Design of Intersections and Pedestrian Treatments for Light Rail

National Highway - Rail Grade Crossing Safety Conference

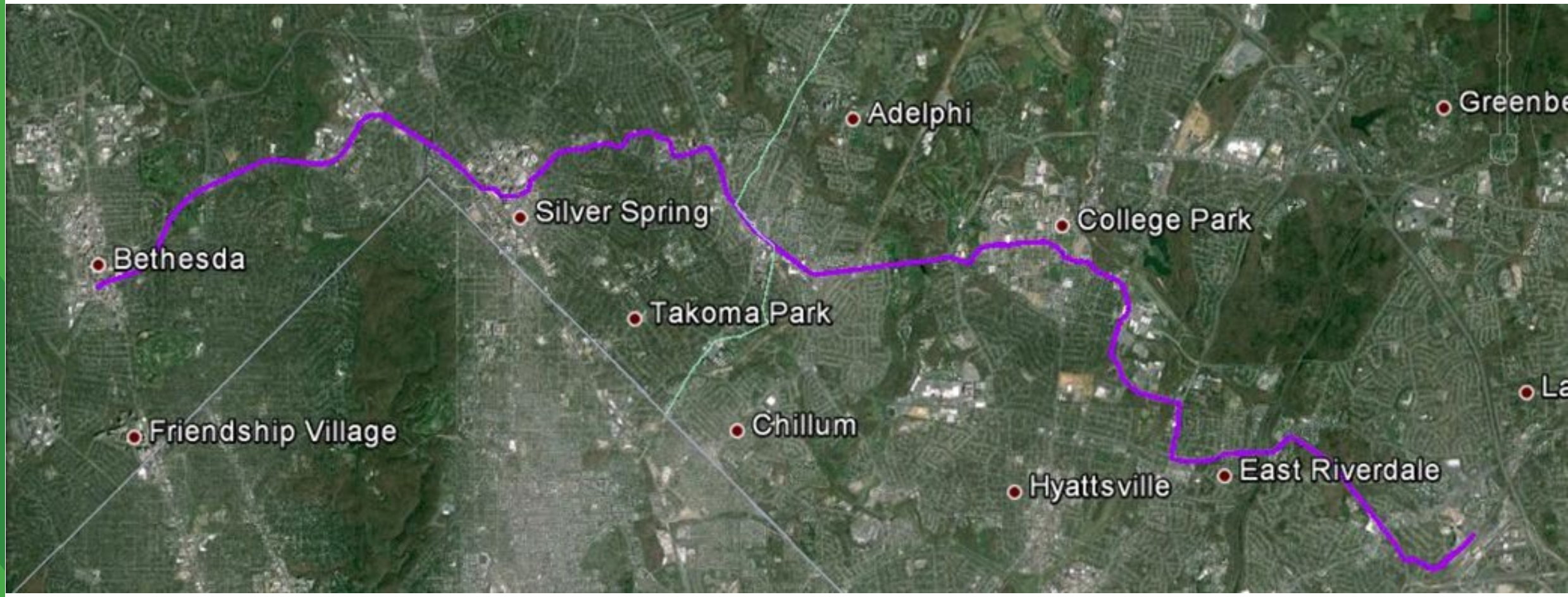
This presentation will address 3 topics on the Purple Line

- The Purple Line Project itself
- Pedestrian Treatments
- Traffic Signal Priority & Preemption

The Purple Line Project

- New 16 mile long Light Rail Transit line in Maryland
- 21 stations
- Connects Bethesda and New Carrollton
- Connects the METRO Rail Red, Green and Orange lines
- Passes through the University of Maryland College Park campus (over 41,000 students)
- Initial projected ridership – 69,000 daily in 2030

