SAN DIEGO TRANSIT ONLY LANE (TOL) CONNECTED VEHICLE PROJECT
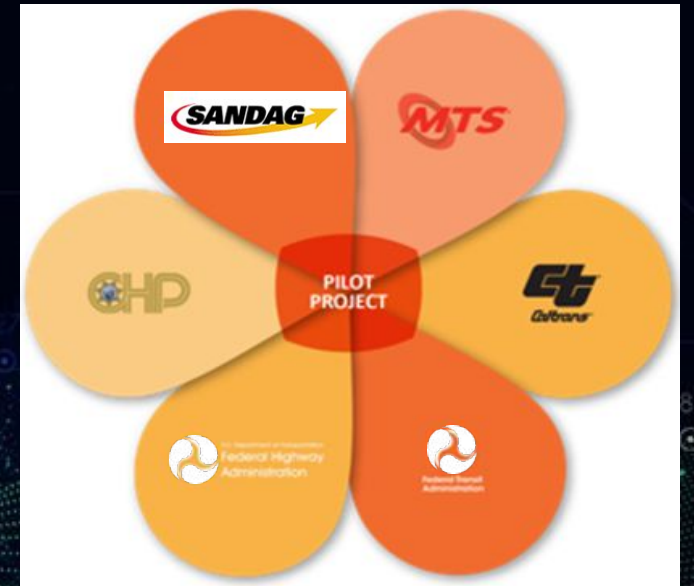
IMPROVING TRANSIT SAFETY AND EFFICIENCY

ITS New York 2022

What is a Transit Only Lane (TOL)?
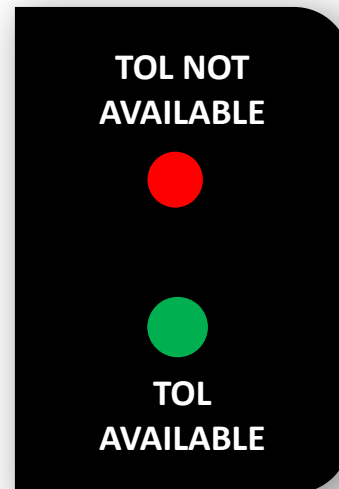
What: Transit Only Lane (TOL) is a **specially designated lane** for transit vehicles

Where: A Pilot project on I-805 and SR94 will use the shoulder as a Transit Only Lane during specific times and conditions

When: Live operations will begin later this year and go through March 2024

Why: This pilot project's main goal is to **improve safety**

How: The buses and the roadway are equipped with **Technology** to aid in safe navigation

When Can the TOL be Used?

1

Traffic conditions are right

2

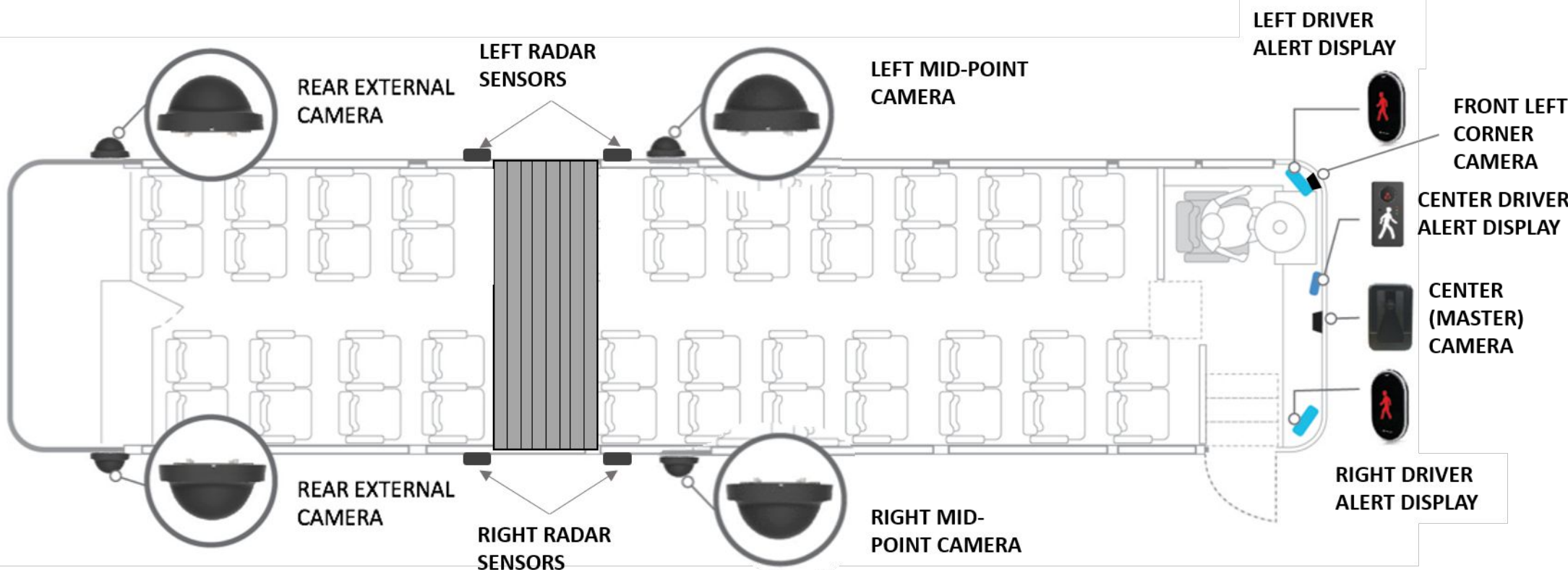**TOL system functioning**

TOL NOT AVAILABLE

TOL AVAILABLE

3

Driver decision – conditions are safe, and shoulder is clear.

