FTA State Safety Oversight Rail Transit Agency Workshop

FTA Safety Research Demonstration Projects -
Managing Safety at Transit Rail Grade Crossings

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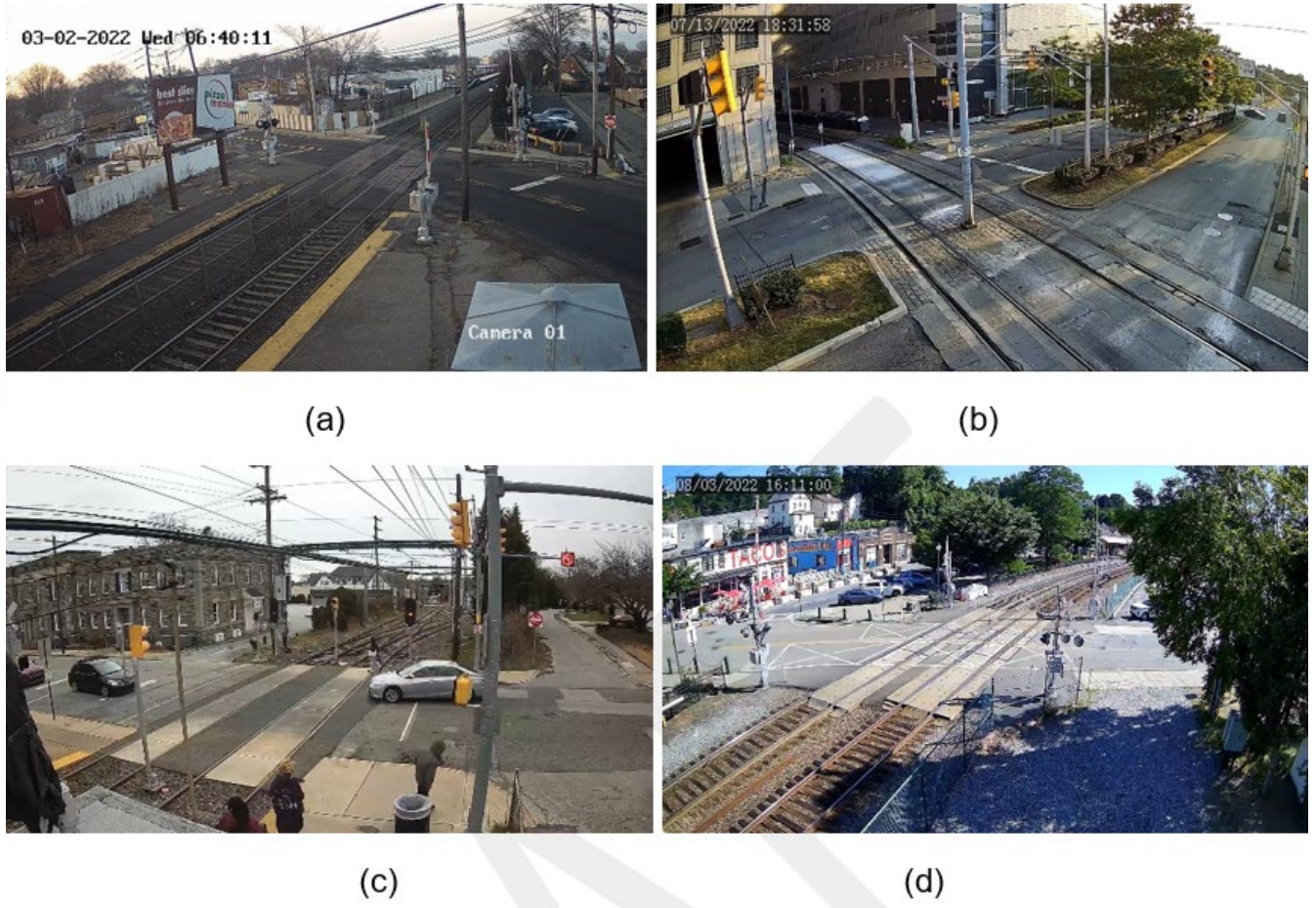
SRD Rail/Grade Crossing Safety Projects