Purple Line



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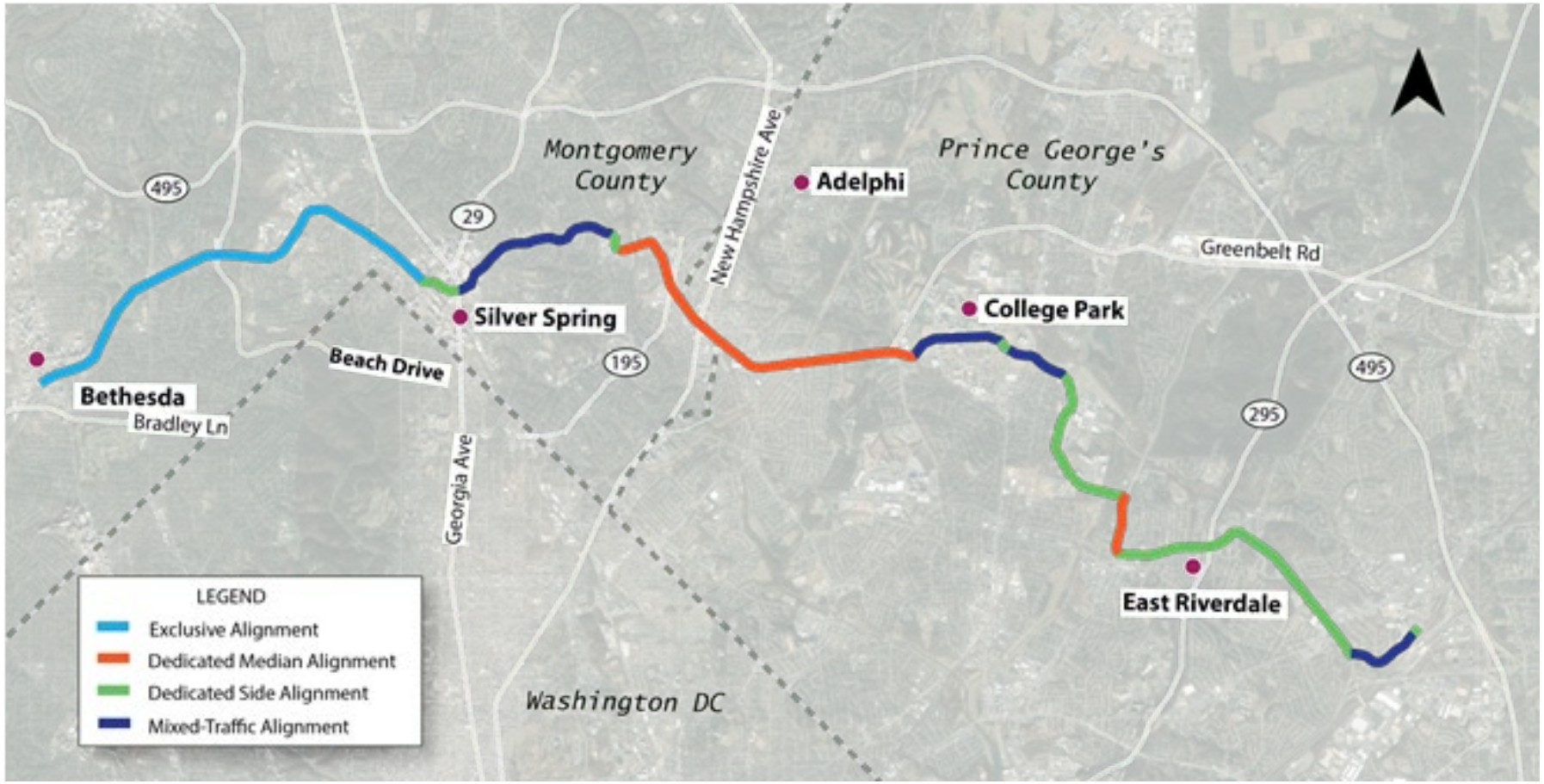
Alignment Types



The Purple Line Project

- Surface running LRT system
- Portions are **exclusive right-of-way** with no grade crossings on an old CSX alignment
- Portions are **semi-exclusive right-of-way**
  - Dedicated corridor
    - Side running
    - Median running

