CITY OF ALEXANDRIA

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

ADAPTIVE SYSTEM

NEED

- Demands on the City's transportation network will continue to increase as population density increases and new venues hosted.

- Congestion is a daily occurrence in the Northern Virginia Region. Much of the regional pass-through traffic that would normally use interstates cuts through Alexandria to bypass freeway congestion.

- Due to this dynamic environment, traffic volumes and the resulting congestion are highly variable hour-to-hour, day-to-day and week-to-week requiring frequent and quick changes to traditional time-of-day pre-schedule traffic signal timings.

- A well managed and intelligent traffic signal system and a smart transportation network will be critical as the population increases and more people and services depend on it.

WHAT IS ADAPTIVE

As the current system can't react fast enough, leaving the signal system out-of-step with real-time traveler demands, it was determined that the adaptive system will be a valuable solution to define the ground truth of traffic conditions and deliver actionable real-time arrangements that can help move our road users faster and safer.

The project was initiated via SMARTSCALE funding and administered through VDOT.

- **What is Adaptive traffic control system (ATCS)?**

It is a traffic management strategy in which traffic signal timing changes, or adapts, based on actual traffic demand. This is accomplished using an adaptive traffic control system consisting of both hardware and software.

MISSION

- Improve traffic safety
- Reduce incident response times
- Improve bicycle and pedestrian opportunity and safety
- Improve transit reliability
- Improve travel time reliability
- Promote seamless multi-modal transportation alternatives to single-occupancy vehicles
- Promote smart cities capabilities
- Allow network and system expansion in an orderly, efficient manner
- Allow future integration of emerging technologies
- Promote automatic analysis and management methods as required to cope with the big data sets produced.
- Improve joint operations between departments and jurisdictions
- Improve quality and availability of traveler information

The Vision for the Adaptive Traffic Signal Control is to collectively improve the quality of life by improving traffic progression, reduce delays and enhance the safety and reliability of the City's multimodal transportation system.

It will do so primarily through the signals adaptive system on the City's arterials, however the technologies used will be expandable to incorporate Autonomous and Connected Vehicle technology, Smart City innovations and other emerging technologies as the City is committed to multimodal transportation and leadership in the use of innovate technology (ITS).

ALEXANDRIA ADAPTIVE PROJECT (PHASE I)

Duke Street Corridor (26 locations)

Van Dorn Street Corridor (14 locations)

ADAPTIVE SYSTEM SOFTWARE

The City of Alexandria chose the "KADENCE" a Kimley Horn real-time adaptive traffic control system that enables traffic signals to immediately adapt to traffic demand.

Kadence is comprised of five principal algorithms for tuning signal splits, offsets, cycle time, phase sequence, and TOD schedule. In the Kadence approach, new signal timing parameters are downloaded to field controllers every 3-4 cycles. All Kadence algorithms and services operate at a central Traffic Management System. There are no field hardware components to install or maintain.

KADENCE ADAPTIVE CONTROL PROCESS

- Poll controllers for phase and detector data
- Calculate new splits, cycle, offset, sequence
- Does not need split libraries
- Download new pattern data to scratch pattern
- Command controller to scratch pattern
- Controller responsible for normal operation at the intersection
- Kadence does not override the operation with holds/force off
- Minimal transitions

FEATURES of KADENCE

- Modern software architecture
- Modern high-speed IP communications
- Windows 7+ and Windows Server 2008+
- Controllers are accessible directly by both KITS and Kadence
- User-definable parameters
- No risk of controller getting stuck or skipping phases
- Pedestrian, transit priority, and preemption support

BENEFITS of KADENCE

- No "recipes", simple setup and operation
- Proven and reliable operating mode
- Effective in delaying onset of oversaturation and clearing congestion after peak period
- Effective in reacting to incident conditions and adjusting to long-term changes in traffic patterns
- Inexpensive to deploy and expand, made in USA
- Continuous path of innovation including features for oversaturation

ADAPTIVE CONTROL METHODOLOGY

- Data-driven parameter tuning
- No calibration
- No specific detector length
- Degree of saturation
  » Current and trend
  » Cycle, split, and phase sequence
- % arrivals on green
  » Current and trend
  » Offset

Phase utilization graphs show when critical phases are oversaturated
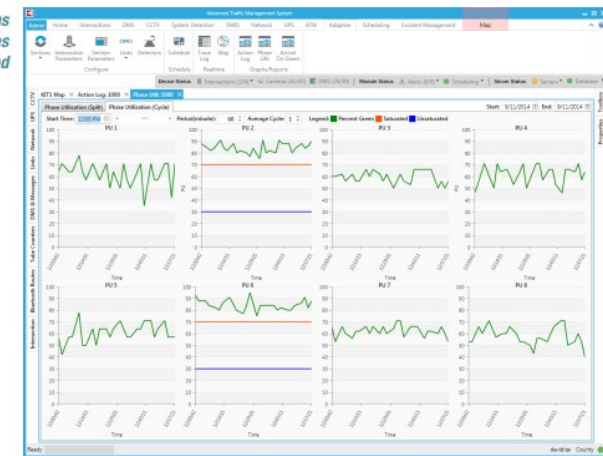
ADAPTIVE SYSTEM HARWARE

- Combination of Fiber Optic, Copper and cellular for the communications media.

- The City of Alexandria chose the ITERIS video detection system and the smart Micro Radar detection technology to be implemented as ideal detection solutions for the Alexandria corridors adaptive traffic control systems.

Vantage Next® with Vantage Vector®

An all-in-one hybrid detection system with powerful performance beyond any other detection solution

PREMIUM MODEL

3D/UHD+ SENSOR

TRUGRD® STREAM

All-in-one solution combining the benefits of radar and camera ✓
Camera with supreme low light performance ✓
Coverage of up to 12 lanes ✓
Range of up to 300m (984ft) ✓

smartmicro

DETECTION

- **Stop bar detection**
  - » Cycle tuning
  - » Split tuning
  - » Phase sequence tuning
- **Upstream/exit detection**
  - » Offset tuning
- **Better if lanes are separated, but not necessary**
- **Tolerates malfunctioning detectors**

CONCLUSION

We are currently waiting for federal authorization to advertise for construction with an anticipated date to start in December

Next Steps

Implementation and real testing. Adaptive Benefits, shortcomings or constraints yet to be known!

Foreseen Profits:

- Upgraded Infrastructure; Traffic Cabinets and Controllers upgraded to the state-of-the-art ATC style to allow the City new future capabilities.

- Some locations with Copper were upgraded to Cellular Communications.