- Rutgers, The State University of New Jersey
- Charlotte Area Transit (CATS)
- Tri-County Metropolitan Transportation District of Oregon (TriMet)
- Utah Transit Authority (UTA)

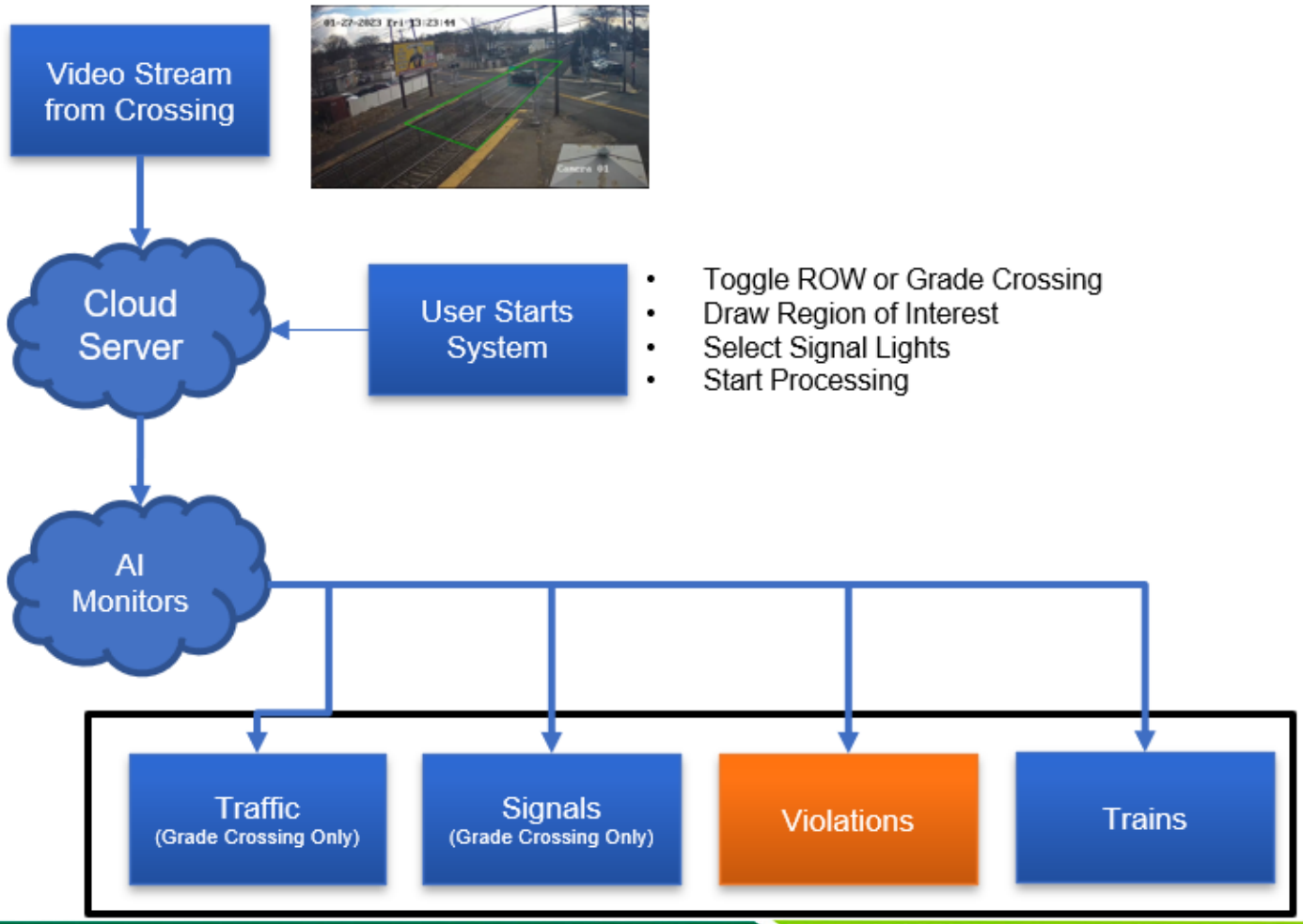
Rutgers – An AI-Aided System for Automated Trespassing Detection

