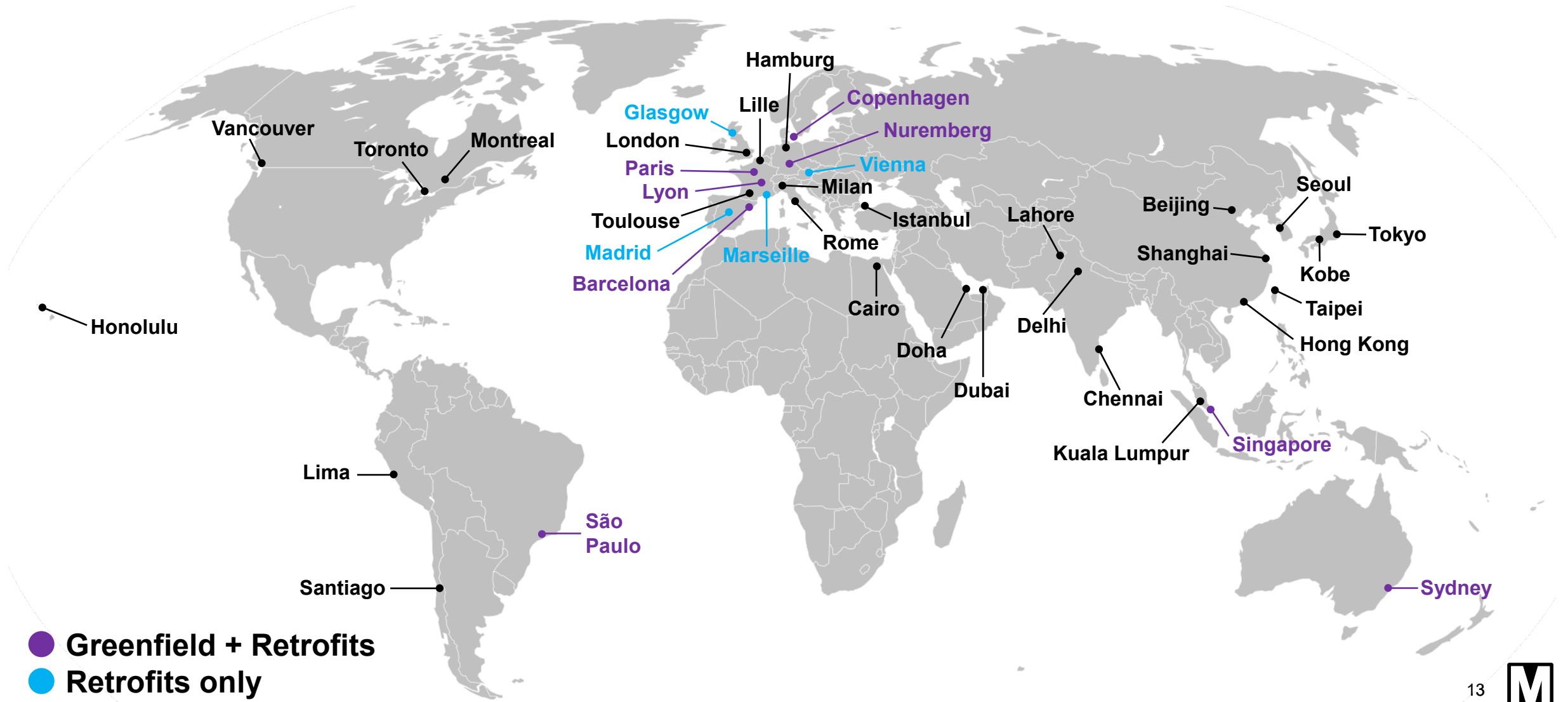


Paris Metro: Line 4 Platform Screen Door Testing

Cities are retrofitting conventional lines (including 100+ year old Lines 1 & 4 in Paris) for full automation to add capacity, improve service and decrease cost

Metros are automating across the world

Rail Automation



- Greenfield + Retrofits
- Retrofits only
- Greenfield only

Selection of Grade of Automation 3/4 (GoA 3/4) lines, current and in development

Trespassing is an ongoing safety problem



Q

Sections

The Washington Post

Democracy Dies in Darkness

Get one year for \$40

Gridlock

Woman struck and killed by Metrorail train at Union Station

By Justin George

June 23, 2021 at 8:35 p.m.

A woman was fatal

Station on the Red

Emergency respon

firefighters from tl

responded, shutting

spokeswoman She

12:30 p.m. and inv

initially identified

Metro Transit

WASHINGTON

METRO (WMATA)

Man Struck by Train at Minnesota Ave.

Published February 14, 2020 • Updated on February 14, 2020 at

f



52°

DC NEWS NOW

MONTGOMERY COUNTY

Trains delayed after person struck, killed by train in Rockville, Metro says

by: Paola Bellosso

Posted: Aug 30, 2024 / 11:12 AM

Updated: Aug 30, 2024 / 11:15 AM

SHARE

f

in

ROCKVILLE, Md. (DC News No

and killed by a train on Friday

WMATA said Red Line trains w

because of the incident in bot

ains are also operating ever

ARLnow

Local is everything

News

Firefighters rescue person struck by a Metro train in Crystal City

By Jo DeVoe

Published March 10, 2023 at 12:45PM



Trespassing incidents have major safety & service impacts



RD Grosvenor-Strathmore

January 25, 2025, 5:26PM: Person fatally struck by train; Montgomery Fire & Rescue and Medical Examiner came to the scene

- Nearly seven hours of service disruption, delaying or canceling over 100 train trips
- Trains turned back to mitigate delays
- Resulted in 8,900 late customers

GR West Hyattsville

March 12, 2025, 2:56pm: Person struck by train; rescued by Prince George's Fire & EMS

- Three hours of service disruption, delaying or cancelling 48 train trips
- Service suspended between West Hyattsville and Hyattsville Crossing; cascading delays for Green and Yellow Lines
- Resulted in 15,000 late customers

Metro's signal system is aging and less reliable



Metro's signal system is old & costly to maintain: few vendors, limited availability of parts and signals are the top cause of infrastructure-related service delays.

Both the infrastructure and technology are obsolete; track circuits of older design, at or approaching obsolescence.

The required investment in signals and rolling stock is an opportunity to plan rail automation.



