A Technology Primer for All-Electronic Tolling and It's Impacts on Safety for the Traveling Public

Kapsch TrafficCom and ITS NY

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No Tool Booth? No Problem!

All-Electronic Tolling (AET)

How Did we Get Here?

Traditional Mixed Mode (Cash, CC, E-ZPass)

- Barrier style toll plazas
- Disruption of traffic flow and throttling due to lane contractions

All-Electronic Tolling (AET)

How Did we Get Here?

Open Road Tolling

- A combination of All Electronic and Traditional Mixed Mode (Cash, E-ZPass)
- Typically a free flow “E-ZPass Only” zone with booths off to one side

All-Electronic Tolling (AET)

How Did we Get Here?

All Electronic Tolling – Gantry Only

- High Occupancy Toll Lanes – HOV Conversions
- General Traffic or Truck Only Tolling

Key Differences Between ITS and Tolling Technologies

A Variety of Sensors Are Used to Detect and Classify Vehicles

- Detection is the ability to count every distinct vehicle that passes thru a toll zone
- Classification is the ability to determine what type of vehicle it is

Accuracy and Reliability are Paramount

- Vehicle detection accuracy is typically 99.99%, or 1 in 10,000 vehicles missed
- Classification accuracy can be as high as 99.95%, or 5 vehicles per 10,000 incorrect
- Some requirements are at least 99.99% and are tied to penalties

It's All About the Money

- Revenue collection is the key and KPIs are usually tied to liquidated damages
- Security of customer and agency data is constantly monitored

How Do We Do It? We Consider:

Performance:
- Technology Needs, Accuracy, Speed, Lane Count, Traffic Type, Capture Zone

Space/Aesthetics:
- Technology Needs, Accuracy, Speed, Lane Count, Traffic Type

Devices:
- On gantry, In Pavement, Overhead, Side Mount

Environmental:
- Weather, Ambient Light, Traffic Conditions

Maintenance and Access:
- Maintenance Over Traffic Acceptable?
- MOT/Lane Closures, Revenue Loss

System Overview

VEHICLE DETECTION & CLASSIFICATION

No loss of revenue – Highly accurate detection of vehicles and triggering of cameras

Lower operational cost – Redundant system for detection of vehicles triggering of front and rear cameras. Supports axle-based classification

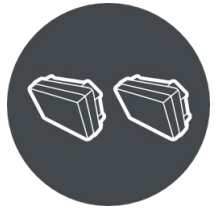
LICENSE PLATE IMAGE CAPTURE SUBSYSTEM

Highly accurate and reliable capture of license plate information

Dual OCR including Kapsch fusion

AUTOMATIC VEHICLE IDENTIFICATION (AVI)

Revenue assurance – Thousands of successful deployments with Kapsch readers (E-ZPass)



PARALLEL REDUNDANT ARCHITECTURE

Revenue assurance – Continuous system availability, seamless failover, and data redundancy, regardless of weather conditions

REMOTE OPERATIONS & MANAGEMENT SYSTEMS (ROMS)

Fully transparent monitoring, reporting, and auditing – Comprehensive view of system operations and data; reporting, and toll auditing

Automatic Vehicle Identification Subsystem

AVI Features and Benefits

RFID Feature

Future Proof	Tri-protocol ready, no additional investment required to adopt interoperability
Accurate	Ensures precise lane reads in multiple applications and protocol environments
Revenue Assurance	Fully redundant, field-proven solution

Kapsch AVI Antennae

Video Detection and Classification - Overview

Kaspch's nVDC technology with Treadles is the ideal solution for ETC systems.

