Massachusetts Bay Transportation Authority

Regional Rail Transformation: Boston-Providence EMU Pilot Update

Fiscal and Management Control Board

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Aim of Review

- Summary of feasibility (and levels of risk) for EMU options for the Providence Line that may be available now
  - Issues specific to rolling stock
  - Cost of
    - Infrastructure mitigations
    - Rolling stock modifications
- Also need to consider needs to meet particular delivery timeline:
  - Layover
  - Maintenance facilities
  - Power upgrades to NEC

Background

- EMU RFI was issued January 2020
  - 6 EMU rolling stock manufacturers responded
  - Summary was presented to the Board on June 15th 2020
- MBTA does not currently have EMU specifications
- Typical procurement timeline 5-6 years
  - Consultant onboarding 6-9 months
  - Develop Request for Proposals & performance requirements 6-9 months
  - Issue RFP to notice to proceed 10–12 months
  - NTP to first trainset delivery is 36–42 months
  - 1 year of testing first trainset before revenue service
  - Production – typically 1 trainset per month
- For this assignment reviewed available option orders that may be available for transfer and modification
  - Caltrain version of Stadler KISS – Option A
  - An alternative for comparison Bombardier (Alstom) Multilevel III – Option B

Summary of Areas of Study

Rolling stock

- Horizontal clearance
  - Causes conflict issues at signals, switches and on curves
- HVAC
  - Heating & cooling requirements
- PTC
  - NEC uses Amtrak standard ACSES
- Track Grade
  - Risk derailing on track which does not meet certain geometry and quality standards without truck modifications
- Interior modifications
- Accessibility
  - Interior clearances
  - Toilets
- Regenerative braking and pantograph operation

Supporting Infrastructure

- Vertical Clearance
  - Bridge & tunnel clearance
  - Access to potential layover and maintenance depots
- Power Distribution System
  - Power demands and distribution system requirements
- Maintenance and Layover requirements
  - Electrified Layover location
  - Service and Inspection (S&I) or Light Maintenance Facility
  - Heavy Maintenance Facility
- Station platforms
  - High or mini-high level platforms
    - Platform versus door height
    - Gap to platform
  - Low level platforms
    - Door and step height

Compatibility Summary

Issue	MBTA/Amtrak Requirement	Option A	Option B
Horizontal Clearance	250' radius Nose: 12'9" Composite curve envelope	V S	S
Vertical Clearance	15'11" (MBTA)	I	I
Platform high level	48"	I	I
Platform low level	8"	V I	V I
Track Class and Track Quality	Class 1 or above 4:02 E, F & G, Warp 10' ≤ 1.25"	S I	S I
Platform edge (horizontal gaps)	ADA regulations – 3" max	V	✓
PTC	ACSES / ITCS	V	✓
HVAC temperature range	-18°F - 104°F	V	V
Interior Accessibility	Various ADA, MBTA	V	
Regenerative braking	Until OCS voltage 27.5kV	✓	✓

Modification key

- I Infrastructure
- V Vehicle
- S Specification

Compatibility issue key

- Major
- Moderate
- Minor
- ✓ No issues

Vertical Clearance Summary

Issue	Option A	Option B	Further Action / Details
Number of high risk bridges/structures	1	0	Arlington / Tremont St
Number of wire adjustments	20	3	**Assumes Special Reduced Minimum Clearances** are granted by Amtrak Assumes surge protection is required for all bridges where the minimum clearance cannot be achieved
Number of bridges requiring additional electrical protection	3	0	

Notes

Assessments based on pre-construction drawings for 1994 Electrification project. Current Amtrak vertical clearance standards are informal and based on MBTA Kawasaki bilevel coach. No actual surveyed bridge/wire height data was available as LiDAR survey data has not yet been processed.

