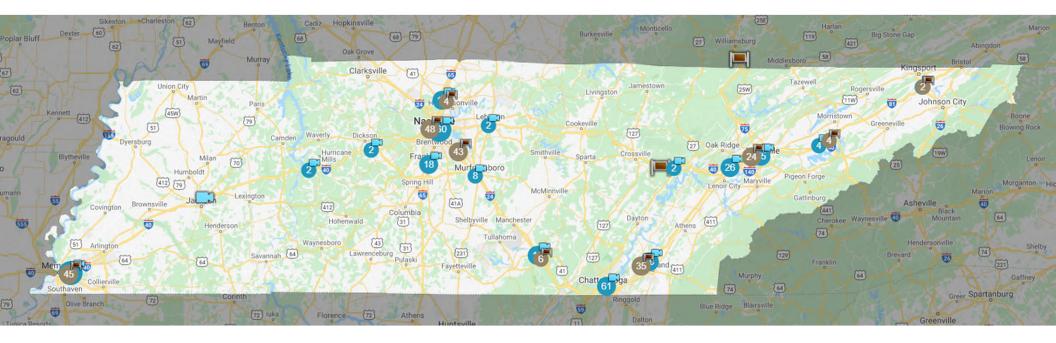


# Rural ITS Deployments: Using Analytics to Maximize Resources

**ITS TN/TSITE Joint Meeting** 

October 27, 2021

### **Current ITS Deployments in Tennessee**



20% of Current TDOT ITS deployments are in Rural areas





## History of Rural ITS in Tennessee

#### I-75 Fog Zone – Calhoun, TN (Hiwassee River)

- Fog related incident on December 11. 1990
  - 99 vehicles, 50 injuries, 15 fatalities
- Low Visibility Warning System initially constructed in 1993. Upgraded periodically.
- System components:
  - 3-mile fog detection area, 8-mile warning zones
  - CCTVs, DMS, visibility and speed sensors, changeable speed limit signs, RWIS, HAR, on-ramp swing gates
- Recognized by FHWA as a best practice in road weather management

#### I-24 - Monteagle Mountain, TN

- Brake check station prior to steep descent.
- 2 runaway ramps w/ detectors and DMS









### **Importance of Rural ITS in Tennessee**

- Deploy ITS infrastructure to save lives and improve operations
  - incident detection and response times
  - Detour traffic during incidents
  - Communication with drivers
- Address unique issues related to weather, freight vehicles, and other factors





### **Project Example**

- I-75 SmartWay ITS Expansion Campbell County
- Goals
  - Vision Zero eliminate crashes and increase safety of transportation system
  - Rapid detection
  - Rapid verification
  - Communicate with Motorists
  - Dispatch emergency services and HELP Trucks





## **Rural ITS Considerations**

#### Where are the needs?

• Safety Analysis

#### What are the needs?

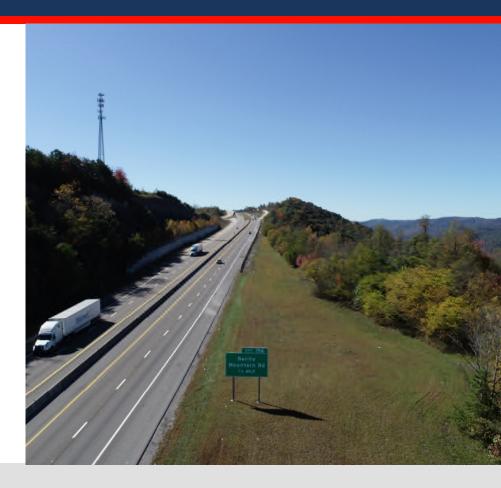
 Traffic Monitoring, Traveler Information, Road Weather Information, Connected Vehicles

#### **Communications Alternatives**

• Wireless, Cellular, Fiber Optics (above and below ground)

