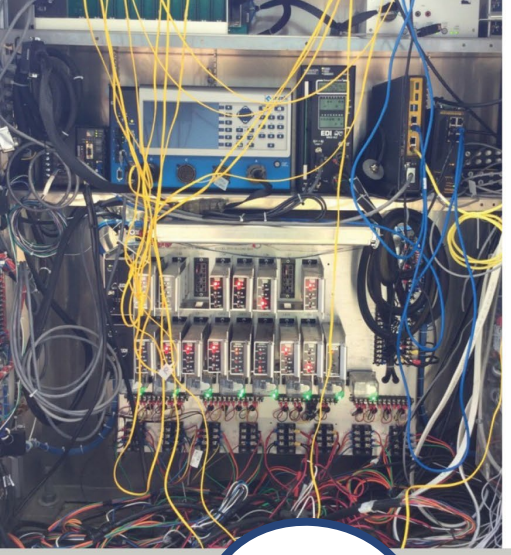


SMART CITIES:

Centralized Transit Signal Priority (TSP) / Emergency Vehicle Preemption (EVP)

A Unified System for Efficient Transit and Swift Emergency Response | June 2, 2026

CITY OF RICHMOND ESTABLISHED 1737

DEPARTMENT OF PUBLIC WORKS

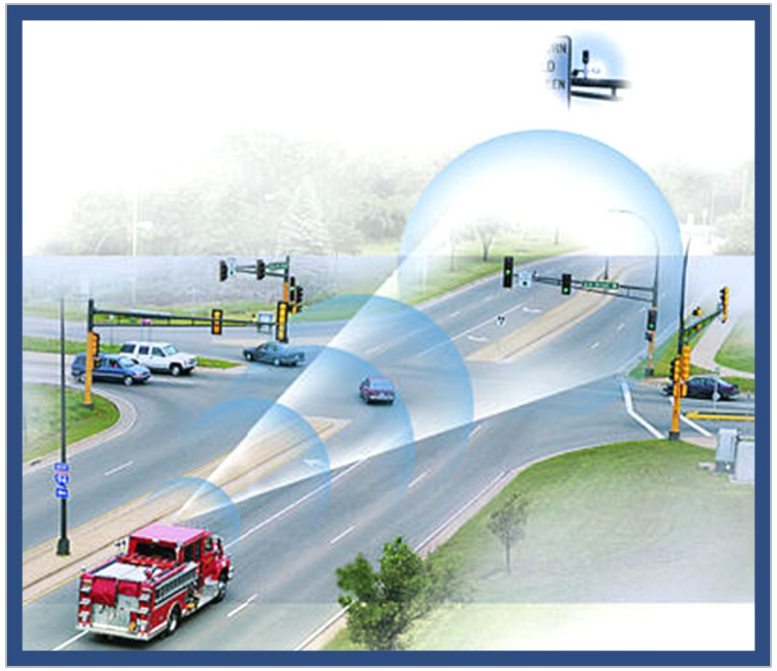
Kimley»Horn

GRTC TRANSIT SYSTEM

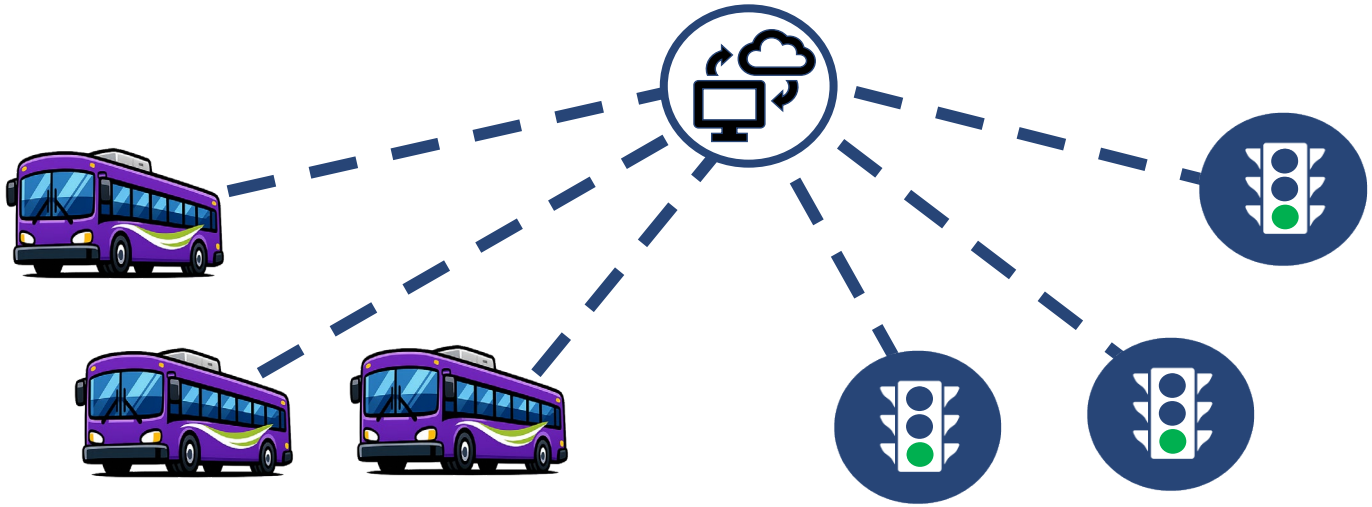
RICHMOND FIRE DEPT SINCE 1858 VIRGINIA

What is a Centralized TSP/EVP System?

- **Traditional Line-of-Sight System**
  - A traditional TSP or EVP system uses field hardware mounted at each traffic signal and on transit or emergency vehicles.