Vital Relays and
Local Control Panel



Track Circuit Module

Train Control Room

Metro will have fewer decentralized assets to maintain

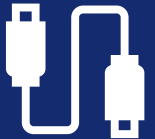


Today's System:

Relay-based track circuits
Grade of Automation 2



165 localized
Train Control Rooms



700+ miles of copper cable
28,000+ vital relays



3,500+ track circuits

- Fewer parts
- Smaller & simpler footprint
- Better performance

Modern, Automated Systems:

Communications-Based Train Control
Grade of Automation 4



Centralized control;
Significant reduction in train
control rooms



Fiber optic infrastructure
Modern zone control



Less wayside equipment;
Railcar-based equipment

Automation increases capacity



Higher signal system throughput and improved reliability enables higher capacity:

Remove variability from service, reduce scheduled buffer time

- Improve on-time performance to 95-99%
- Increase throughput: more trains per hour
- Turn trains faster at the end of the line

Service flexibility: Automated systems can respond to unplanned events or surges in demand easier



Copenhagen Metro

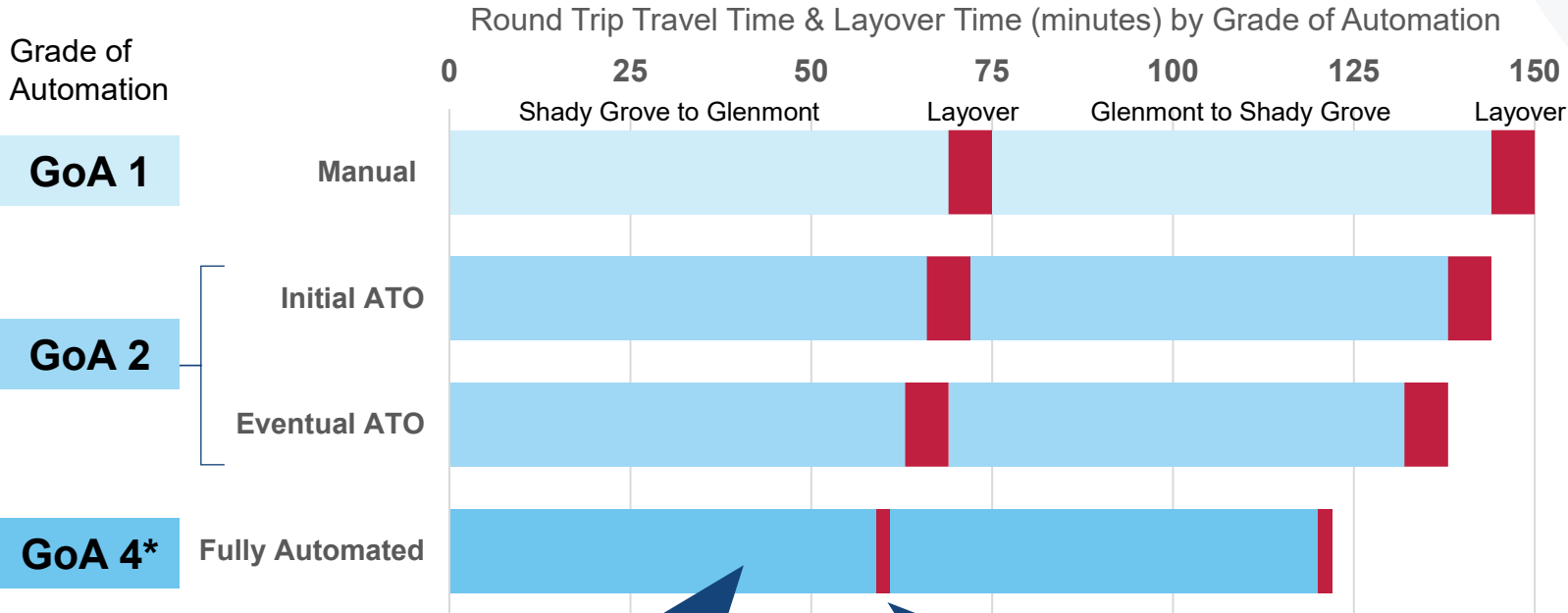
M3 Service operating in a different pattern to serve special events

Automation means better service

Automated operations are faster and more efficient, increasing capacity with the same infrastructure



RD Red Line Round Trip Cycle Time



Cycle Time (minutes)	Trains Required for 5 min headway	Trains Required for 4 min headway
150	30	38
144	29	36
138	28	35
122*	25	31

Full Automation reduces scheduled buffer time, speeding up travel time compared to GoA 2

Automated turn-arounds and less delay recovery at terminals reduces scheduled layover time

Shorter cycle time enables same service with fewer assets

*Fully Automated cycle times are illustrative and hypothetical, based on performance of similar systems. Actual system performance will need to be determined.

Reliable, fast service drives efficiency

\$ Efficiency

- **Higher Asset Productivity:** Provides more service and capacity from the same infrastructure and assets
- **Lower Operating Costs:** Costs are driven more by system uptime and less by level of service provided, enabling more service at low marginal cost
- **Higher Ridership and Revenue:** frequent and reliable service drives ridership growth



MRT – Singapore

Initial strategy to implement rail automation

Rail Automation

Metro would take a regional, system-level approach to phase in automation

Implementation for automation would occur in phases across the rail network. Incremental benefits will be realized with each segment completed.

- Modernize signal system with Communications-Based Train Control (CBTC)
- Upgrade railcars for CBTC
- Install platform screen doors integrated with signal system
- Phased roll-out of automated operations



Critical to align fleet and signaling decisions

With the 8000-series fleet acquisition underway, now is the time to make decisions on rail automation

Fleet and signaling systems are highly interconnected

- Agencies typically make major decisions on signaling systems in conjunction with railcar purchases
- The 8000-Series are designed for conversion to CBTC and automation compatibility

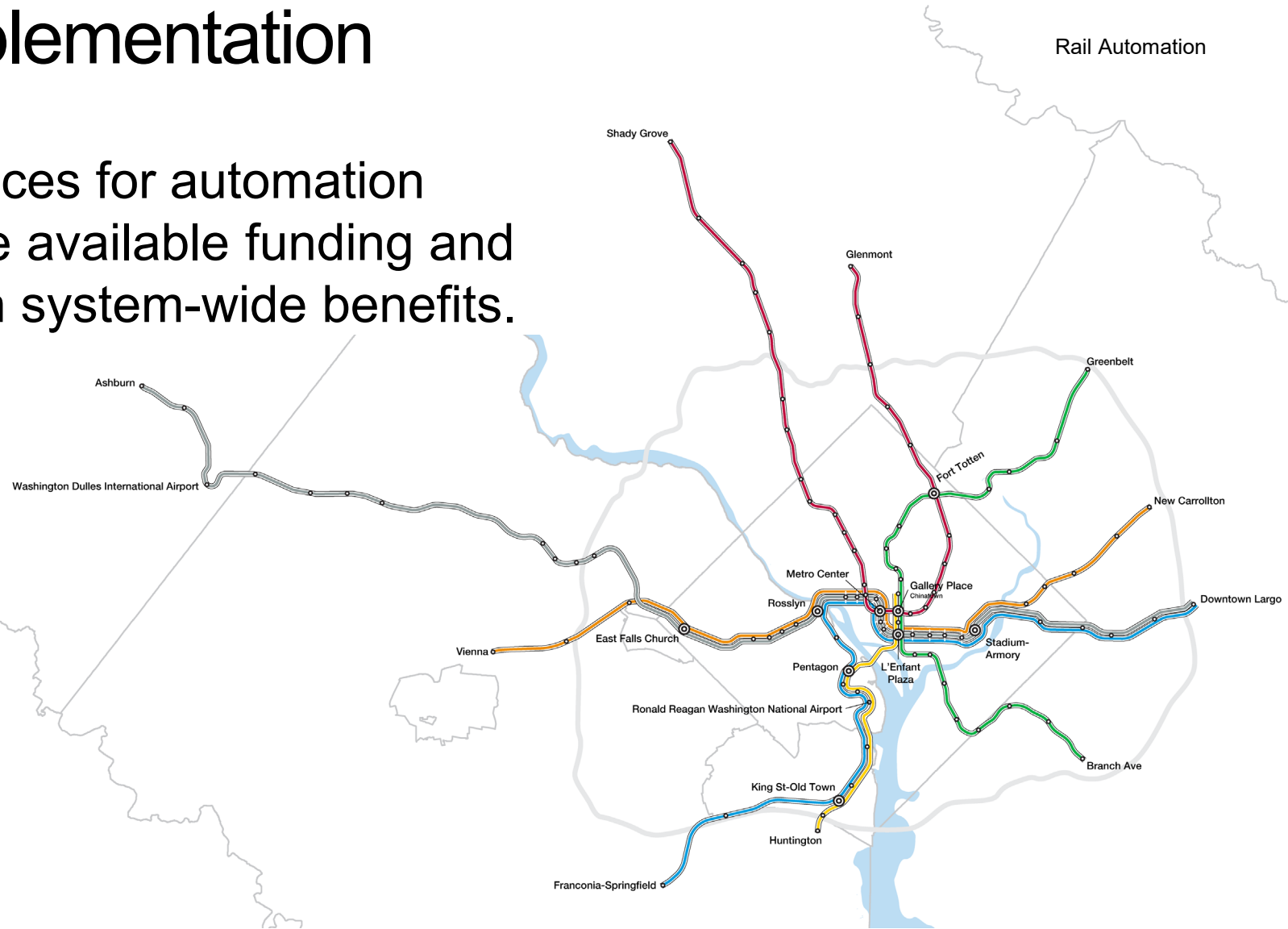
Railcar Series	Entered Service	Current Fleet	Future Fleet
3000	1984-1988	276	-
6000	2006-2008	180	180
7000	2015-2020	748	748
8000	2028-	-	256 to 800
TOTAL		1,204	1,184 to 1,728



