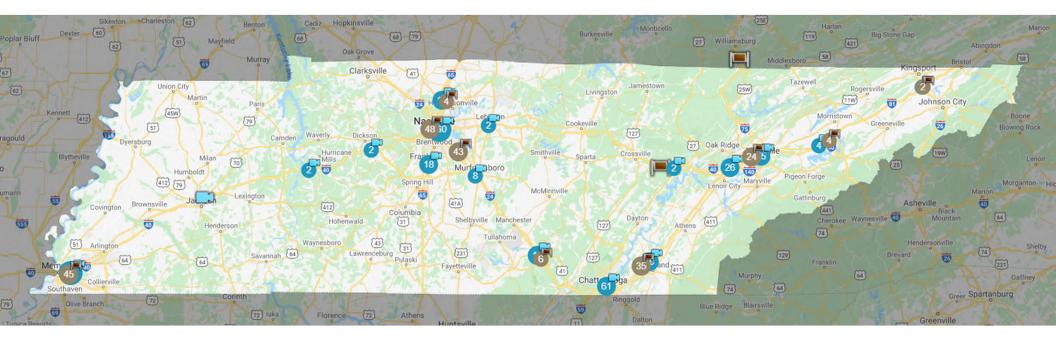


Rural ITS Deployments: Using Analytics to Maximize Resources

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?

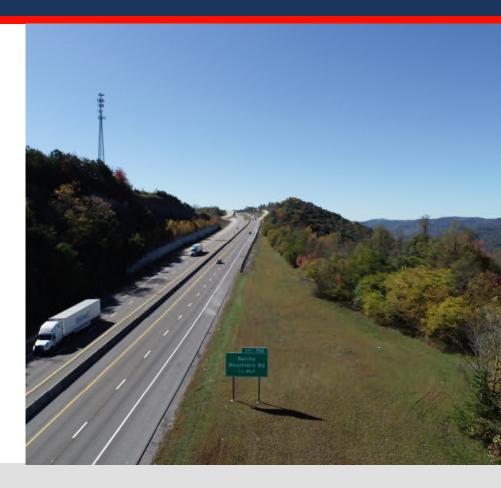
 Traffic Monitoring, Traveler Information, Road Weather Information, Connected Vehicles

