



# RTA-NCDOT Intersection Solutions Forum Spring 2019 event

Thursday, March 21, 2019 SAS



## **NCDOT Welcome**

Kevin Lacy, NCDOT State Traffic Engineer



## RTA Welcome

Geoff Lang, MetLife RTA 2019 Chair



## RTA Acknowledgements

Joe Milazzo II, RTA Executive Director

#### RTA Gold Members





























#### **RTA Silver Members**





































#### **RTA Silver Members**























#IntxForum















## RTA Senior Regional Partners

Capital Area MPO

Durham-Chapel Hill-Carrboro MPO

GoRaleigh / City of Raleigh

GoTriangle

North Carolina Railroad Company

Raleigh-Durham Airport Authority

Town of Cary

#### RTA Member Chambers of Commerce

Angier Greater Raleigh

Apex Greater Smithfield-Selma Area

Benson Area Holly Springs

Cary
Knightdale

Chapel Hill-Carrboro Moore County

Chatham Morrisville

Clayton Rolesville Area

Greater Durham Roxboro Area

Franklin County Sanford Area

Fuquay-Varina Area Wake Forest

Garner Wayne County

Greater Cleveland Wendell

Hillsborough/Orange County Zebulon

#### **RTA Bronze Members**

ABB Inc.

**Atkins** 

Bayer CropScience

Biogen

Blue Cross and Blue Shield of NC

Branch Banking & Trust Co.

Capitol Broadcasting Co., Inc.

Clancy & Theys Construction Company

Dewberry

Fairway Outdoor Advertising

Fox Rothschild LLP

GlaxoSmithKline

Highwoods Properties, Inc.

**PNC** 

Raleigh Regional Association of Realtors

Ramey Kemp & Associates, Inc.

Skanska USA Building Inc.

TheeDigital

TRIMAT

WakeMed Health & Hospitals

Wake Technical Community College

York Properties, Inc./

McDonald-York Building Company



## Agenda overview

Joe Milazzo II



## Today's Agenda

#### Agenda topics

- Data analytics and mobility
- Interchange innovations
- Emergency vehicle pre-emption, dynamic school zones, and other smart/connected city efforts
- Connected/autonomous vehicles pilot on NC 55
- Enhanced pedestrian detection
- Variable number of left turn lanes pilot
- RTA-municipal intersection partnerships
- NCDOT signal system prioritization tool
- Interactive group discussion



## Data analytics and mobility

Eric Hunley, SAS

## Changing the Game ... w/ Data & Analytics

Eric Hunley

Senior Manager, Government Practice

SAS



#### Driving change through Innovation!!!

Easter morning 1900: 5<sup>th</sup> Ave, New York City. Spot the automobile.



Source: US National Archives.

Kennedy

"Change is the law of life, and those who look only to the past and present are certain to miss the future" -John F.

Easter morning 1913: 5<sup>th</sup> Ave, New York City. Spot the horse.



Source: George Grantham Bain Collection.



#### Driving change through Innovation!!!

Modern day: 5<sup>th</sup> Ave, New York City



Source: Google Images

"Wra Wro Wrorge ... Wrying wrars wright waround the waroner" -Astro Jetson

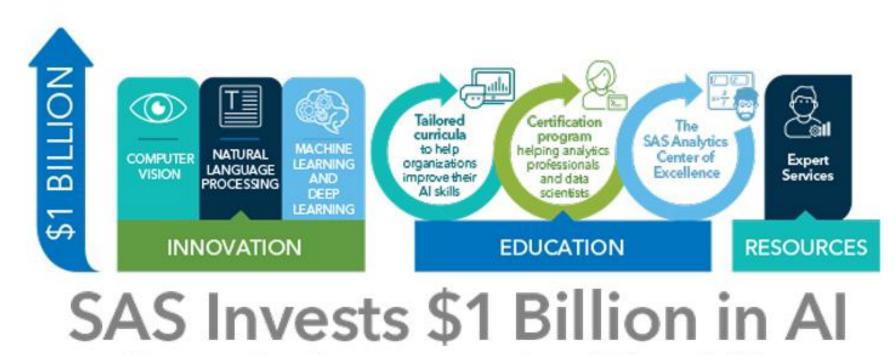
Way ahead of their time .... Jetsons!!!



Source: Google Images



#### Artificial Intelligence ... A Game Changer!!!



Empowering the next generation of AI possibilities

"Al has been an integral part of SAS software for years. Today we help customers in every industry capitalize on advancements in Al, and we'll continue embedding Al technologies like machine learning and deep learning in solutions across the SAS portfolio." Jim Goodnight, CEO, SAS



#### **Artificial Intelligence**

is the science of training systems to emulate human tasks through

**Learning** and **Automation** 









## What customers are saying about SAS AI



#### WildTrack

Data for Good

90%

accuracy for ID of wildlife using tracks

#### Rogers

Telecom

53%

fewer customer complaints<sup>1</sup>

#### VUmc

Healthcare

**Improved** liver & brain tumor diagnosis with AI & analytics

#### Daiwa

**Financial** 

2.7x

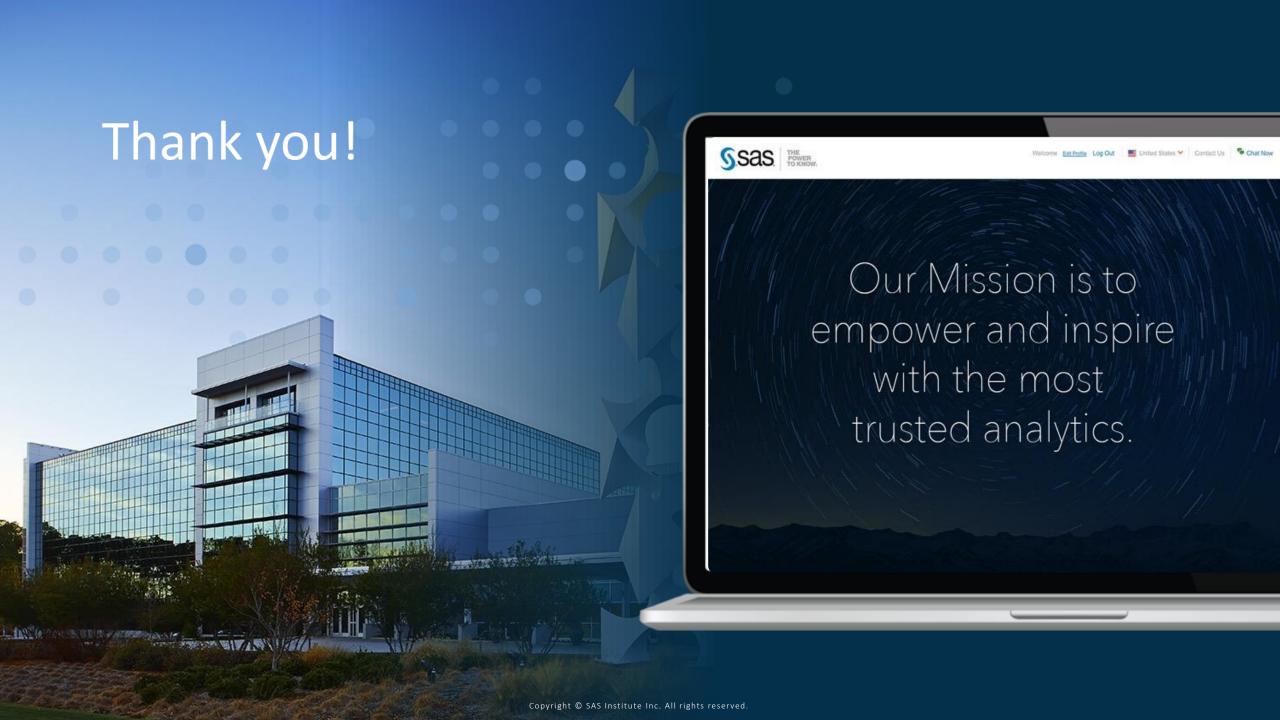
increase in client purchase rates

#### DOT

Transportation

89%

Accurately classified road & seasonal conditions





## Interchange innovations

Dr. Joe Hummer, NCDOT



#### NORTH CAROLINA

Department of Transportation



















## Super DDI and Parclo ProgressA:

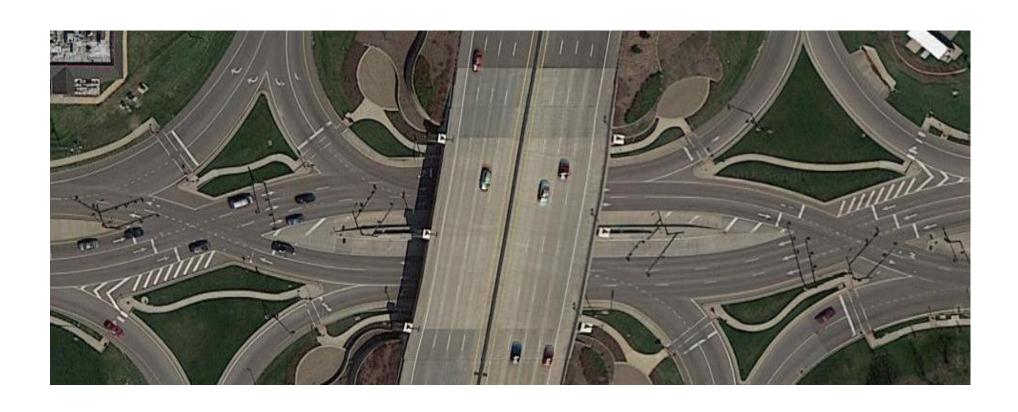
New Designs that Improve a DDI and Rescue a Parclo A

Joe Hummer, PhD, PE

State Traffic Management Engineer

For RTA Intersection Solutions Forum 2, March 21, 2019

## A DDI Is Good at Many Things



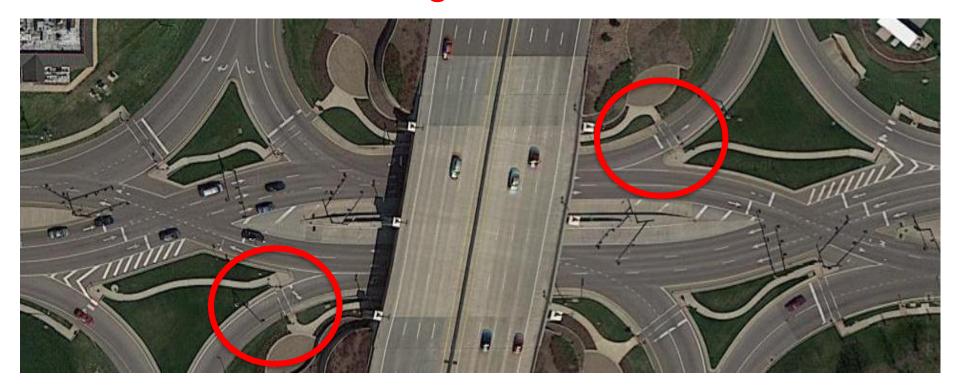
## But Not Signal Progression...

Two full signals at awkward spacing Also means mediocre through capacity



#### ...Or Pedestrian Service

Either unexpected crossing of an on-ramp Or cross and re-cross through lanes



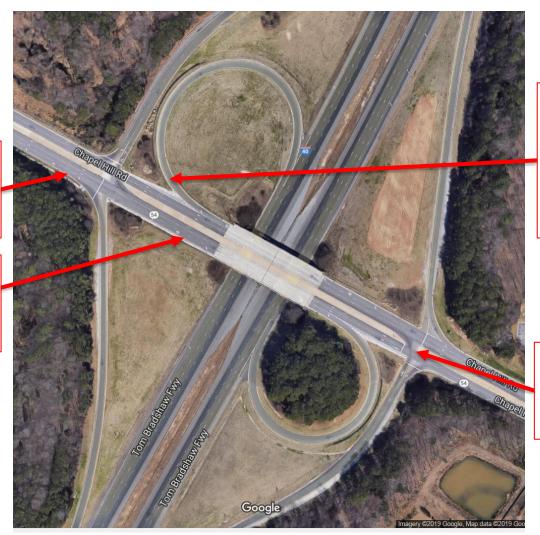
### A Parclo A is Bad at Many Things



## A Parclo A is Bad at Many Things

Both turns go right means poor lane utilization

Both turns go right means surprised drivers



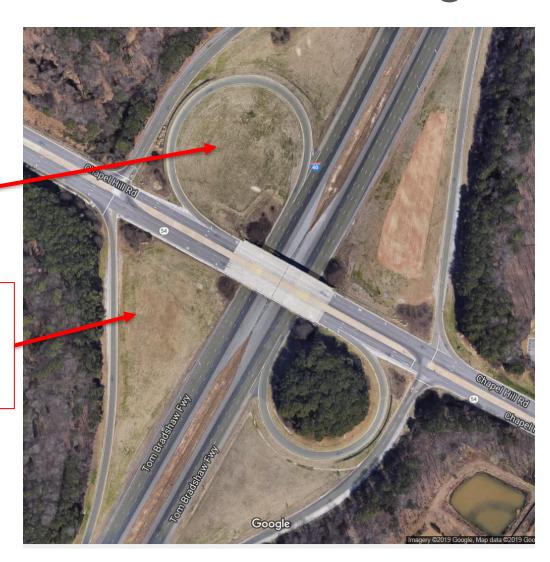
Four free-flow on-ramps means terrible pedestrian service