Safety Systems on the Bus

LEFT RADAR SENSORS

REAR EXTERNAL CAMERA

LEFT MID-POINT CAMERA

LEFT DRIVER ALERT DISPLAY

FRONT LEFT CORNER CAMERA

CENTER DRIVER ALERT DISPLAY

CENTER (MASTER) CAMERA

REAR EXTERNAL CAMERA

RIGHT RADAR SENSORS

RIGHT MID-POINT CAMERA

RIGHT DRIVER ALERT DISPLAY
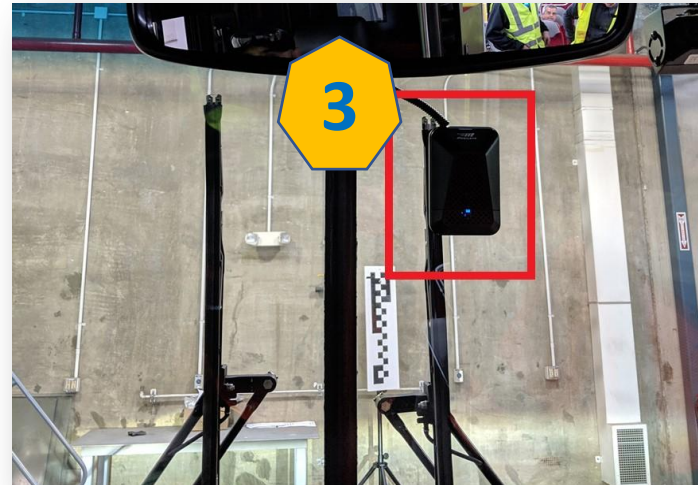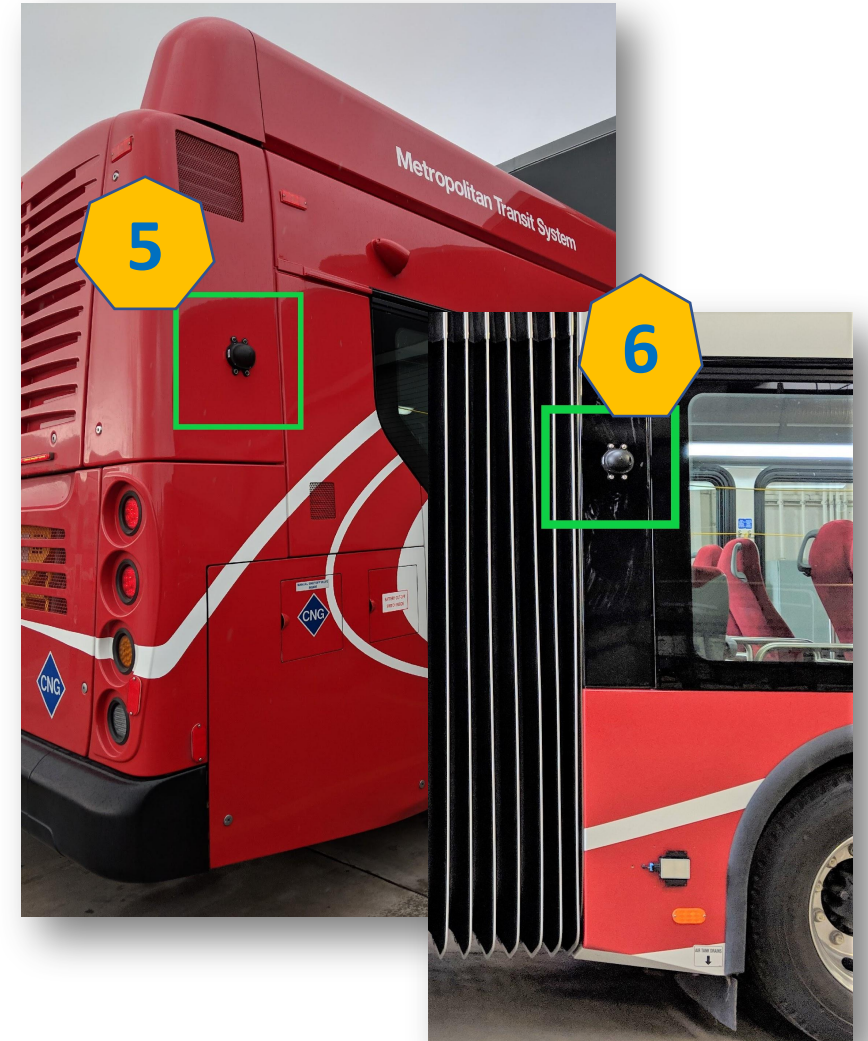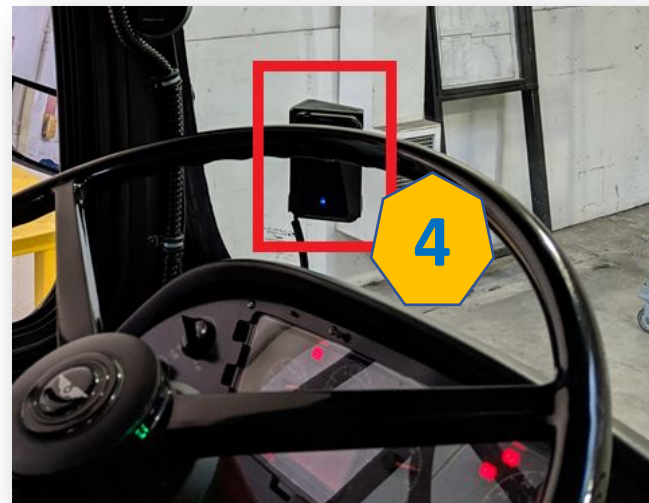
Cameras on the Bus