Potential Phased Implementation

Following industry best practices for automation retrofits, Metro would balance available funding and infrastructure constraints with system-wide benefits.

- Modernize signals by segment across the system, linking segments together
- Prioritize installation of platform screen doors by location, based on infrastructure needs and operational benefits
- Start automated operations once infrastructure and systems are in place



More direct delivery approach reduces costs

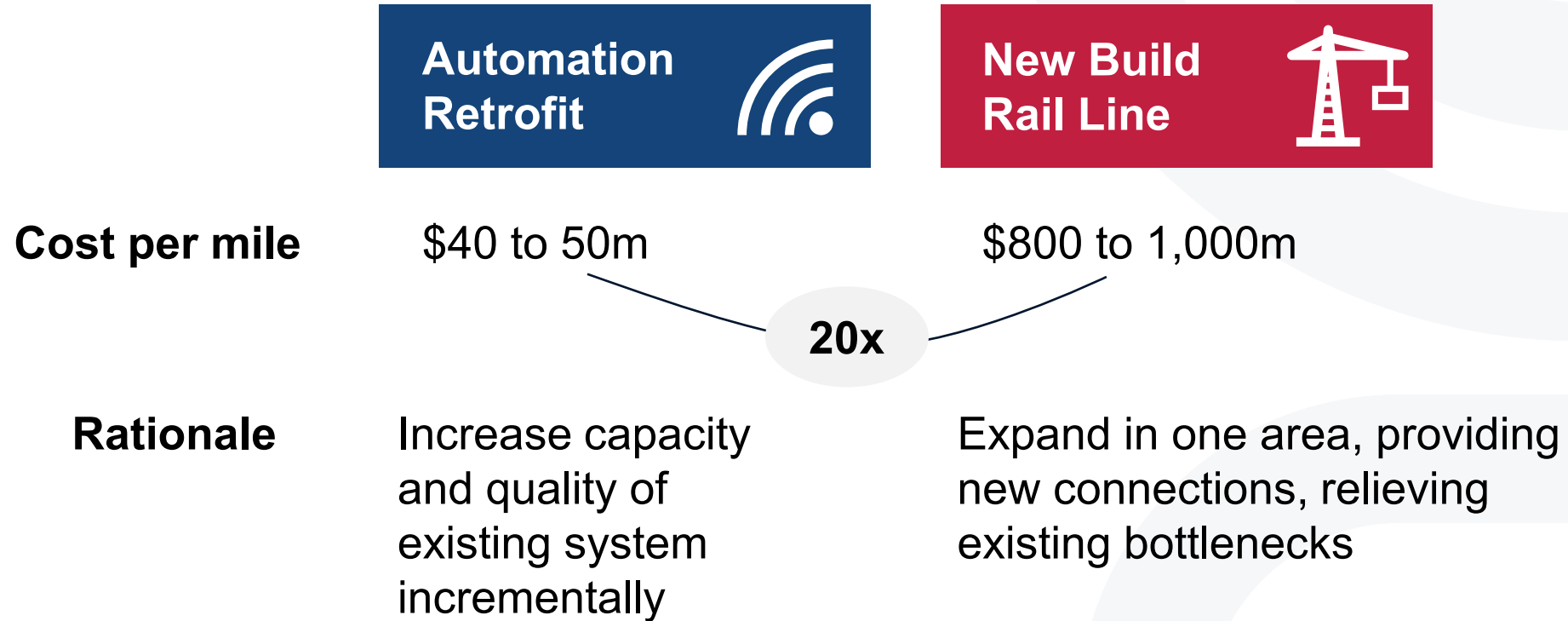
Rail Automation

- **Commit to Rail Automation vision and plan**
 - Pursue system-wide automation utilizing a phased implementation strategy
- **Formulate an integrated program management team to reduce soft costs**
 - Utilize internal experts for project management and oversight to deliver the project with fewer consultants
 - Change the way we do things: Drive delivery efficiency by optimizing installation and testing practices
- **Combine benefits of staff expertise, repetition, and efficiency to reduce costs over lifespan of the project**
- **More details in December 2025 Business Plan strategy review**



**Potential
Total
program
cost**

Retrofitting for automation is less expensive and benefits the whole system faster than building new lines



Conceptually, systemwide automation retrofit is achievable with incremental funding of \$100 to 150 million per year and federal capital investment grants

Conceptual return on investment

Rail Automation Business Plan is underway, including detailed lifecycle cost analysis and alternative delivery options to reduce cost.

Preliminary results:

- **Faster, more efficient service:** Red Line service with automation would save 5 trains compared to manual operations
- **Higher capacity:** Automation enables productivity. The efficiencies from faster, more reliable service can be reinvested in service, increasing capacity
- **Lifecycle cost savings:** Efficient and productive service means saving money by purchasing fewer railcars to achieve the same capacity – requiring fewer yard expansion projects and avoiding lifetime maintenance costs for those railcars



Example: Red Line Automation

Grade of Automation	Trains Required for 5 min headway	Conceptual Impacts of Red Line Automation:
GoA 1	30	Automation saves five trains from manual mode; up to 40 fewer railcars to run the same service
GoA 2	28	~\$220 million in lifecycle cost savings to acquire and maintain 40 railcars
GoA 4	25	Plus additional savings to avoid cost of yard expansion

Preliminary Costs and Benefits

Automation Program enables

Rail Automation

Capital Investments



\$5.65b Automation Program

Cost: Rough order of magnitude (FY2025 dollars)

- **Communications-Based Train Control:** \$3.6b investment in upgrading signal systems and railcars to modern standards
- **Platform Screen Doors:** \$2.1b for improved safety, customer experience, and full GoA 4 automation

Efficiencies



Automation investments make it possible to deliver more service at lower cost

- **Capital Cost Offsets:** \$0.9b in lifecycle cost savings with a smaller, more productive fleet & avoiding yard expansion
- **Operating Efficiencies:** Transform Metro's cost structure with 5% to 10% reduction in annual net operating costs

Regional Benefits



Faster, reliable service benefits the entire region

- **Capacity Increases:** 10% to 25% increase in capacity
- **Safety Improvements:** Platform Screen Doors prevent trespassing deaths and injuries
- **Time saved for customers:** gives customers access to more jobs, and saves \$100m to \$215m of their time annually

Preliminary results. Detailed analysis of costs and benefits is underway as part of the Rail Automation Business Plan.