- **Centralized System**
  - The ***centralized*** system makes priority service decisions at a central location which does not require field hardware to be mounted at each traffic signal



Drivers for a Centralized TSP/EVP System

- **Growing system complexity**
  - Expanding BRT and field hardware
  - Increasing operations & maintenance demands
- **Limited resources, scaling operations**
  - Small staff with an ever-growing system
  - No existing EVP system
  - Need for better multimodal operations
- **Today's scale**
  - 485 signalized intersections | ~85 miles of fiber | 13 full time staff

Project Stakeholders: Organization Chart

GRTC
Greater Richmond Transit Company

Clever Devices
CAD/AVL

RDOT
Richmond Department of Transportation

Kimley-Horn
Owner's Representative and Technical Advisor

Econolite
Centracs Mobility and Centracs Priority

DIT
Department of Information Technology

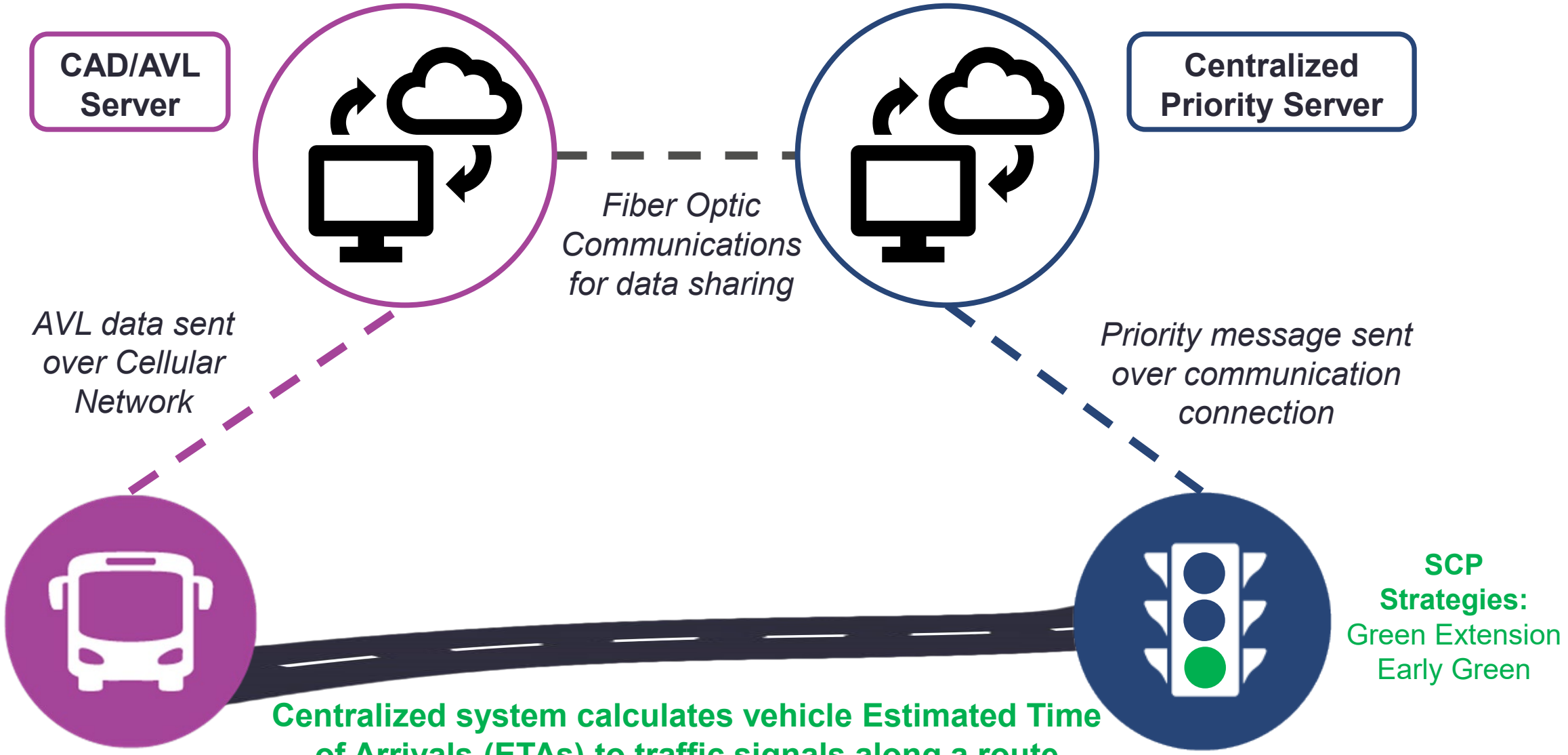
DECPR
Department of Emergency Communications, Preparedness and Response