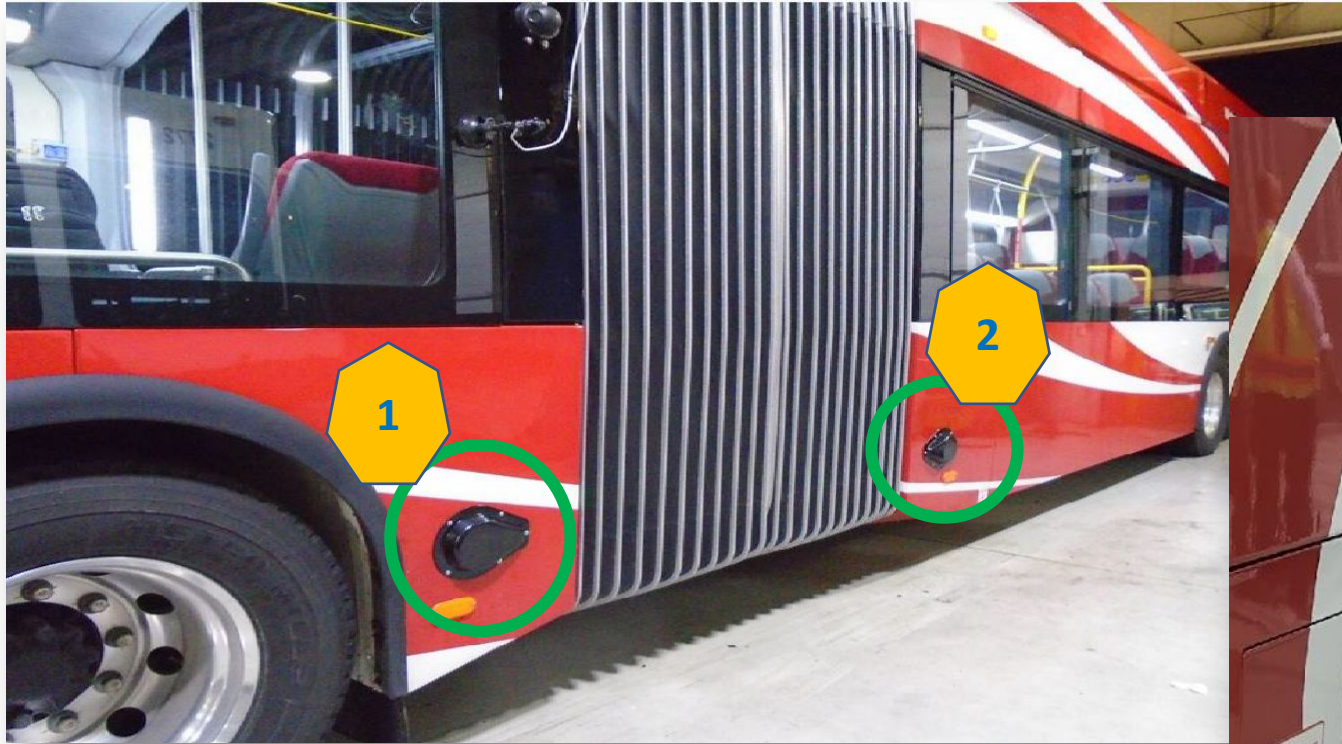Left Exterior
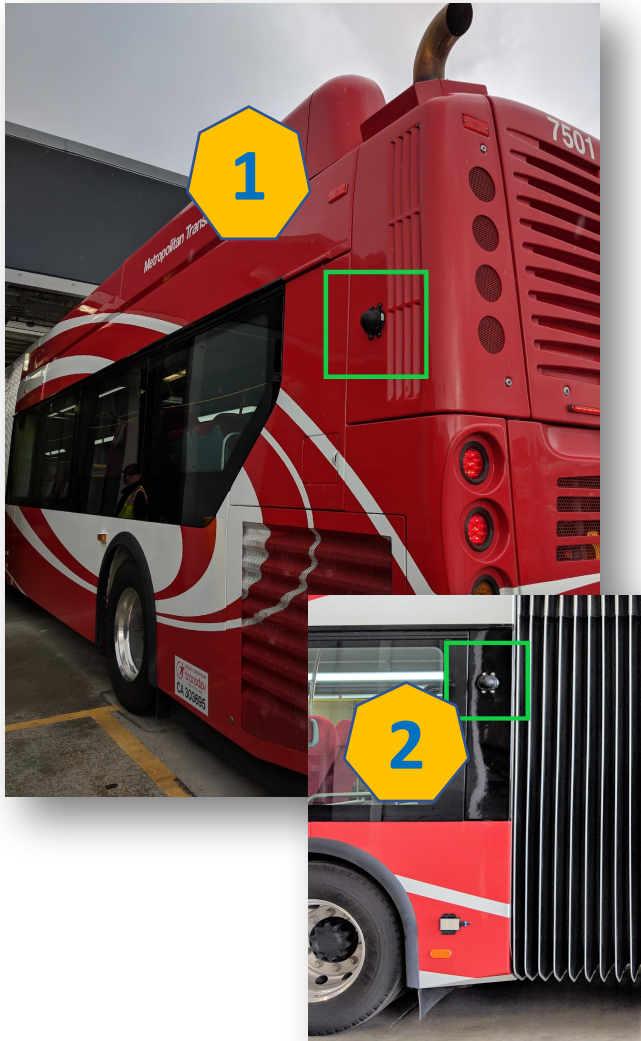
Center Interior