Two full signals means poor progression

### ...And a Parclo A is Tough to Fix

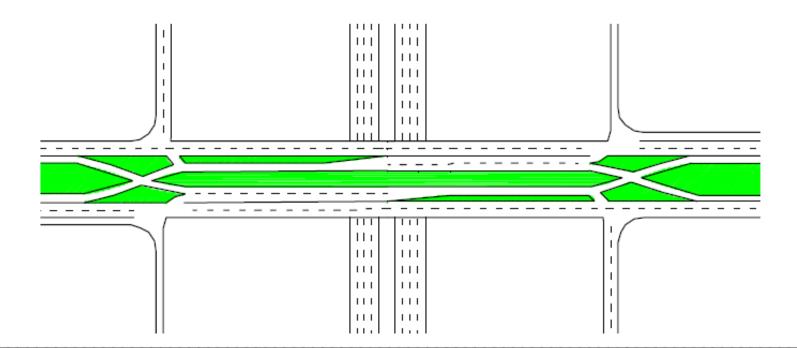
This ROW is pretty useless

This ROW is much more useful but we never have enough of it



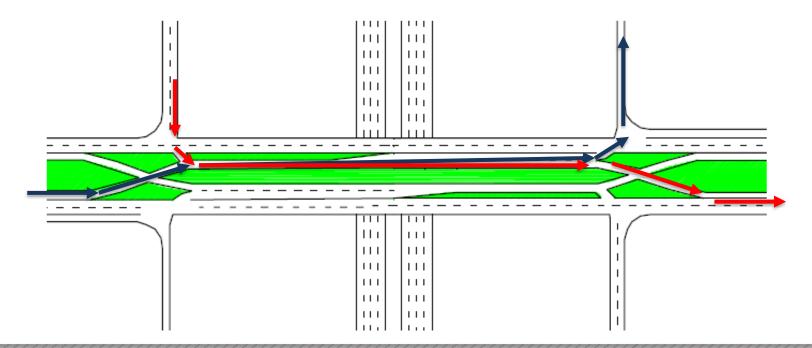
## We Have Improvements Super DDI

- Standard ramp terminal spacing
  - Fits in standard diamond or DDI ROW



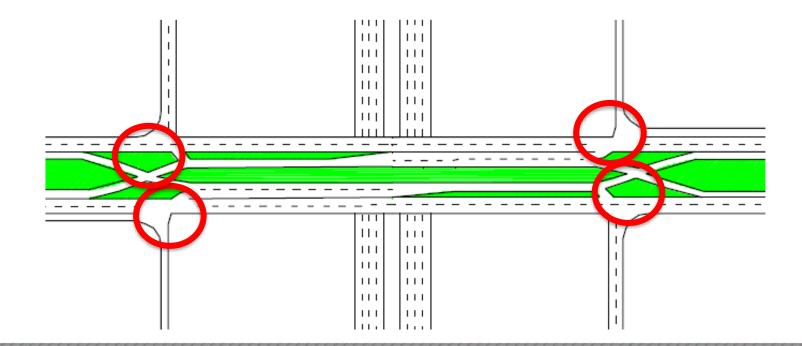
## We Have Improvements Super DDI

- Standard ramp terminal spacing
- Cross the left turns, not the through movements
  - Contraflow lefts
  - Higher capacity, no wrong way potential



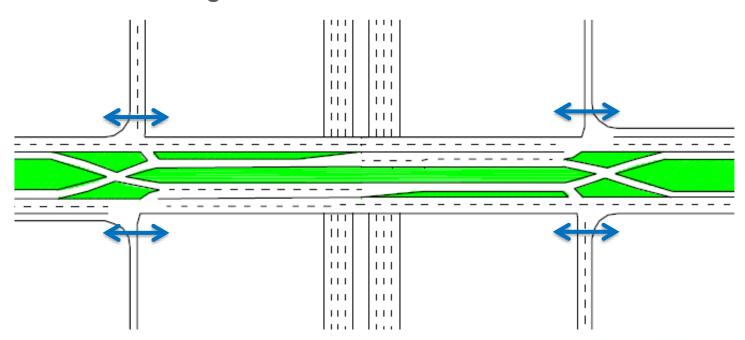
## We Have Improvements Super DDI

- Standard ramp terminal spacing
- Cross the left turns, not the through movements
- Four two-phase half-signals



## Super DDI

- Perfect progression
  - Both directions, any speed, any spacing
- Higher through capacity
- Terrific pedestrian quality
  - Two short, signal-controlled crosswalks each side



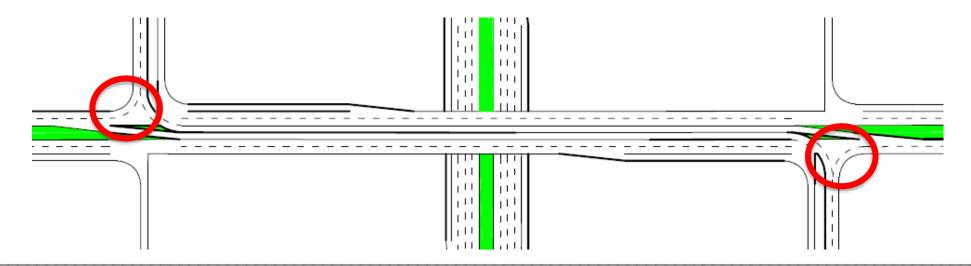
## Super DDI Simulation Results

- Extensive set of high-demand VISSIM runs
  - Details in Trans Res Record paper, 2019

Measure	Diamond	DDI	Super DDI	Parclo A	Parclo progressA
Network travel time, sec/veh	169	143	121		
Percent VISSIM runs completed	43	68	100		
Pedestrian travel time, sec/ped	346	386	356		
Network number of conflicts per hour	3340	468	240		

## We Have Improvements Parclo ProgressA

- Contraflow left turns from the freeway
- Keep the loops
- Two three-phase half-signals
  - Perfect progression
- No help for peds, lane use, or driver expectations



#### Parclo ProgressA Simulation Results

Measure	Diamond	DDI	Super DDI	Parclo A	Parclo progressA
Network travel time, sec/veh	169	143	121	133	123
Percent VISSIM runs completed	43	68	100	98	100
Pedestrian travel time, sec/ped	346	386	356	Not simulated	Not simulated
Network number of conflicts per hour	3340	468	240	1120	757

## Disadvantage is Bridge Width

- Super DDI needs 8 lanes plus median
  - Compare to 6-lane DDI bridge
  - At least \$2 million more
- Parclo ProgressA needs 6 lanes plus medians
  - Compare to 4-lane parclo A bridge
  - At least \$3 million more

### Summary

- DDI is good but has weaknesses
- Super DDI great for progression, capacity, and pedestrians
- Parclo A is generally awful, with four sizeable weaknesses
  - And not many good improvement options
- Parclo progressA great for progression
- Simulation results show promise of both
  - Efficiency and safety

#### If We Can Build the Wider Bridge, Consider Super DDI or Parclo ProgressA

- We control the bridge
  - No environmental impacts
- We often need wider bridge during construction anyway

 Work needed: design details, signing, signals



#### Thank You!

- Let's go fix some intersections and interchanges
- Joe Hummer
  - 919-814-5040, jehummer@ncdot.gov
- Thanks to co-author and inventor of the super DDI and parclo progressA, Dr. Amir Molan





# Emergency vehicle pre-emption, dynamic school zones, and other smart/connected city efforts

David Spencer, Town of Cary



### **Smart and Connected Cities Applications**

**RTA Intersection Solutions Forum 2** 

**David Spencer, PE Cary** 

#### **Smart & Connected Cities**



SAFETY &

ENVIRONMENT





BIKE





#### Town of Cary SMART CITY INITIATIVES



#### **FACILITY USAGE TEST AREA**

Facility and park usage tracking



#### **SMART PARKING TEST AREA**

Real-time parking availability provided by smartphone app; usage statistics tracking



#### **ENERGY AND UTILITIES TEST AREA**

Reducing energy consumption, controlling lights, tracking usage



#### PUBLIC SAFETY LAB

Testing Smart Cities public technology



#### TRANSPORTATION LAB

Testing Smart Cities traffic and transportation technology



#### CITIZEN ENGAGEMENT LAB

Testing Smart Cities citizen engagement technology



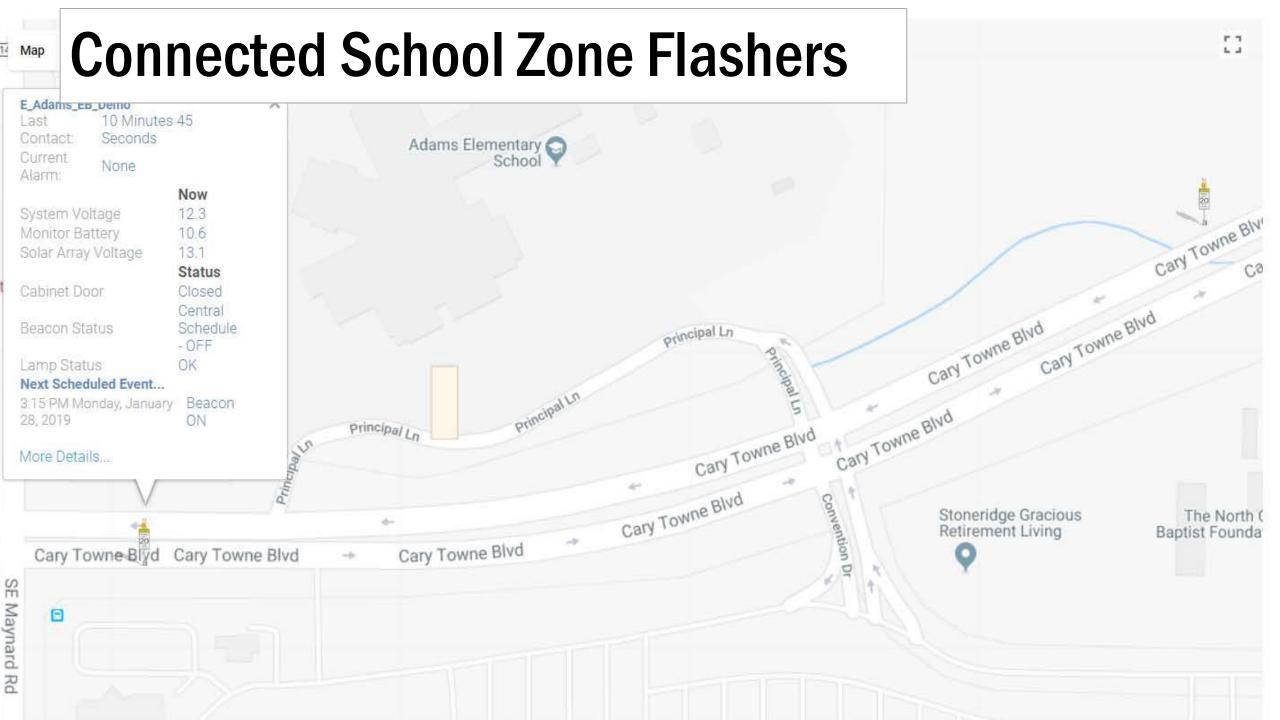
#### INNOVATION AND INFRASTRUCTURE HUB

All Smart Cities technology testing and primary location for all backend infrastructure