RFD
Richmond Fire

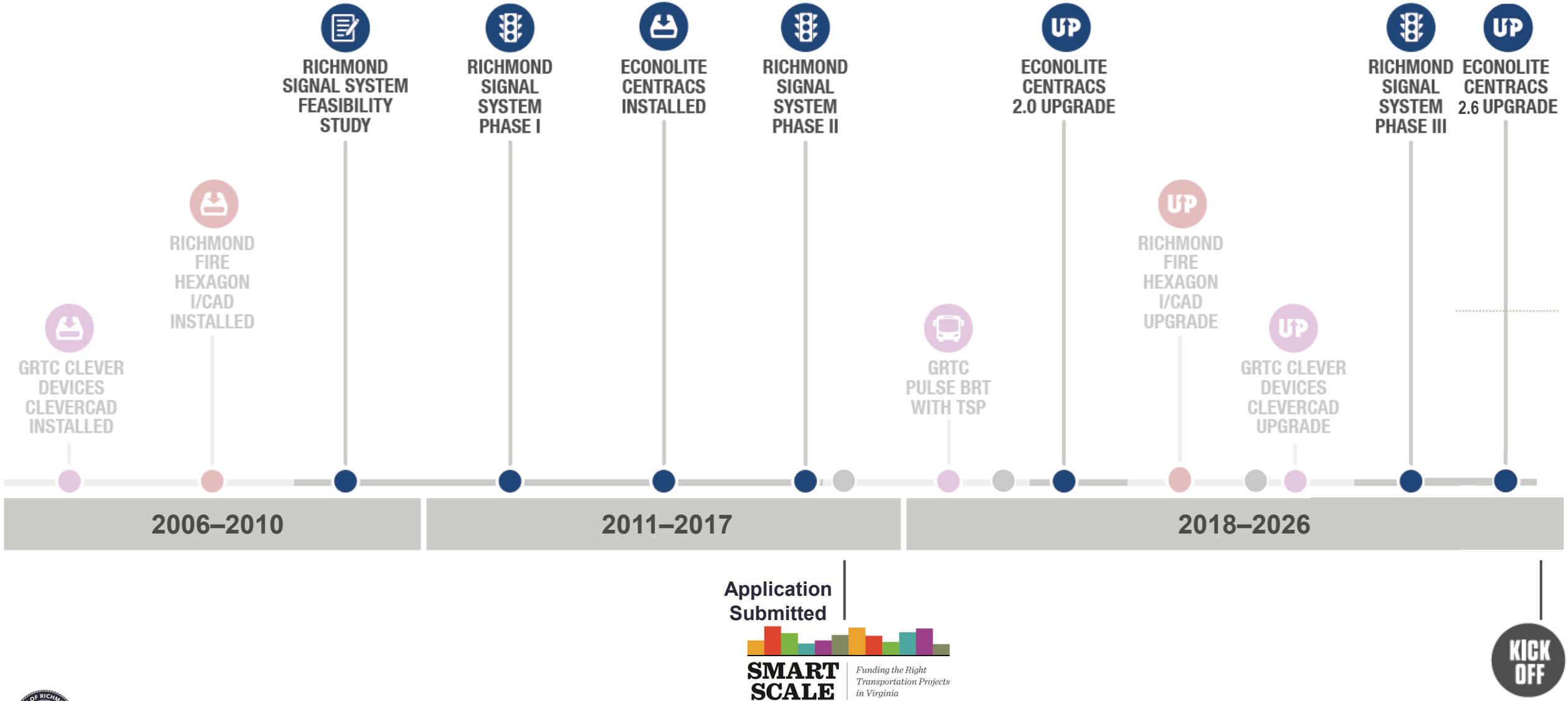
Hexagon (Octave)
CAD/AVL

Who has engaged with transit / emergency response / IT agencies on transportation projects?

Concept of Operations Example: Centralized TSP



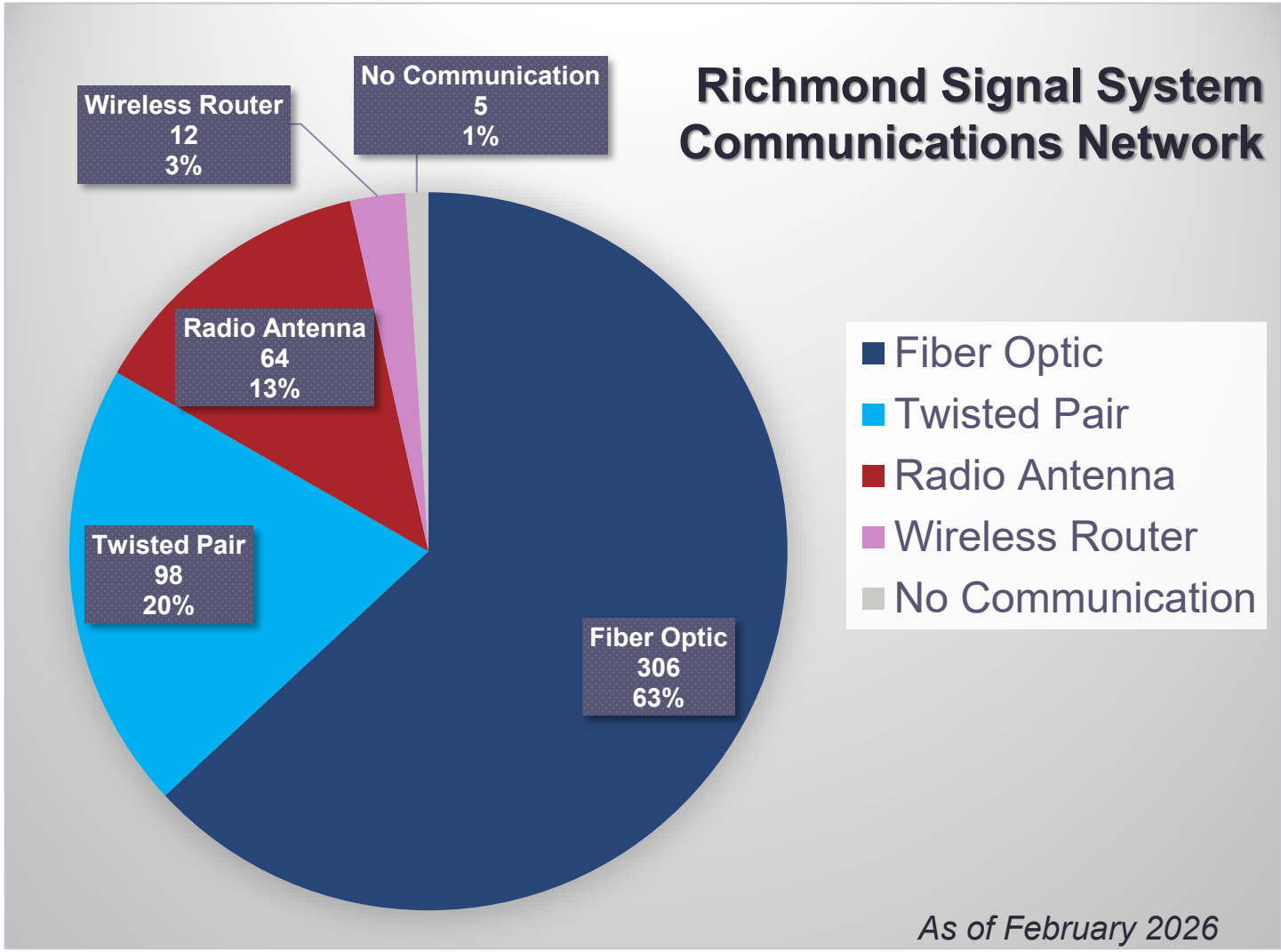
Preparing for this project didn't happen overnight...