Communications Alternatives

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

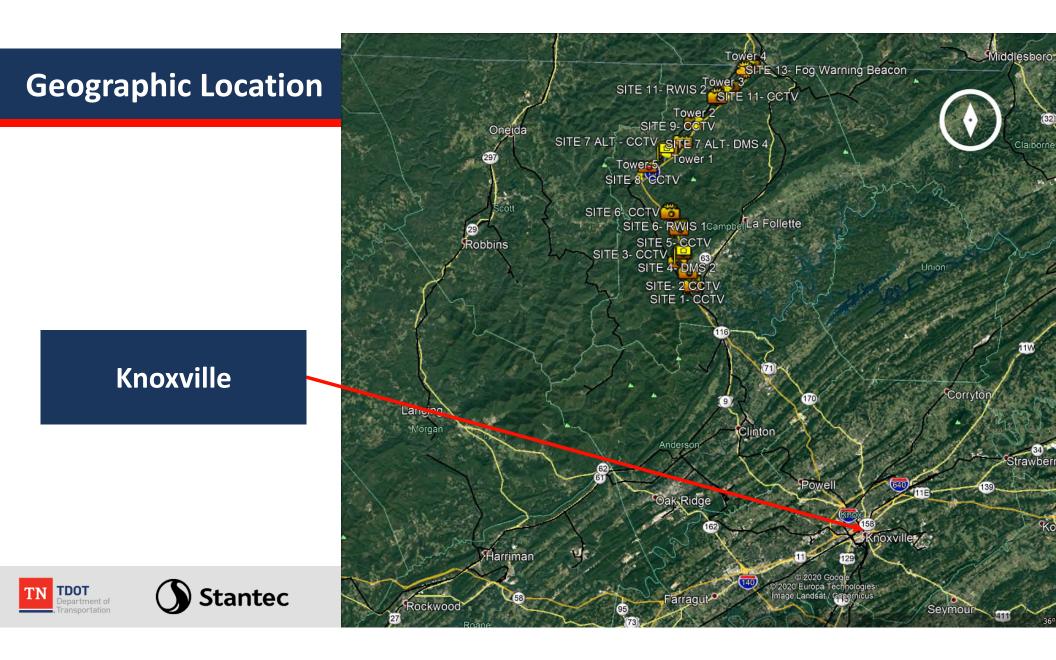
Power Alternatives

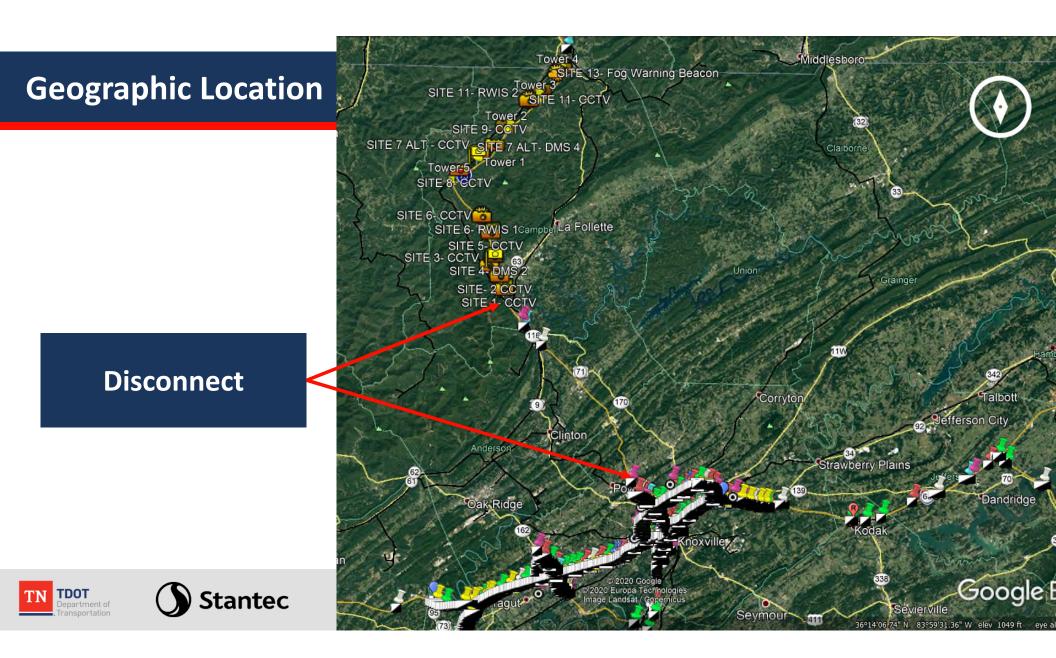
• Grid (above and below ground), Solar, Fuel Cells, Wind, Thermoelectric, Remote Line Power