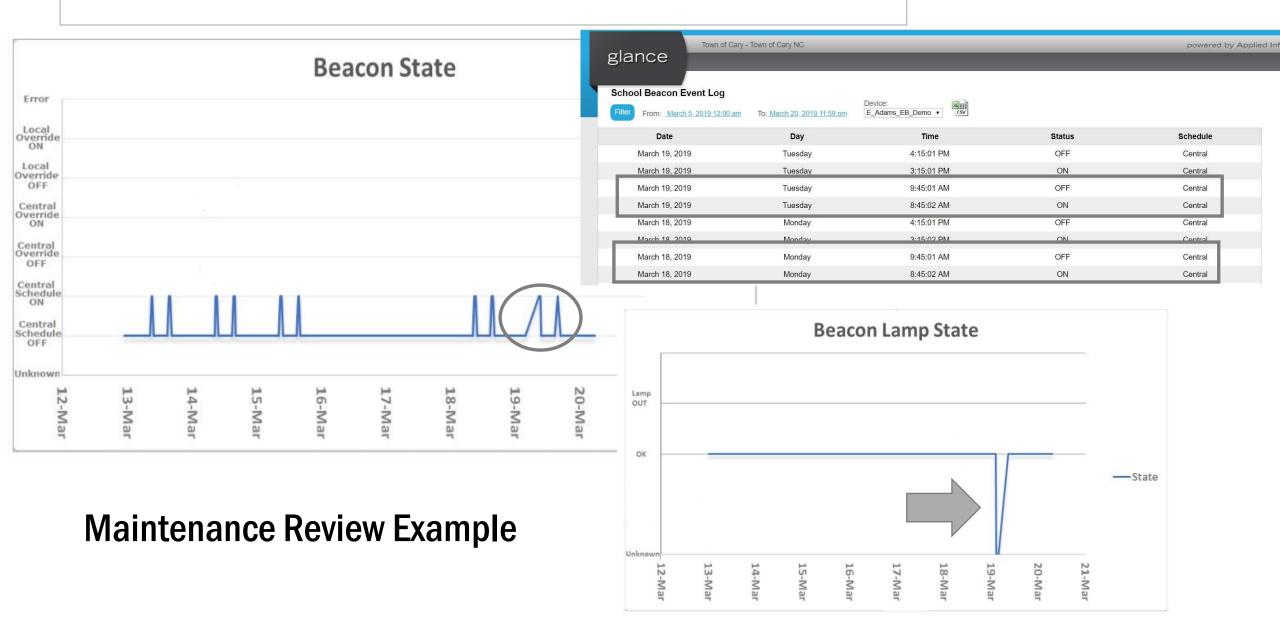


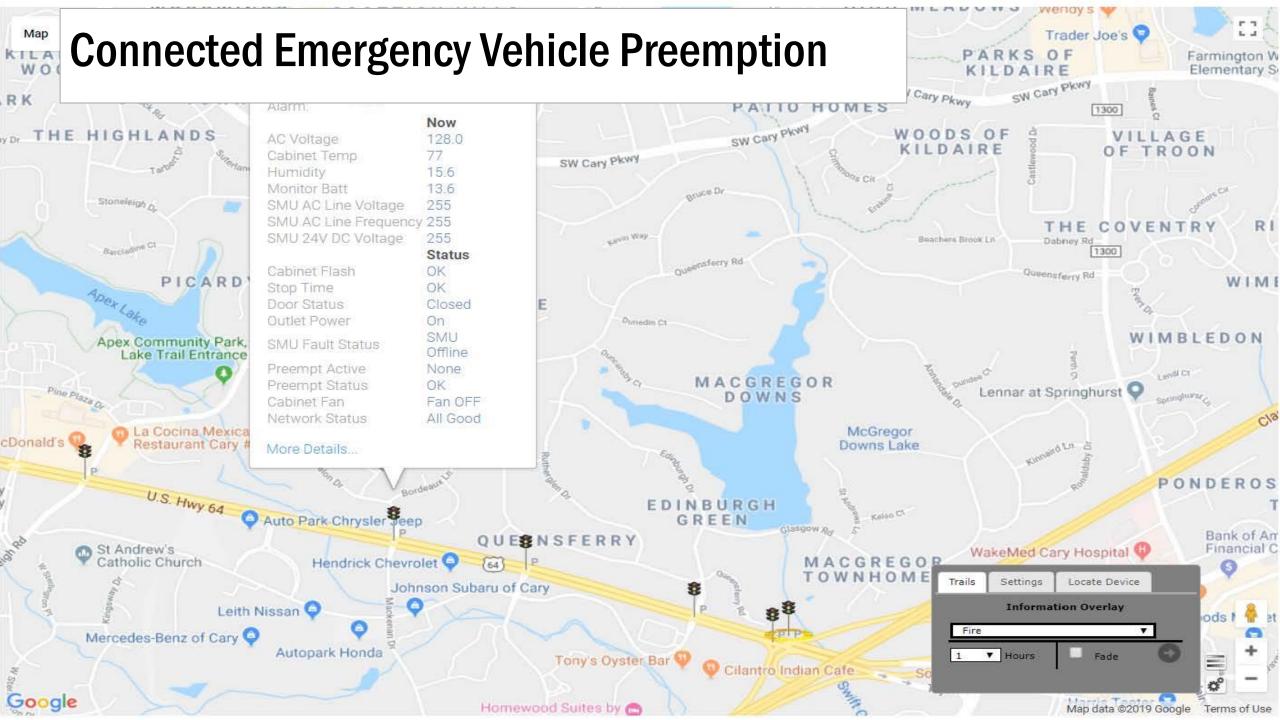
### **Smart Campus**



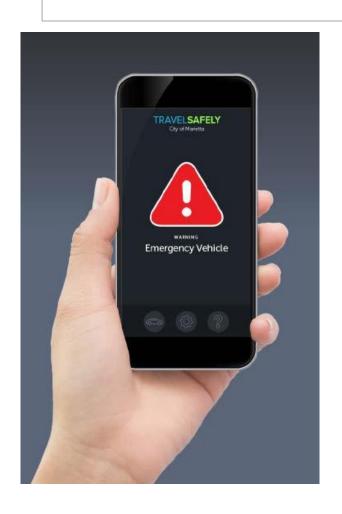


### **Connected School Zone Flashers**

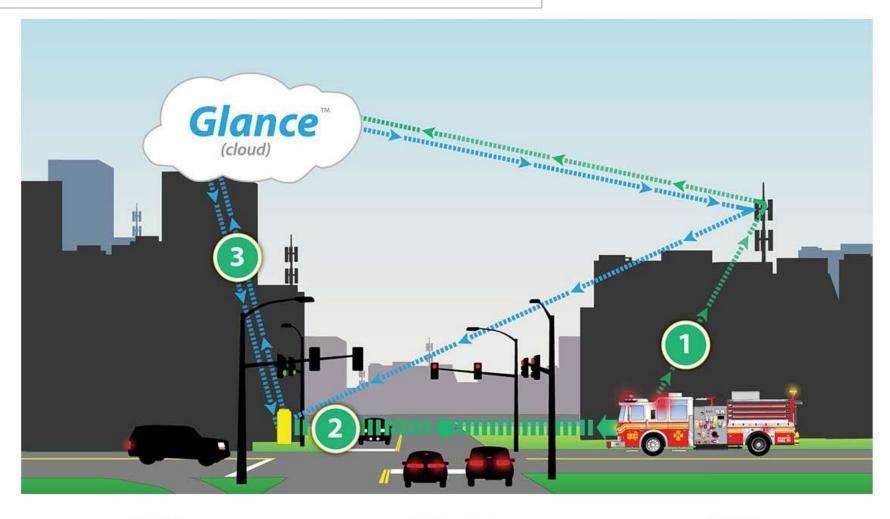




#### **Connected Emergency Vehicle Preemption**



Benefits for drivers and emergency responders.



#### 1. Notify

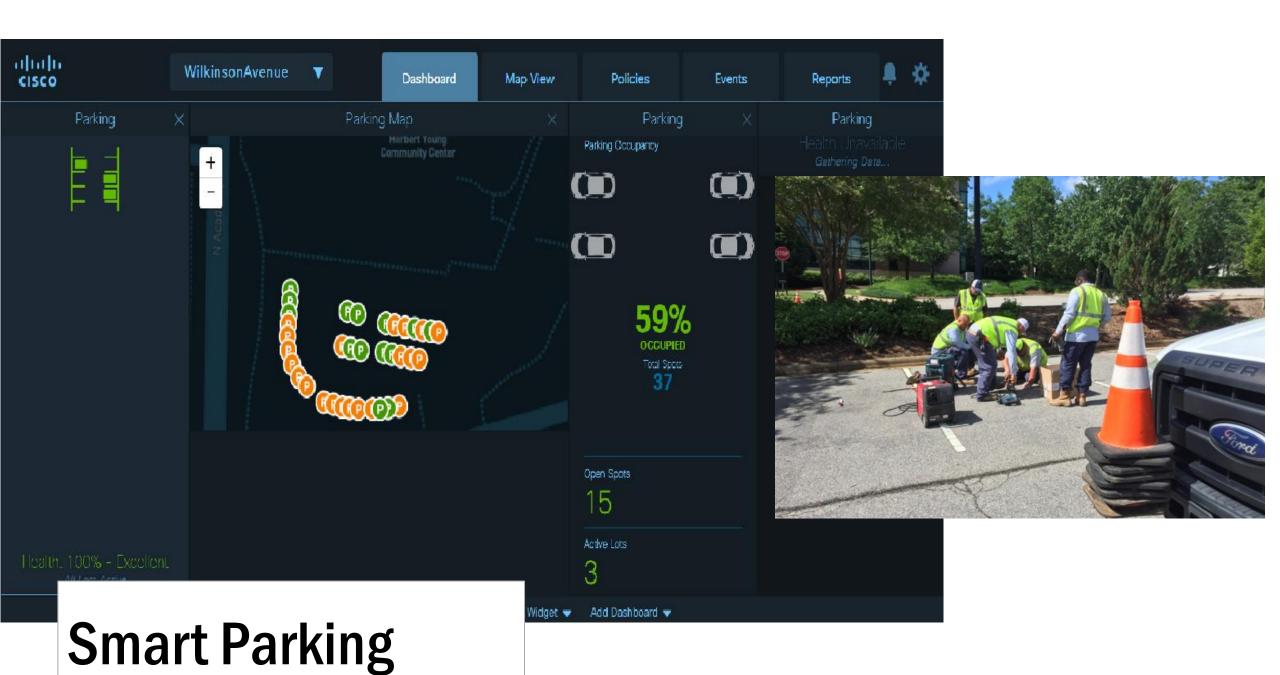
The moment a route starts, the in-vehicle unit uses a cellular signal to alert Glance of the emergency call.

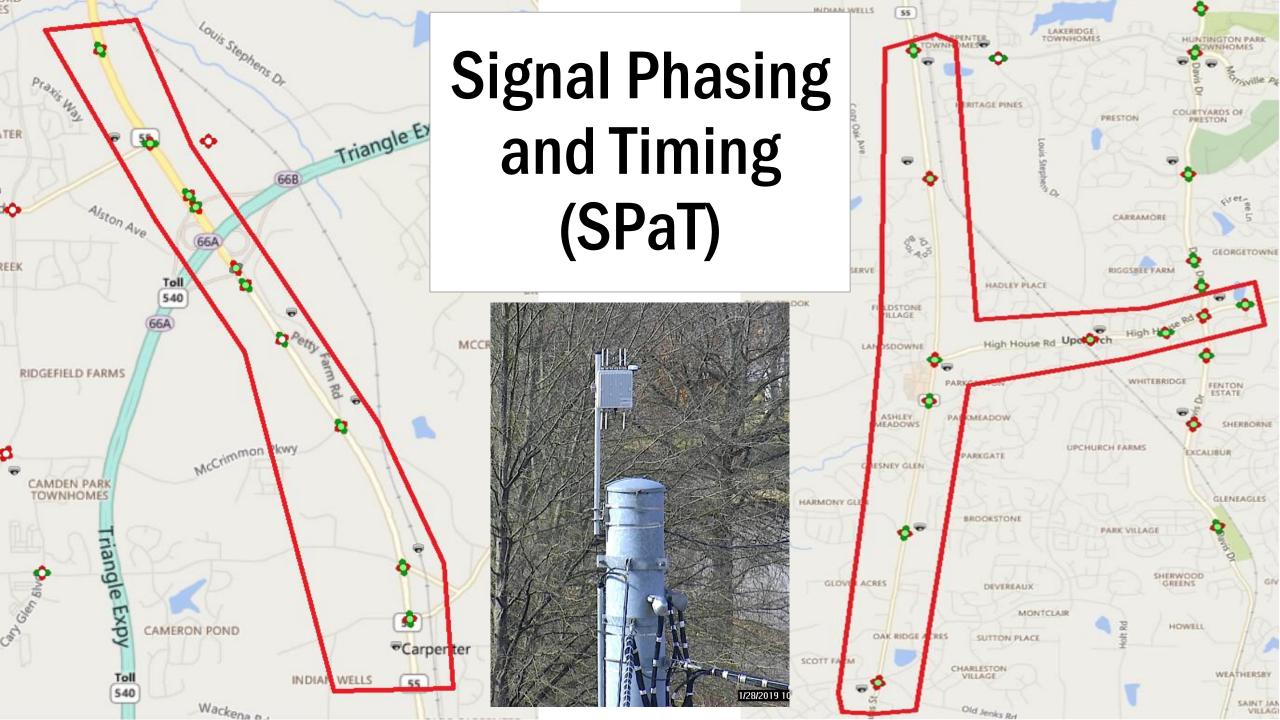
#### 2. Preempt

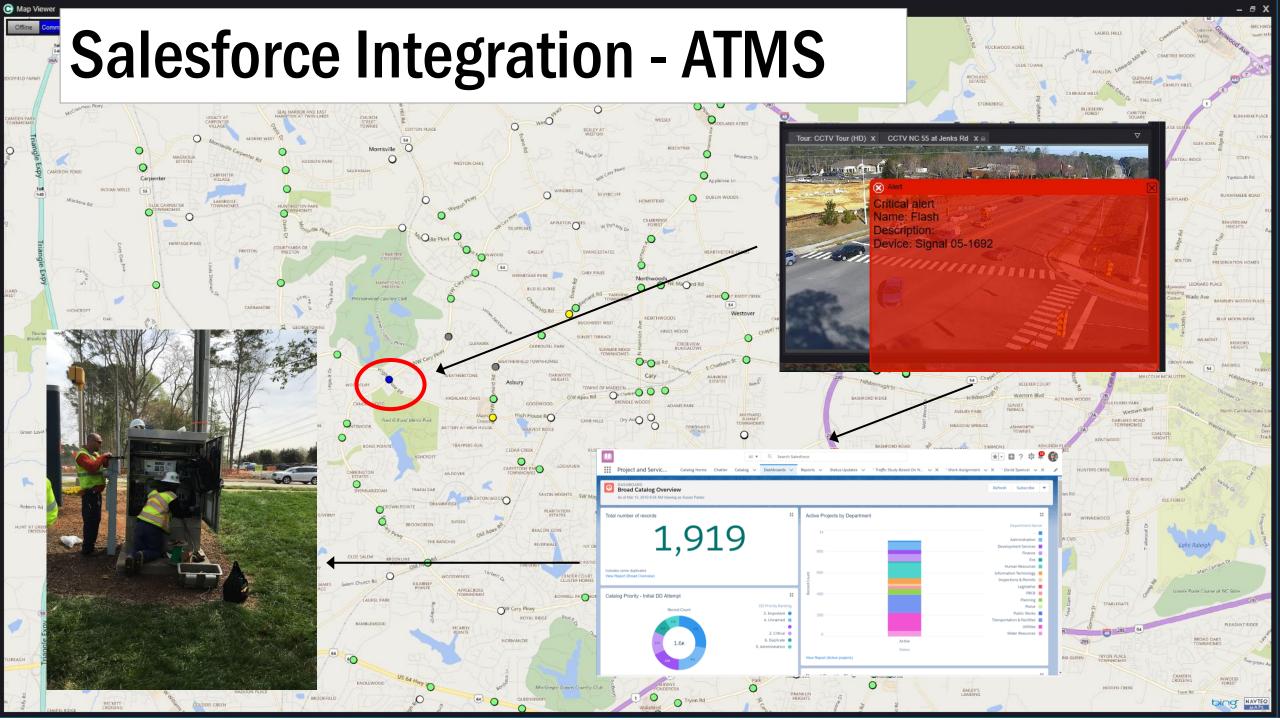
Glance processes the route and communicates whrelessly with the traffic cabinet to clear traffic ahead of the vehicle's arrival.