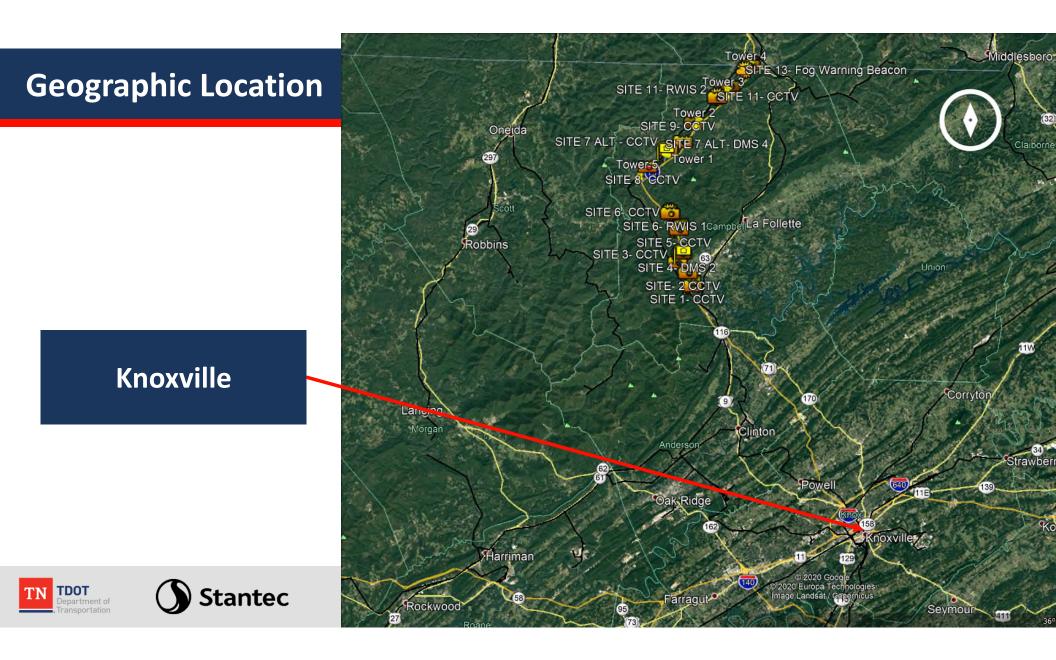
#### **Power Alternatives**

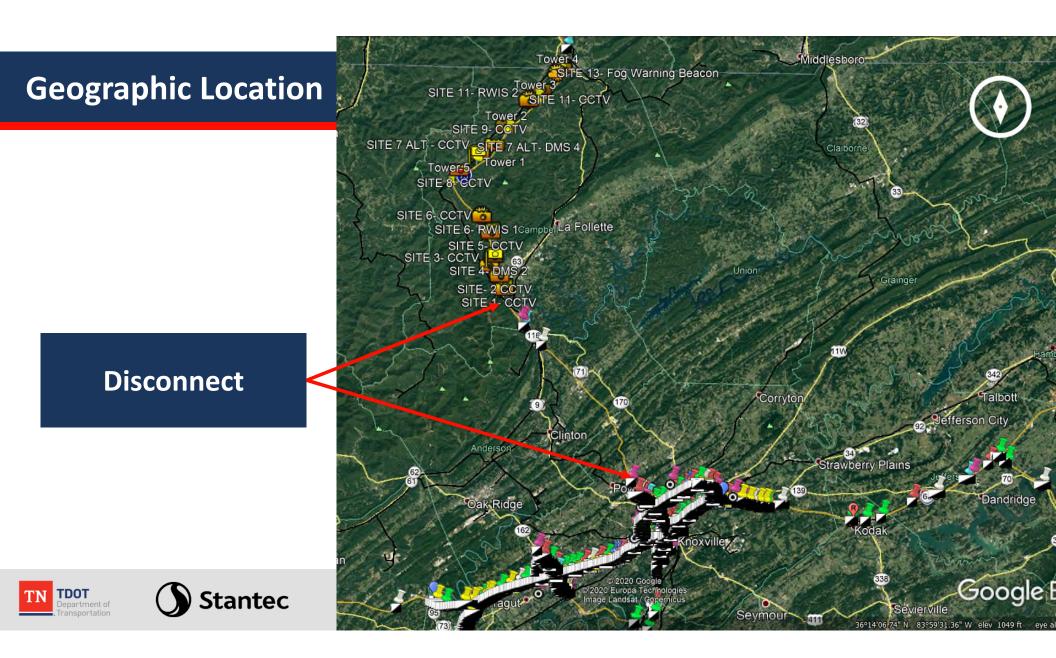
• Grid (above and below ground), Solar, Fuel Cells, Wind, Thermoelectric, Remote Line Power