- Four cameras deployed:
  - Commuter and light rail crossings (NJT) (a,b)
  - Light rail crossing (SEPTA) (c)
  - Commuter Rail (MNR) (d)
- Weatherproof camera/ enclosure affixed to telescoping pole
- Data collection from September 2022 – February 2023



Rutgers

- Detection system operates in 3 steps:
  - Video streaming from crossing
  - Transmission of live feed to cloud-based server
  - Data transmitted to AI monitors that identify video clips of interest



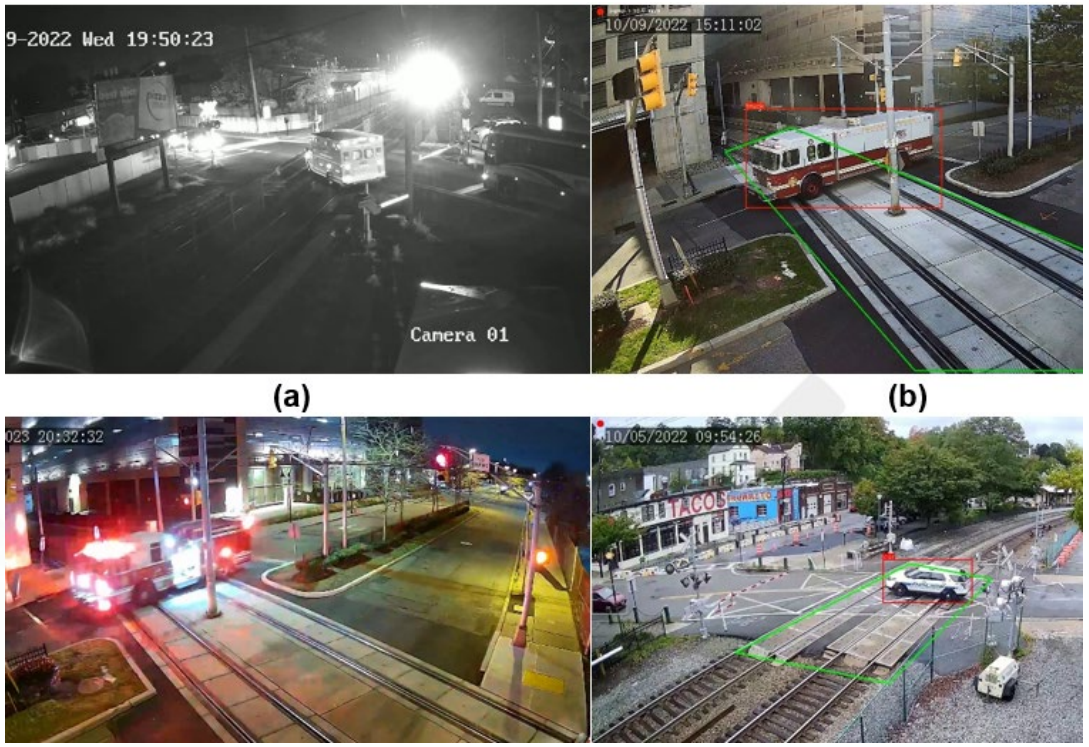
Rutgers - Enforcement

- Enforcement Blitzes
  - Weekly and hourly trespassing hotspots
- License plate readers and red-light camera enforcement
- Can be used by law enforcement to plan patrols and enforce compliance