- Portions are **mixed-use right-of-way**
  - Tracks embedded in traffic lanes
  - LRVs operate in traffic lanes with all vehicle types
  - LRT vehicles operate through signalized intersections with rubber-tired vehicles
- All intersections in semi-exclusive or mixed-use ROW are grade crossings (with or without traditional railroad flashing lights and gates)

Mixed-use street running

Semi-exclusive to mixed-use street running transition

Through the center of the UMD campus

Semi-exclusive alignment through a major intersection

Semi-exclusive side running alignment

Pedestrian Treatments
Along the Purple Line

- Intersections
- Sidewalks
- Station Crossings

Pedestrian use and accessibility are major considerations

- Sidewalk grade crossings at signalized intersections
  - Pedestrian signals (hand-man) at signalized intersections where LRVs move with bar signal indications
  - No crossbuck signs

Pedestrian use and accessibility are major considerations

- Sidewalk grade crossings
  - Pedestrian gates where roadway gates are provided
  - Pedestrian sized warning devices
  - Detectable surfaces
  - Pedestrian channelization
  - Another Train Coming illuminated signs
  - Another Train Coming audible warning

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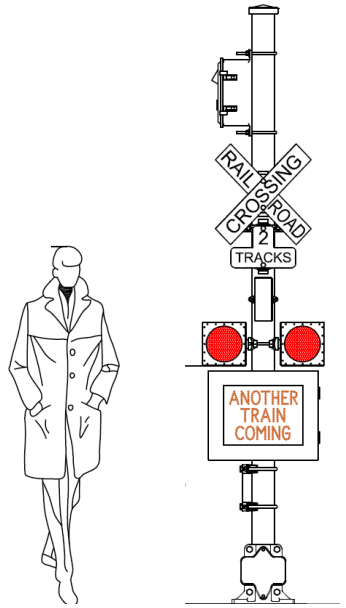
Pedestrian use and accessibility are major considerations

- Station or Pathway grade crossings
  - Pedestrian sized flashing light signals with
  - Another Train Coming illuminated signs
  - Another Train Coming audible warning providing bell and speech message



Progress underway

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Pedestrian use and accessibility are major considerations

- Sidewalk grade crossings at intersections
  - Pedestrian signals (hand-man) at signalized intersections where LRVs move with traffic signal indications.
  - No crossbuck signs

Traffic Signal Priority & Preemption

Traffic Signal Preemption or Priority or TSPP

- **Preemption** – interrupts the normal sequence of the traffic signal to permit the LRV to pass without stopping
- **Priority** – reduces side street green time to serve a LRV but the LRV may (likely) have to stop and wait
- **None** – LRV almost always stops – equal priority as rubber-tired vehicles – sometimes as much as a 3+ minute wait for a proceed bar signal indication

TSPP operations are scattered over 53 signalized intersections in 2 counties under the Maryland State Highway Administration

MDSHA mandated the use of Econolite Cobalt controller units for all signalized intersections

Then Econolite dropped the bomb on us – they were developing a brand-new operating system called EOS – never before operated on the street at a real live intersection – (BTW – They had not yet told MDSHA this)

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Controller Programming and Testing in the Lab