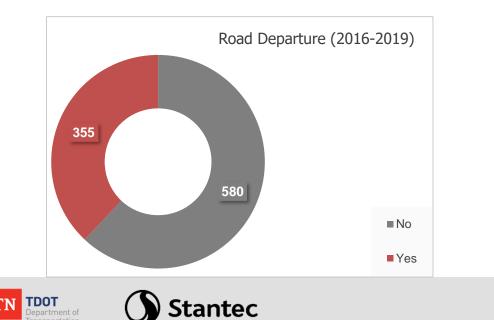


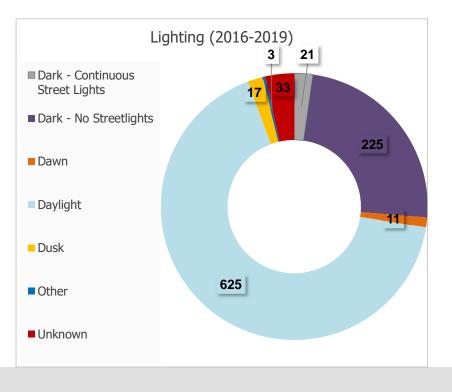




## Safety Analysis Methodology

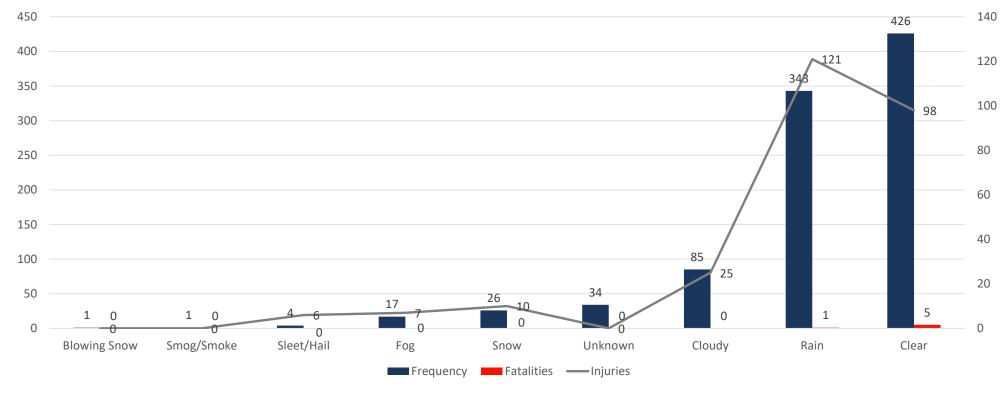
- 2016-2019 Crash Data
- Focus on Fatal and Serious Injury Collisions
- Identify Crash Hotspots
- 1/2 Mile Radius Clusters





## Safety Analysis Methodology

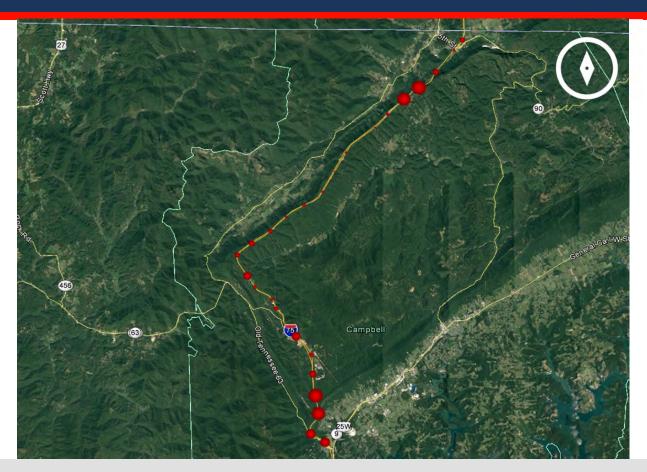
#### Weather Condition (2016-2019)





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## Safety Analysis: Hotspots

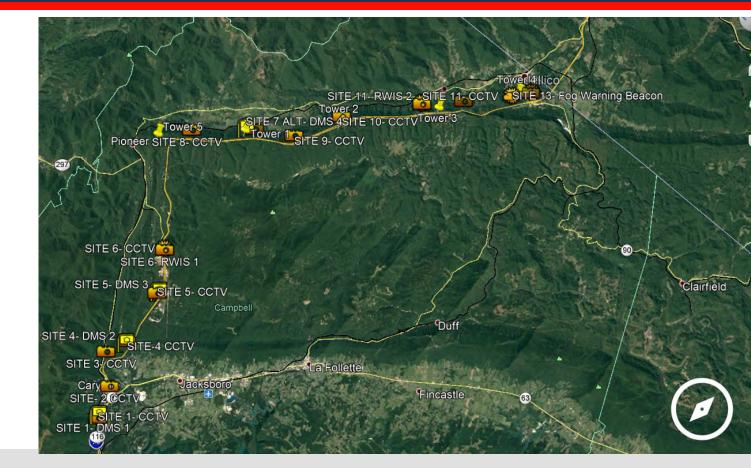






#### **User Needs**

- 1. Traffic Monitoring
- 2. Traveler Information
- 3. Road Weather Information
- 4. Connected Vehicles
- 5. \$14M Budget





# Communications

- 1. Traffic Monitoring
- 2. Traveler Information
- 3. Road Weather Information
- 4. Connected Vehicles