#### 3. Adapt

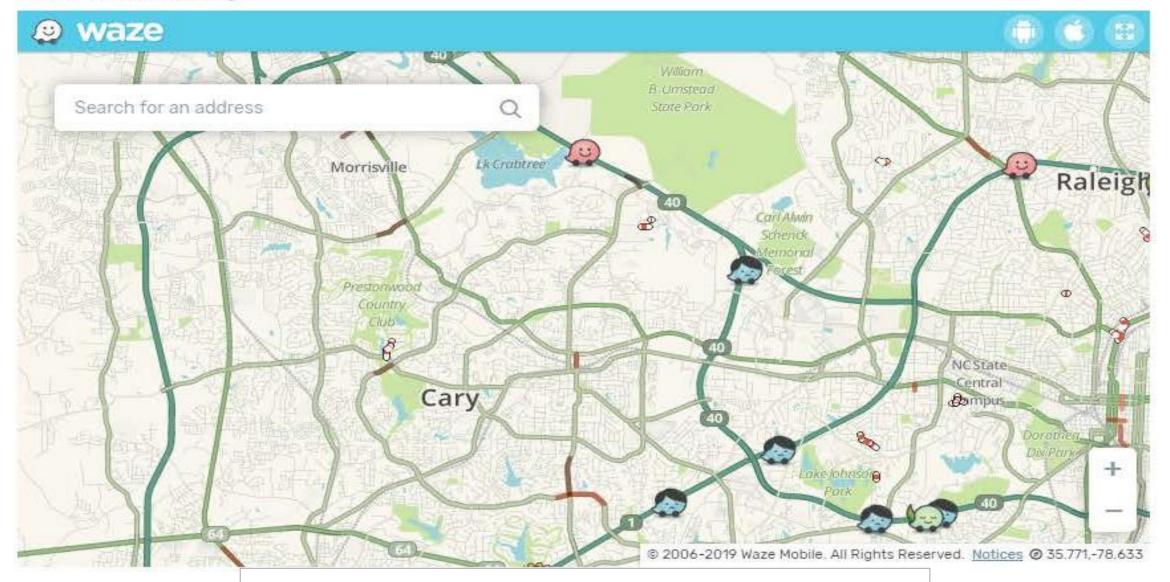
Glance monitors route progress in real time and dynamically adapts preemption requests as the situation changes.



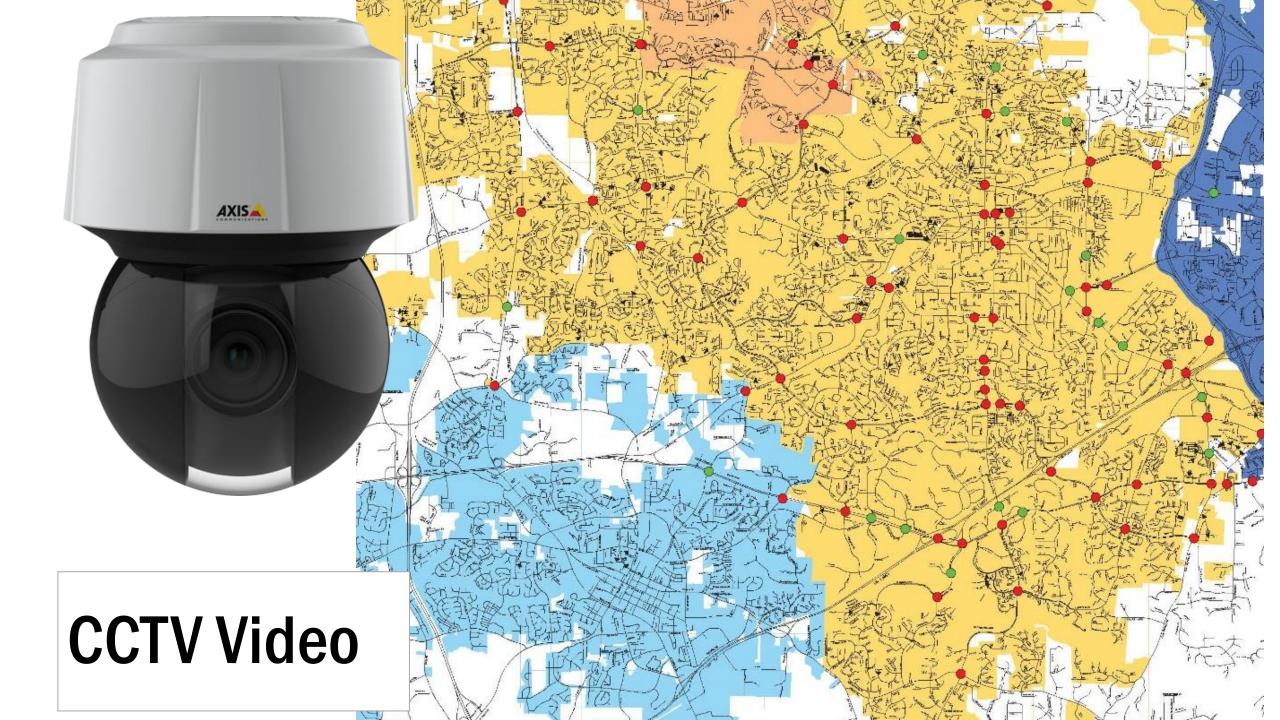




#### **Live Traffic Map**



### **Waze Connected Citizens**





### TownofCary.org/Live

LIVE

Get Help

Getting to Town Hall

Giving

- + Jobs & Employees
- + Newsroom
- Town Departments & Offices

Directory

**Town Holidays** 

**Development Services** Department

Finance

Fire Department

- Human Resources Department
- Information Technology
- **Inspections & Permits**
- Parks, Recreation & Cultural Resources
- Planning and Development

Offices » Town Manager's Office » Public Information »

Font Size: 🛨 🧧

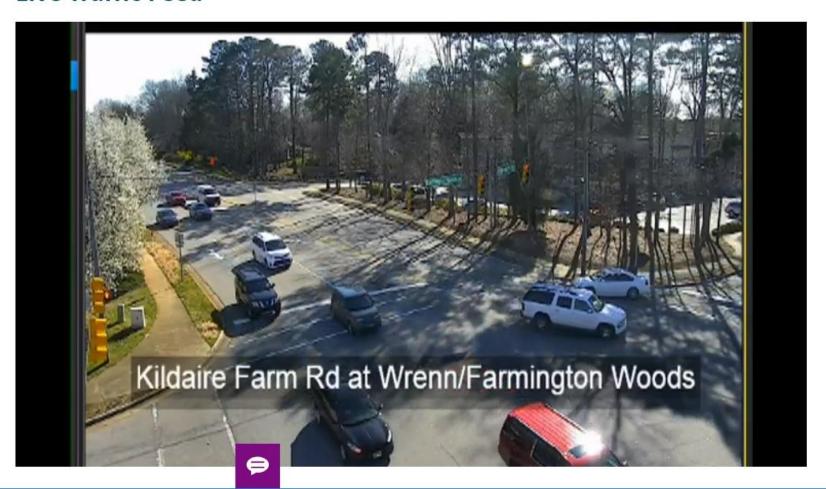






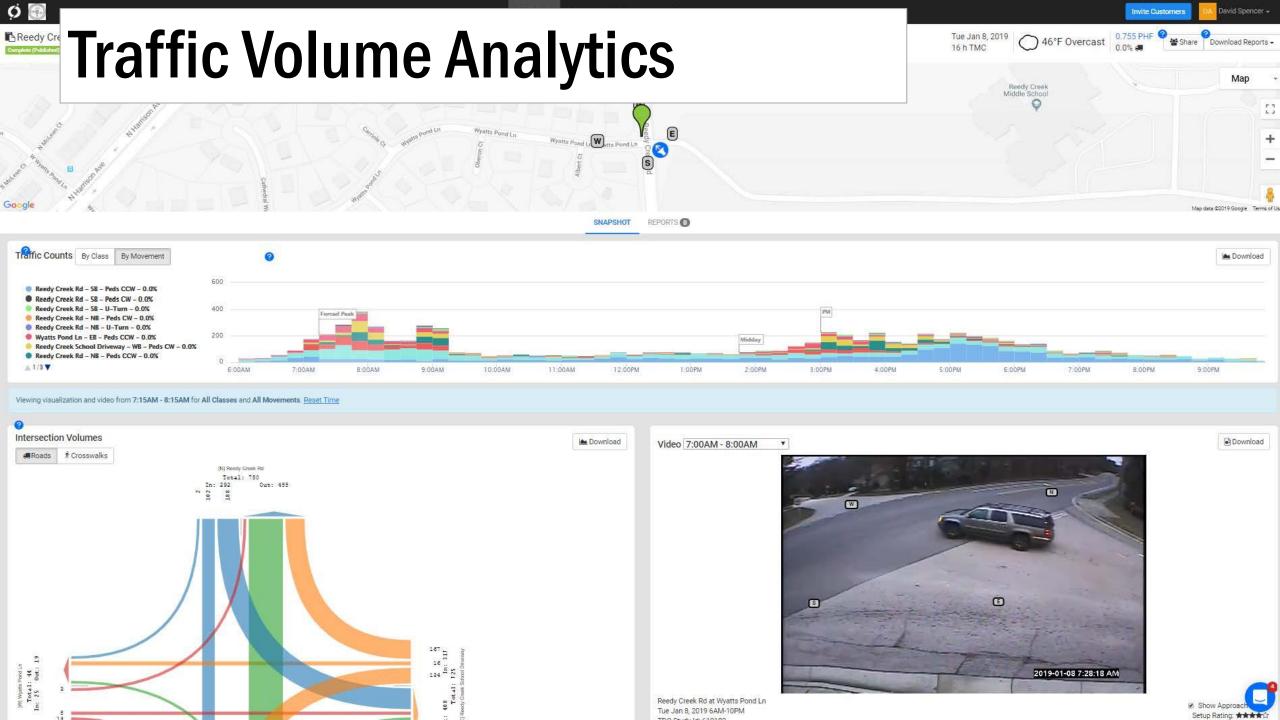


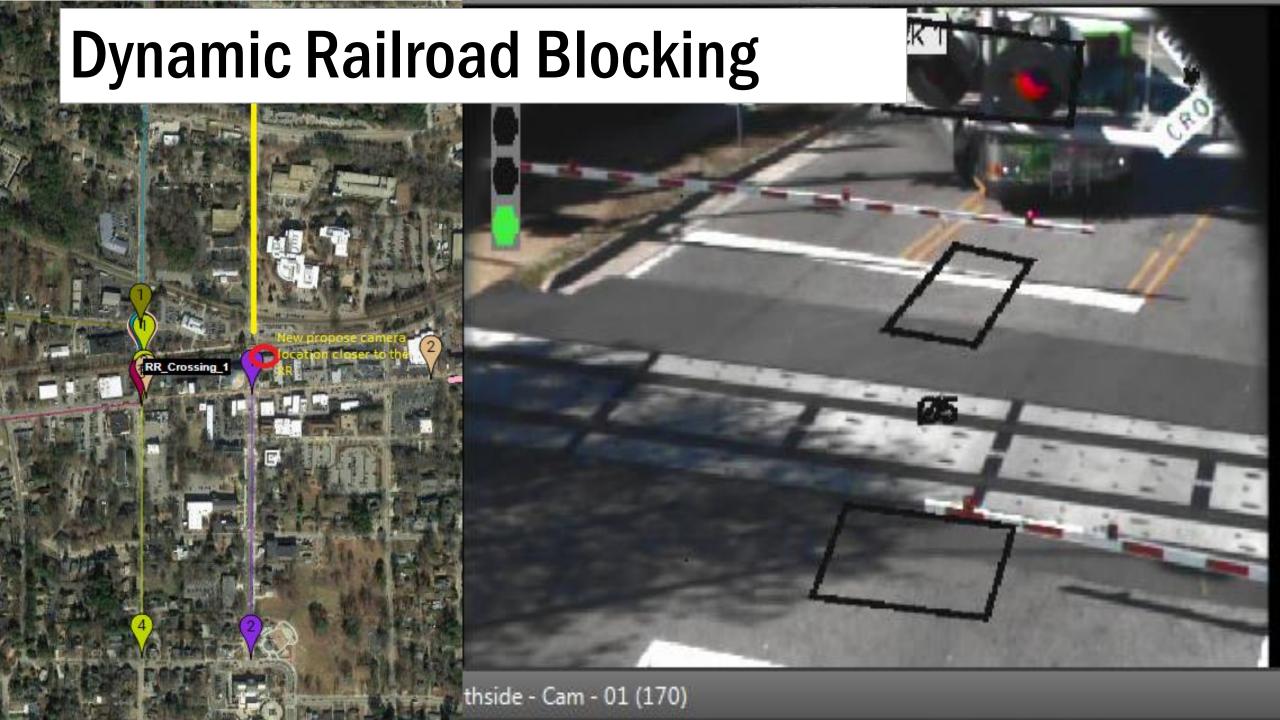
#### **Live Traffic Feed**











## **Connected Vehicles**



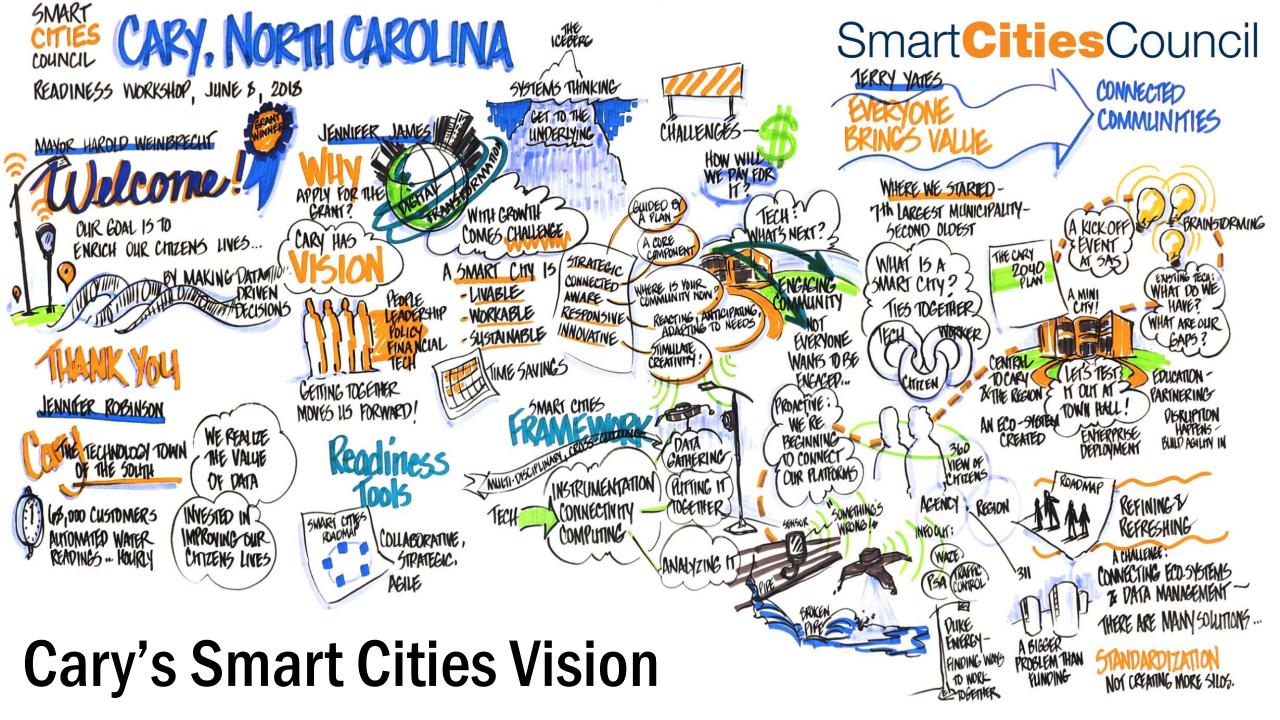


Traffic lights and monitoring systems communicate real-time conditions and traffic signal information.