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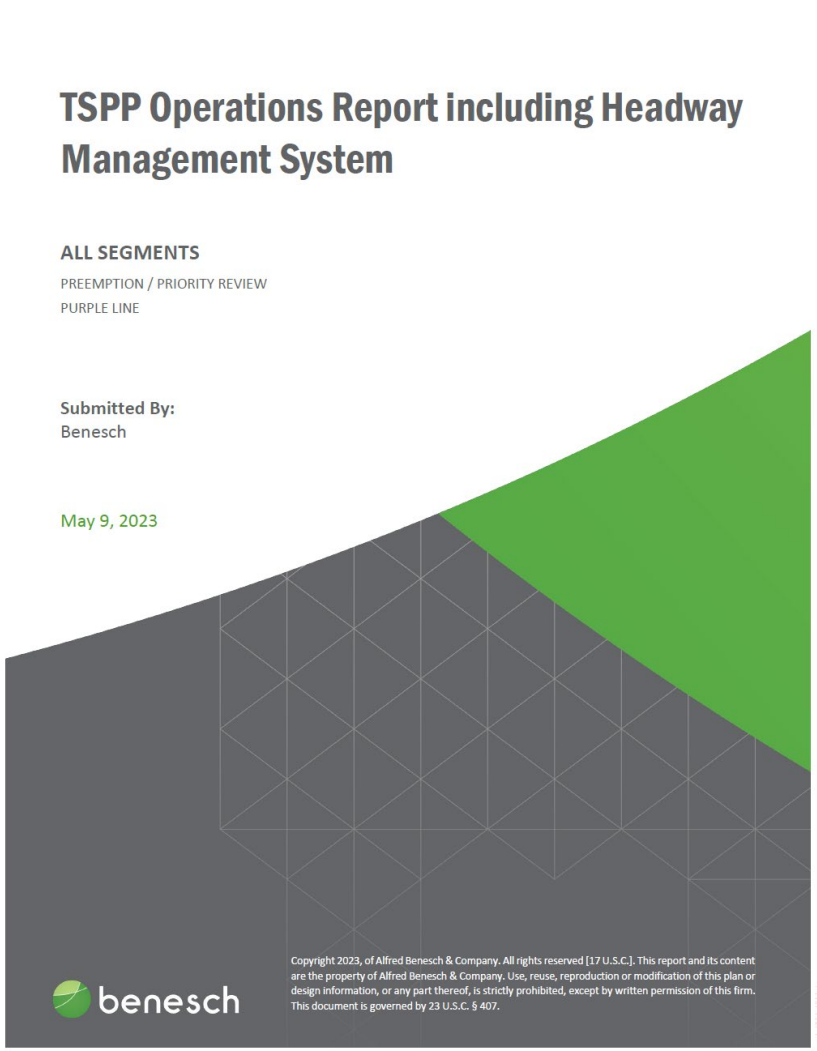
MDSHA was not happy about the project – giving up traffic lanes on busy roadways for LRVs

They did not want LRT system personnel in their controller cabinets

We had to program SYNCHRO timing for the AM and PM peak periods as a part of the TSPP requirements - in a controller that was full of development bugs

Econolite had never developed any priority routines in their earlier products before EOS



Where did we begin?

First, we developed the TSPP Operations Report

- Intersection by intersection
- TSPP operation plan
- LRT signal system requirements

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How did we guarantee success with insurmountable challenges?

We specified an Intelligent Interface Device or the IID

One unit allows us to provide preemption, priority or none operation at each intersection – even change by time of day

Remote programming and monitoring on the Purple Line network – no SHA involvement