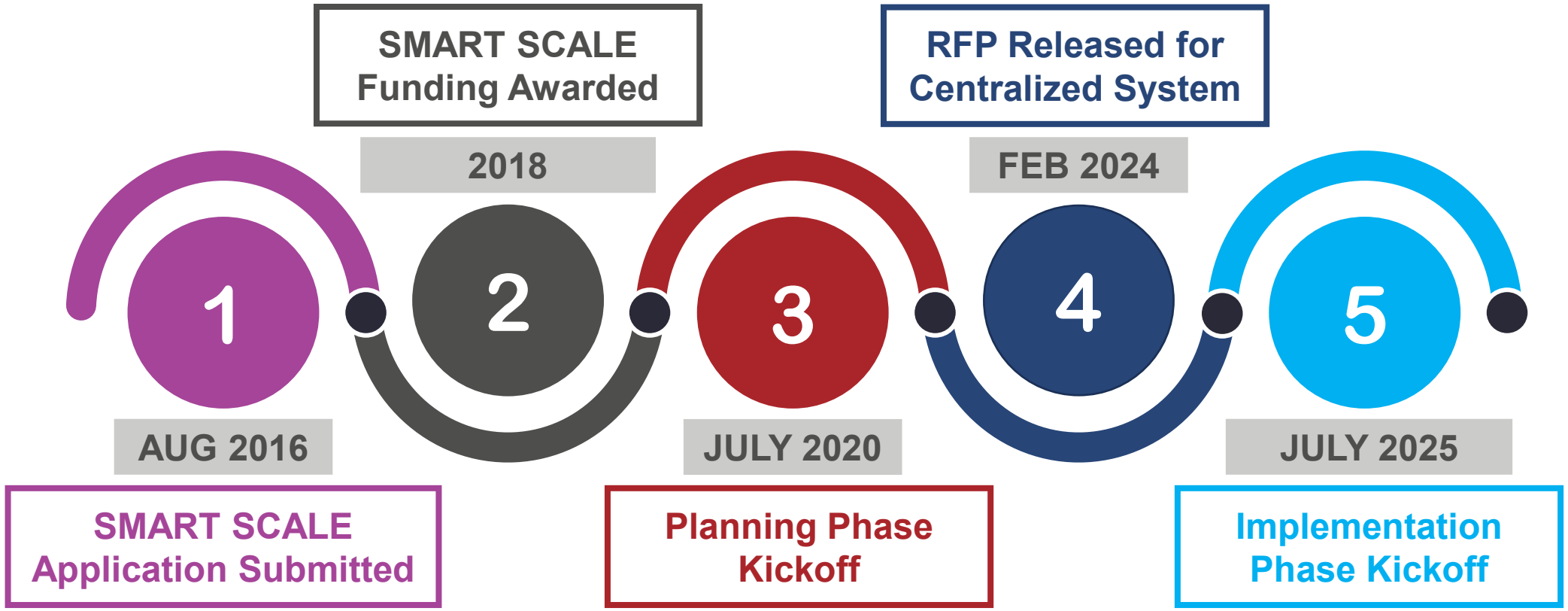
Richmond Signal System Architecture Overview

Fast Facts

- 485 traffic signals in Richmond
  - 480 connected (99%)
  - 306 connected via fiber (63%)
- Existing ATMS: Econolite Centracs
- Ongoing signal system upgrades
  - Cobalt EOS controllers
  - Centracs Mobility
  - ATSPM
  - Cabinet modernization



Project History

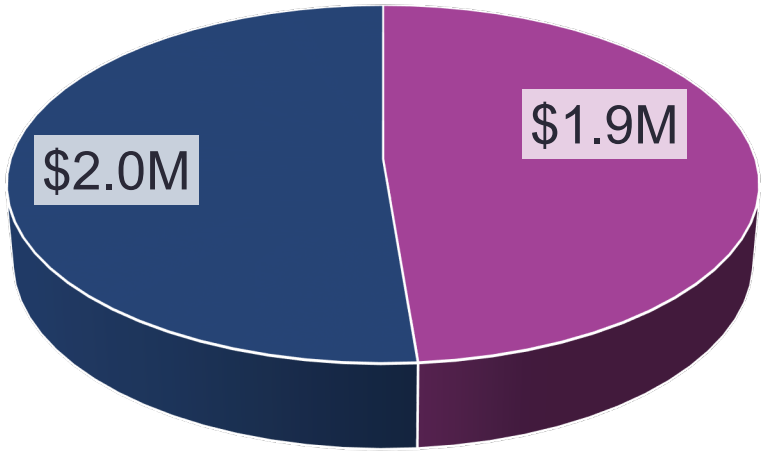


SMART SCALE
Funding the Right Transportation Projects in Virginia

The Funding Puzzle

- Preliminary Engineering and Construction phases funded through SMART SCALE 🤝 Richmond CIP

Funding Source (Millions of Dollars)



- SMART SCALE
- Richmond CIP

VDOT Virginia Department of Transportation — Six-Year Improvement Program

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All Projects | Major Projects | MPO | Fund | Reports