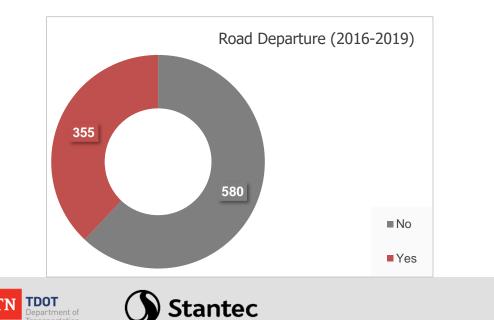


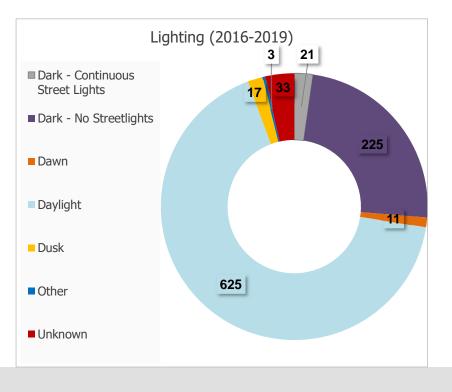




Safety Analysis Methodology

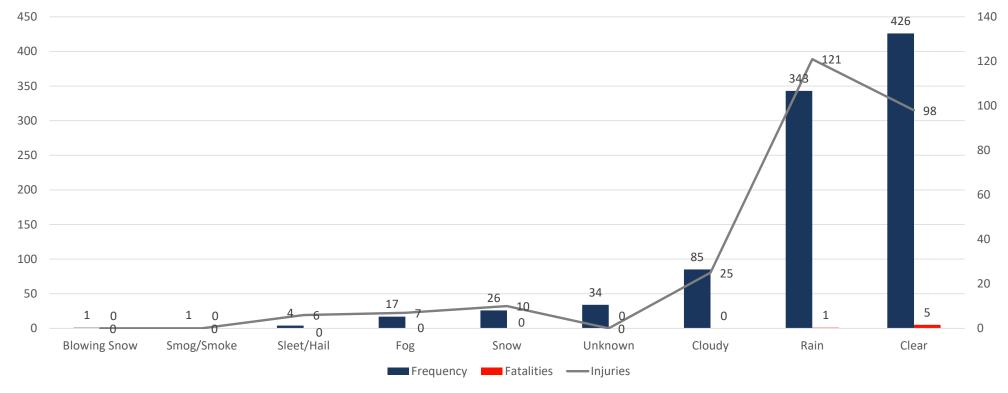
- 2016-2019 Crash Data
- Focus on Fatal and Serious Injury Collisions
- Identify Crash Hotspots
- 1/2 Mile Radius Clusters





Safety Analysis Methodology

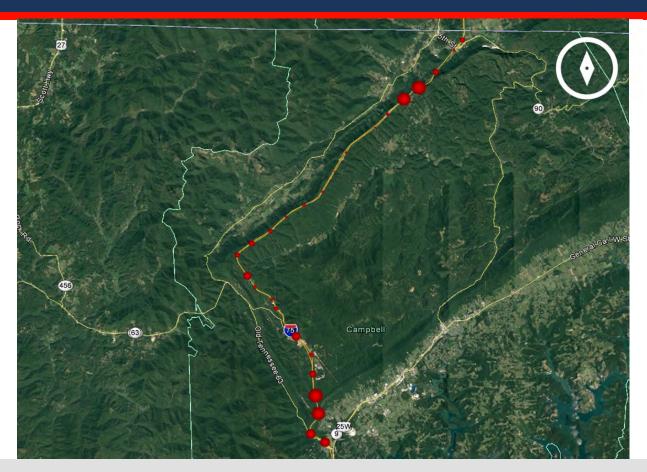
Weather Condition (2016-2019)