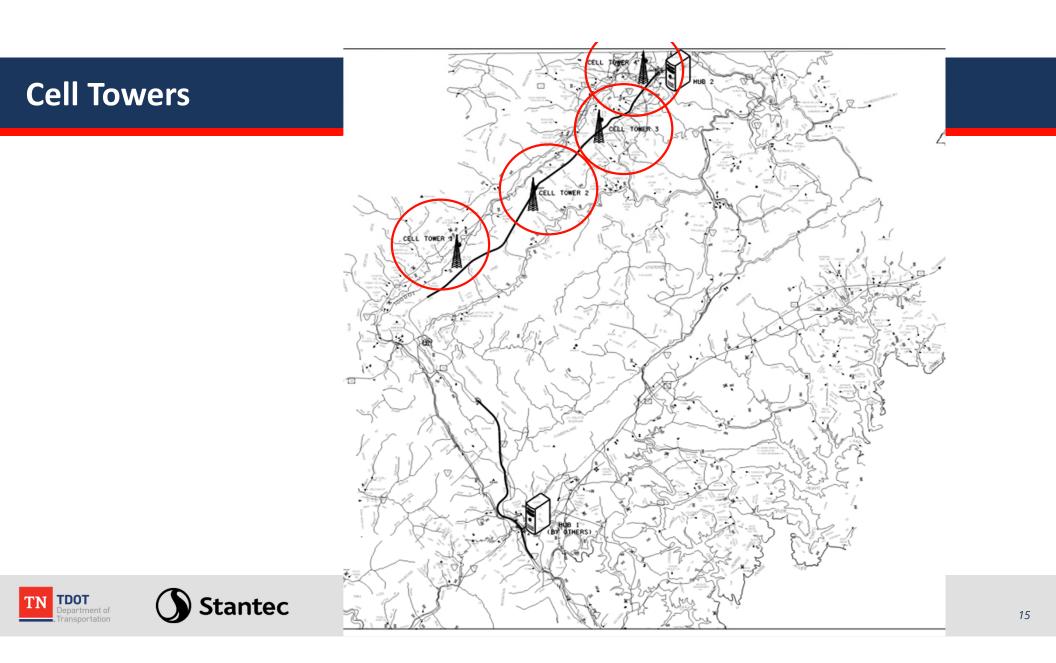
## **Full Corridor Fiber Optic Comms**

## \$16.4 Million

			e 1	e 2	e 3	e 4	e 5	s 6	8 9	7 Alt	6 e	Site 10	Site 11	12	13	Total	Total Item Cost	
		Unit Cost	Site 7	Site	Site	Site	Site	Site	Quantity	IC	ital Item Cost							
Typical Project Cost	\$	1,650,000.00							1							1	\$	1,650,000.00
Underground Backbone Fiber – Conduit (All Sites)	\$1	1,290,276.80							1							1	\$1	1,290,276.80
Underground Backbone Fiber – Conduit (Sites 1-6)	\$	3,662,138.70														0	\$	-
Underground Backbone Fiber – Conduit (Sites 8-13)	\$	5,351,418.60														0	\$	-
Aerial Fiber Backbone (Sites 8-13)	\$	1,094,858.60														0	\$	-
Wireless Point-to-Point Radio Communications (Sites 8 – 13)	\$	534,600.00														0	\$	-
ITS Communications Hub	\$	86,377.50		1												1	\$	86,377.50
Typical Single Run Guardrail	\$	30,263.75	2			2	2			2						8	\$	242,110.00
Typical Truss DMS Site	\$	322,091.00	1			1	1			1						4	\$	1,288,364.00
Typical Pedestal DMS Site	\$	261,591.00														0	\$	-
Typical 50' CCTV Site	\$	68,651.00		1	1								1	1		4	\$	274,604.00
Typical 80' CCTV Site	\$	85,151.00	1			1	1	1	1	1	1	1			1	9	\$	766,359.00
Typical 110' CCTV Site	\$	123,651.00														0	\$	-
Typical Additional CCTV Camera	\$	7,700.00														0	\$	-
Typical Infrared CCTV Camera	\$	17,050.00														0	\$	-
Typical RDS at CCTV	\$	12,210.00	1	1	1	1	2	1		1	1	1	1	1	1	13	\$	158,730.00
Typical ESS at CCTV	\$	11,000.00														0	\$	-
Typical Standalone RWIS Site	\$	88,000.00						1					1		1	3	\$	264,000.00
Typical Electrical Service – Grid Power	\$	32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$	420,777.50
Typical Solar Power Connection (1 Day Autonomy)	\$	38,500.00														0	\$	-
														Tota	al Cos	t	\$1	6,441,598.80

TN TDOT Department of Transportation





#### **Cell Tower Communications**

#### EQUIPMENT

#### - Final Configuration Summary

THE FINAL EQUIPMENT CONFIGURATION WILL REPRESENT ALL OF TENANT'S ENTITLEMENTS, INCLUDING ANY RESERVED SPACE, IF APPLICABLE, UPON FULL EXECUTION OF THE ASSOCIATED LEASE OR AMENDMENT,

- Antenna: 2 Redline Communications AN-80i @ 150' [Tip:150.5'] [Base:149.5'], 11.4" x 16.9" x 1.8", Weight: 11 lbs. [Radio/ODU]
- · Ground Space: 1, 4' x 4', SBA Shelter Space: No, Provided by: Tenant [Concrete Pad]
- Cables: , 2 lines Cat 5 @ 0.24"
- Frequency:, RX: 3.5 GHz WIMAX band, 4.9 GHz public safety band and license-exempt 5.4 and 5.8 GHz bands, TX: 3.5 GHz WIMAX band, 4.9 GHz public safety band and license-exempt 5.4 and 5.8 GHz bands.
- Mount Equipment: 2 Redline Communications Mounting Kit for AN-80i antenna @ 150' [Mounting Kit for AN-80i antenna]

Select Equipme	nt Category:					
Antenna (2)	O Mount Equipment (2)	ODish	O ODU / Coupler	O Ice Shield		
O RRU Module	O DC Surge Suppressor / COVP / OVP	O Other Cable (2)	O Fiber / Junction Box	O Diplexer	OCombiner	O RET / ACU / RCU
O Filter	O PDU (Mounted on ground)	O BIAS-T	O Ground Space (1)	O Generator	O AC Unit	O GPS Receiver
O Transmitter	O Transmitter Cabinet	O Battery Bank	Other	O Frequency		
Antenna Qty:	2					
Type:	Radio/ODU					
Manufacturer:	Redline Communications					
Model:	AN-80i					
Dimensions:	11.4" x 16.9" x 1.8"					
Weight:	11 lbs.					
Base:	149.5					
Center:	150'					
Tip:	150.5'					



Ground Space Total:

TOTAL CONTRACTED SPACE

Down Tilt: Orientation: 0°

0° & 0°

Final (ft<sup>2</sup>)

## **Cell Tower Communications**

Comments:         New tenant lease.           changes/reglacements must be included on application if required. Applications with new equipment being installed require CD's to be uploaded to the application for review and approval by Regional Ops Site M           and Configuration will be determined pursuant to the Structural Analysis completed for this application           cease Comments:         na           coax Comments:         na           d Space Requested:         Yes           Total Ground Space         16 sqft           Push Fence Out?:         No           No         Site Visit Required:           Yes         Ground Space Expansion Needed:           No         Site Visit Required:           Yes         Site Visit Required:           Yes         And Detune / Intermod Req:           No         AM Detune / Intermod Req:           Yes         Lease Exhibit Req:           Yes         Ative           Yes         Ative		Requestor:	sbasite\eclanton			Request Date:	11/1/2019 5:04:33 PM						
is Approved:         Yes         Tower Extension Needed:         No           Structural Required:         Yes (Full SA)         Tenant Structural Cost:         52,50.00           Comments:         New tenant lease.         Structural Required:         Yes (Full SA)         Tenant Structural Cost:         52,50.00           Comments:         New tenant lease.         Structural Analysis completed for this application with new equipment being installed require:         Us to be uploaded to the application for review and approval by Regional Ops Site M           Read Configuration will be determined pursuant to the Structural Analysis completed for this application         Structural Required:         No         Structural Analysis completed for this application           Coax Comments:         na         Structural Space Approved:         Yes         Structural Space Approved:         No           Coax Comments:         na         Structural Space Approved:         No         Structural Space Approved:         No           Coax Comments:         na         Ground Space Approved:         Yes         No         Structural Space Approved:         No           Structural Required:         Yes         Ground Space Expansion Needed:         No         No         Structural Space Approved:         No           Structural Required:         Yes         Structural Space Approved:         No	:	SS Validated By:	sbasite\jstempel			Validated On:	11/6/2019 3:40:25 PM						
Structural Required in the service of the s		Approver:	sbasite\jstempel			Approval Date:	11/6/2019 3:48:20 PM						
Comments:         New tenant lease.           changes/reglacements must be influded on application if required. Applications with new equipment being installed require CD's to be uploaded to the application for review and approval by Reglanal Ops Site New and Configuration will be determined pursuant to the Structural Analysis completed for this application           c painting Required:         No           c Doar Comments:         na           c Doar Comments:         No           na         State         State         No           c Doar Comments:         No         State         No           c Doar Comments:         No         State         State         State         No           c Doar Comments:         No         State         State         State         No         State           c Doar Comments:         No         Atte         No         State         No         State            No         Atte		Is Approved:	Yes			Tower Extension Needed:	No						
Note that the service of the se	Stru	Structural Required: Yes (Full SA)				Tenant Structural Cost:	\$2,500.00						
and Configuration will be determined pursuant to the Structural Analysis completed for this application <ul> <li>Coax Comments</li> <li>na</li> <li>Coax Comments</li> <li>na</li> <li>Total Ground Space Requested</li> <li>Yes</li> <li>Ground Space Approved:</li> <li>Yes</li> </ul> Total Ground Space         16 sqft         Ground Space Approved:         Yes           Total Ground Space         16 sqft         Ground Space Expansion Needed:         No           Push Fence Out?         No         SBA Generator         No           Site Visit Required:         Yes         Ground Space Expansion Needed:         No           Using SBA Shefter:         No         SBA Generator         No           arate Tenant Metter:         Yes         Att Detune / Intermod Req         No           Const Drawing Req:         Yes         Lease Exhibit Req:         Yes           Ste Lasses         Yes         Attive         Pending           At Att T         Active         Pending         Attiv           At Att T         Terminated         Terminated         Terminated           At Att T         Active         Yes         Yes		Comments:	New tenant lease	e.									
Required:       No       Image: State of the s	All mount chang	ges/replacements m	ust be included on a	pplication if required. A	Applications with new	quipment being installed require	CD's to be uploaded to the application for review and approval by Regional Ops	s Site N					