	Hour of Day																							
Day of Week	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**Grand Total**
Monday	4	11	0	0	7	20	37	134	135	77	78	61	66	74	101	264	179	216	144	100	66	46	35	12	1,867
Tuesday	31	7	0	0	2	24	73	181	200	90	79	63	85	69	114	260	218	222	149	105	79	49	46	13	2,159
Wednesday	33	6	2	3	1	14	41	172	163	108	69	56	76	74	114	265	239	243	149	107	82	44	47	24	2,132
Thursday	32	4	0	0	3	24	37	139	144	85	65	61	56	85	103	273	173	199	137	116	85	44	43	15	1,923
Friday	35	7	4	0	14	18	47	153	157	90	86	66	96	76	129	290	186	201	155	94	73	45	56	24	2,102
Saturday	27	3	1	0	0	10	13	31	48	44	32	39	40	43	51	49	43	67	52	36	30	29	20	21	729
Sunday	3	3	0	0	0	8	11	11	34	27	28	47	54	42	52	61	46	31	43	27	21	26	12	18	605
Grand Total	165	41	7	3	27	118	259	821	881	521	437	393	473	463	664	1,462	1,084	1,179	829	585	436	283	259	127	11,517

Rutgers – Emergency Vehicle Safety Improvements

- Emergency vehicles were observed violating the crossings – New Jersey and New York crossings
- Exact frequency not know due to AI not being trained to differentiate trucks – emergency versus non-emergency vehicles
- Additional AI training may be necessary



Rutgers – Lessons Learned

- Violations:
  - During data collection/monitoring via live feed – two light rail crossings: over 47,000 violations
  - Pedestrians made up the largest proportion of violations at both crossings
- System and Demonstration:
  - Glare and weather challenges can require algorithm retraining
  - Legal track occupiers are unable to be filtered out (transit police, maintenance of way personnel, heavy-rail vehicles, and other objects)
  - Adequate workforce availability and contractor staffing is vital for system upkeep and reliability

Rutgers – Lessons Learned

- System and Demonstration
  - Bandwidth limitations may require modifications to frame and bit rates to improve streaming stability and resolve video glitching
  - Alternative power sources may be required
  - Camera placement and angle are crucial
  - Localized image training improves misclassifications
- Performance
  - After adjustments to address video glitches, performance improved to well over 90% accuracy at each demonstration site (99% at New York and New Jersey commuter rail locations)

CATS – Watch Out for CityLYNX! Be Streetcar Smart

- Project objectives:
  - Enhance pedestrian, bicyclist, and vehicle occupant safety through innovative marketing
  - Decrease preventable streetcar incidents

CATS

- Innovative Outreach and Educational Initiatives
- Social Media Messaging
- Signage and Pavement Markings
- Educational Parking Video
- Increased Parking Enforcement

CATS

- Key Messaging:
  - No parking on streetcar tracks
  - Designated parking near streetcar tracks
  - Safely sharing the road with streetcars and cyclists while driving
  - Cross at designated crosswalks
  - Cross streetcar tracks at a 90-degree angle to prevent bicycle tires from getting stuck in the rails

CATS – Safety Community Surveys (Public Perceptions)

CityLYNX Gold Line Safety Survey I and II: Results	Average Safety Rating	
Ratings from 1 to 5, with 1 = unsafe and 5 = safe	Sep 2021	Nov 2023
On a scale from 1 to 5, with 1 being unsafe and 5 being safe, rate how safe you feel the CityLYNX Gold Line streetcar operates:	4.3	4.2
As a Vehicle Driver/Vehicle Passenger, rate how safe you feel when you interact with the CityLYNX Gold Line?	4.1	4.3
As a Pedestrian, rate how safe you feel when you interact with the CityLYNX Gold Line?	4.1	4.4
As a Bicyclist/Scooter, rate how safe you feel when you interact with the CityLYNX Gold Line.	3.6	4.0
As a CityLYNX Gold Line Passenger, rate how safe you feel when you interact with the CityLYNX Gold Line.	4.2	4.2

CATS – Survey Instrument Interactive Quiz

Survey Question	Sep 2021	Nov 2023	Correct Answer
How should a bicyclist cross CityLYNX Gold Line tracks with their bike?	55%	70%	At a 90-degree angle
Streetcars can avoid pedestrians, cars or bicyclists who cut in front of them.	83%	90%	False. Streetcars cannot swerve out of the way, as they run on their own tracks
Can you drive on streetcar tracks?	78%	91%	Yes, however, be sure not to follow too closely and give the streetcar extra space to be able to stop safely.
Where should a pedestrian cross within the streetcar corridor?	84%	92%	Only at designated crosswalks or where signs show you where to cross
How far does it take for a streetcar to come to a complete stop?	69%	70%	100 feet
Why is it important to cross the street at a crosswalk?	Not asked	89%	It's the safest place to cross in this designated area.