- 4th-generation, based on missile-targeting technology
- Performance not affected by weather and traffic conditions, or vehicle types
- Can also be used for exact measurement of speed and lane usage
- Easy installation, easy maintenance = minimal impact to traffic

nVDC User Interface

Image Capture System

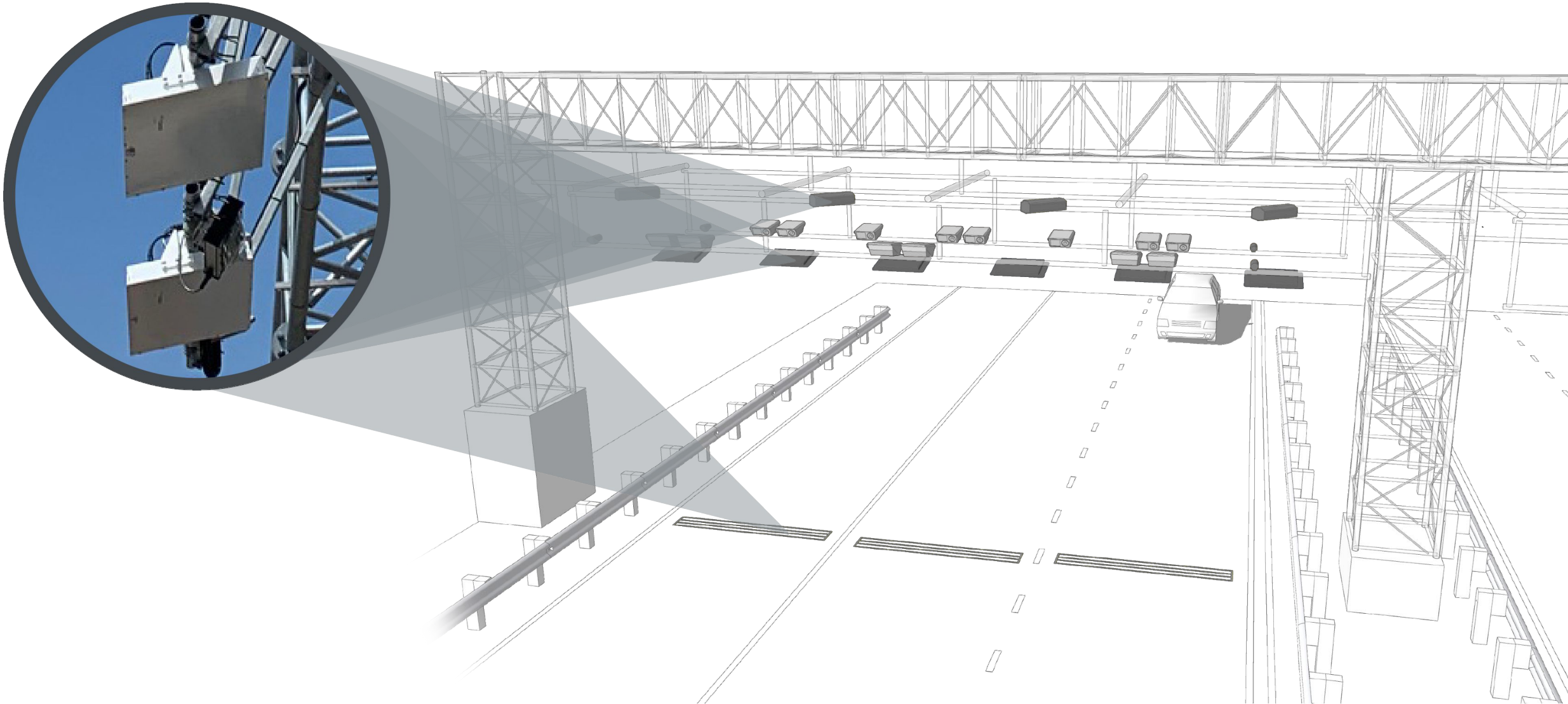
The VRX-3500 with onboard OCR is the latest in a field-proven product series that is successfully deployed globally, in thousands of lanes.