Data for routes to potential yards was not comprehensively available and additional survey work or processing will be required

No data available for Signal bridge (mile post 224.05)

Mitigating Schedule Risk

Pilot Step 1

- Service Pattern
  - 2 trains per hour Boston-Providence
- Infrastructure Construction
  - Layover electrification 18-24 months
  - Light Maintenance/S&I Facility 18-24 months
  - Station upgrades 12-18 months
  - Vertical clearance work 6-36 months
- Key Risks
  - Need for more extensive clearance changes to structures/track
  - Need for upgrade works for Electromagnetic Compatibility issues
  - Delays in fleet modification (supply chain/complexity)
  - Environmental approvals for facilities

Pilot Step 2

- Service Pattern
  - Additional frequency or service to Stoughton or Wickford Junction
- Infrastructure Construction
  - Power upgrade 48+ months
  - Additional layover electrification 18-24 months
  - Heavy Maintenance Facility 36+ months
- Key Risks
  - Planning & environmental timescales for power utility upgrades
  - Need for additional upgrade works for EMC issues
  - Factory remobilization and supply chain issues
  - Technology risk for battery modifications

Cost Indications

		Option A	Option B	Comments
Pilot Step 1	Infrastructure cost	$50m-160m	$35m-50m	Clearance work, platform modifications, electrified layover, Light Maintenance Facility
	Rolling stock cost	$225m-270m	$190m-250m	5 – 6 EMU Train sets with modifications
	Total	$275m-430m	$225m-300m	
Step 2 Increment	Infrastructure cost	$40m-120m	$40m-120m	New AC feeder in Boston, additional layover, Heavy Maintenance Solution
	Rolling stock cost	$30m-45m	$40m-55m	Potential battery option or additional cars for short trainset option
	Total	$70m-165m	$80m-175m	
Total cost	Infrastructure cost	$90m-280m	$75m-170m	Costs estimates are planning level estimates only expressed in current prices. Estimates are based on comparable projects with appropriate indexation. Ranges are based on potential variability in scope not contingency or formal risk analysis
	Rolling stock cost	$255m-315m	$230-305m	
	Total	$345m-595m	$305-475m	

Risk Summary

Option A

- Vertical & horizontal clearance issues
- Cost of modifications
- Procurement negotiation
- Federal approval
- Challenge to deliver infrastructure in time (mitigated by step 1)
  - Maintenance facilities
  - Power upgrades to NEC
- Environmental approvals

Option B

- Horizontal (& possibly vertical) clearance issues
- Cost of modifications
- Procurement negotiation
- Pricing risk
- Federal approval
- Some challenge to deliver infrastructure in time to operate step 2
  - Power upgrades to NEC
- Production delays for initial options delay later ones
- Environmental approvals

Conclusion

- Both options require some platform modifications
- Option A
  - Potentially available sooner than other options
  - Modern dedicated EMU design
  - Buy America compliant
  - Potential to add battery for short sections being studied
  - However requires significant modifications
- Option B
  - On similar timeline to starting a procurement now
  - Does not have clearance issues
  - However still requires some modification to platforms
- Pilot (initial step) reduces the risks in either case
- Other options under consideration require *all* high level boarding and/or a longer procurement timeline