CATS – Project Outcomes

- Reduced near misses from 9 to 7 per 100,000 vehicle miles
- Improved on time performance from 68.8% to 95.2%
- Improved safety perceptions
- Increased public awareness

CATS – Lessons Learned

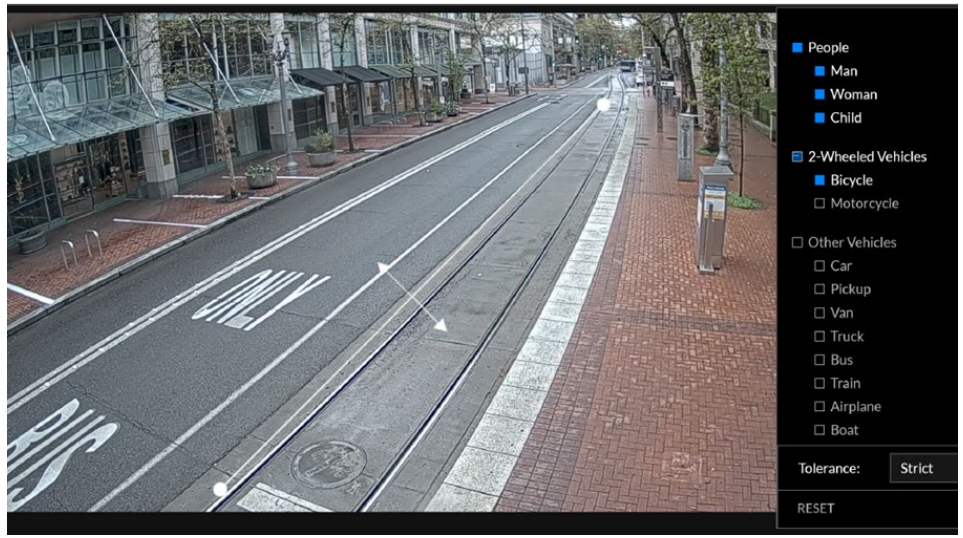
- Coordination with Charlotte DOT beneficial – signage, pavement markings, and armadillo installations
- Raised paver armadillos significantly reduced illegal drop-off/pick-up parking
- No parking signage placement and enforcement capabilities must be in place in pre-revenue phase
- Certain elements should have been included in initial system design (pavement markings, lane delineators/dividers, signage)

TriMet – Risk Ranking Tool and Data Validation for Grade Crossing Safety Enhancement

- Project Objectives:
  - Use a video analytic system (VAS) and camera technology to determine human behavior and densities associated with accidents and incidents at at-grade crossings
  - Develop a Risk Ranking Tool to measure the relative risk of at-grade crossing existing conditions, including operational factors

TriMet

- BriefCam operational intelligence platform
- 12 individual high-definition cameras - grade crossings along TriMet light rail lines
- Specific rule parameters created for each camera to capture insights – pedestrian and motorized and non-motorized vehicle density, directionality, and proximity
- Manual audits used to validate
- TriMet manual audits and internal close call and NTD used to verify results



TriMet

- Risk Ranking Tool – Numeric Values
  - Crossing configurations
  - Active/passive treatments
  - VAS data – assigned levels of severity/probability for density of pedestrian, two-wheeled and vehicular traffic, and observed human behaviors with goal of assigning appropriately weighted values
- Hazard Risk Index (HRI) Rating Assigned

TriMet

- Demonstration Period – October 2022 – May 2024
- Full Demonstration – data collection averaged 3 months for each of 28 grade crossings/5 location groups
- Risk Factors/Treatments Reviewed
  - Risk Factors- crossing type, track layout, sight restrictions, and train speed.
  - Active Treatments- automatic auto gates, LED ped flashing and audible warning devices, automatic ped gates, and city ped heads.
  - Passive Treatments- city/TriMet tactile, “stop here” markings, “look both ways” signage, swing gates, channeling/barriers, ped z-crossing, crosswalk delineation, dynamic envelope delineation and over or under crossings.