Stantec

Safety Analysis: Hotspots

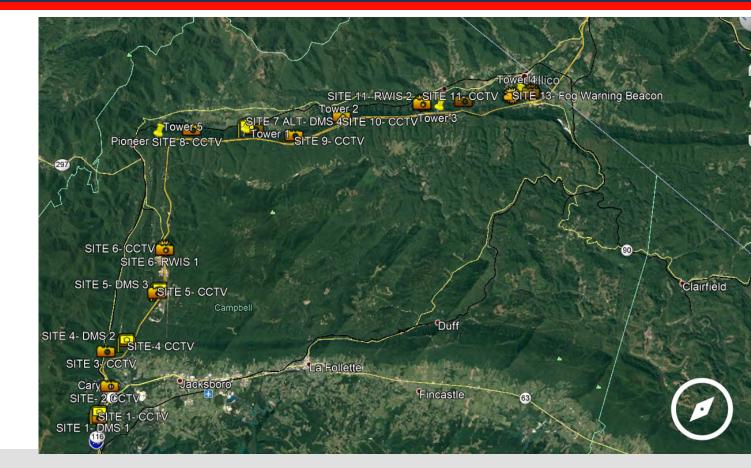






User Needs

- 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

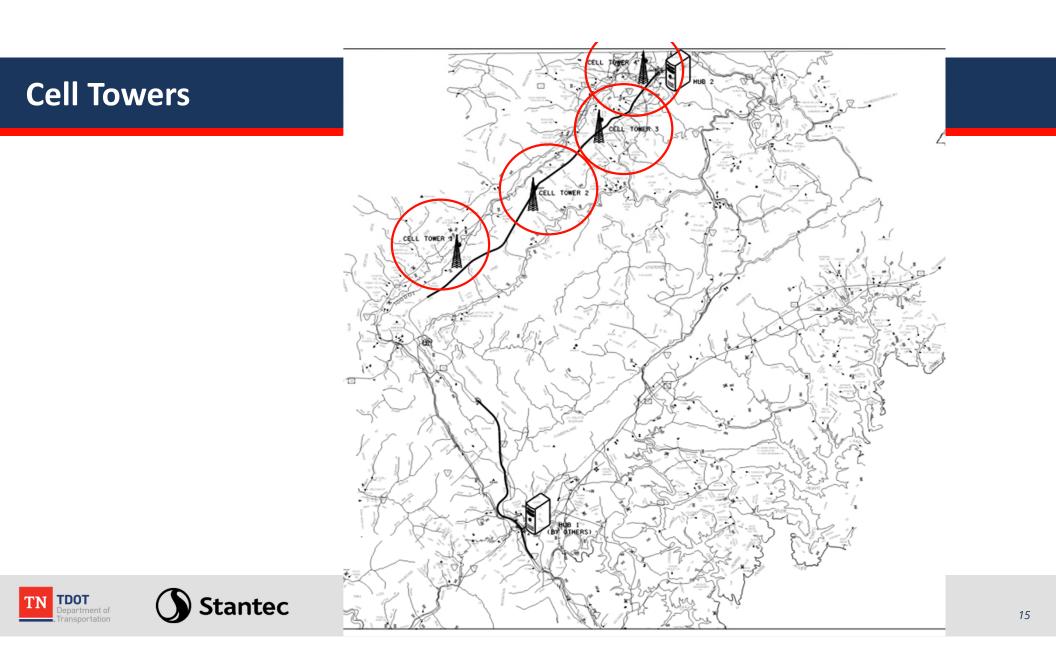
Full Corridor Fiber Optic Comms

\$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 (ft²)

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						
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and Configuration will be determined pursuant to the Structural Analysis completed for this application Coax Comments na Coax Comments na Total Ground Space Requested Yes Ground Space Approved: Yes 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.									
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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											
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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						
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# 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