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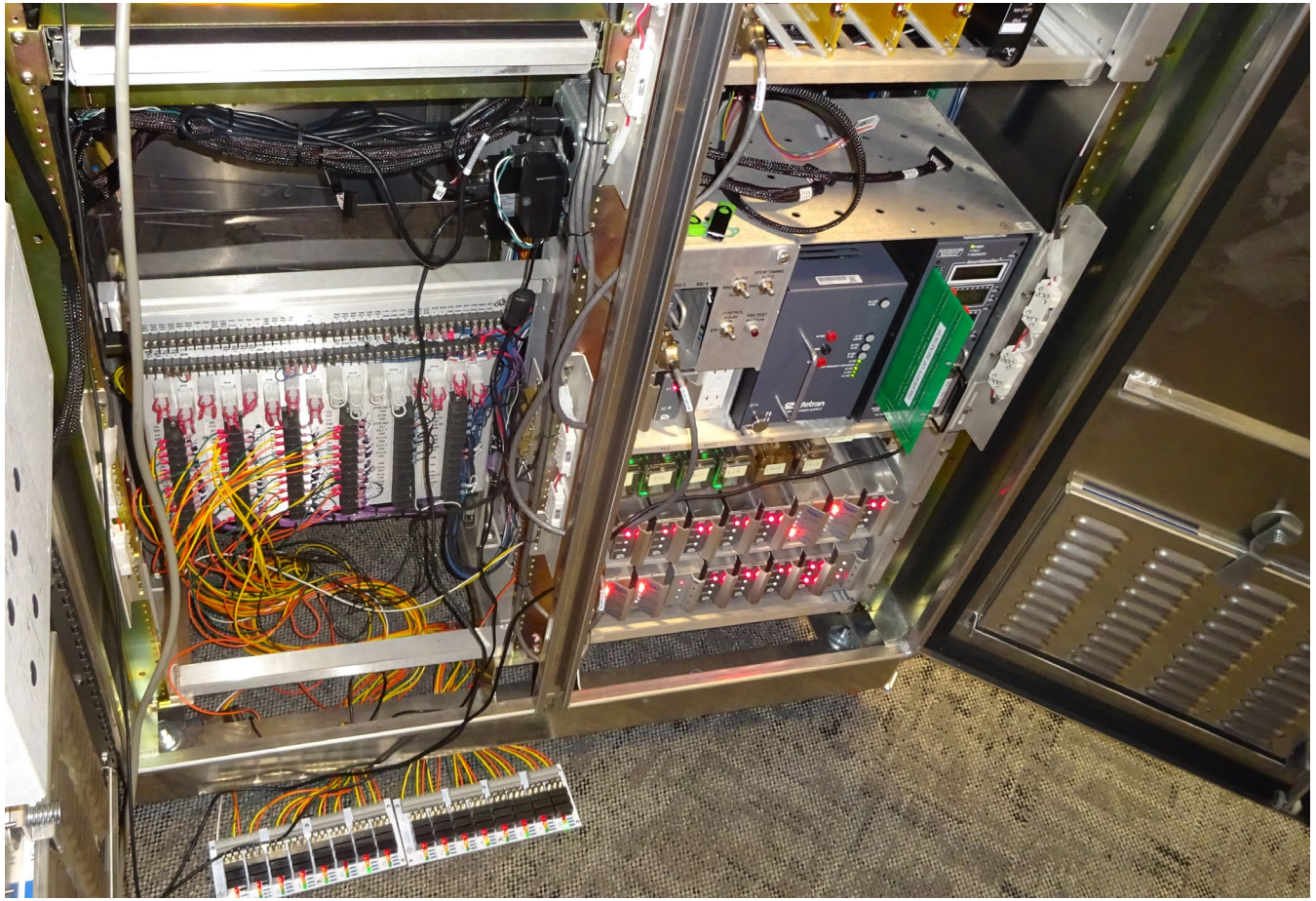

Controller Programming and Testing in the Lab
Verify & Validate Everything

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Controller Programming and Testing in the Lab

Did you notice the title of the Ops Report stated “including Headway Management System?”

The Purple Line will be a headway managed operation instead of a scheduled operation.

Never before implemented in US LRT systems

What exactly is a headway managed LRV system?

- Prevents “bunching” of LRVs at stations due to extended station delays.
- Implemented in BRT systems primaraly by varying bus speeds
- Holds following LRVs in upstream stations
- Significant TSPP impact due to delayed LRVs
- Significant grade crossing impact due to delayed LRVs
- The impacts were unrecognized by preliminary system concept designers

INTERCONNECTION

The following circuits are required for the interconnection between the rail equipment and the traffic signal:

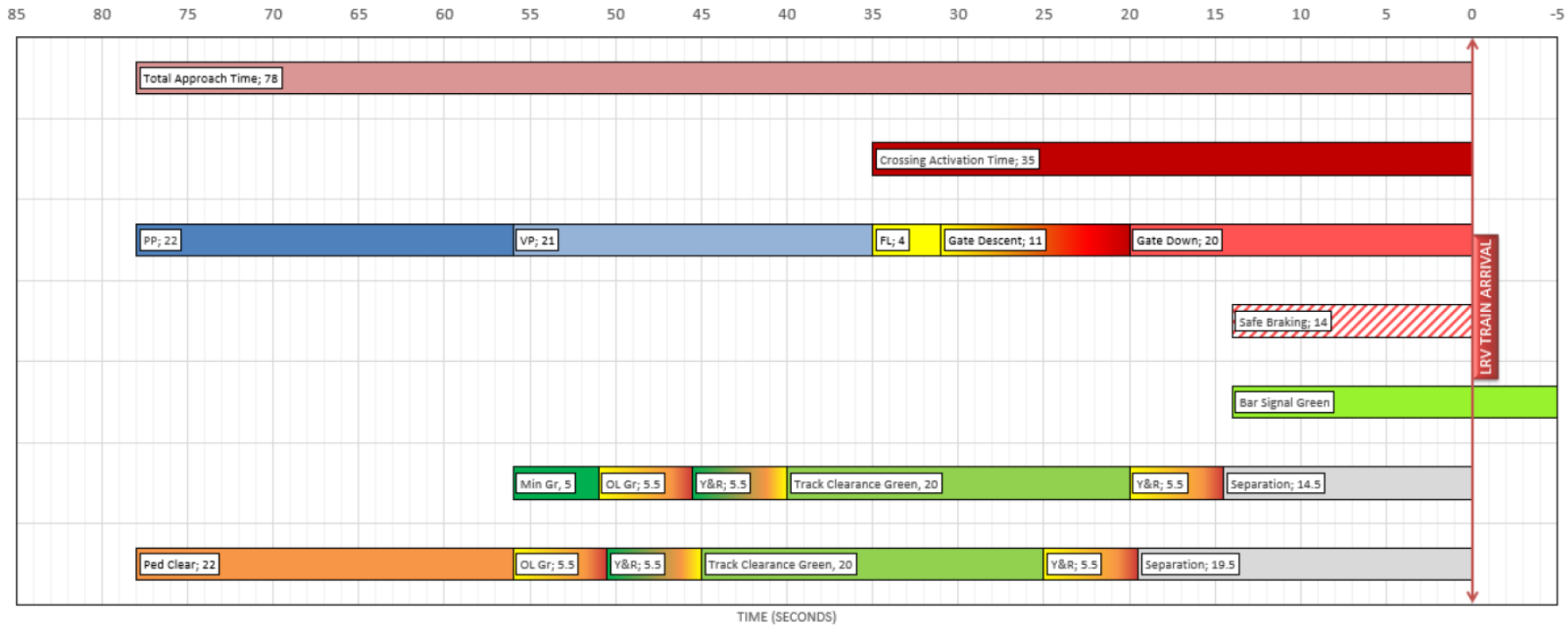
Rail		IID		Traffic Controller	Function
EB T1 & T2 Service Req	->	Eastbound Service Req			Service Request
WB T1 Service Req	->	Westbound Track 1 Service Req			Treated with HMS, activated at HMS <= 30 seconds
WB T2 Service Req	->	Westbound Track 2 Service Req			Treated with HMS, activated at HMS <= 30 seconds
WB T1 & T2 Depart Bit	->	Westbound Service Req			Service Request
		Phase Call	->	Phase Call	Calls Track Clearance Parent Phase
		End of Pre-signal Yellow	<-	Through & Left Turn Phase Yellow	Preemption Trigger
		Background Preemption Call	->	Background Preemption Call	Background Preempt Signal
Train Window	<-	Activate Warning System	<-	Track Clearance Green	Begins Operation of Flashing Lights and Gates
Gate Down	->	Gate Down			Confirms Gates Down
XR	->	XR			Warning Devices Active
Traffic Health	<-	Traffic Signal Health	<-	Traffic Signal Health	For Recording Purposes
Train Go	<-	Bar Signal Proceed	<-	Bar Signal Proceed	For Recording Purposes / ATP Integration

We had a railroad signal system designer that took an ostrich approach to TSPP – just tell us what you want