Appendix

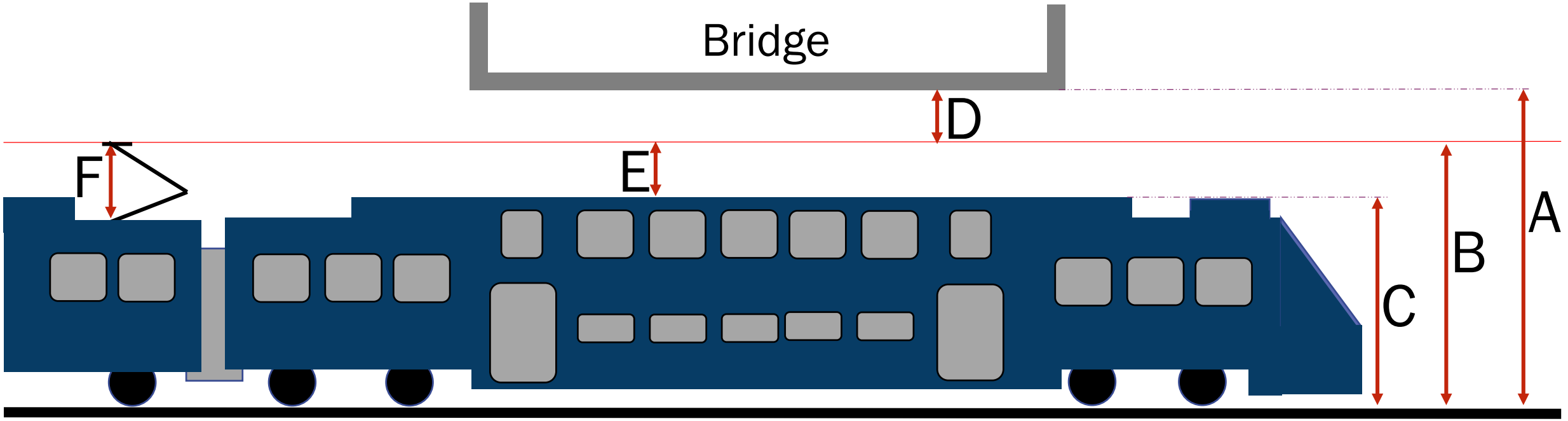
Benefits of the EMU Pilot

- The Pilot will lead to the following benefits, which are currently being quantified:
  - Reduced travel times from a faster more frequent rail service
  - Wider Economic Impacts due to improved synergies
  - Reduced Noise and Air Quality Improvements from newer electric vehicles
  - Improved journey time reliability for customers
  - Reduced Carbon Emissions
  - More cost efficient operation
- High-Level boarding at all stations would:
  - Reduce dwell times,
  - Reduce journey times and reliability
  - Improve safety of passengers and staff (frequent injuries operating traps)
- However, both options have low-level doors, delivering most of the benefits

Compatibility Summary (detailed)

Issue	MBTA Requirement	Option A	Option B	Mitigation
Horizontal Clearance	250' radius Nose: 12'9" Composite curve envelope	288' radius Nose: 18' 2.5" One excursion of 1.6" static	240' radius One excursion of 4.4"	Modified specification - 250' limit not needed
Vertical Clearance	15'11"	16'1"	14' – 9.83"	Modify wire or lower track
Platform high level	48"	50.5"high door	51" high door	Platform Modification
Platform low level	8"	21.85" low door with retracting step	19" low door	Platform Modification
Track Class and Track Quality	Class 1 4:02 E, F & G Warp 10' ≤ 1.25"	Class 3-7 Compliant when Class 3 and above	Class 3-7 Compliant when Class 3 and above	
Platform edge (horizontal gaps)	ADA regulations – 3" max	4"	3"	Factory Modification for Option A
PTC	ACSES / ITCS	IETMS	ACSES	Factory Modification
HVAC temperature range	-18°F - 104°F 100% Humidity	28°F - 105°F	-12°F - 110°F	Factory Heating Modification
Traction Power	25kV	25kV	25kV	
Regenerative braking	Until OCS voltage 27.5kV	Operates on NEC.	Operates on NEC.	

Vertical Clearance Explanation



Key
A – Bridge Soffit Height
B – Contact wire (CW) height above top-of-rail
C – Dynamic train height
D – Contact wire to bridge soffit
E – Contact wire to top of train carriage
F – Minimum operable height of pantograph

Horizontal Clearance Summary

Issue	MBTA Requirement (specification)	Option A	Option B
Horizontal Gauge	Gauge Clearance Envelope	1.6" outside envelope (static)	4.4" outside envelope (static?) [or 3"?]
Maximum curvature	250' radius	288' radius	240' radius
Maximum 'nose'	12'9"	18' 2.5"	Compatible?