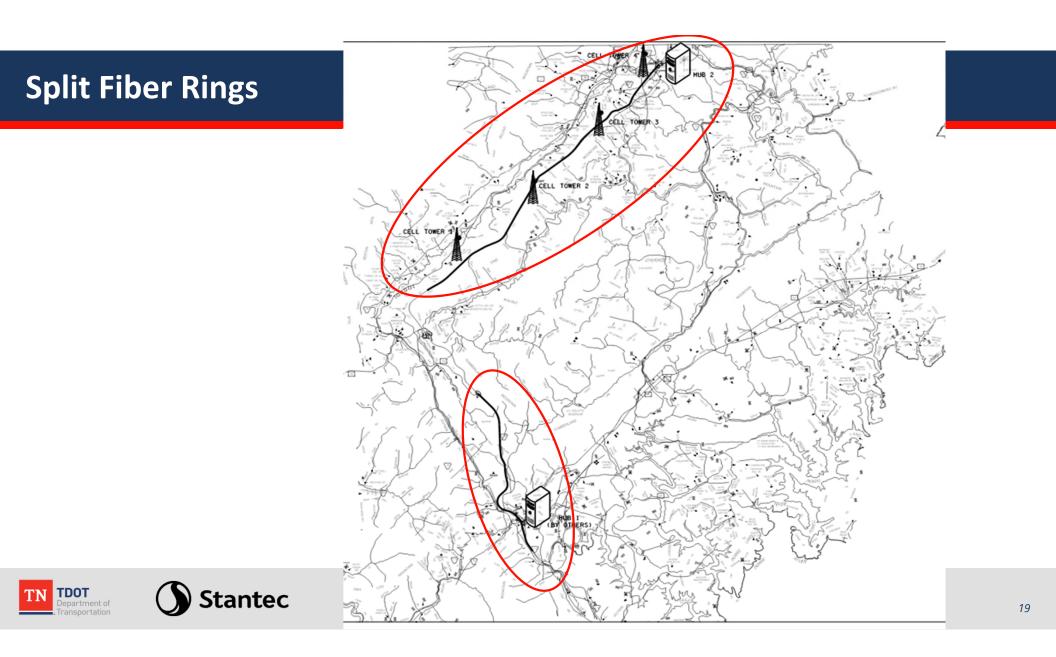
Fiber Optic/Wireless Hybrid Comms

\$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	\$ -
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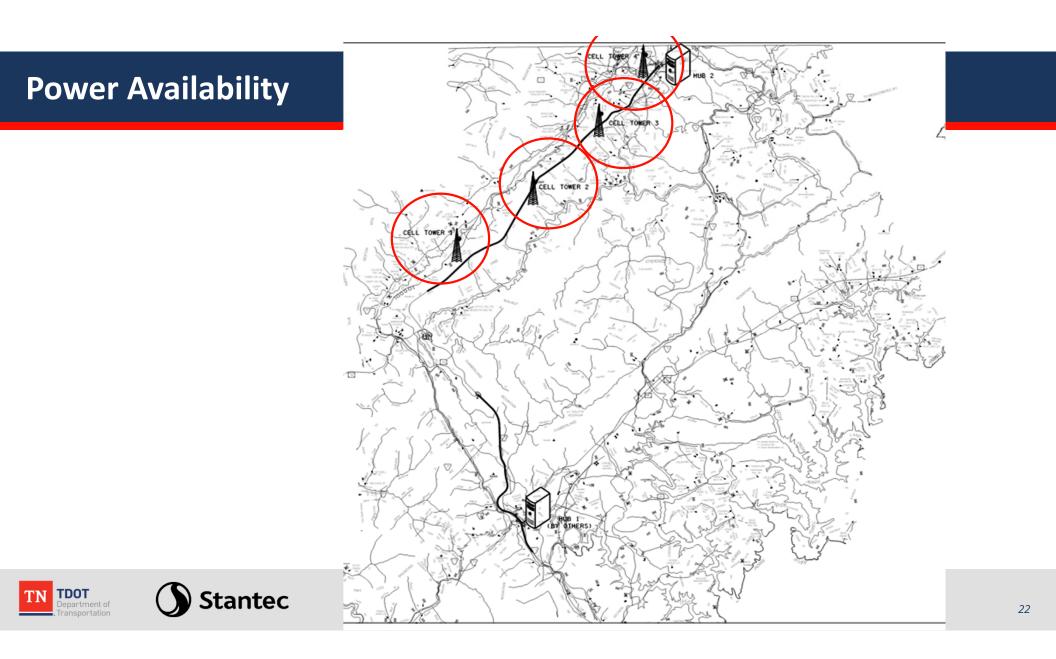






Power

- 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





Stantec

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

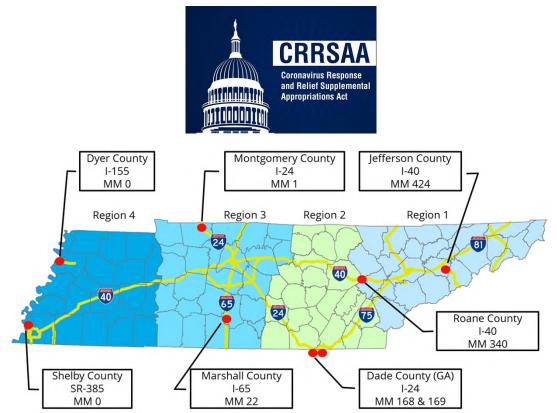
Funding from the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA)

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:

Greg Dyer - TDOT Traffic Operations Division, Project Manager 615.253.0046, Greg.Dyer@tn.gov

Matt Davis - Stantec Consulting Services Inc. 615.499.7160, Matt.Davis@stantec.com