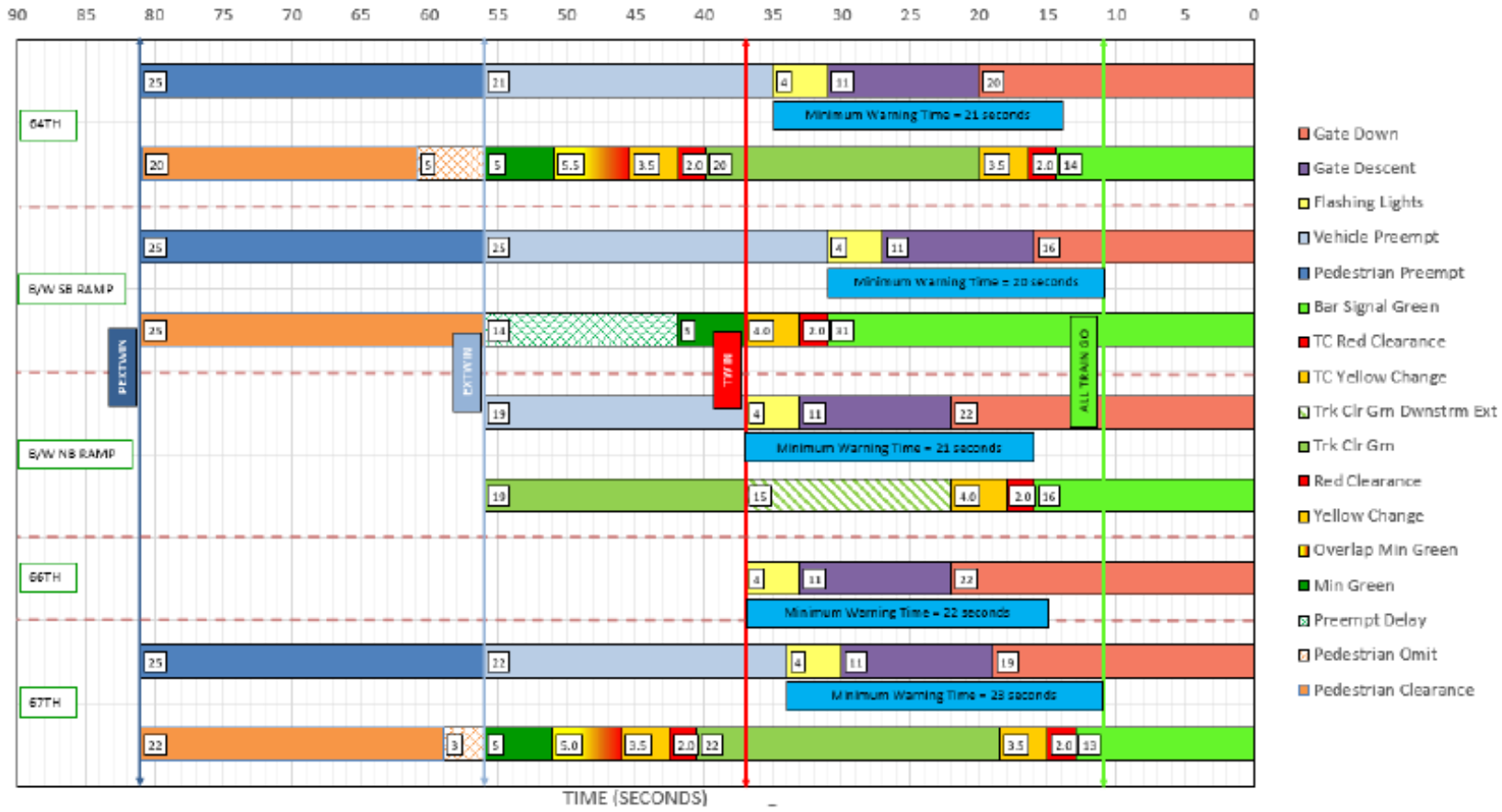
We described the interface between the LRV grade crossing system and the traffic signal controller

THEORY OF OPERATIONS

The advance preemption calls for eastbound and westbound LRVs on track 1 and track 2 should be placed 78 seconds out.



From a simple grade crossing preemption example



To the incredibly complex B/W Parkway Area all based on a single None location

Diagrammed for all to understand

Where are we today?

Test trains are beginning to run

The first 4 intersections are slated to be placed in-service for through runs by the end of April

Revenue service is slated to begin in 2027

Questions / Discussion