Coax Comments:         na           d Space Requested:         Yes         Ground Space Approved:         Yes           Total Ground Space         16 sqtt         Ground Space Expansion Needed:         No           Push Fence Out?         No         SBA Generator:         No           Site Visit Required:         Yes         And Detune / Intermod Req         No           site Terrant Meter:         Yes         And Detune / Intermod Req         No           Const Drawing Req         Yes         Lease Exhibit Req         Yes	Coax Route and	Configuration will	be determined pursu	ant to the Structural Ar	nalysis completed for 1	his application							
d Space Requested     Yes       Total Ground Space     16 sqtt     Ground Space Approved     No       Total Ground Space     16 sqtt     Ground Space Expansion Needed:     No       Ster Visit Required     No     Ster Visit Assigned To     John Leonard       Ster Visit Required     Yes     Attor     Attor     No       T-Mobile Sprint     Active     Pending     Yes	Coax Pai	Coax Painting Required: No											
If sqtt     Ground Space Expansion Needed:     No       SBA Generator:     No       Site Visit Required:     Yes       Site Visit Required:     No       Site Visit Required:     No       Site Visit Required:     No       Site Visit Required:     No       Const Drawing Req     Yes       Version Const Drawing Req     Yes <th colspa="&lt;/td"><td>C</td><td>oax Comments:</td><td>na</td><td></td><td></td><td></td><td></td><td></td></th>	<td>C</td> <td>oax Comments:</td> <td>na</td> <td></td> <td></td> <td></td> <td></td> <td></td>	C	oax Comments:	na									
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AM Detune / Intermod Req         No           AM Detune / Intermod Req         No           arate Teant Meter         Yes           Const Drawing Req         Yes         Lease Exhibit Req         Yes           Status         Termination Status           Active         Pending           Artar         Terminated           T. Active         Pending           Active         Active						SBA Generator:	No						
Yes       Lease Exhibit Req:       Yes       Lease Exhibit Req:     Yes	Site Visit Required: Yes					Site Visit Assigned To:	John Leonard						
Const Drawing Req:         Yes         Lease Exhibit Req:         Yes           Site Lease:           Site Lease:         Termination Status           1         AT&T         Active         Pending           20         T-Mobile Sprint         Active         Pending           3         ATAT         Terminated           4         T-Mobile Sprint         Active           5         T-Mobile Sprint         Active	Tenant Using SBA Shelter: No					AM Detune / Intermod Req:	No						
Site Leases       e #     Carrier     Lease Status       11     AT&T     Active       22     T-Mobile Sprint     Active       23     AT&T     Terminated       24     T-Mobile Sprint     Active       25     T-Mobile Sprint     Active	Separat	Separate Tenant Meter: Yes											
#         Carrier         Lease Status         Termination Status           M         AT&T         Active         Active           Z         T-Mobile Sprint         Active         Pending           30         AT&T         Terminated         Terminated           4         T-Mobile Sprint         Active         Active           55         T-Mobile         Active         Active	Con	st Drawing Req:	Yes			Lease Exhibit Req:	Yes						
#         Carrier         Lease Status         Termination Status           M         AT&T         Active         Active           Z         T-Mobile Sprint         Active         Pending           30         AT&T         Terminated         Terminated           4         T-Mobile Sprint         Active         Active           55         T-Mobile         Active         Active	DM Minus of Cito	Langer											
12     T-Mobile Sprint     Active     Pending       33     AT&T     Terminated     Terminated       44     T-Mobile Sprint     Active     Ending       55     T-Mobile     Active     Ending	SBA Lease #		Carrier	Lease Status	Termination	itatus							
33     AT&T     Terminated       44     T-Mobile Sprint     Active       55     T-Mobile     Active	TN00932-B-01	AT&T		Active									
J4         T-Mobile Sprint         Active           J5         T-Mobile         Active	TN00932-B-02	T-Mobile Sprint		Active	Pending								
5 T-Mobile Active	TN00932-B-03	AT&T		Terminated	Terminated								
Verizon Active													
	TN00932-B-06	Verizon		Active									
	TN00932-B-01 TN00932-B-02 TN00932-B-03 TN00932-B-04 TN00932-B-05 TN00932-B-06	T-Mobile Sprint AT&T T-Mobile Sprint T-Mobile		Active Terminated Active Active	-								
	•	DATE	VER#	AUTHOR	COM	MENT							
DATE VER# AUTHOR COMMENT	+	5/21/2020 10:	14:54 AM 1	sbasite\eclan	ton Plac	ng on hold until receive proje	ct update from customer.						
	+	10/28/2019 4:	52:21 PM 1	zdomingue	No	round equipment is required							
5/21/2020 10:14:54 AM 1 sbasite\eclanton Placing on hold until receive project update from customer.	-			-									