Right Exterior

Left Interior

Radar Units on the Bus

Two Radar Units on driver's side of the bus

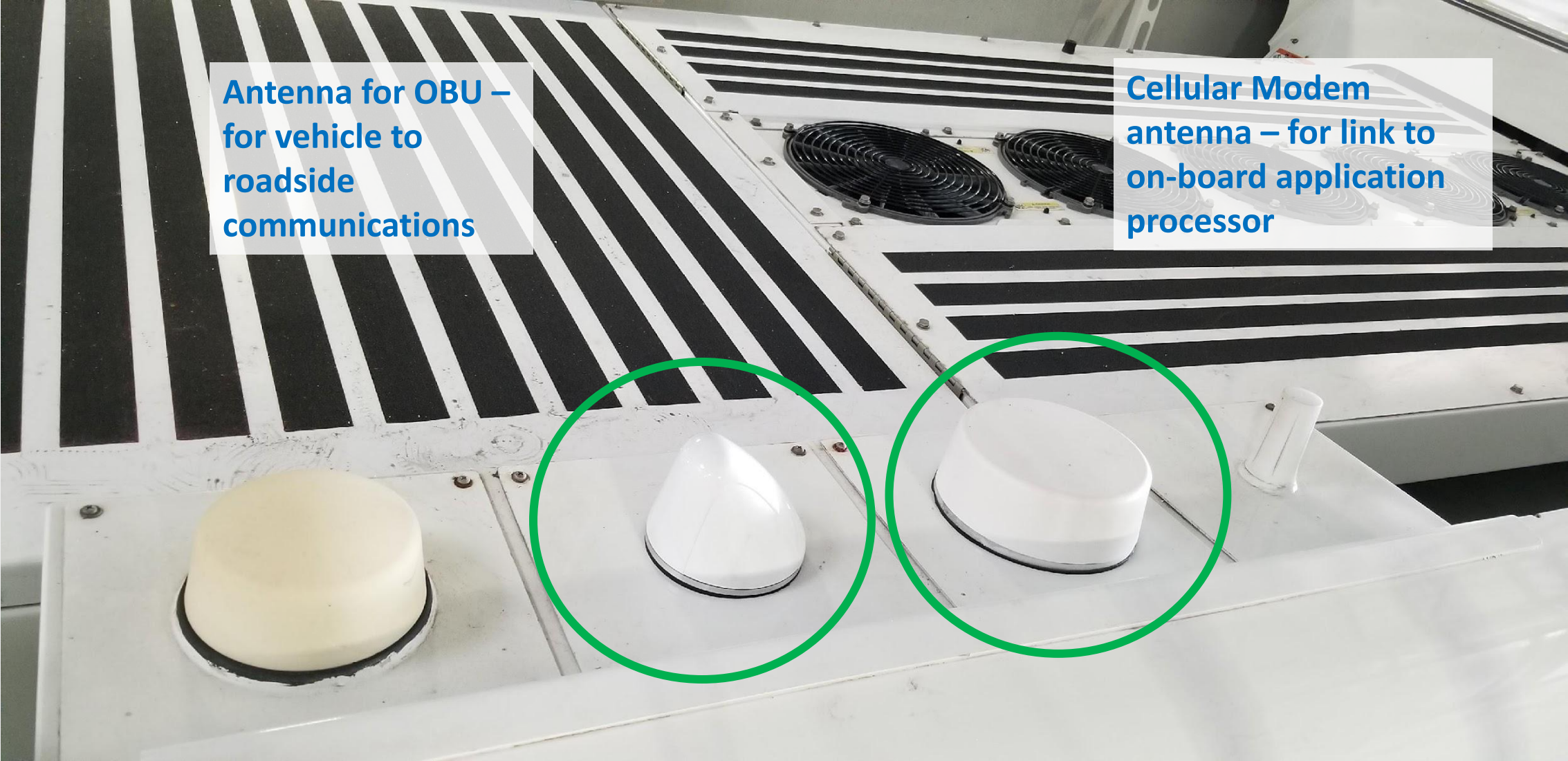**Two Radars Units on right side of the bus**

Computers and other Equipment on the Bus

Inside the bus equipment cabinet:

- Cellular V2X Radio
- Lumina Computer
- Power supply
- Cellular modems (2)
- Peripheral hardware
- Cabling

Antennas on the Bus Roof

Antenna for OBU – for vehicle to roadside communications

Cellular Modem antenna – for link to on-board application processor

What the Driver Sees

Driver Displays

Pedestrian and Blind Spot Warning

TOL Availability

Forward Collision Warning

Roadside System Overview

The systems on the roadside—sometimes referred to as the "Tech Package" include:

- **Radios** that communicate with other radios on the buses

- A **Video Detection System** (ViDS) that serves as a backup to identify buses operating in the Transit Only Lane

- Computers that **process information and communicate** with the buses and the back-office system at SANDAG

- Computers that **interface with the Ramp Meter Controllers** at four ramp locations on I-805 Northbound