Rail automation is the path to World Class Transit

Rail Automation

Benefits have potential to transform Metro's operations



Safety

- ✓ Safer operations: reduce staff on roadway, keep trespassers off tracks, reduce track fires



Capacity

- ✓ Increased capacity with faster travel and more trains per hour



Reliability

- ✓ Increase service reliability up to 99%
- ✓ Less physical infrastructure to maintain

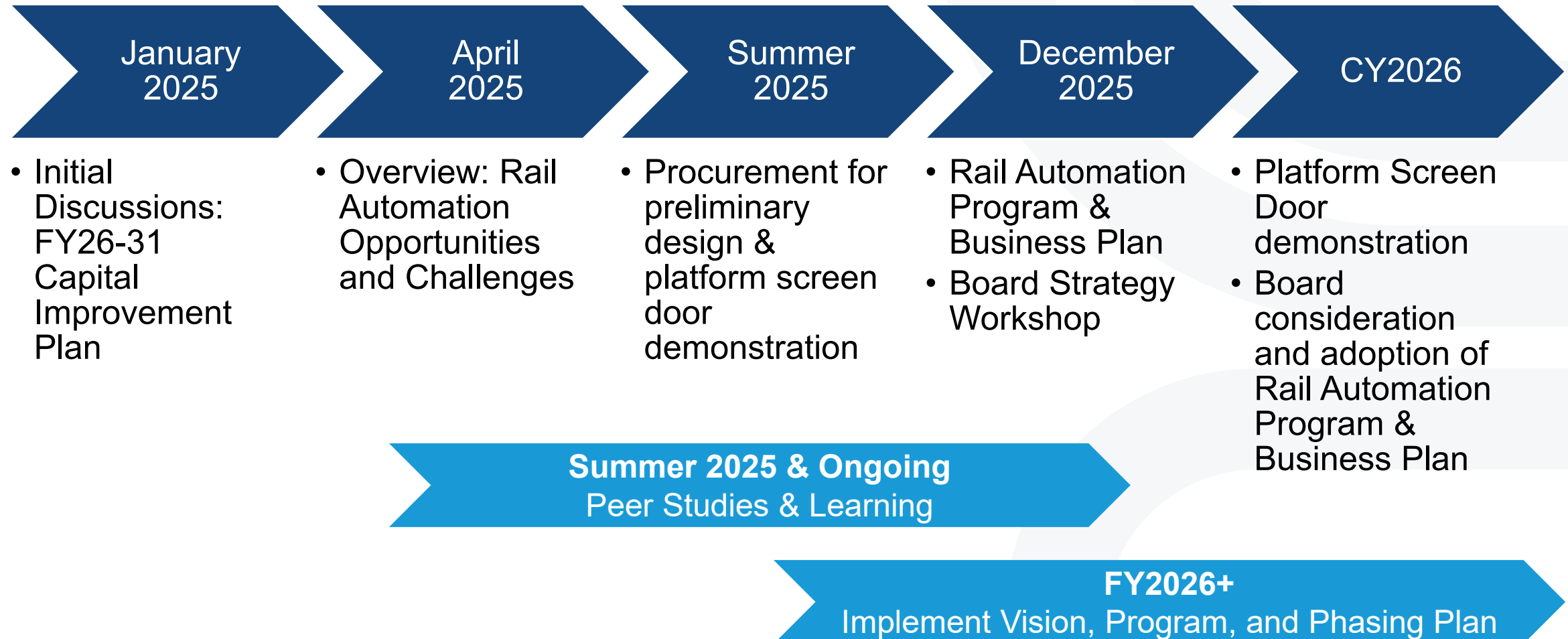


Efficiency

- ✓ More productive service with lower operating costs
- ✓ Grow ridership and revenue

Proposed Rail Automation Timeline

Rail Automation



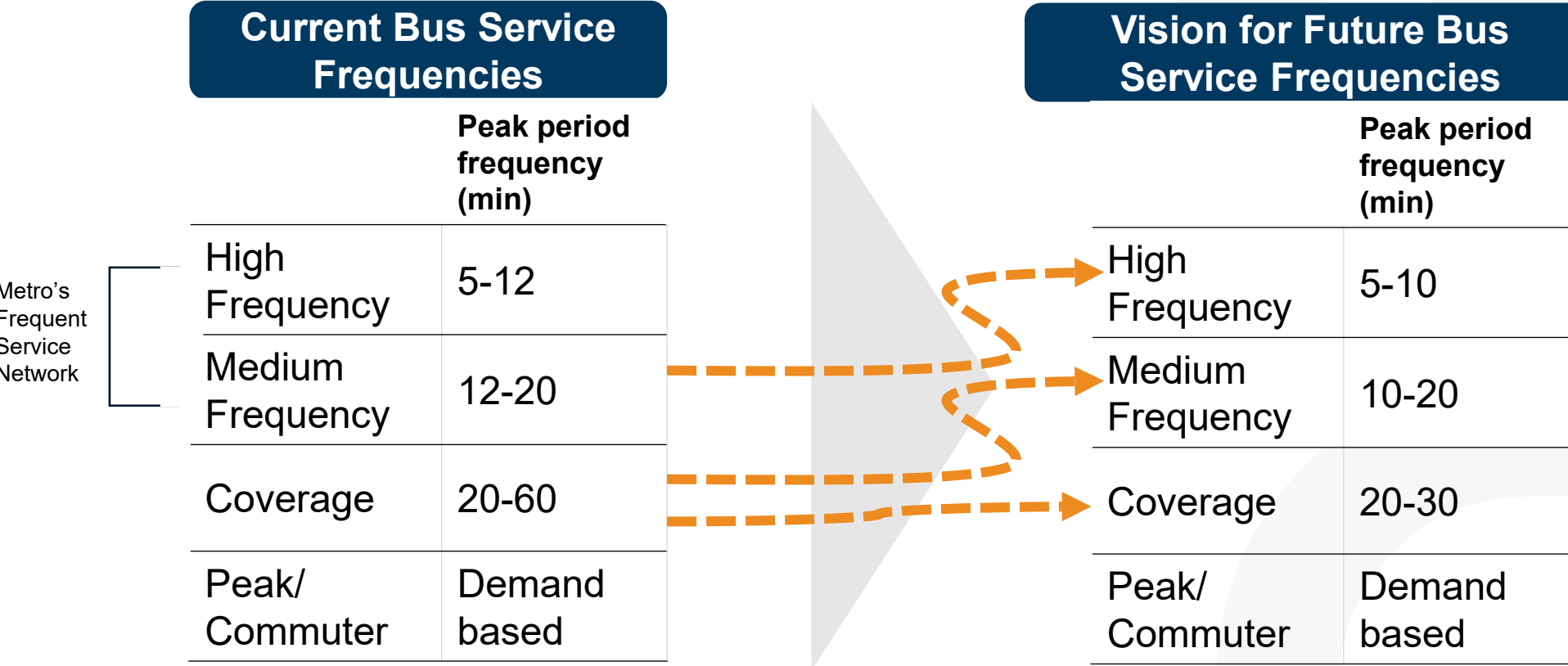
World Class Transit: Frequent Bus Service and Bus Priority