TriMet

- Operational Data Points:
  - Pedestrian activity
  - Incidents
  - Close calls
  - Injuries
  - Fatalities
- Evaluated captured data points
- Compared original HRI rating versus that with operational data
- Out of 28 crossings (41 cameras) – 4 received modified HRI ratings

TRIMET

DECEMBER 2022

DMP Monthly Dashboard

Close Calls

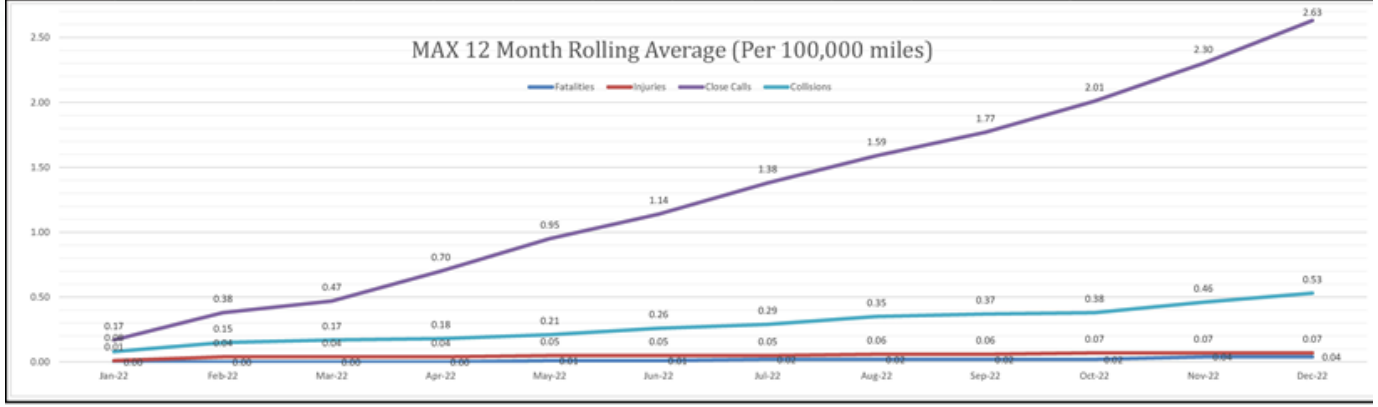
2022	Current Month		Q1			Q2			Q3			Q4			
Sytem Wide	Mo	YTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Running Totals
ACID Close Calls	27	212	14	16	8	18	20	15	19	18	14	20	23	27	212

Collisions, Injuries and Fatalities

System Wide	Mo	YTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Running Totals
NTD Collisions	6	43	7	5	2	1	2	4	2	5	2	1	6	6	43
NTD Injuries	0	6	1	2	0	0	1	0	0	1	0	1	0	0	6
NTD Fatalities	0	3	0	0	0	0	1	0	1	0	0	0	1	0	3

Close Calls, Collision, Injuries and Fatality Rolling Averages

TriMet MAX LR	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
MAX Fatalities	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04	0.04
MAX Injuries	0.01	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.07
MAX Close Calls	0.17	0.38	0.47	0.70	0.95	1.14	1.38	1.59	1.77	2.01	2.30	2.63
MAX Collisions	0.08	0.15	0.17	0.18	0.21	0.26	0.29	0.35	0.37	0.38	0.46	0.53



TriMet – Lessons Learned

- Camera quality and placement are vitally important in collecting accurate human behavior data
- VAS qualitative data showing density of people and vehicles were found reliable and relevant for future planning
- Combining grade-crossing safety treatments and operational data can provide a more comprehensive approach to assessing how installed safety treatments are working, how the public interacts with them, and what potential improvements could be made
- Modifications and adjustments are important – after camera rule adjustments, false positives/negatives were reduced and VAS accuracy improved to over 90%