Line Item Details

Project Summary

UPC	111701
Project	#SMART18 - SMART CITIES: CENTR. TRANSIT SP / EV PREEMPTION
Scope of Work	Safety
Description	FROM: various TO: various
Report Note	
Fund Source	

Project Location

District	Richmond	Jurisdiction	Richmond
Road System	Urban	Length	0.0600 MI
Route	U000	Street	Broad Street
MPO Area	Richmond		

Estimates & Schedule

	Estimated Cost (Thousands)	Schedule
Prelim. Eng. (PE)	$219	Complete
Right of Way (RW)	$0	N/A
Construction (CN)	$3,696	Underway
Total Estimate	**$3,915**	

Required Allocations

Fund Sources	Previous Allocations	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Required After FY2031
	Values in Thousands of Dollars							
District Grant Program: Federal	$1,911	$0	$0	$0	$0	$0	$0	
Other Funds: Other	$2,004	$0	$0	$0	$0	$0	$0	
Total Funding	**$3,915**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

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Phased Implementation Plan Process

ECONOLITE CENTRACS CENTRALIZED TECHNOLOGY RESEARCH

- Assess functionality of the Econolite Centracs Priority technology

FALL 2020

PROJECT STAKEHOLDER FUNCTIONALITY REVIEWS

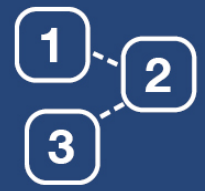
- Review existing signal, transit, and fire department system infrastructure
- Conduct needs assessment

WINTER 2020-21

AGENCY PEER REVIEWS

- Compile lessons learned from peer agencies operating an Econolite Centracs Priority system (Charlotte, NC and Nashville, TN)

WINTER 2020-21



PHASED IMPLEMENTATION PLAN

- Identify challenges and needs
- Develop recommendations and timeline

SPRING 2021

Project Benefits

- Improved emergency vehicle response time

- Reduced maintenance burden for citywide functionality

- Improved transit on time performance and increased ridership

- Improved multimodal safety across the City

- Optimized and efficient signal operation
- Reduced vehicle emissions and fuel consumption

System Design: Providing Priority

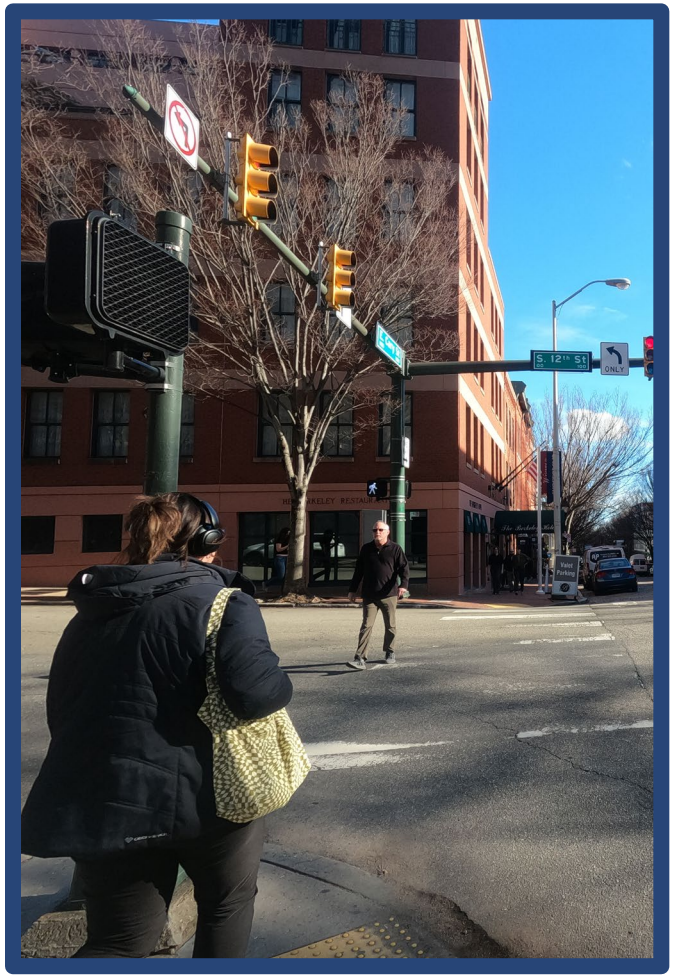
- Allows for TSP and EVP operations via a **Signal Control and Prioritization** (SCP) software system
- SCP system offers up to **10 configurable levels** of priority operations

Level 10
Less aggressive signal strategies (e.g., extended green only)

Level 1
More aggressive signal strategies (e.g., skipped phases)

System Design: Prioritizing Pedestrians

- Challenge: how can we *prioritize* pedestrian safety while granting *priority* service?
  - TSP 🚌: all riders are pedestrians at the start and end of their journey
  - EVP 🚒: there are safety risks to skipping pedestrian intervals in efforts to optimize EVP signal strategies
- Outcome: configurable priority service strategy *aggression* based on vehicle type
  - Guiding principle: consistency with pedestrian expectation



VISION ZERO
RICHMOND, VIRGINIA

System Design: Determining Richmond Fire Priority

Key lessons learned from Firefighters:

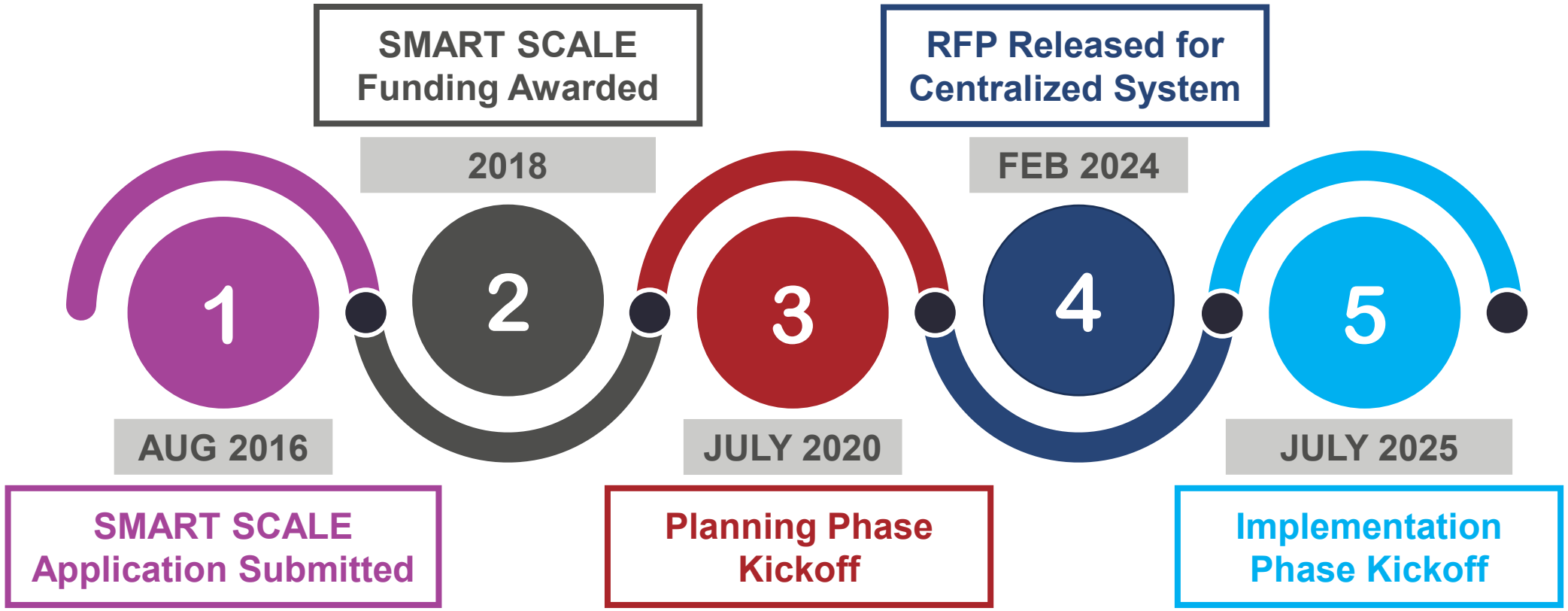
1. They rarely use GPS: mental map > GoogleMaps
2. They constantly adapt to changes in traffic
3. The “destination” is complex: aim to arrive at a specific side of a building, or closest hydrant
4. Each fire apparatus is a unique design vehicle

System Design: Determining Richmond Fire Priority

Outcome: EVP as *"The Silent Assistant"*

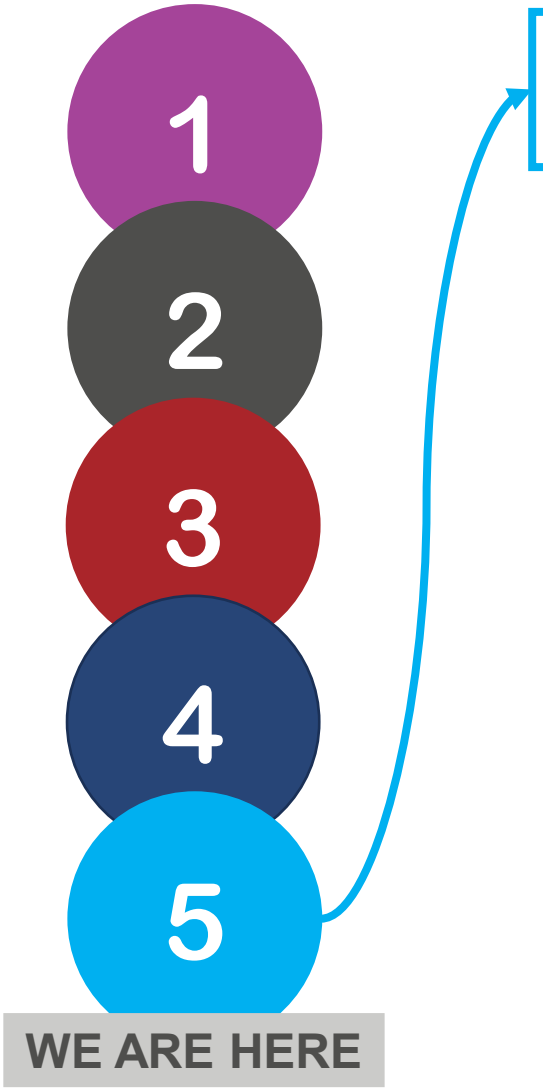
1. No change to existing operations
2. System should adapt to ad-hoc routing
3. Expected improvements to incident response times as operators learn which corridors give a "green wave"

Implementation Schedule and Next Steps



SMART SCALE
Funding the Right Transportation Projects in Virginia

Implementation Schedule and Next Steps



Implementation Phase

June 2026

- Finish software ecosystem upgrades
- Integrate vehicle data
- Configure test corridor
- Finish software development