### Thank You

David Spencer david.spencer@townofcary.org



# Connected/Autonomous vehicles pilot on NC 55

Mohd Aslami, NCDOT



### **SPaT Challenge Implementation**



Mohd Aslami, PE NC DOT-TSMO Unit





### **National SPaT Challenge Map**



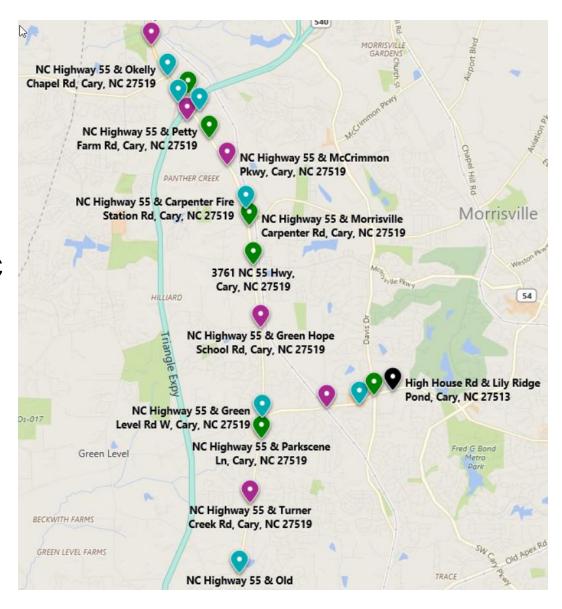






### **System Overview**

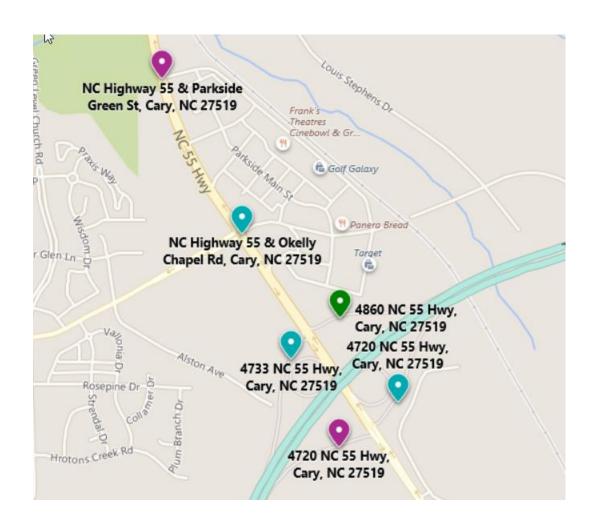
- 20 Locations in Cary, NC
- 16 locations along NC Highway 55 – 6.6 miles
- Additional 4 locations along High House Rd -1.6 miles







#### Locations



- NC Highway 55 & Parkside Green
- NC Highway 55 & O'Kelly Chapel
- NC Highway 55 & 540 NB On Ramp
- NC Highway 55 & 540 NB Exit Ramp
- NC Highway 55 & 540 SB On Ramp
- NC Highway 55 & 540 SB Exit Ramp

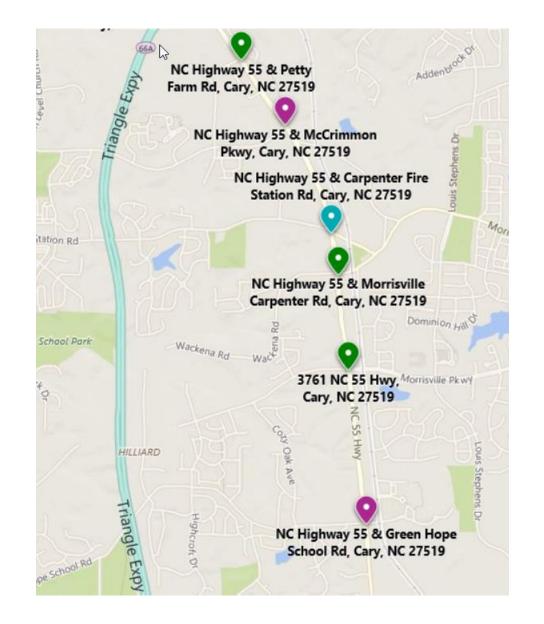






#### Locations

- NC Highway 55 & Petty Farm Rd
- NC Highway 55 & McCrimmon Pkwy
- NC Highway 55 & Carpenter Fire Station Rd
- NC Highway 55 & Morrisville Carpenter Rd
- NC Highway 55 & Morrisville Pkwy
- NC Highway 55 & Green Hope School Rd

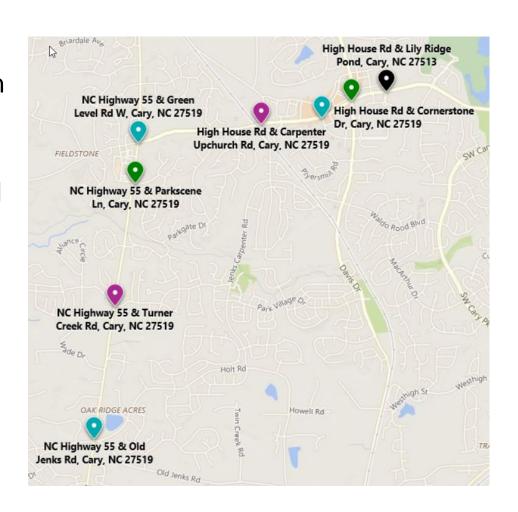






#### Locations

- NC Highway 55 & High House Rd
- NC Highway 55 & Parkscene Ln
- NC Highway 55 & Turner Creek
   Rd
- NC Highway 55 & Old Jenks Rd
- High House Rd & Carpenter Upchurch Rd
- High House Rd & Cornerstone Dr
- High House Rd & Davis Dr
- High House Rd & Lily Ridge Pond







#### **Existing Infrastructure**

- Existing signal infrastructure included NEMA TS2 Cabinets with 2070E controllers and Econolite ASC/3 OS9 software
- The system resides on a Ethernet fiber optic network
- The central software is Econolite Centracs 2.x





#### Required Upgrades

- Upgrade the existing 2070E controller units
  - Replaced the existing 2070-1B/1E CPU modules with 2070-1C
  - Replaced ASC/3 OS9 local controller software with ASC/3 Linux





### **Additional Equipment**

- RSUs
- OBUs
- PoE Injectors
- Surge suppressors
- Cabling
- Signal pole mounting hardware





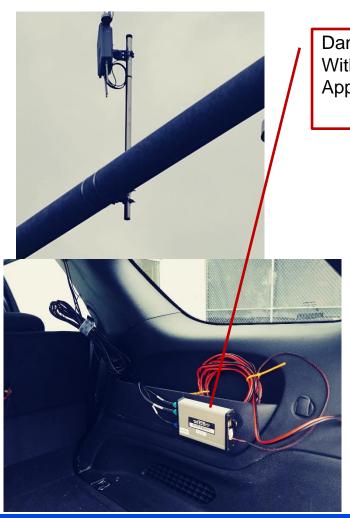
### **Applications Implemented**

- SPaT & Map
- Red Light Violation Warning
- School Zone Warning
- Construction Zone Warning
- Curve Speed Warning
- Speed Zone Warning





### **Installation Images**



Danlaw OBU With eTrans **Applications** 

> Lear OBU Applications

Samsung Tab A **HMI** Device











## **Lear App Images**



Red Light Violation Warning





Flashing Yellow Arrow Demonstration









# **Danlaw OBU with** eTrans App Images















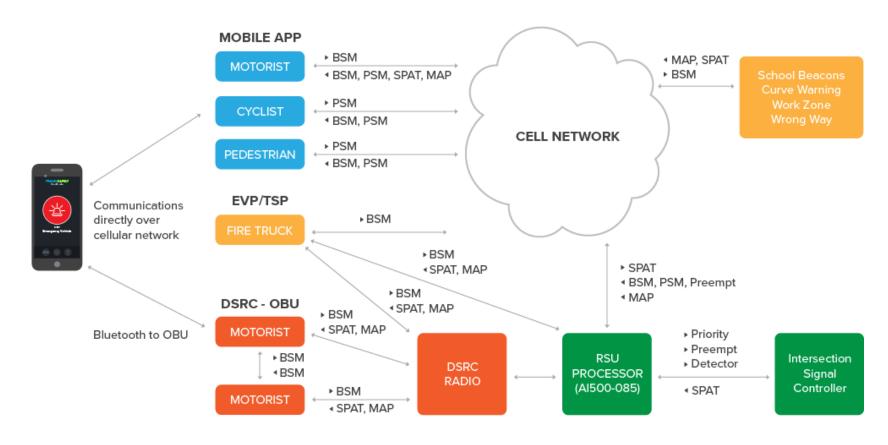
## What is Next

- Expansion of the test corridor to another 18 intersections from Parkside Green to NC147 using DSRC technology
- Planed Hybrid test corridor in Greenville
- Deploy new signals with hardware & software ready for CV deployment
- Develop a statewide CV deployment policy
- Develop a statewide Communications Policy





## **Greenville Hybrid Solution**



BSM = Basic Safety Message (vehicles) | PSM = Personal Safety Message (cyclists & pedestrians) SPAT = Signal Phase and Timing Messages | MAP = Geometry Message





## What is Next

- New 2070LX controllers have been added to the QPL to facilitate CAV readiness
- An statewide contract for 2070LX is in the process to streamline purchase and deployment
- AC3LX have been ported to other vendors
- EOS software is in evaluation
- New software specification is in development for the future of CAV





## Questions

For more information, contact:

Mohd A. Aslami, PE, CPM

State ITS & Signals Management

Engineer

NCDOT

Phone: (919) 814-4923

maslami@ncdot.gov

Keith M. Mims, PE

Signal Equipment Design Engineer

NCDOT

Phone: (919) 814-4931

kmmims@ncdot.gov









Scott Clark, Town of Chapel Hill



Scott Clark, Town of Chapel Hill

# RTA-NCDOT Intersection Solutions Forum

Thursday, March 21, 2019, 3 pm – 5 pm



### **AT&T Smart Cities Framework**



Highly Secure Connectivity

Wi-Fi

4G LTE

**Broadband** 

Giga Power



**Platforms** 

**Control Center** 

M2X,

Flow Designer

Security

NetBond

Cloud



Vertically Integrated Solutions

Energy & Utilities

Transportation

Citizen Engagement

**Public Safety** 

Infrastructure



Strategic Alliances

Cisco

Deloitte

Ericsson

GE

**IBM** 

Intel

Hitachi

Qualcomm

Southern Company



**Spotlight Cities** 

Atlanta, GA
Chicago, IL
Dallas, TX
Georgia Tech
Miami Dade
Montgomery
County, MD
Chapel Hill, NC





## The Problem:







### The Problem:

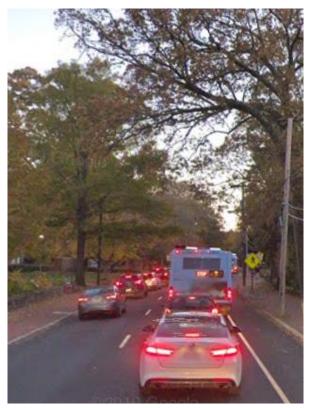








### The Problem:







### The Plan:

- Hitachi built an interface for the Carmanah Technologies
   Traffic Control System.
- Testing of units similar to the Town's existing crosswalk controllers.
- The Town has a tentative agreement for attachment with Duke.

### The Plan:

- The HVA system will trigger the WebRelay momentarily each time it generates an alert.
- Based on some walking in the direction of the street from each side at the cross sign level.
- When alerts stop, the lights will stop blinking.



## Intrusion Detector

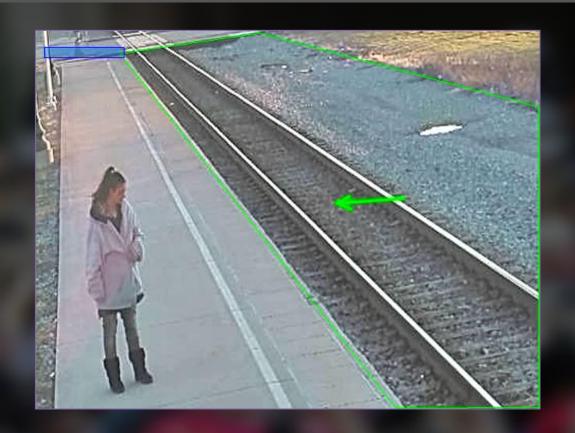
### **Alerts for Restricted Areas**

- Real-time alerts for the protection of critical properties, perimeters and buildings
- Warning zone with perspective provides the highest possible level of protection



**Insight:** Intrusion detection can assist in protecting boundaries and property or improve safety in the event that a person or obstruction enters a dangerous area, such as train tracks.