UTA – Radar Camera Surveillance and Detection System

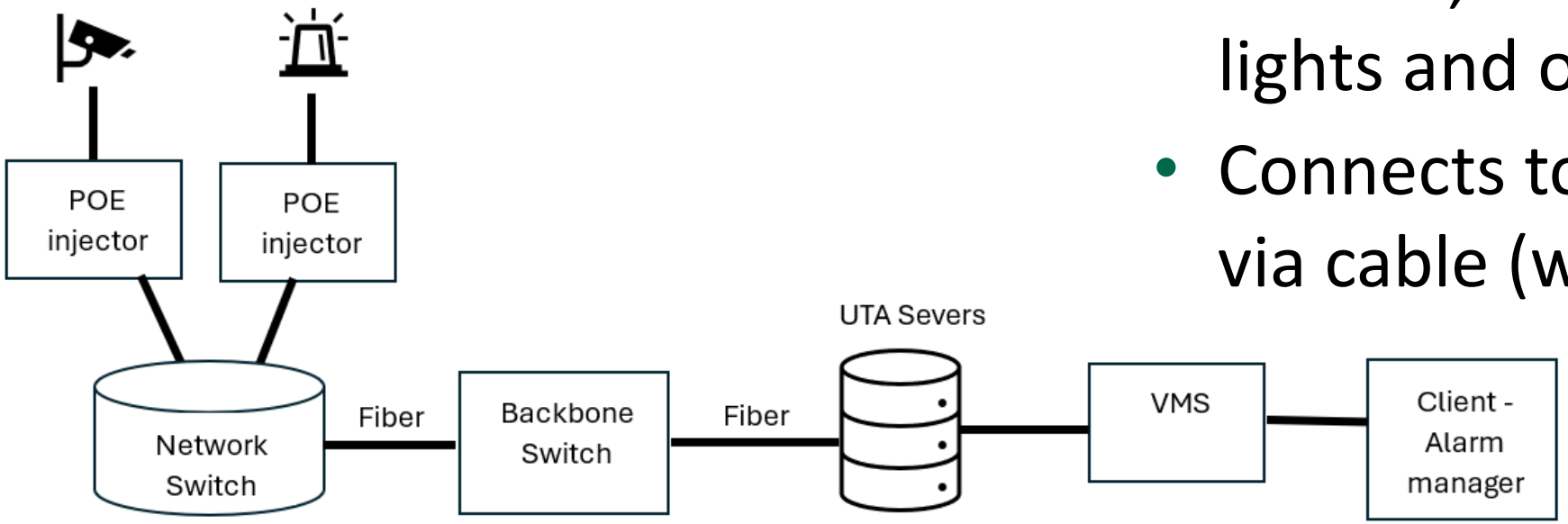
- Goal: Prevent Deaths within Rail Corridor
  - Reduce trespassing activities
  - Alert operations when trespassing occurs
  - Reduce suicide events through identification of and response to suicidal behavior
  - Address UTA's overall goal of improved public safety

UTA

- Pan tilt zoom cameras enabled with thermal radar analytics to identify movement
- 360° continuously rotating thermal cameras at each of six locations - three on TRAX line (light rail) and three on the Frontrunner (commuter rail)
- Classification algorithm determines if detected object meets parameters
- If parameters met, Video Management System alerts control room and sends associated video footage.

UTA

Radar Camera Surveillance and Detection Infrastructure



- Aluminum enclosure housing antennas, modem, PTZ camera, thermal radar, LED lights and other equipment
- Connects to UTA's network via cable (where possible)

UTA

- Signage across system with motion activated lights that illuminate the sign: “There is Hope. There is Help. We can get through this together. Call or text 988”
- Other local collaborations to support suicide intervention/ outreach
- Average 6 – 7 suicides/year and in CY 2024 through October 31, only 3 incidents

UTA – Lessons Learned

- Infrared cameras alone presented too many false positives, required use of radar cameras in addition to infrared
- It was important to not only rely on alarms (due to false positives)
- Human monitoring for validation/confirmation was vital
- Importance of working closely with control room operators, technology providers, and IT technicians could not be overstated
- Radar Camera Surveillance and Detection System had no self-diagnostic capabilities and could result in unknown inactive surveillance

Grantee Contacts

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