Late June-December 2026

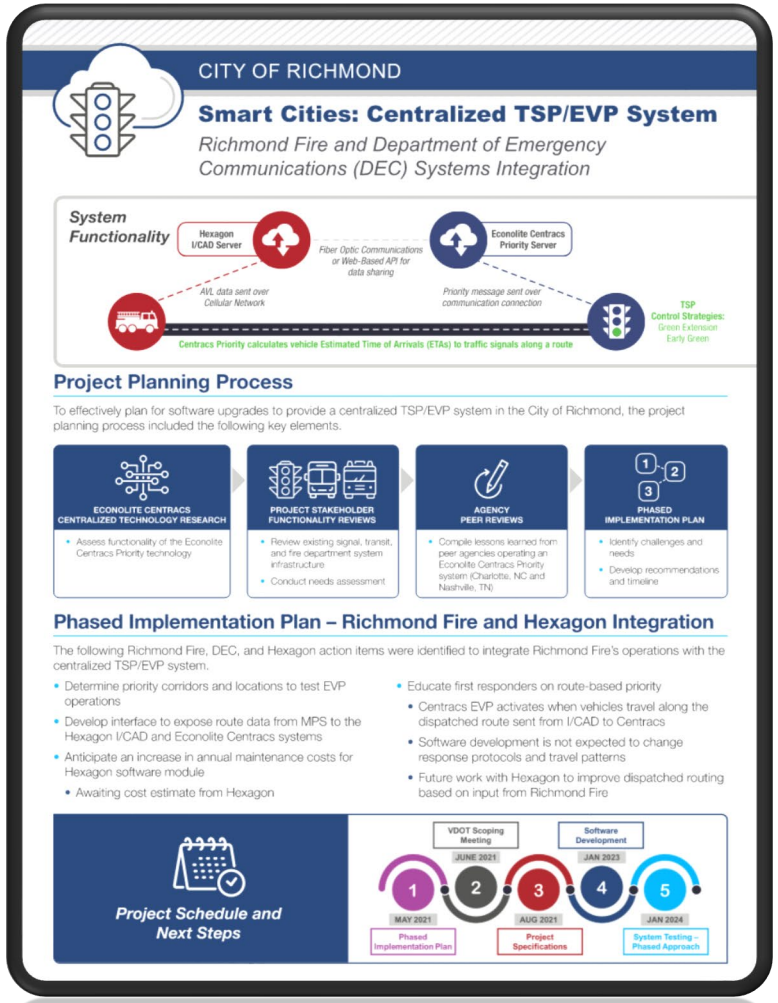
- System testing

Lessons Learned: Planning Phase

- Proactively identify the technology “backbone” needed to enable centralized SCP

  Key components: reliable communications network, modern controllers, high-frequency (≤5 sec.) data polling, coordinated signal system timing

- Engage IT, transit, and emergency services leadership from the start
- Develop an operations and maintenance plan to keep the signal system operating


CITY OF RICHMOND

Smart Cities: Centralized TSP/EVP System

Richmond Fire and Department of Emergency Communications (DEC) Systems Integration

System Functionality

Hexagon I/CAD Server

Econolite Centracs Priority Server

Fiber Optic Communications or Web-Based API for data sharing

AVL data sent over Cellular Network

Priority message sent over communication connection

TSP Control Strategies: Green Extension, Early Green

Centracs Priority calculates vehicle Estimated Time of Arrivals (ETAs) to traffic signals along a route

Project Planning Process

To effectively plan for software upgrades to provide a centralized TSP/EVP system in the City of Richmond, the project planning process included the following key elements.

ECONOLITE CENTRACS CENTRALIZED TECHNOLOGY RESEARCH
- Assess functionality of the Econolite Centracs Priority technology

PROJECT STAKEHOLDER FUNCTIONALITY REVIEWS
- Review existing signal, transit, and fire department system infrastructure
- Conduct needs assessment

AGENCY PEER REVIEWS
- Compile lessons learned from peer agencies operating an Econolite Centracs Priority system (Charlotte, NC and Nashville, TN)

PHASED IMPLEMENTATION PLAN
- Identify challenges and needs
- Develop recommendations and timeline

Phased Implementation Plan – Richmond Fire and Hexagon Integration

The following Richmond Fire, DEC, and Hexagon action items were identified to integrate Richmond Fire's operations with the centralized TSP/EVP system.

- Determine priority corridors and locations to test EVP operations
- Develop interface to expose route data from MPS to the Hexagon I/CAD and Econolite Centracs systems
- Anticipate an increase in annual maintenance costs for Hexagon software module
  - Awaiting cost estimate from Hexagon
- Educate first responders on route-based priority
- Centracs EVP activates when vehicles travel along the dispatched route sent from I/CAD to Centracs
- Software development is not expected to change response protocols and travel patterns
- Future work with Hexagon to improve dispatched routing based on input from Richmond Fire

Project Schedule and Next Steps

1 MAY 2021 Phased Implementation Plan

2 VDOT Scoping Meeting JUNE 2021

3 AUG 2021 Project Specifications

4 Software Development JAN 2023

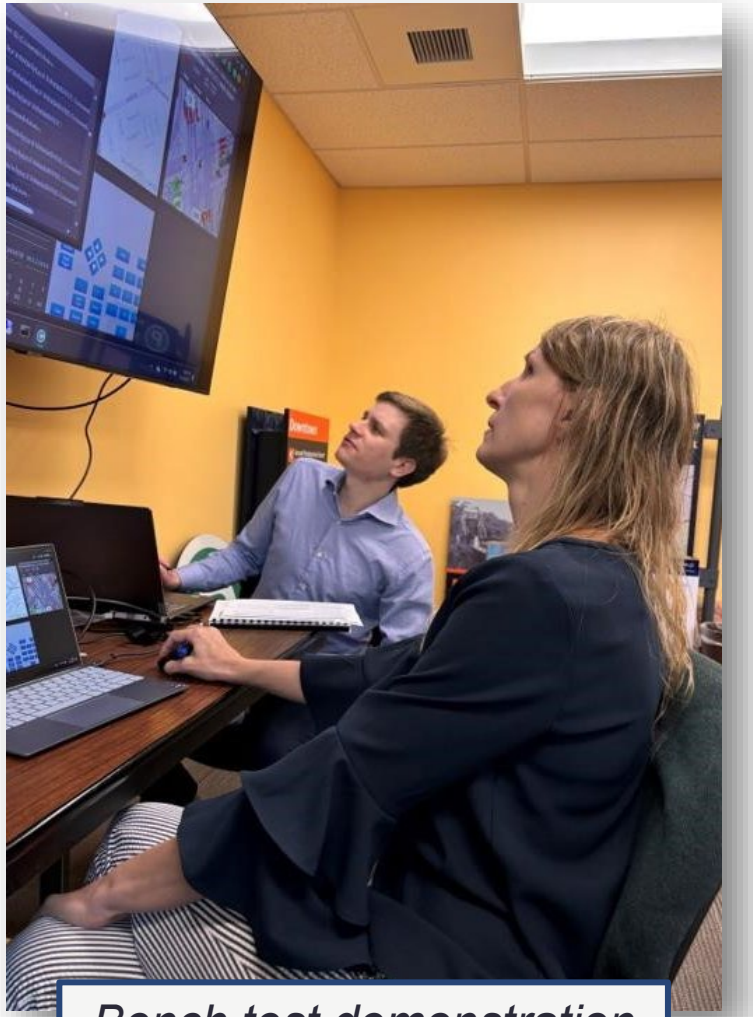
5 JAN 2024 System Testing – Phased Approach