**Stantec** 

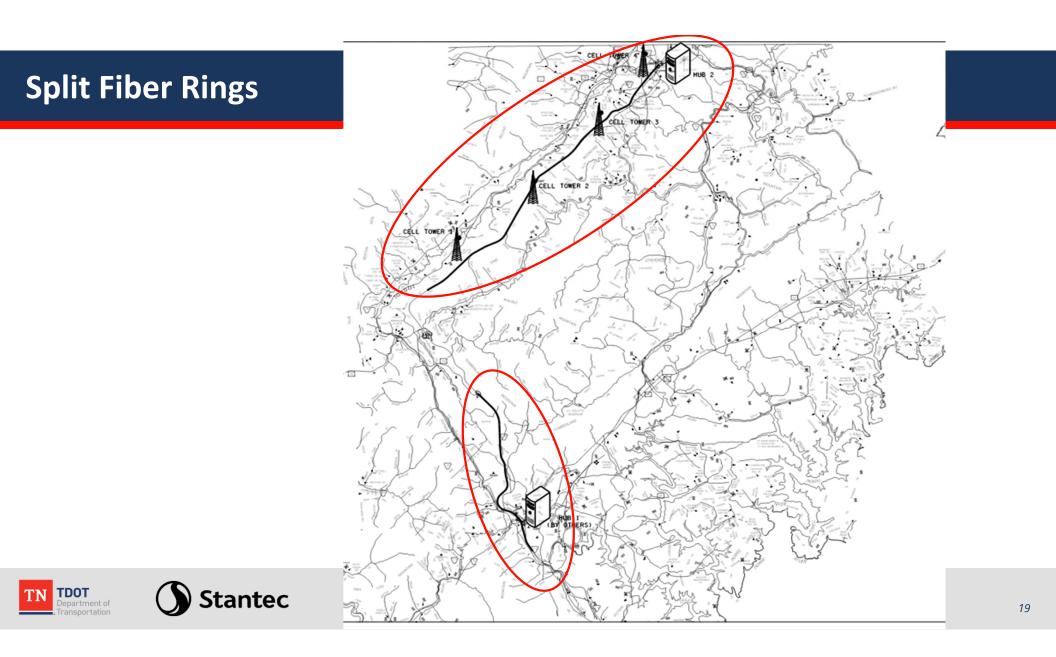
## Fiber Optic/Wireless Hybrid Comms

### \$9.0 Million

		Unit Cost	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 8	Site 7 Alt	Site 9	Site 10	Site 11	Site 12	Site 13	Total Quantity	Tota	l Item Cost	
Typical Project Cost	\$	1,650,000.00							1							1	\$ 1,	650,000.00	
Underground Backbone Fiber – Conduit (All Sites)	\$1	1,290,276.80														0	\$	-	
Underground Backbone Fiber – Conduit (Sites 1-6)	\$	3,662,138.70			:	1										1	\$3,	662,138.70	
Underground Backbone Fiber – Conduit (Sites 8-13)	\$	5,351,418.60														0	\$	-	
Aerial Fiber Backbone (Sites 8-13)	\$	1,094,858.60														0	\$	-	
Wireless Point-to-Point Radio Communications (Sites 8 – 13)	\$	534,600.00										1				1	\$	534,600.00	
ITS Communications Hub	\$	86,377.50		1											1	2	\$	172,755.00	
Typical Single Run Guardrail	\$	30,263.75	1			1	1			1						4	\$	121,055.00	
Typical Truss DMS Site	\$	322,091.00														0	\$	-	
Typical Pedestal DMS Site	\$	261,591.00	1			1	1			1						4	\$ 1,	046,364.00	
Typical 50' CCTV Site	\$	68,651.00		1	1								1	1		4	\$	274,604.00	
Typical 80' CCTV Site	\$	85,151.00	1			1	1	1		1	1	1			1	8	\$	681,208.00	
Typical 110' CCTV Site	\$	123,651.00							1							1	\$	123,651.00	
Typical Additional CCTV Camera	\$	7,700.00														0	\$	-	
Typical Infrared CCTV Camera	\$	17,050.00														0	\$	-	
Typical RDS at CCTV	\$	12,210.00	1	1	1	1	2	1		1	1	1	1	1	1	13	\$	158,730.00	
Typical ESS at CCTV	\$	11,000.00	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$	143,000.00	
Typical Standalone RWIS Site	\$	88,000.00														0	\$	-	
Typical Electrical Service – Grid Power	\$	32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$	420,777.50	
Typical Solar Power Connection (1 Day Autonomy)	\$	38,500.00														0	\$	-	
														Tota	al Cos	t \$ 8,988,883.2			







## Fiber Optic/Wireless Hybrid Comms

### \$14.3 Million

	Unit Cost	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 8	Site 7 Alt	Site 9	Site 10	Site 11	Site 12	Site 13	Total Quantity	Total Item Cost
Typical Project Cost	\$ 1,650,000.00							1							1	\$ 1,650,000.00
Underground Backbone Fiber – Conduit (All Sites)	\$11,290,276.80														0	\$ -
Underground Backbone Fiber – Conduit (Sites 1-6)	\$ 3,662,138.70	) 1												1	\$ 3,662,138.70	
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Typical Pedestal DMS Site	\$ 261,591.00														0	\$ -
Typical 50' CCTV Site	\$ 68,651.00		1	1								1	1		4	\$ 274,604.00
Typical 80' CCTV Site	\$ 85,151.00	1			1	1	1	1	1	1	1			1	9	\$ 766,359.00
Typical 110' CCTV Site	\$ 123,651.00														0	\$ -
Typical Additional CCTV Camera	\$ 7,700.00														0	\$ -
Typical Infrared CCTV Camera	\$ 17,050.00														0	\$ -
Typical RDS at CCTV	\$ 12,210.00	1	1	1	1	2	1		1	1	1	1	1	1	13	\$ 158,730.00
Typical ESS at CCTV	\$ 11,000.00														0	\$ -
Typical Standalone RWIS Site	\$ 88,000.00						1					1		1	3	\$ 264,000.00
Typical Electrical Service – Grid Power	\$ 32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$ 420,777.50
Typical Solar Power Connection (1 Day Autonomy)	\$ 38,500.00														0	\$ -
,	•												Tota	al Cos	t	\$ 14,251,256.80