Roadside System Overview

Roadside Systems components are installed as shown in the figures below

Backpack Cabinet
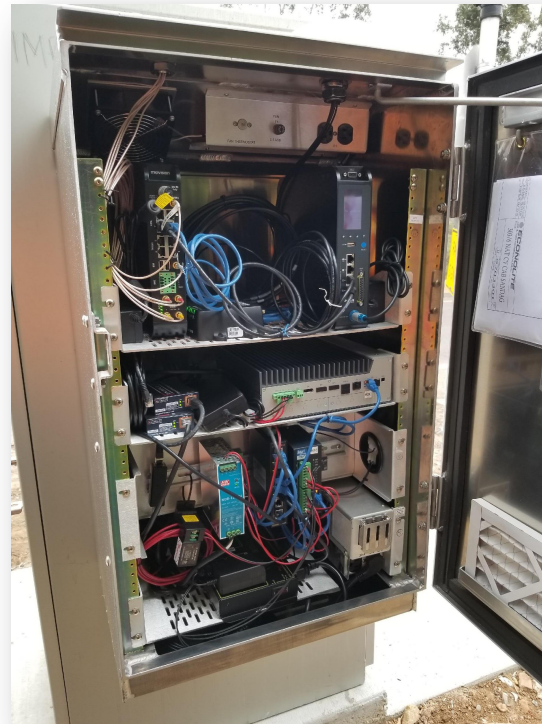
TOL Cabinet Equipment

ViDS Camera

Radio

Radio and ViDS Camera

Back Office System

The back-office system consists of:

- **Servers -** ingests status and operational information from buses and roadside systems

- **Database -** stores ingested information for use in system monitoring and reporting

- **Main User Interface** - to monitor overall system status and access information about sub-systems

- **PowerBI Reporting Application** - to produce reports on various system functions and activities

- **Interface with the Regional Data Hub** - captures operational information necessary to ensure the system works safely

- **Ituran Bus Safety Interface** – monitors buses and generates operating data and reports related to safety

Back Office System

Via the Main TOL User Interface the user can:

- Access an **overview map** of project activity

- View the **status** of project **technology components and systems**

- Access the **dashboard** for Transit Only Lane operational status

- Utilize a **PowerBI reporting application** to produce reports on various system functions and activities

- **Download data** from the Transit Only Lane database

- **Conduct administrative functions**

- Access the Ituran bus **Driver Assistance System (DAS)** data interface
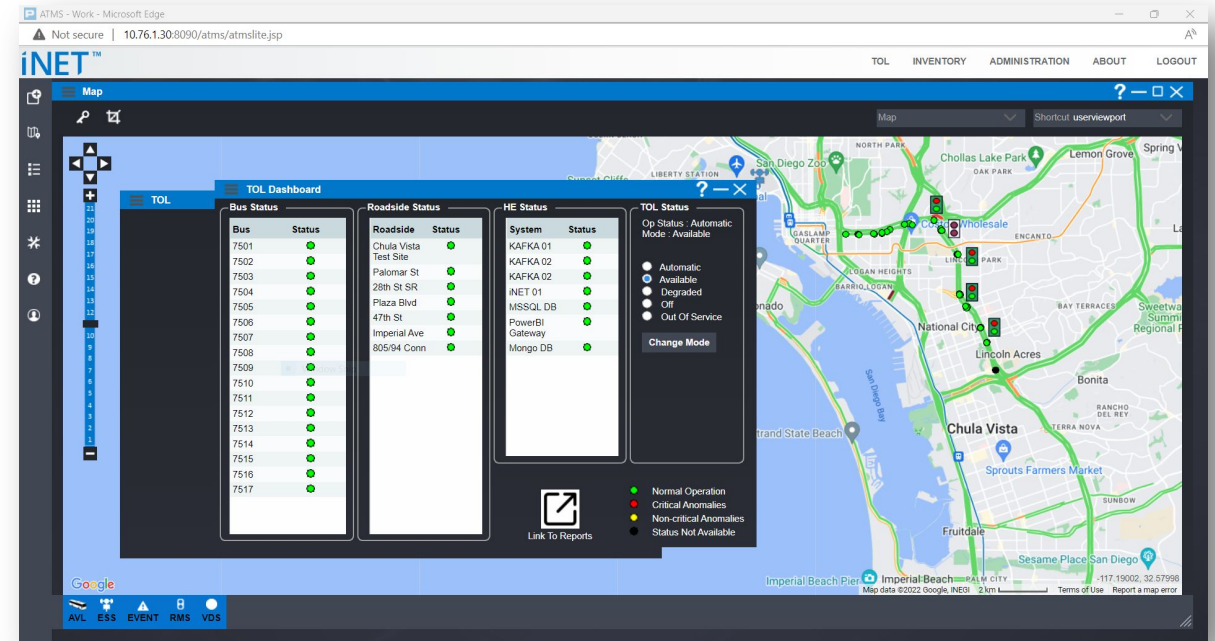
TOL User Interface