1. Frequent Metrobus service
2. Opportunities and Challenges of Frequent Metrobus service
3. Benefits and Outcomes of Bus Priority
4. Next Steps

Customers respond to frequent service

Frequent Bus and
Bus Priority

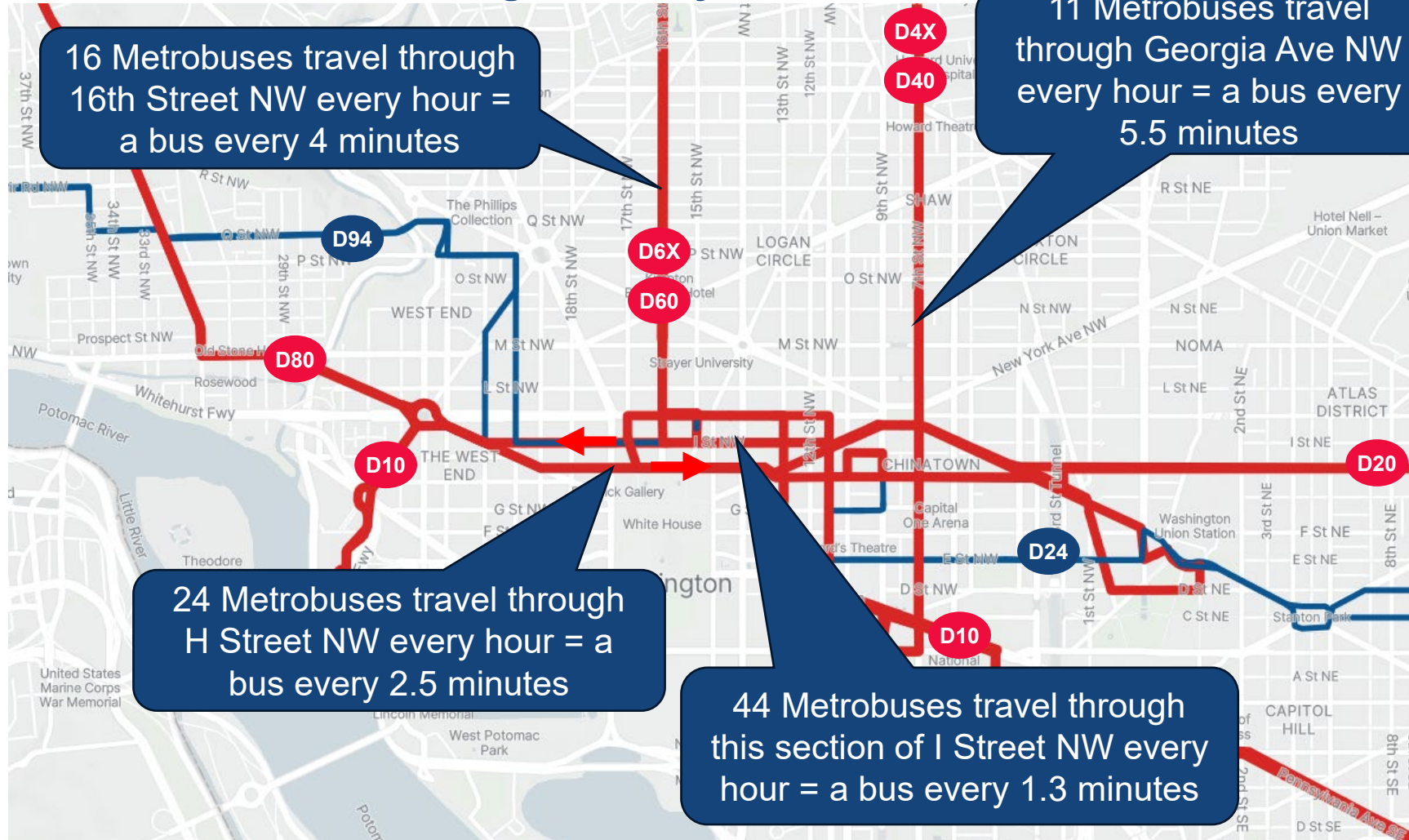
Better Bus Network is adding more frequent service and with additional investment, we can continue to improve access and grow ridership with more frequent service



Interlining multiple routes and operators can create even more frequent service corridors

Frequent Bus and
Bus Priority

Metrobus service during weekday rush hours



- 7 Metrobus routes serve I Street NW
- Service frequency ranges from 6- 20 minutes during peak hours (44 buses total)
- Additionally, OmniRide and other commuter services use H, I, and K street corridors
- Georgia Avenue carries over 23,000 customers daily, almost as many ride the Green Line between Greenbelt and Petworth

On-street infrastructure investments on major roads varies widely

Frequent Bus and
Bus Priority

No Priority

- **Service: 5-20 min peak frequency, 16 hr span**
- Bus Lanes: 0%
- Signal Priority: 0%
- Stop Spacing: 0.2-0.3 mile
- Bus Stop Infrastructure: Shelters



Bus Priority (aka BRT Lite)

- **Service: 5-10 min peak frequency, 16 hr span**
- Bus Lanes: 25 to 50% peak period or all-day, off-set or curb lane
- Signal Priority: 25 to 50%
- Stop Spacing: 0.2-0.3 mile
- Bus Stop Infrastructure: Shelters and potential all-door boarding



Bus Rapid Transit

- **Service: 5-8 min peak frequency, 18-20-hr span**
- Bus Lanes: 50 to 100% exclusive right-of-way
- Signal Priority: 75 to 100% and auto turning restrictions
- Stop Spacing: 0.3-1.0 mile
- Bus Stop Infrastructure: Shelters + Fast, all door boarding



Region's frequent service network provides the highest benefit for bus priority investments

Frequent Bus and
Bus Priority



Customers want **frequent, reliable, and fast** service



High frequency routes (12-mins or better) carry almost **50% of bus customers** daily and have opportunity to grow ridership