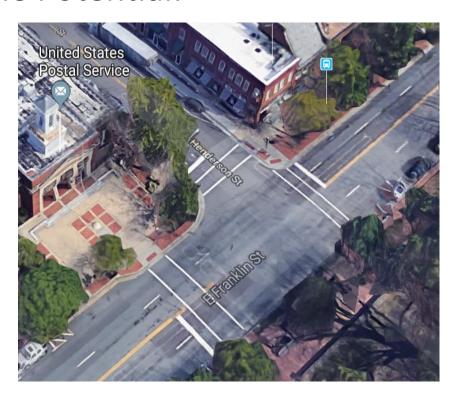
## **Direction Controller**

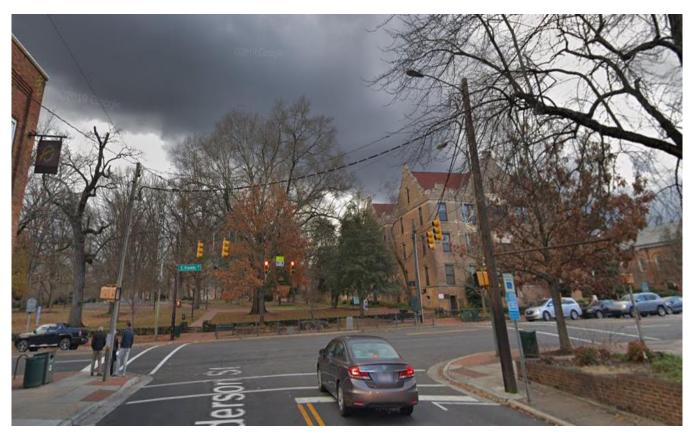




**Insight:** Direction Controller detects "wrong way" movement to help alert public safety officers to dangerous behavior and driving, as well as unlawful entrances through exits and prohibited areas.

### The Potential:







## Questions



# Variable number of left turn lanes (VNLTL) pilot

Kevin Lacy, NCDOT Joe Milazzo II, RTA

# Variable Number of Left Turn Lanes (VNLTL) Peak / Off-Peak Left Turn Lanes (P/OP LTL)

Vary the number of available left turn lanes (1 or 2) and signal phasing (protected-permitted or protected-only) by time-of-day (off-peak or peak)

## **VNLTL:** Expected operational benefits

Reduce off-peak delay for targeted <u>left turn movements</u>:

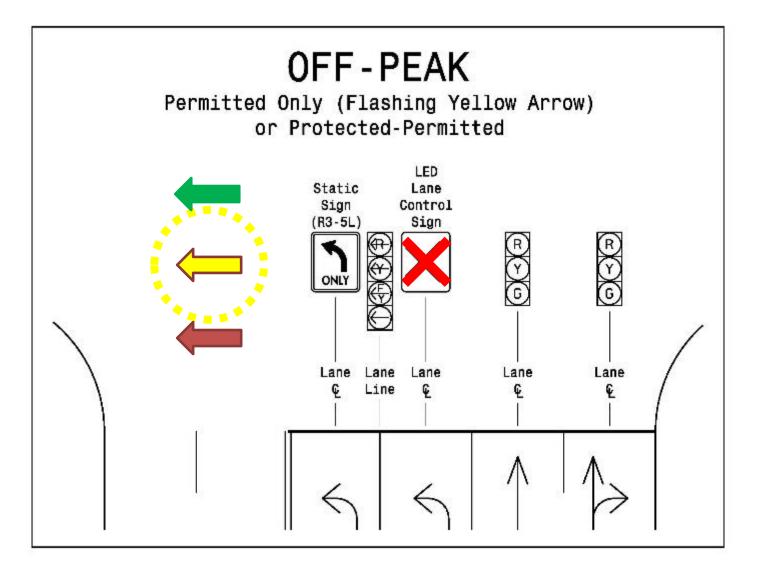
More permitted phases = more opportunities to turn

Reduce off-peak delay for <u>all movements</u>:

Fewer or shorter left turn phases frees up cycle time

Could reduce <u>peak</u> delay for all movements:

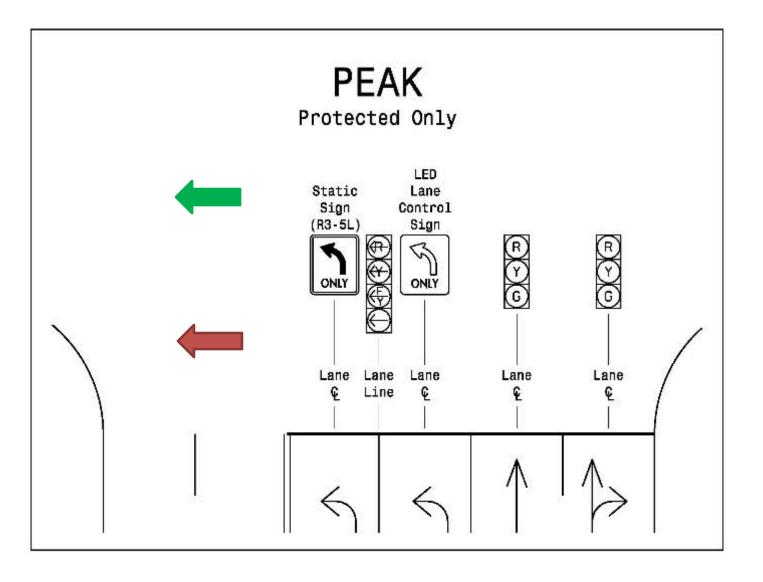
Mitigates concern of constructing second left turn lane



Off-peak = "Default" phasing

Number of left turn lanes: 1

**Left turn phasing:** Protected-permitted



Peak = "Alternate" phasing

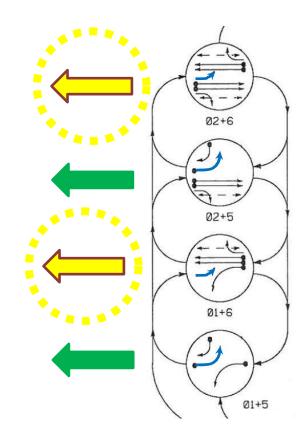
Number of left turn lanes: 2

**Left turn phasing:** Protected only

### Off-peak = "Default" phasing

Number of left turn lanes: 1

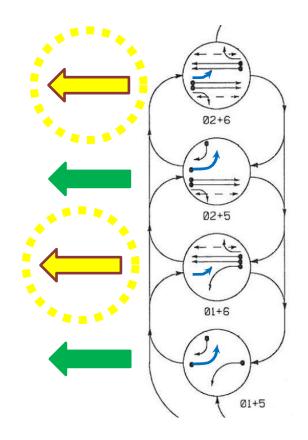
**Left turn phasing:** Protected-permitted



### Off-peak = "Default" phasing

Number of left turn lanes: 1

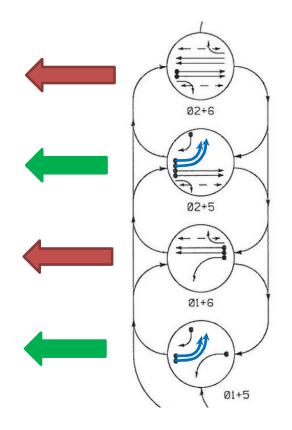
**Left turn phasing:** Protected-permitted

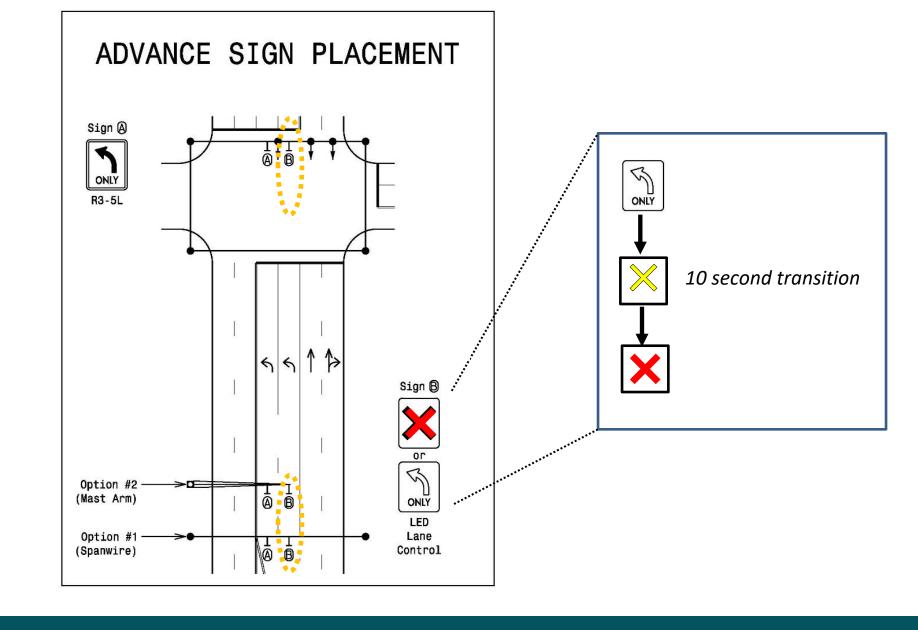


### Peak = "Alternate" phasing

Number of left turn lanes: 2

**Left turn phasing:** Protected-only





## VNLTL: Proposed pilot locations, under design

Cary, Wake Co.

- Tryon at Cary Parkway
- Clayton, Johnston Co.
- US 70 business at Town Centre

Raleigh, Wake Co.

- Poole at Birch Ridge (on hold)

## **VNLTL:** Expected overall benefits

- Mitigate tradeoff of "peak capacity vs. off-peak delay"
- Provide operational flexibility by time-of-day, by approach
- Improve public support by tailoring operations to demands

# Variable number of left turn lanes (VNLTL) pilot update

Kevin Lacy, NCDOT Joe Milazzo II, RTA



# RTA-Municipal Partnerships

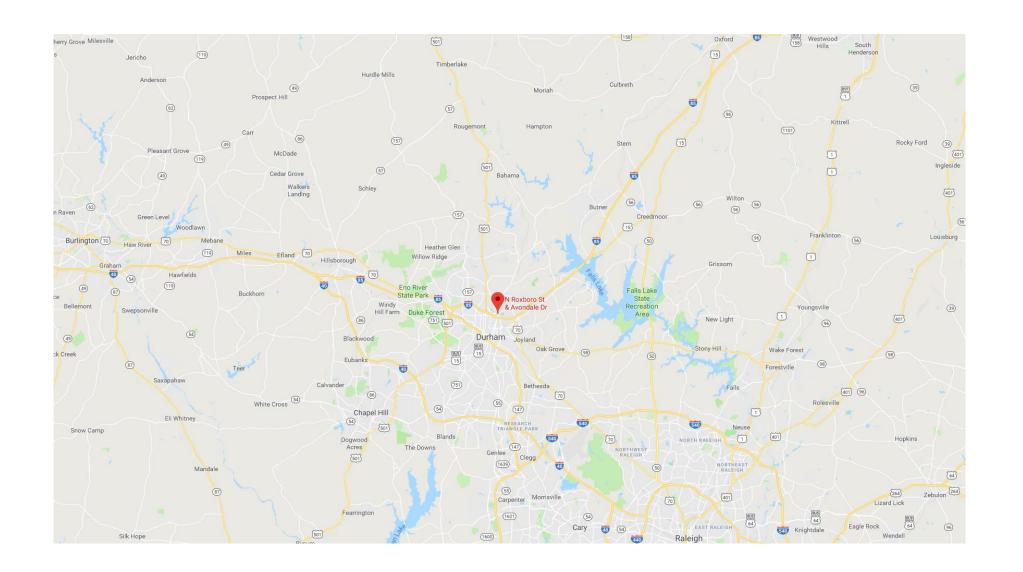
France Campbell, AECOM Phil Loziuk, City of Durham





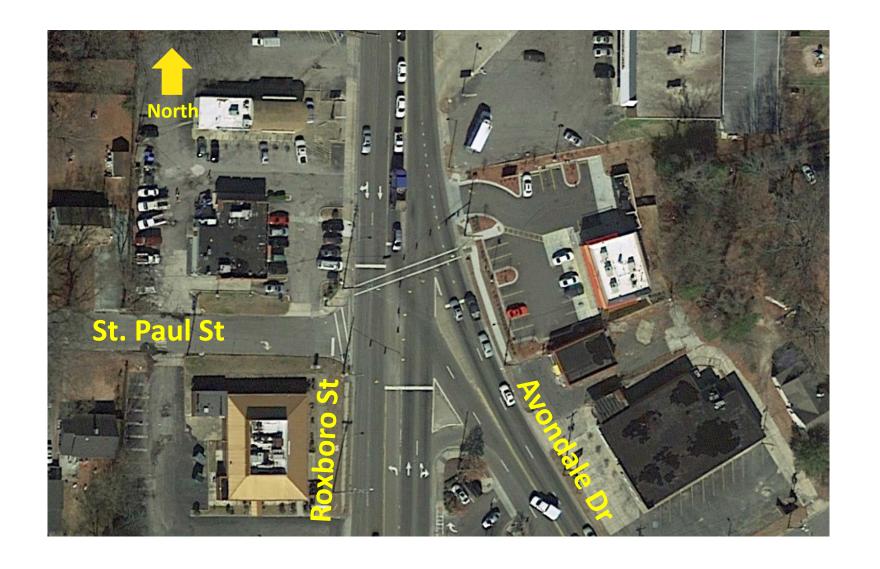
Mohammad Islam, PE (City of Durham)

France Campbell, PE, PTOE (AECOM)