Video Demonstration

Integration Testing Sample

Important Events in Video:
- Video runs from 6:45 AM PT to 7:00 AM PT
- Bus Becomes Visible (9:55 in video = 6:54:55 AM)
- Bus Detected by ViDS (10:04 in video = 6:55:04 AM)
- Signal & BBO On (9:58 in video = 6:54:56 AM)
- Bus Crosses Ramp (10:17 in video = 6:55:17 AM)
- Signal & BBO Off (10:14 in video = 6:55:14 AM)
- CHP Vehicle Detected as Copycat (10:12 in video = 6:55:12 AM)
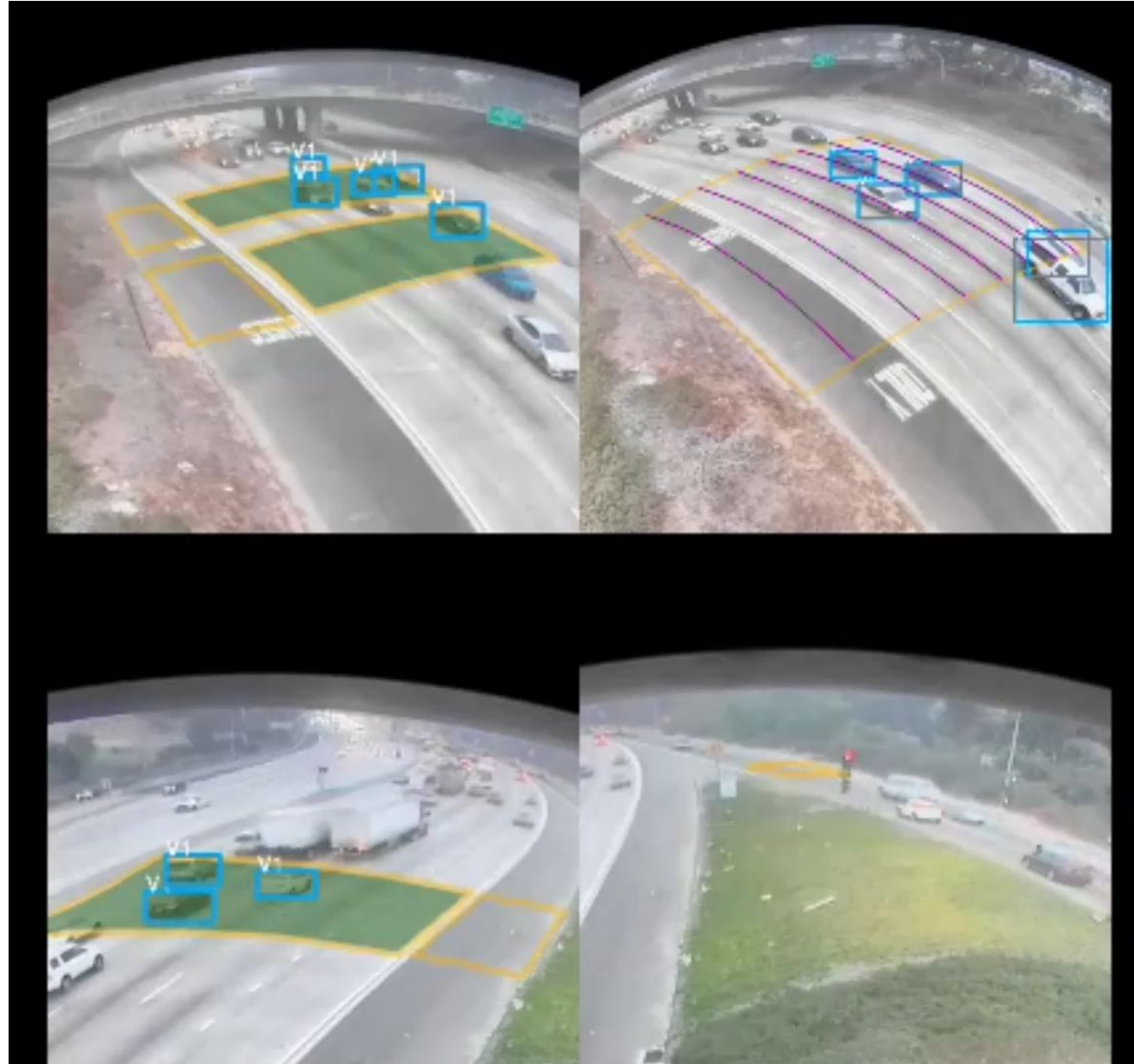
TSP Event Report

Event
- Select all
- Bus entered ramp co...
- Bus entered Shoulde...
- Bus entered Shoulde...

Date Range
12/2/2021   12/2/2021   — Date of Testing

TSP TOL Events

Event Source
- Select all
- RSAP: 43rd Str
- RSU: 28th Str
- RSU: 47th Str

TSP Count of Events

Date	Event Code Count	Event Code	Event Description
12/2/2021	19	1	RSAP sent TSP request to RMC
12/2/2021	19	2	RSAP sent TSP end to RMC
12/2/2021	18	5	RSAP received BBO sign activation
12/2/2021	19	6	RSAP received BBO sign deactivation
12/2/2021		13	Bus entered Shoulder lane: zone Frw-PreCZ Lane 3
12/2/2021	1	13	Bus entered Shoulder lane: zone Shld-PreCZ Lane 1
12/2/2021	22	13	Bus entered Shoulder lane: zone Shld-PreCZ Lane 1
12/2/2021	1	13	Bus entered Shoulder lane: zone Shld-PreCZ Lane 5
12/2/2021	20	14	Bus exited Shoulder lane: zone
12/2/2021	4	14	Bus exited Shoulder lane: zone Frw-PreCZ Lane 3
12/2/2021	136	21	Bus is detected using V2X radio
12/2/2021	13	28	Bus entered ramp conflict zone
12/2/2021	12	29	Bus exited ramp conflict zone

TSP Events by Type

Date	1	2	5	6	13	14	21	28	29	30	Total
12/2/2021	19	19	18	19	25	24	136	13	12	43	328
Total	19	19	18	19	25	24	136	13	12	43	328