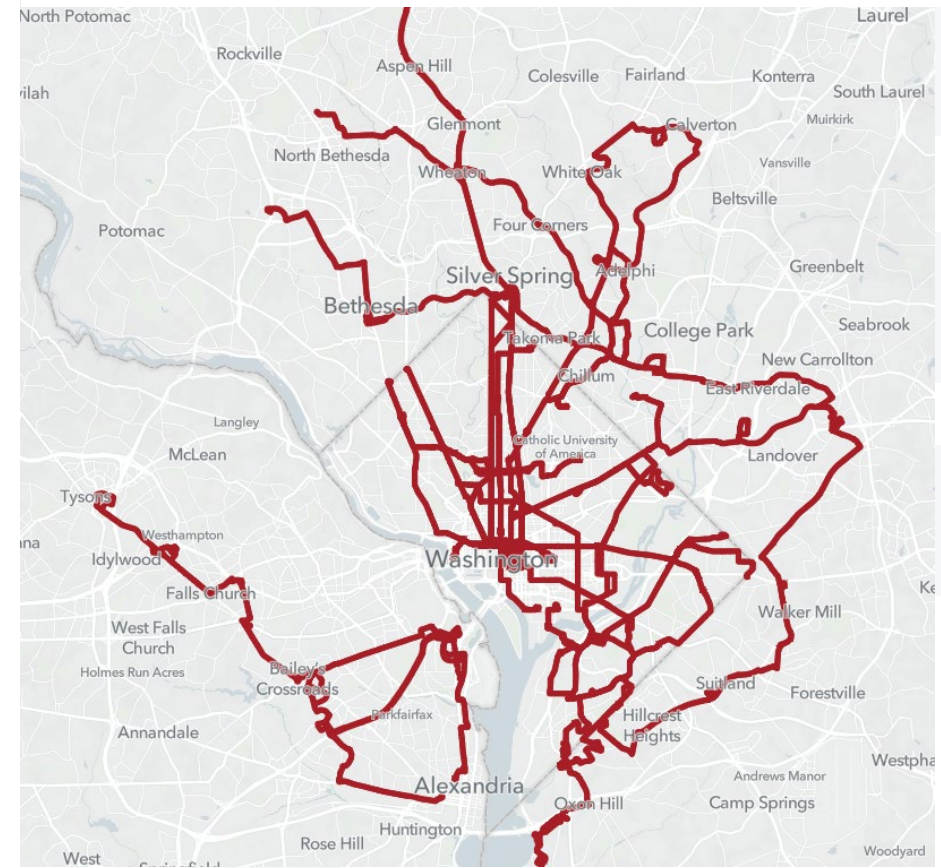


Average **scheduled speeds** are **7-10 mph**, while **actual speeds** may be as slow as **3 mph**



Opportunity to **expand this network** to include additional interlining with local and commuter bus providers

Region's Frequent Service Network of 12-min or better service



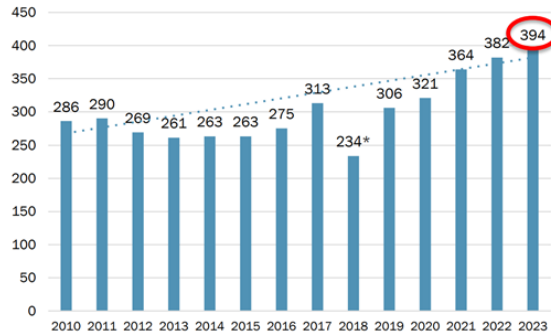
Challenges to maximizing benefits from our frequent Metrobus network

Frequent Bus and
Bus Priority

Safety



TPB Region Fatalities 2010-2023



Our region's streets are increasingly unsafe

- 394 traffic deaths in 2023, a 10+ year high

Reliability



Congestion makes buses slow and unreliable

- **73% on-time performance** on the 12-minute bus network
- **45%** of late trips due to inadequate scheduled runtime or congestion

Capacity



Our streets are underutilized

- **1.1%** increase in congestion between 2019 and 2024
- **Cars are not space-efficient** and can't scale with growth

Efficiency



Slow Metrobus service costs taxpayer dollars

- **\$70M+** annual cost for buses stuck in traffic



Our region's streets and traffic signals can and should **work harder** for transit and bus customers

When congestion makes buses slower, we need more buses to run the same service

Frequent Bus and
Bus Priority

To keep buses
running every...

10
minutes



On a route that takes...

50
minutes



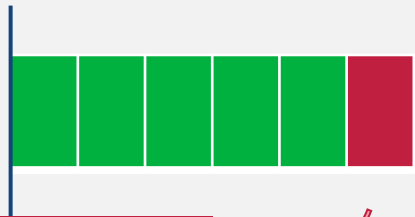
Metro needs to provide...

5
buses and operators



When that service
becomes 10 minutes
slower because of
congestion...

60
minutes



+20%
time penalty for customers

6
buses and drivers

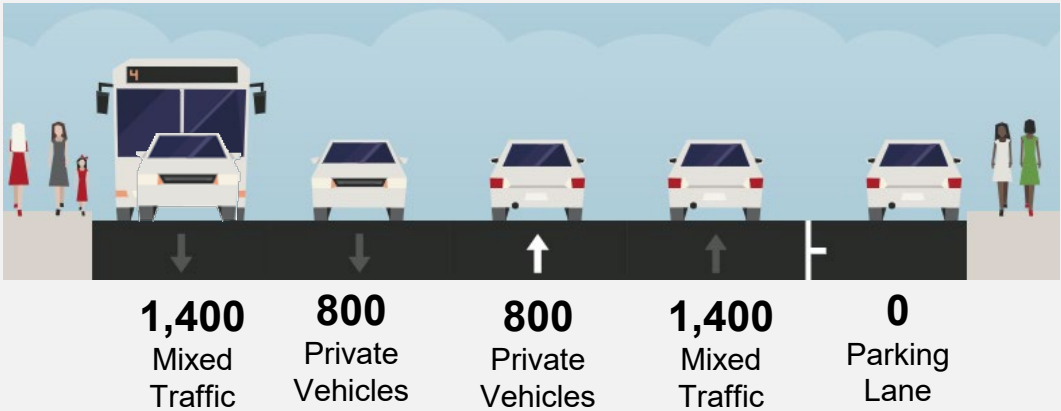


+1
bus to purchase and maintain,
additional bus operator to hire

With dedicated bus lanes, the same street can serve almost 50% more customers

FREQUENT BUSES¹ IN MIXED TRAFFIC

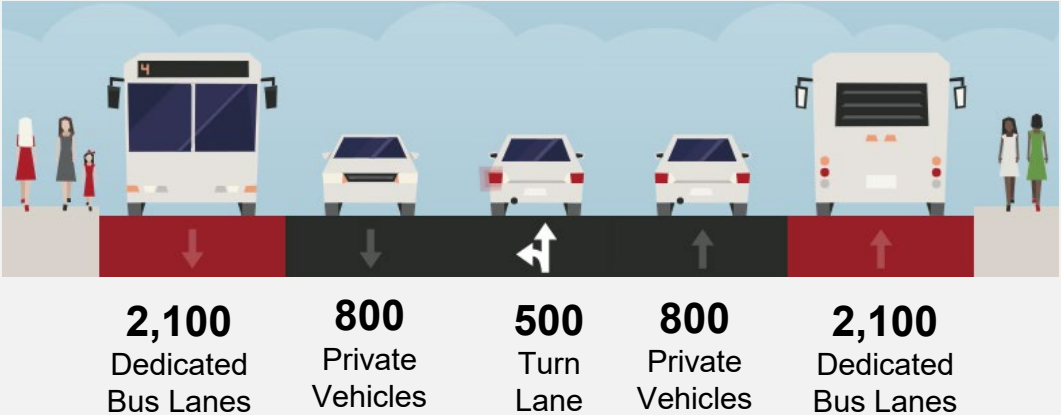
Person Throughput: **4,400** per hour



¹Assumes buses at 6-minute headways

FREQUENT BUSES² IN DEDICATED BUS LANES

Person Throughput: **6,300** per hour



²Assumes buses at 3-minute headways

Investments may vary but length, continuity, and consistency drives speed and reliability outcomes