Executive Summary shared with emergency communications leadership

Lessons Learned: Design and Procurement Phases

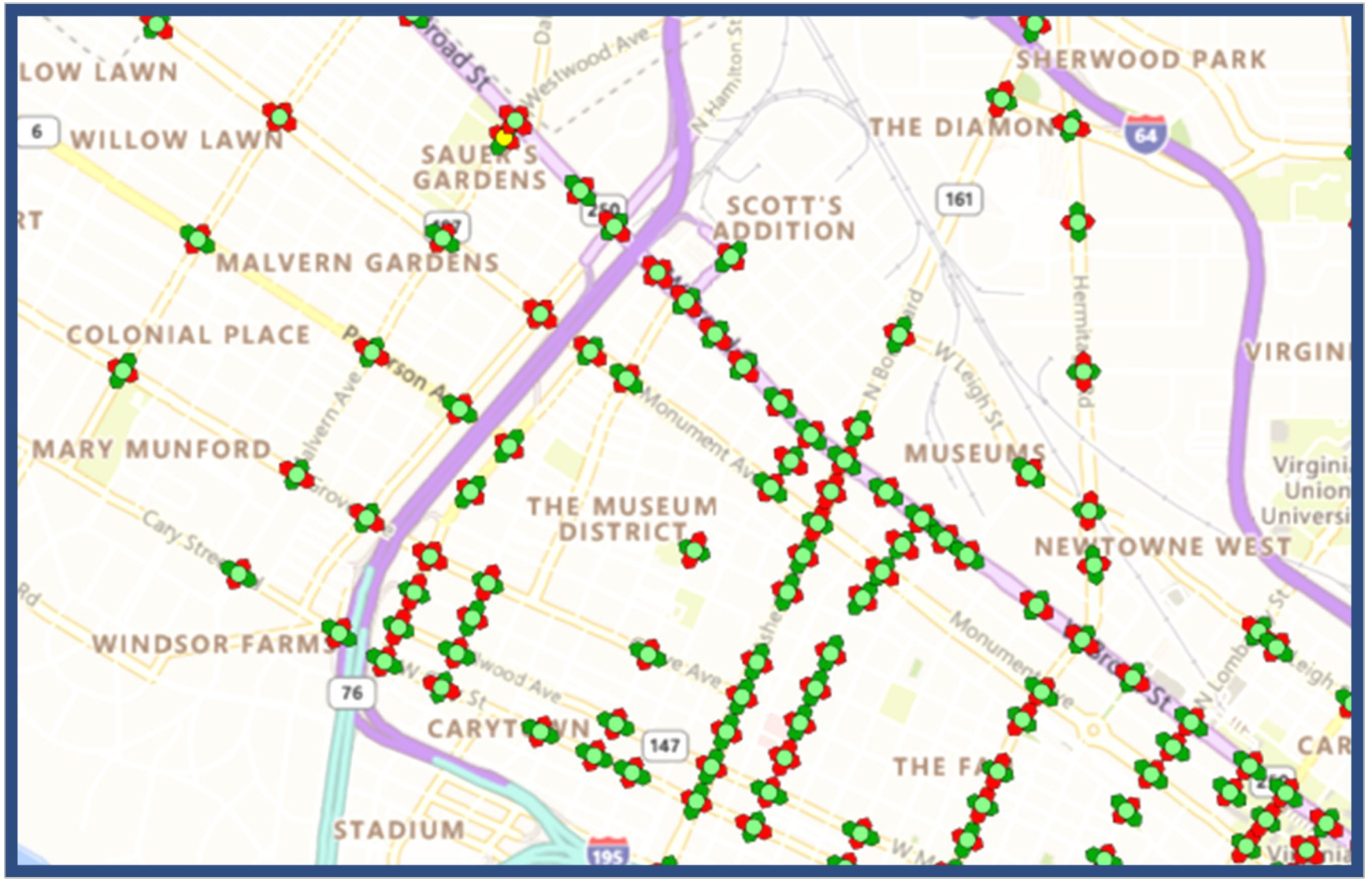
Design and Procurement

- Plan for a ***long*** procurement and award process due to the “non-traditional” nature (software development, not construction)
- Add DIT to your selection committee
- Educate funding partners about the “non-standard” elements of the project
- Put vendors to the test when procuring cutting-edge technologies



Bench test demonstration at the RDOT Signal Shop

Questions?


SHERWOOD PARK
THE DIAMOND
SCOTT'S ADDITION
SAUER'S GARDENS
WILLOW LAWN
MALVERN GARDENS
COLONIAL PLACE
MARY MUNFORD
THE MUSEUM DISTRICT
MUSEUMS
NEWTOWNE WEST
WINDSOR FARMS
CARYTOWN
STADIUM
64
161
6
76
147
195