Bus

Test Bus
- 7515
- 7516
- 7517

Day of Week
- Select all
- Thursday

Recorded TSP Event Summaries

Hour of Day
5   9

Recorded TSP Event Details

Event Log

Date/Time		Event Description		
12/2/2021 6:54:38 AM	21	Bus is detected using V2X radio		
12/2/2021 6:54:39 AM	13	Bus entered Shoulder lane: zone Shld-PreCZ Lane 1		
12/2/2021 6:54:55 AM	1	RSAP sent TSP request to RMC		
12/2/2021 6:54:56 AM	5	RSAP received BBO sign activation		
12/2/2021 6:55:04 AM	30	ViDS vehicle detection started on channels [2]	RSU: Imperial Ave	7517
12/2/2021 6:55:09 AM	30	ViDS vehicle detection started on channels [11]	RSU: Imperial Ave	7517
12/2/2021 6:55:12 AM	2	RSAP sent TSP end to RMC	RSU: Imperial Ave	7517
12/2/2021 6:55:12 AM	30	ViDS vehicle detection started on channels [11]	RSU: Imperial Ave	7517

Date
- Select all
- 12/2/2021

Integration Testing Sample

Report Correlation:
- Bus detected by Radio (6:54:24 AM)
- Bus Detected by ViDS (6:55:04 AM)
- TSP Request sent (6:54:55 AM)
- Signal & BBO On (6:54:56 AM)
- TSP End Request Sent (6:55:12 AM)
- Signal & BBO Off (6:55:14 AM)
- CHP Vehicle Detected as Copycat (6:55:12 AM)

Events Monitored by the System

The system monitors the network and becomes inactive if:

- Caltrans or CHP report an event in the shoulder (planned or unplanned)

- One of the weather stations reports rain in the area

- One or more roadside sites become inoperable or lose communication
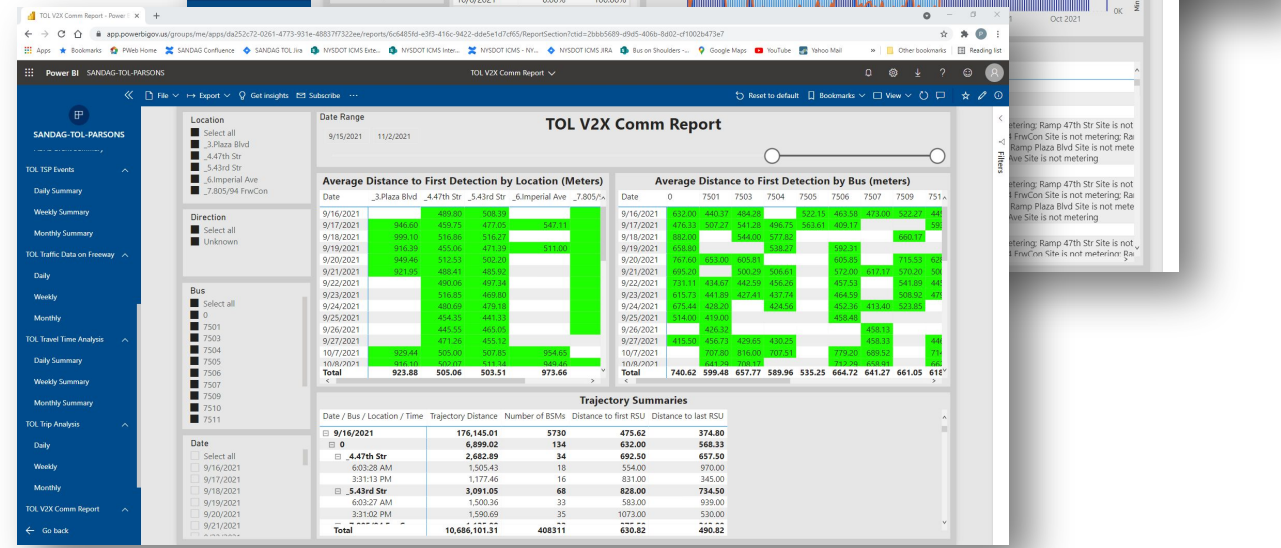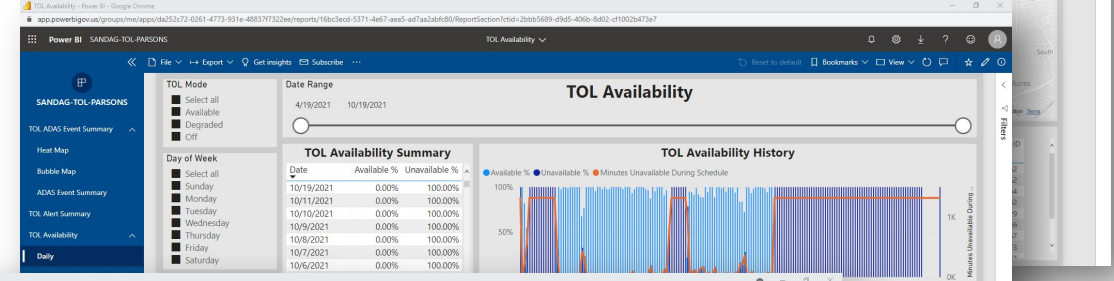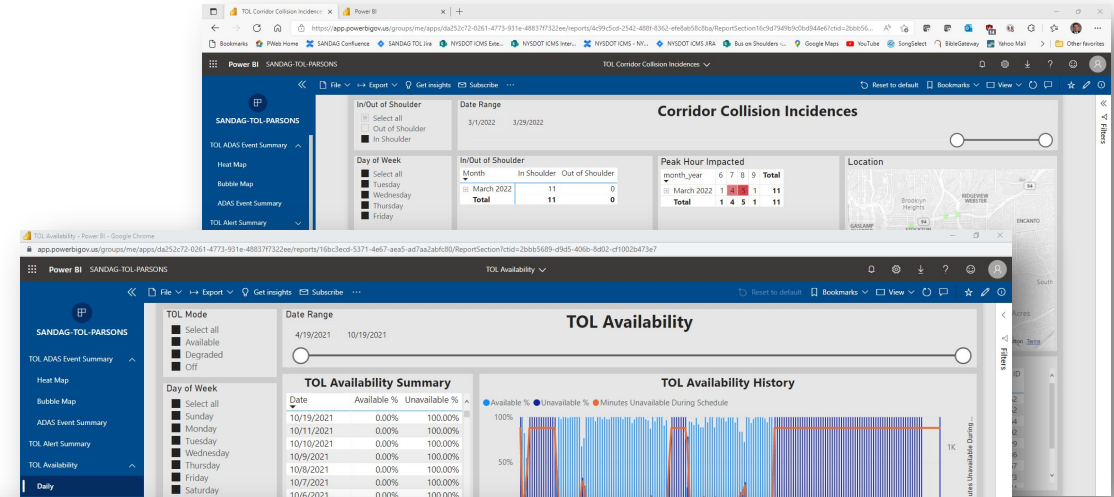
Data Collected by the System