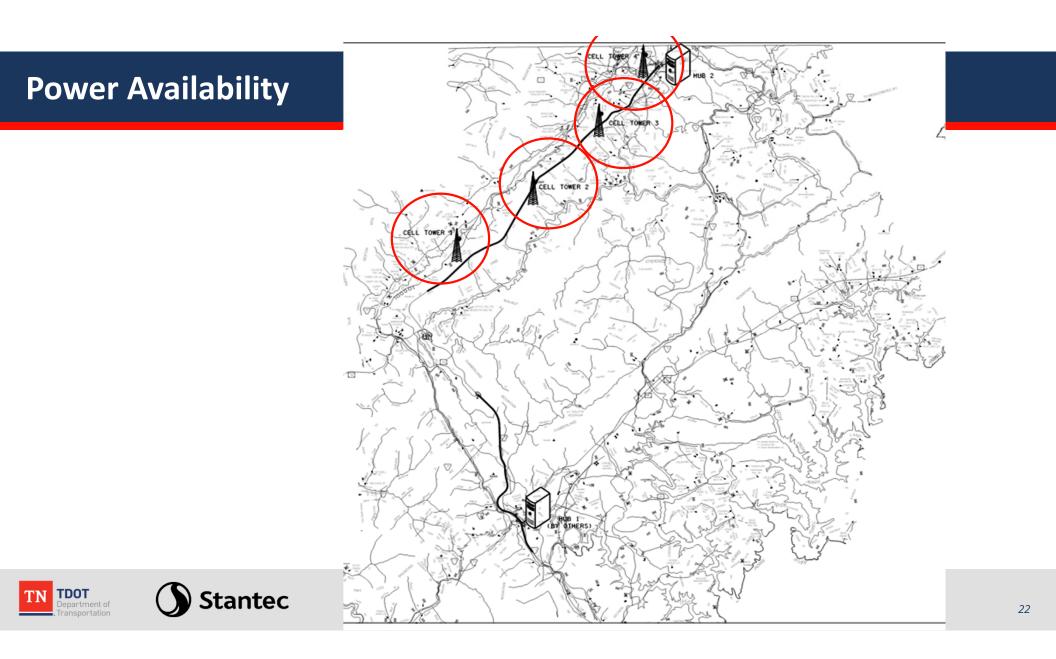






## **Power**

- 1. Underground Grid
- 2. Aerial Grid
- 3. Solar
- 4. Fuel Cells
- 5. Wind
- 6. Thermoelectric
- 7. Remote Line Power



## I-75 SmartWay ITS Deployment Current Progress

- 1. Preliminary and ROW Plans Complete
- 2. Construction Plans Underway
- 3. \$13M Construction Estimate
- 4. FY 2022 Letting





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## **Other Rural ITS Deployments**

#### I-40 Smart Fiber – ITS Expansion

#### 2020 INFRA Grant Award recipient

#### Project Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Lay the foundations of technology infrastructure for future connected and automated vehicles
- Lay the foundation for future broadband expansion

#### Project Scope

- Approximately 143 miles of fiber optic communications.
- ITS Devices at strategic locations
  - CCTV cameras
  - Dynamic message signs
  - Road weather sensors
  - Connected vehicle roadside units









### **Other Rural ITS Deployments**

#### **CRRSAA Rural ITS Expansion**

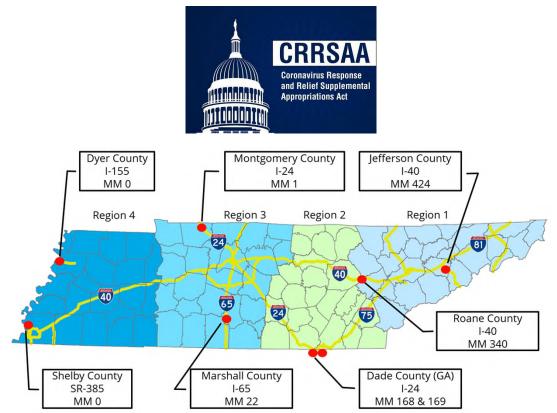
Funding from the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA)

#### Project Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Smaller, individual deployments with standardized devices and minimal footprint

#### Project Scope

- 8 locations selected (2 per TDOT Region)
  - 1-2 CCTV cameras
  - Dynamic message sign
  - Road weather sensor
  - Connected vehicle roadside unit







### **Other Rural ITS Deployments**

#### **Improve Act - Rural ITS Expansions**

#### Cocke County, I-40

- From the Jefferson County Line to the North Carolina State Line (22 miles)
- Fiber Optic Communications
- 12 CCTVs, 2 DMS, Radar and Road weather sensors

#### Sullivan County, I-81

- From I-26 to the Virginia State Line (19 miles)
- Fiber Optic Communications
- 20 CCTVs, 3 DMS, Radar sensors

#### Cumberland and Putnam Counties, I-40

- From near MM 285 to near SR-299 (53 miles)
- Fiber Optic Communications
- 43 CCTVs, 8 DMS, Radar and Road weather sensors







## **Future Rural ITS Opportunities**

#### Program Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Lay the foundation of technology infrastructure for future ITS expansions involving:
  - CCTVs, DMS, and Traffic Sensors
  - Connected and Automated Vehicles
- Bridge existing TDOT fiber communications gaps to provide network resiliency and center to center communications for the Regional TMCs
- Explore leveraging TDOT ITS projects to support rural broadband expansion efforts















### **Contact Info:**

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