Frequent Bus and
Bus Priority



16th Street NW (Peak Only Bus Lanes), DC
Frequency: 3 – 4 minutes



RapidRide G Line, Seattle
Frequency: 6 minutes



Livingston Avenue Busway, Brooklyn
Combined Frequency: 2 minutes



Rouen, France (BRT Silver)
Frequency: 2-4 minutes



*Note: Gold, Silver, Bronze ratings via Institute for Transportation and Development Policy Bus Rapid Transit Standard

Bus priority in our region show promise and can do more with coordinated, scalable investments

Frequent Bus and
Bus Priority



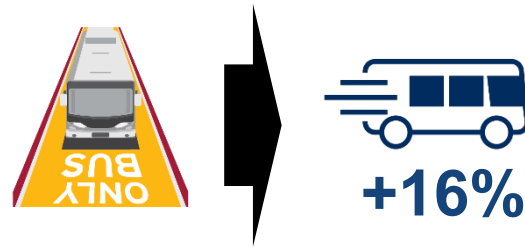
Safety



- **28% fewer crashes** on 16th Street NW (DC)
- **56% reduction in injury crashes** on Pennsylvania Avenue SE (DC)



Reliability



- Georgia Avenue bus lanes **sped up the slowest buses by 16%** (MD)
- **90% OTP on Metroway** compared to the systemwide Metrobus standard of 79% (VA)



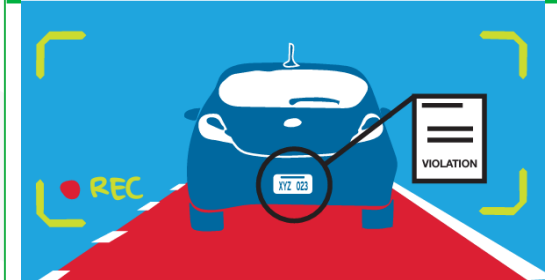
Capacity



Georgia Avenue bus lanes **moved 900 more people** per hour in the same street space with dedicated lane (MD)



Efficiency



- Clear Lanes (DC) improves bus stop access, allowing some paratransit customers to use buses instead of MetroAccess
- *Every paratransit trip that shifts to Metrobus **saves over \$100***

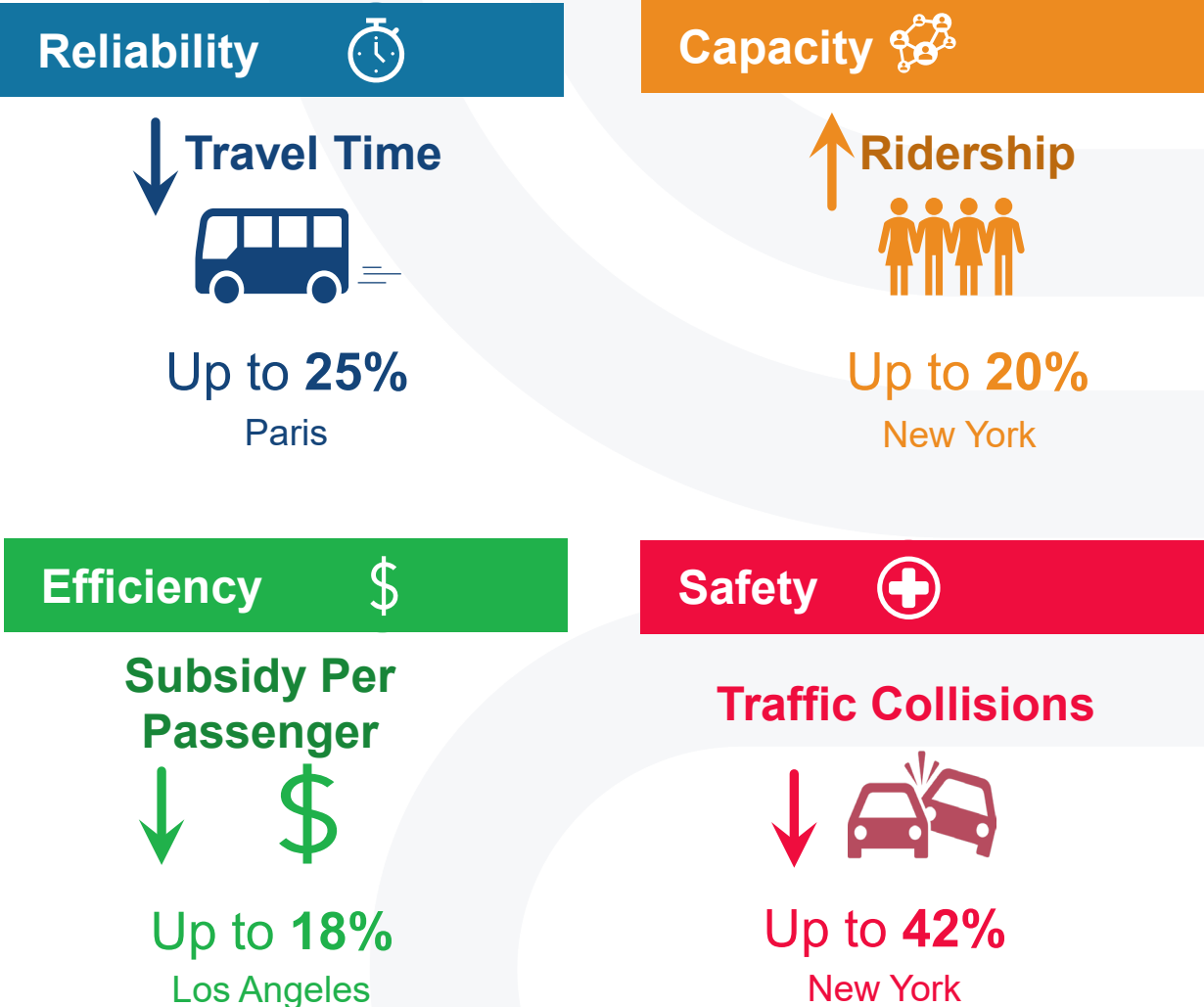
Cities across the world have demonstrated the benefits of bus priority

Frequent Bus and
Bus Priority



Rouen France TEOR Bus Rapid Transit

A **high-quality bus-based transit system** can provide faster, more frequent, reliable service delivered faster and more cost-efficiently



*Note:
Performance outcomes can vary significantly by corridor context and infrastructure investment.