The system gathers data about:

- Unauthorized use of the TOL

- The level of use of the TOL by authorized buses

- The travel time of project buses vs. general traffic

- V2X radio performance

- ADAS Events

- Traffic Data
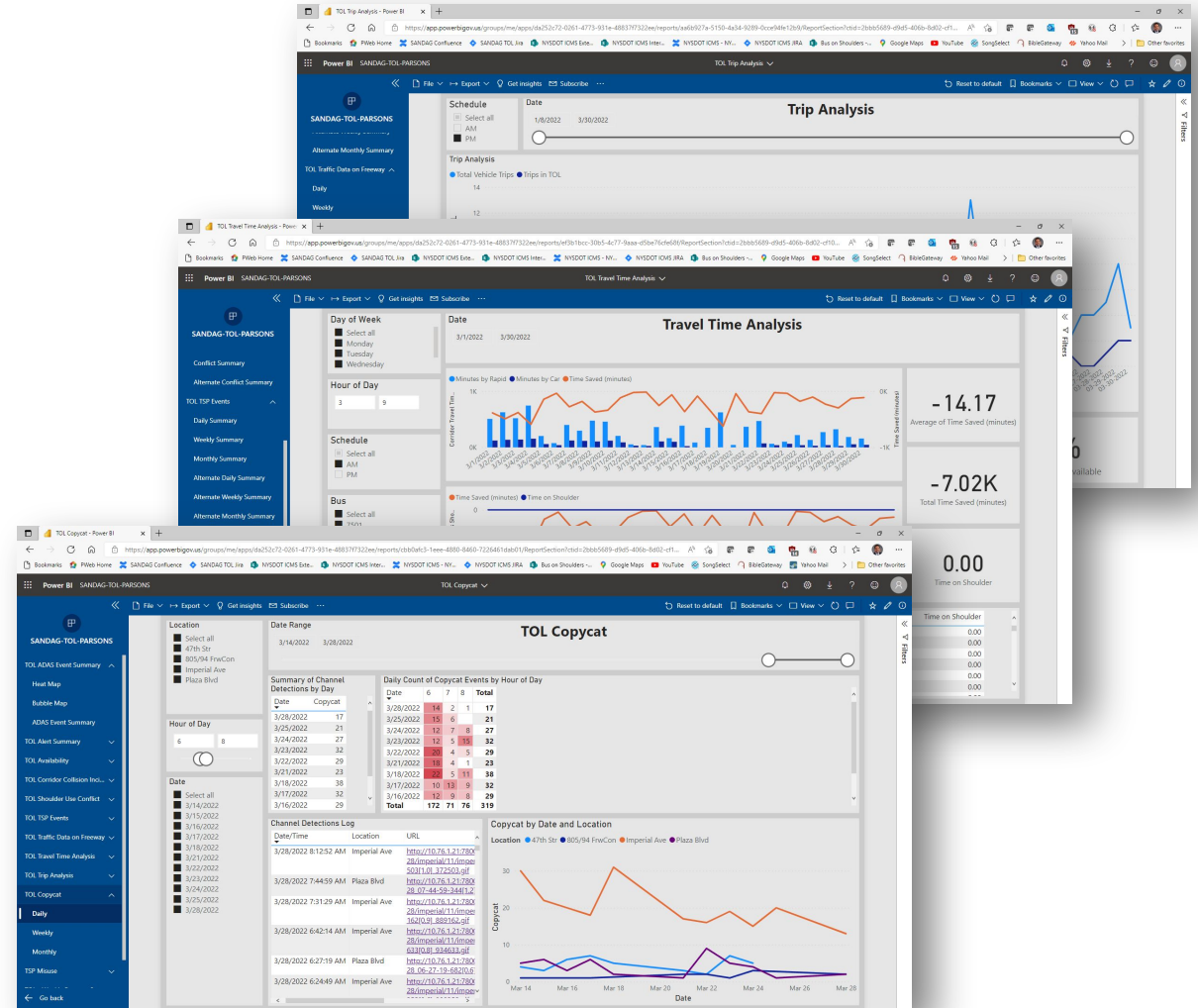
Project Status

- Acceptance Testing is underway

- Live operations will be evaluated by stakeholders June-August 2022

- Successful stakeholder evaluation will lead to full operations through March 2024