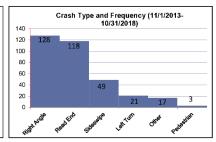






### Roxboro Street from Club Boulevard to I-85





#### Field Observations:

- · Pedestrians present in areas, most accessing mass transit (bus)
- Major bus route. High volume of bus stop activity at the McDonald's.
- Southbound inside lane of Roxboro Street underutilized between Club Boulevard and Avondale Drive. Through traffic cannot get into southbound inside lane after Club Boulevard because the left turn lane backs up through the intersection of Roxboro Street and Club Boulevard.
- Very low volume of left turns from Roxboro Street northbound to St Paul St westbound.
- · Major crash types are right angle and rear end
  - o These crash types typically indicate congestion and aggressive driving behavior due to congestion

#### Operations Analysis:

Short-Term Considerations:

Intersection	AM Peak	PM Peak	95 <sup>th</sup> Queue
Configuration	LOS	LOS	SB Left
Existing traffic signal	В	С	625'
Modified traffic signal	В	С	300'
Roundabout	Α	Α	150'

#### Long-Term Considerations:

- Convert southbound Roxboro St inside through lane to a second left turn lane (dual left)
- Remove the left turn phase on Roxboro St northbound to St Paul St westbound and prohibit northbound left turns onto St Paul St
- · Add flashing yellow arrows at Club Blvd and Roxboro St
- Add a "I-85 NB" and through arrow sign on the overhead span wire for southbound Roxboro St to potentially reduce the number of southbound lefts

southbound direction of traffic and prevents left and thru's from queueing to Club Blvd Roundabout has a B or better level of service on

· Modified traffic signal with dual lefts on southbound Roxboro St improves the

- all movements, and an overall LOS of A
- · Dual lane roundabout at Avondale Dr and Roxboro St
- Needed by 2040 (based on southbound queues)
- Based on a 2% annual growth rate and when southbound 95th queue equals 625'
- Would require major business(s) relocations
- . Eliminate Howard St connection to Avondale Dr
- Reconstruct north leg of intersection to provide two southbound through lanes and southbound dual lefts on Roxboro St



Transportation ▲ liance



### Roxboro Street from Club Boulevard to I-85



Southbound Roxboro St at Club Blvd



Northbound Roxboro St at Avondale Dr



Southbound on Avondale Dr at Roxboro St



Roxboro St and Avondale Dr



McDonald's on Corner of Roxboro St and



Proposed Dual Southbound Left Turn Lanes on Roxboro St at Avondale Dr







**Business Leadership** 

Regional Transportation Miliance











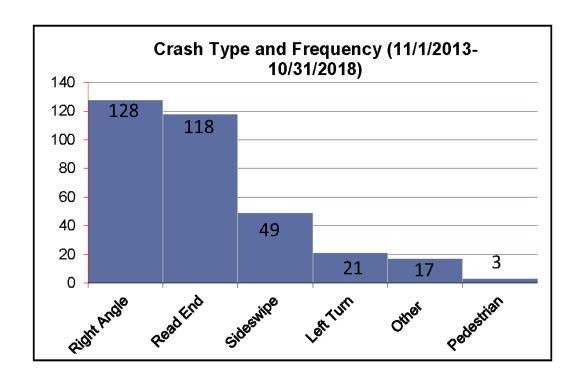
### **Field Observations:**

- Pedestrians present in areas, most accessing mass transit (bus)
- Major bus route. High volume of bus stop activity at the McDonald's.
- Southbound inside lane of Roxboro Street underutilized between Club Boulevard and Avondale Drive. Through traffic cannot get into southbound inside lane after Club Boulevard because the left turn lane backs up through the intersection of Roxboro Street and Club Boulevard.
- Very low volume of left turns from Roxboro Street northbound to St Paul St westbound.
- Major crash types are right angle and rear end
  - These crash types typically indicate congestion and aggressive driving behavior due to congestion





## Roxboro St at Avondale Dr - Durham







## Roxboro St at Avondale Dr - Durham

#### **Operations Analysis:**

Intersection Configuration	AM Peak LOS	PM Peak LOS	95 <sup>th</sup> Queue SB Left
Existing traffic signal	В	С	625'
Modified traffic signal	В	С	300'
Roundabout	Α	Α	150′

- Modified traffic signal with dual lefts on southbound Roxboro St improves the southbound direction of traffic and prevents left and thru's from queueing to Club Blvd
- Roundabout has a B or better level of service on all movements, and an overall LOS of A









#### Roxboro St at Avondale Dr - Durham

#### **Short-Term Considerations:**

- Convert southbound Roxboro St inside through lane to a second left turn lane (dual left)
- Remove the left turn phase on Roxboro St northbound to St Paul St westbound and prohibit northbound left turns onto St Paul St
- Add flashing yellow arrows at Club Blvd and Roxboro St
- Add a "I-85 NB" and through arrow sign on the overhead span wire for southbound Roxboro St to potentially reduce the number of southbound lefts

#### **Long-Term Considerations:**

- Dual lane roundabout at Avondale Dr and Roxboro St
  - Needed by 2040 (based on southbound queues)
    - Based on a 2% annual growth rate and when southbound 95<sup>th</sup> queue equals 625'
  - Would require major business(s) relocations
  - Eliminate Howard St connection to Avondale Dr
- Reconstruct north leg of intersection to provide two southbound through lanes and southbound dual lefts on Roxboro St









## RTA-Municipal Partnerships

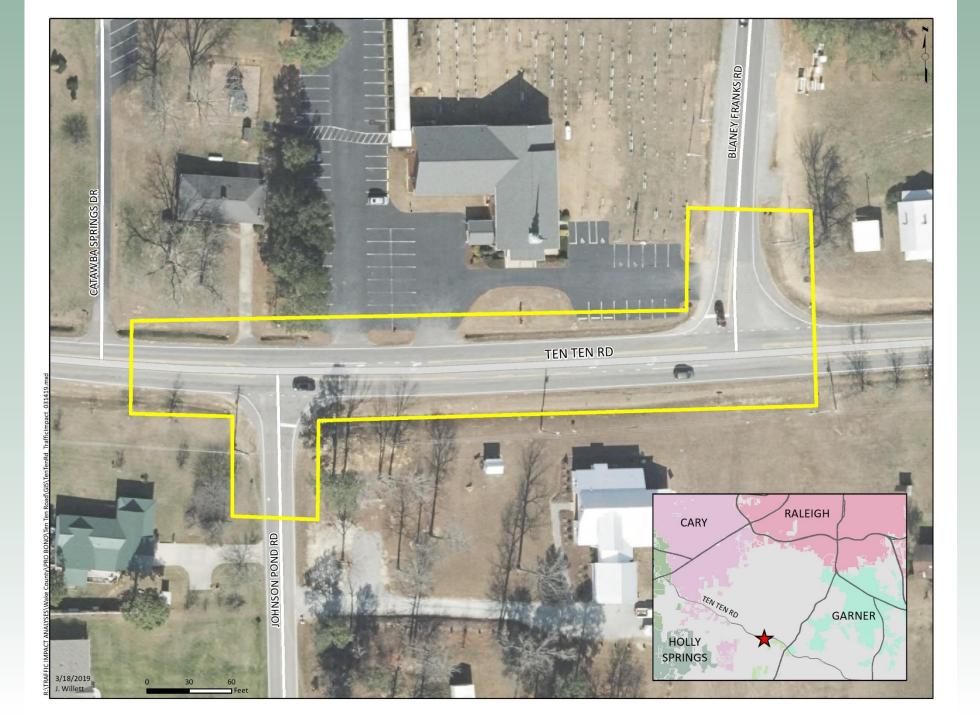
## Drew Draper, Wetherill Engineering John Sandor, NCDOT



March 21, 2019









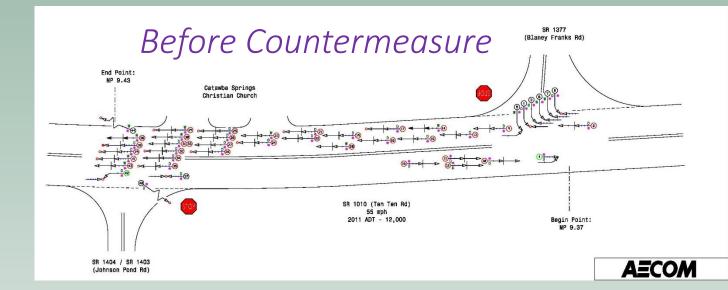
March 21, 2019

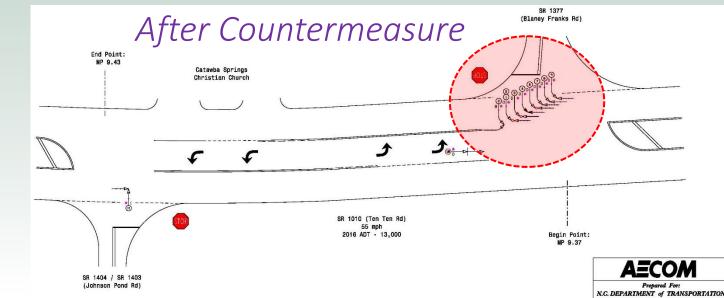




## Background

- Turn lanes installed in 2014
- Reduced overall crashes
- SB left crashes
   at Blaney Franks
   Rd have
   increased by
   50%







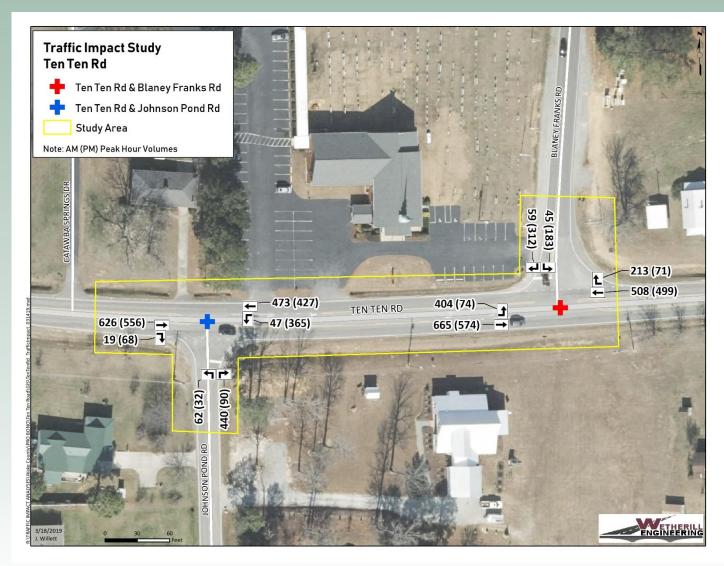
March 21, 2019





## Existing Peak Hour Traffic

- Congestion now a factor
- Heavy cross-street movements
- Satisfies signal warrants
- Access management concerns
- Sight distance issues





March 21, 2019





## Junction Screening Tool

- PM peak
- CAP-X software
- Volume to capacity ratios

Туре	Maximum V/C Compared to Conventional V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Conflict Points
Conventional	0.54		48
Continuous Green-T*	0.54	-	12
Echelon	0.54	+	28
Full Displaced Left Turn	0.54	-	40
Partial Displaced Left Turn	0.54	-	44
<b>Quadrant Roadway N-W</b>	0.54		40
Single Loop	0.54	-	28
Bowtie	0.59	+	24
Center Turn Overpass	0.59	+	32
Roundabout	0.60		8
Partial Median U-Turn	0.63	+	28
<b>Quadrant Roadway N-E</b>	0.63		40
<b>Quadrant Roadway S-E</b>	0.63		40
Split Intersection	0.63		36
<b>Restricted Crossing U-Turn</b>	0.68		20
<b>Quadrant Roadway S-W</b>	0.70		40
Median U-Turn	0.88	+	20
75 Mini Roundabout	0.90		8
Two-Way Stop Control	0.98		48
50 Mini Roundabout	0.99		8



March 21, 2019









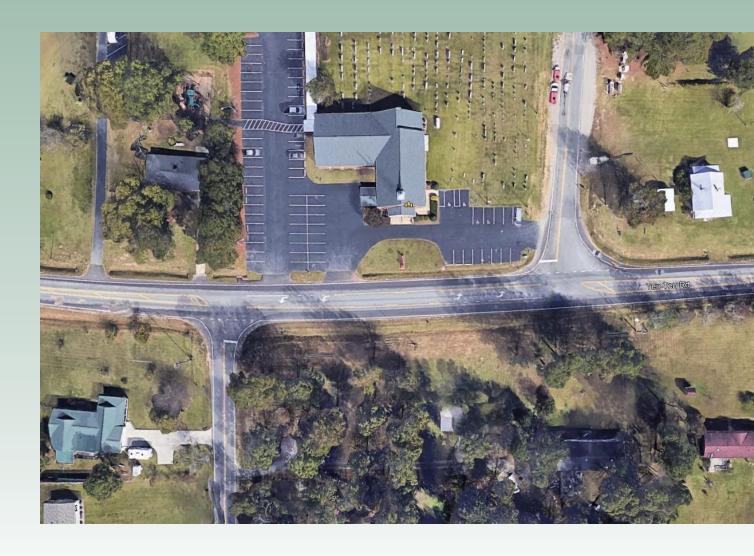
March 21, 2019





## Other Ideas?

- Conventional traffic signal
- Roundabout (s)
- Addition of turn lanes
- Consolidate driveways



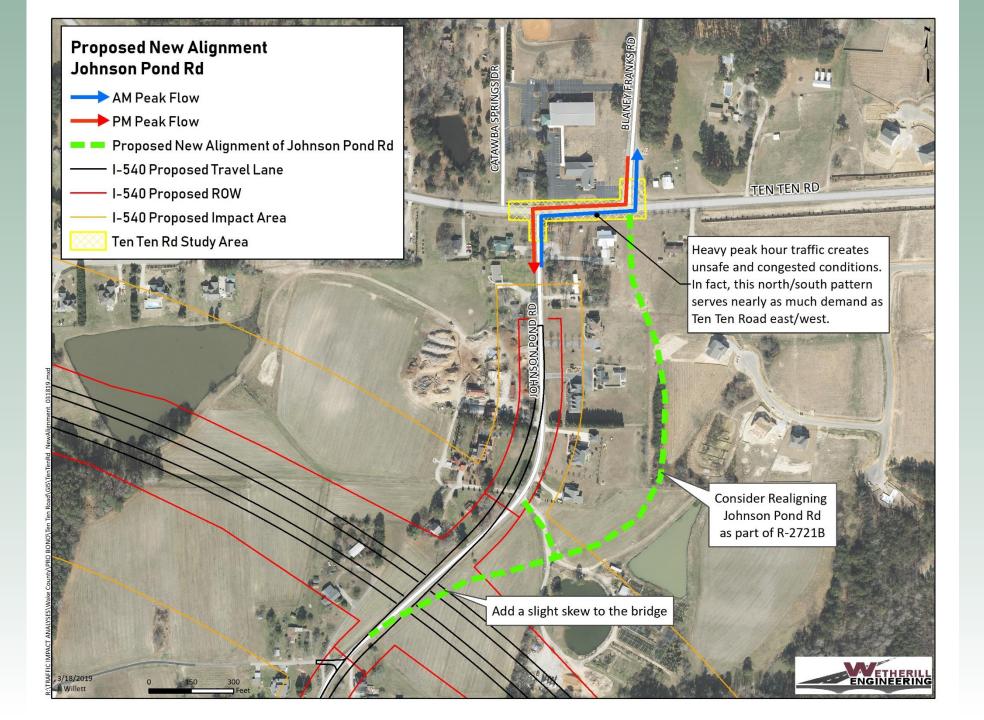
Or maybe.....