Frequent bus service that is fast and reliable with bus priority is the path to World Class Transit

Frequent Bus and
Bus Priority

Through DMVMoves, develop regional bus priority network and implementation framework that maximizes benefits:



Continuous, enforced bus lanes



Consistent all-day hours



Optimized transit signal priority



Enhanced, widely spaced bus stops

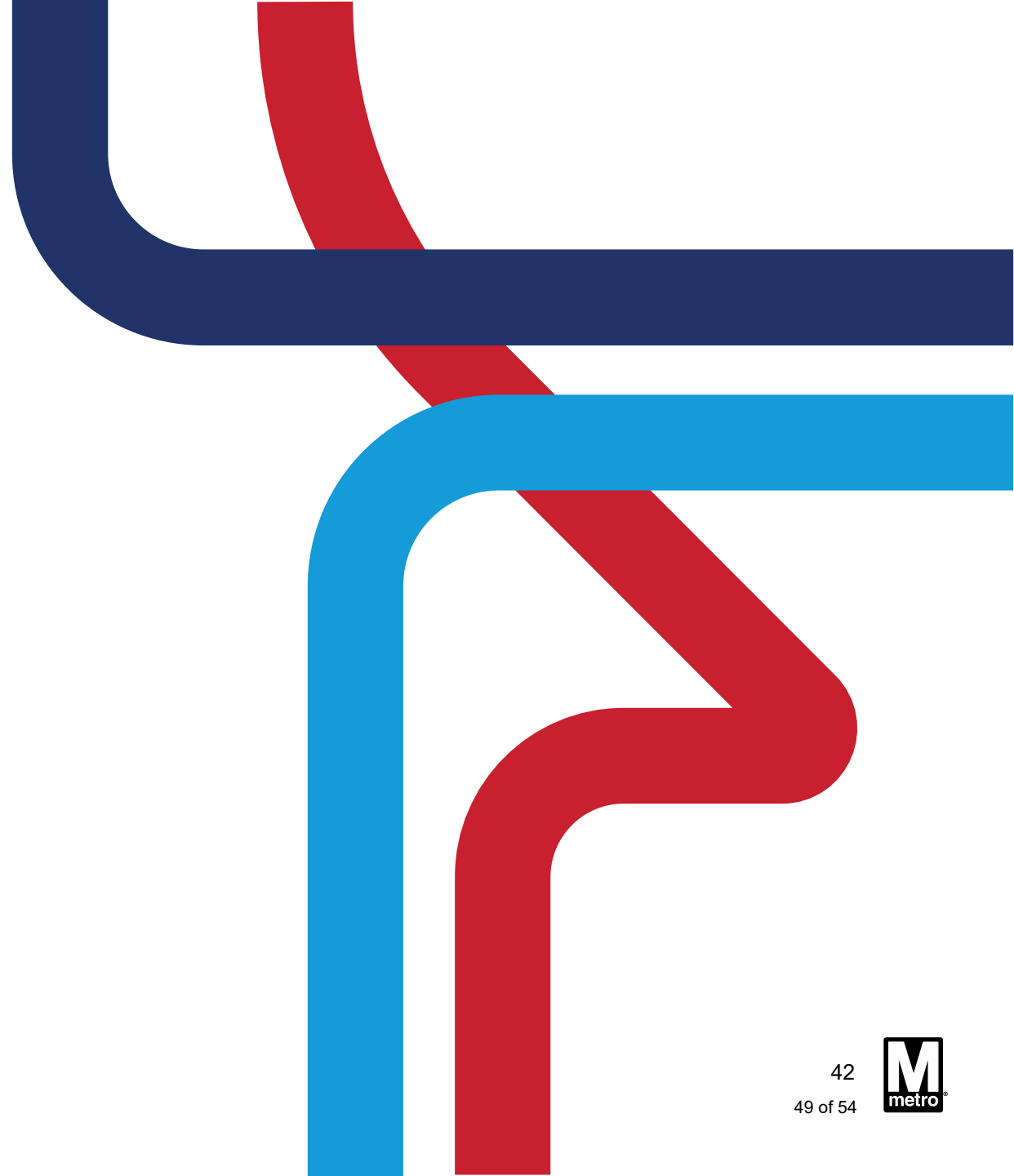


Fast, level boarding

Region's High Frequency Bus Corridors



Applying World Class Transit Solutions to the Blue/Orange/ Silver Corridor

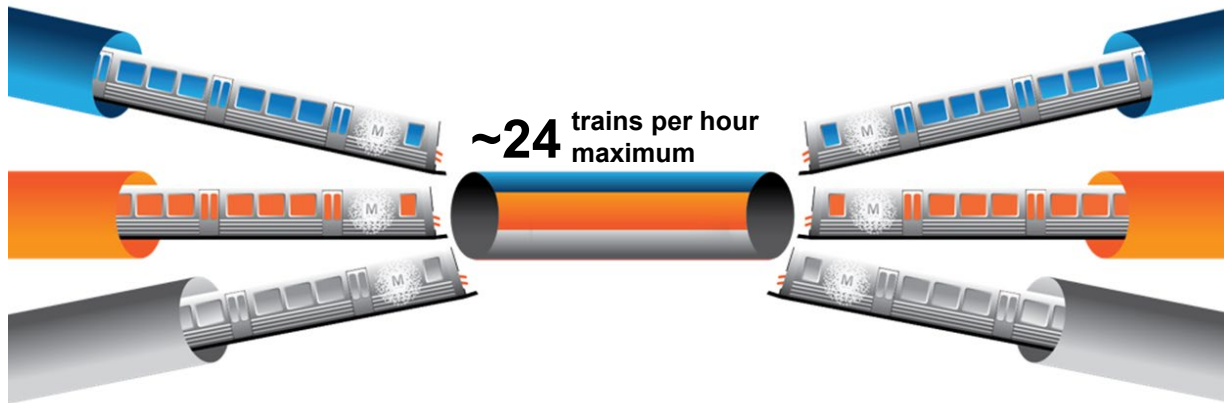


The Blue/Orange/Silver Study focused on addressing capacity and reliability challenges with rail extension

Blue/Orange/
Silver Corridor

BOS Study Purpose and Scope

- Blue, Orange, and Silver lines share a tunnel and tracks between Rosslyn and Stadium-Armory stations
 - *Challenges: reliability and capacity*
- Investigated new rail tunnels and extensions to address these challenges



Option with Highest Benefits: Blue Line Loop

- Separated Blue Line with new tunnel
- High benefits to ridership, capacity, and ability to achieve regional goals
- \$30-\$35B in capital costs and decades of lead time to realize benefits



~\$30-35B over ~20 years

Blue/Orange/
Silver Corridor

Next Steps

Next steps to advance elements of World Class Transit in the DMV

Rail Automation

- Deliver a Rail Automation Program and Business Plan by December 2025, including a vision for automation and lifecycle cost approach
- Advance program delivery readiness – focus program approach on managing costs by using internal capacity to deliver with fewer consultants
- Continue to engage peer systems who have successfully retrofit lines & automated operations

Frequent Bus Service and Bus Priority

Through DMVMoves

- Advance regional bus priority network that connects high frequency bus service
- Develop implementation framework to maximize benefits across region

Blue/Orange/Silver Corridor

- Revise purpose and need to develop new alternative
- Update cost-benefit analysis
- Deliver updated approach by December 2025

Metro's vision for world-class transit

Deliver best-in-class service that maximizes transit ridership and supports a thriving economy

Investments



Fast, frequent service all day/ all week



Modern vehicles, infrastructure, and technology



Integrated customer-focused system

Benefits to Customers, Metro, and the Region



Safer and cleaner system, fewer incidents



Consistent and **reliable** service



Maximize system **capacity**



Deliver **more service with same resources**



Thriving economy



More access to jobs and activities



Enhance quality of life



Grow ridership



Cleaner air