March 21, 2019









March 21, 2019





## Questions?

Thank you!



# NCDOT signal system retiming prioritization tool

Matthew T. Carlisle, NCDOT

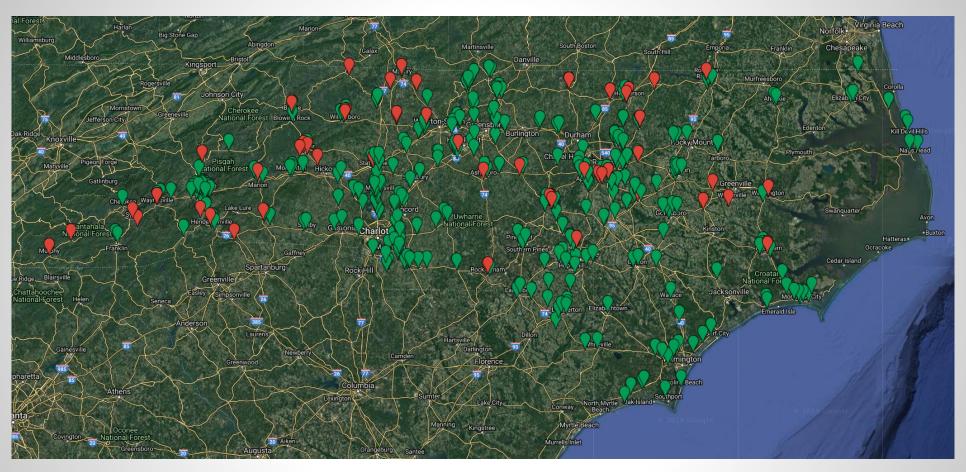
# NCDOT Signal System Retiming Prioritization Tool

**Intersection Solutions Forum** 

Matthew T. Carlisle, PE – State Signal Systems Engineer, NCDOT

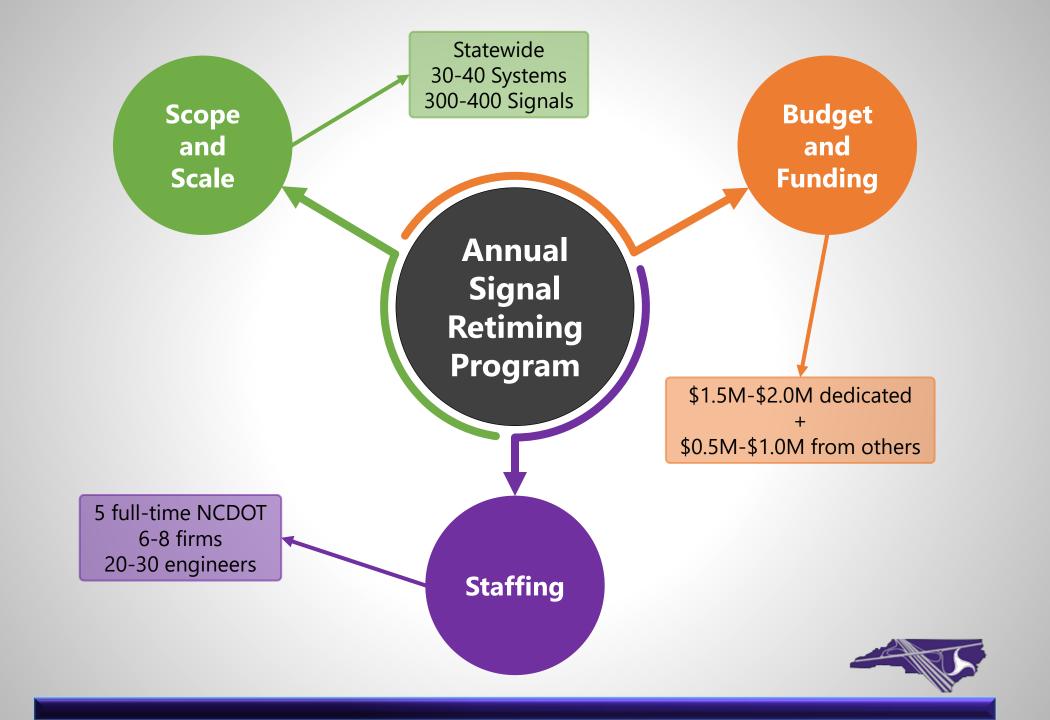


## **NCDOT Signal System Overview**

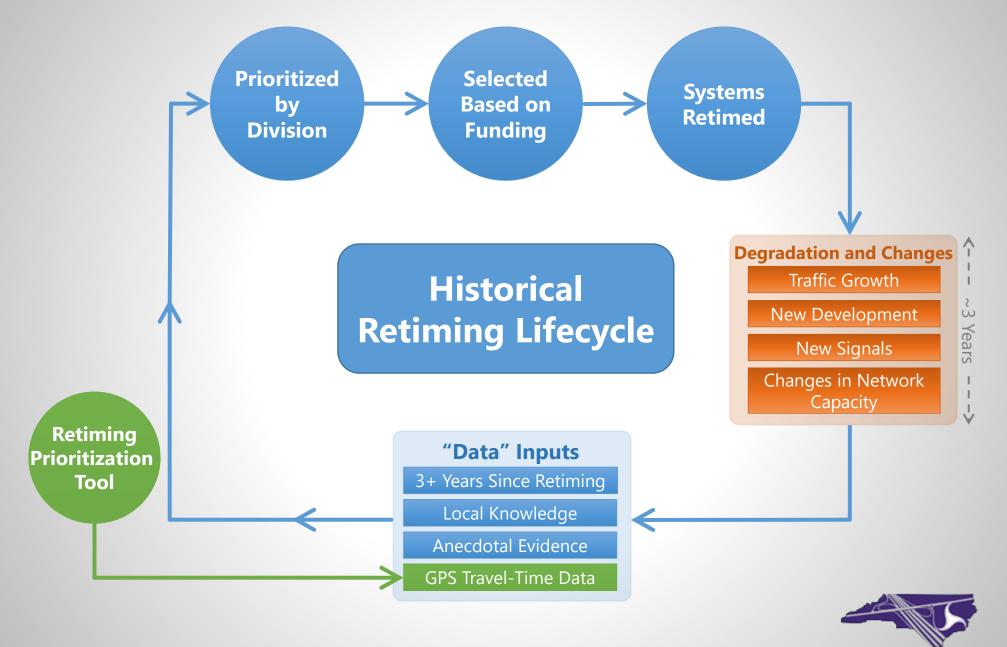


*385 systems – 2,400 signals* 



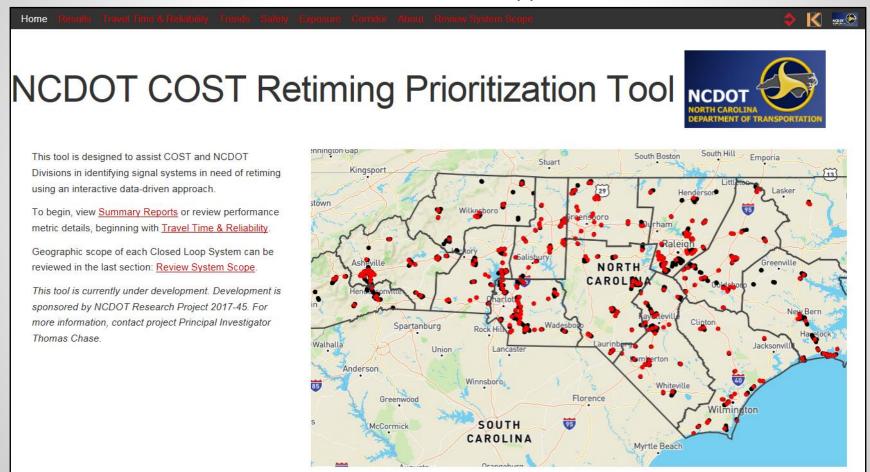


## **Need for Prioritization Tool**



## What is the Retiming Prioritization Tool?

A tool designed to assist NCDOT in identifying signal systems in need of retiming, using an interactive, data-driven approach.





### What data are used?

#### **HERE GPS Probe Data**

- Travel Time Measure
  - Normalized Travel Times (NTT)
- Reliability Measures
  - Interquartile Range (IQR)
  - Level of Travel Time Reliability (LOTTR)
- Performance Trends
  - Changes in Travel Times and Reliability

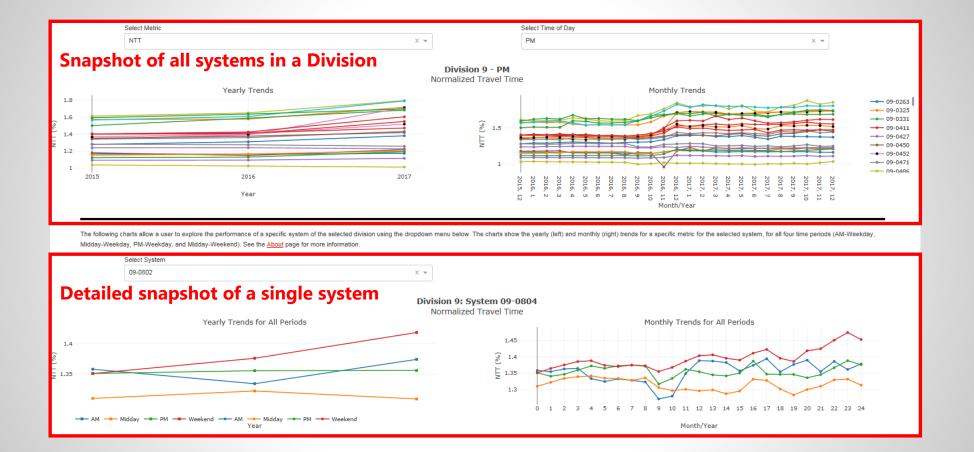
#### **NCDOT Data**

- Exposure
  - Annual Average Daily Traffic
- Safety
  - Crash patterns, frequency, rates



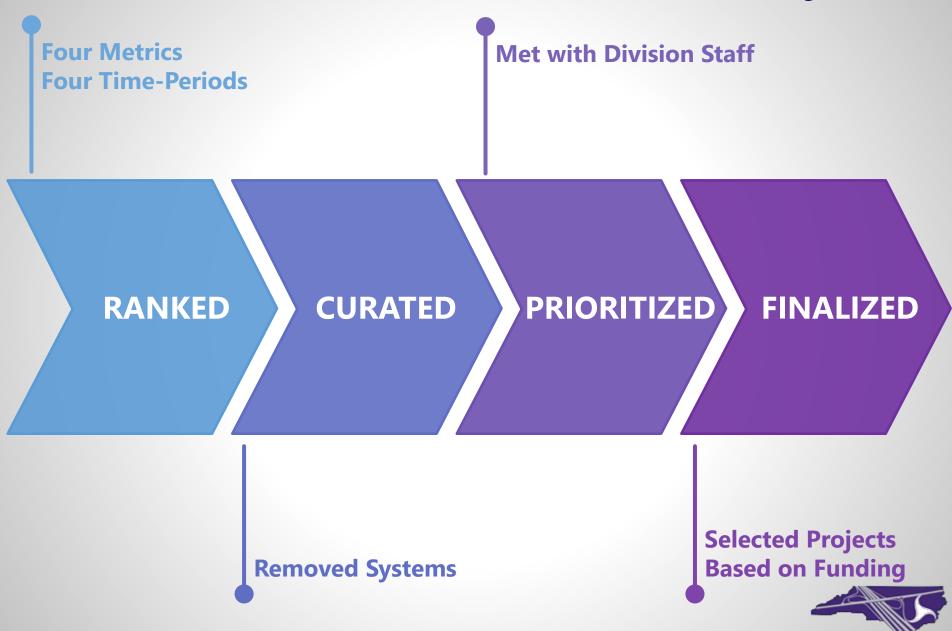


## **Example Charts from Tool**





## **How the Tool Was Used for 2019 Projects**



## **Benefits and Limitations**

#### **BENEFITS**



Called attention to some systems
Retiming efforts are seen in the data
Capable of comparing systems across Divisions

Data population not automated Ranking process not automated Accurate data difficult for some systems







## **Questions?**

**Matthew T. Carlisle, PE** – State Signal Systems Engineer, NCDOT mtcarlisle@ncdot.gov, (919) 814-4934





## Group Discussion: Advancing transportation innovations



## Final remarks





# RTA-NCDOT Intersection Solutions Forum Spring 2019 event

Thursday, March 21, 2019 SAS