VRX Feature

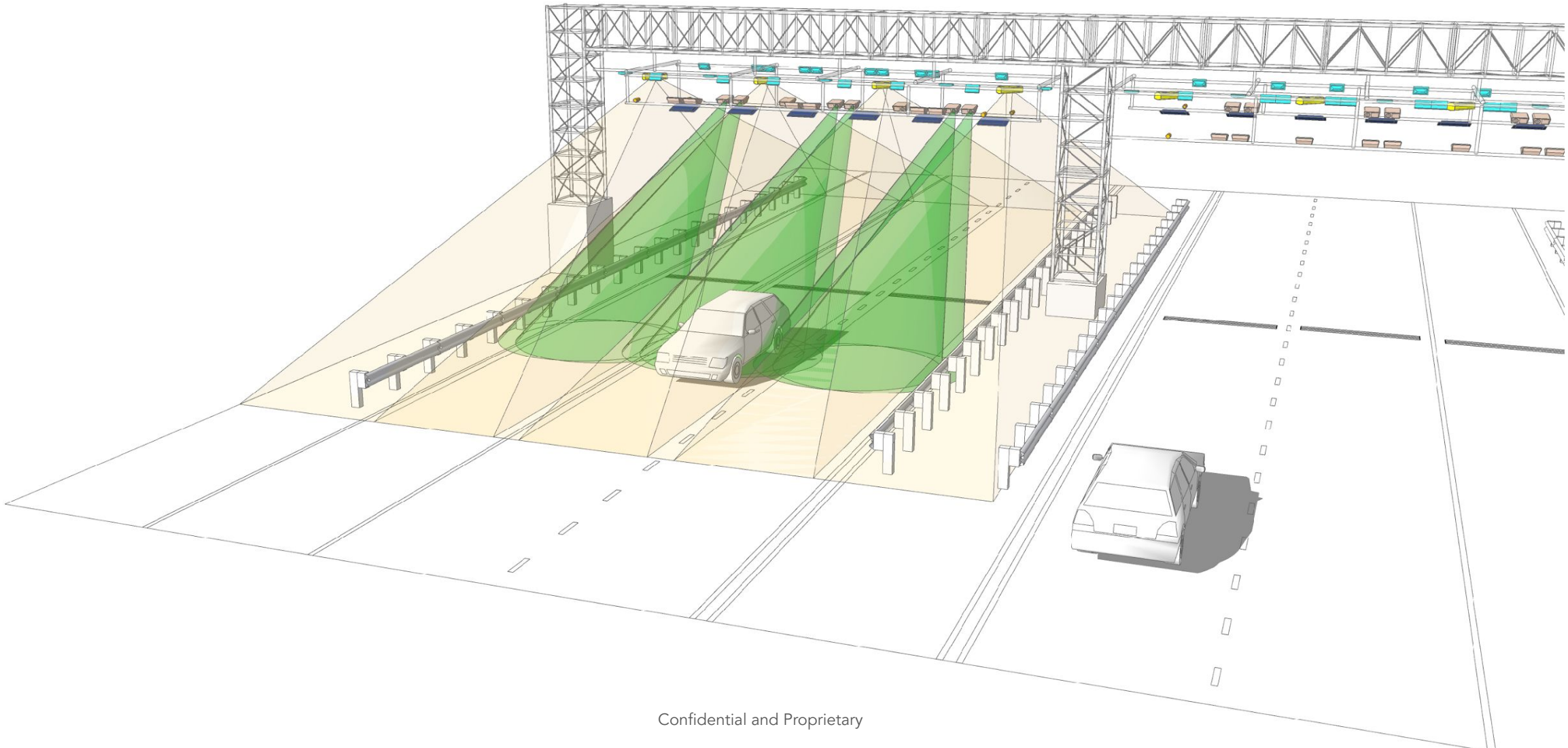
5 Megapixel High Dynamic Range Image Sensor	Provides high quality color images, regardless of lighting conditions
HD Quality Images using Varifocal Lens	Flexible Accommodates various lane geometries, with the maximum- available pixels for high OCR confidence rates.
Remote Configuration Software and Full SNMP Capabilities	Ease of monitoring and maintenance

Kapsch VRX Camera

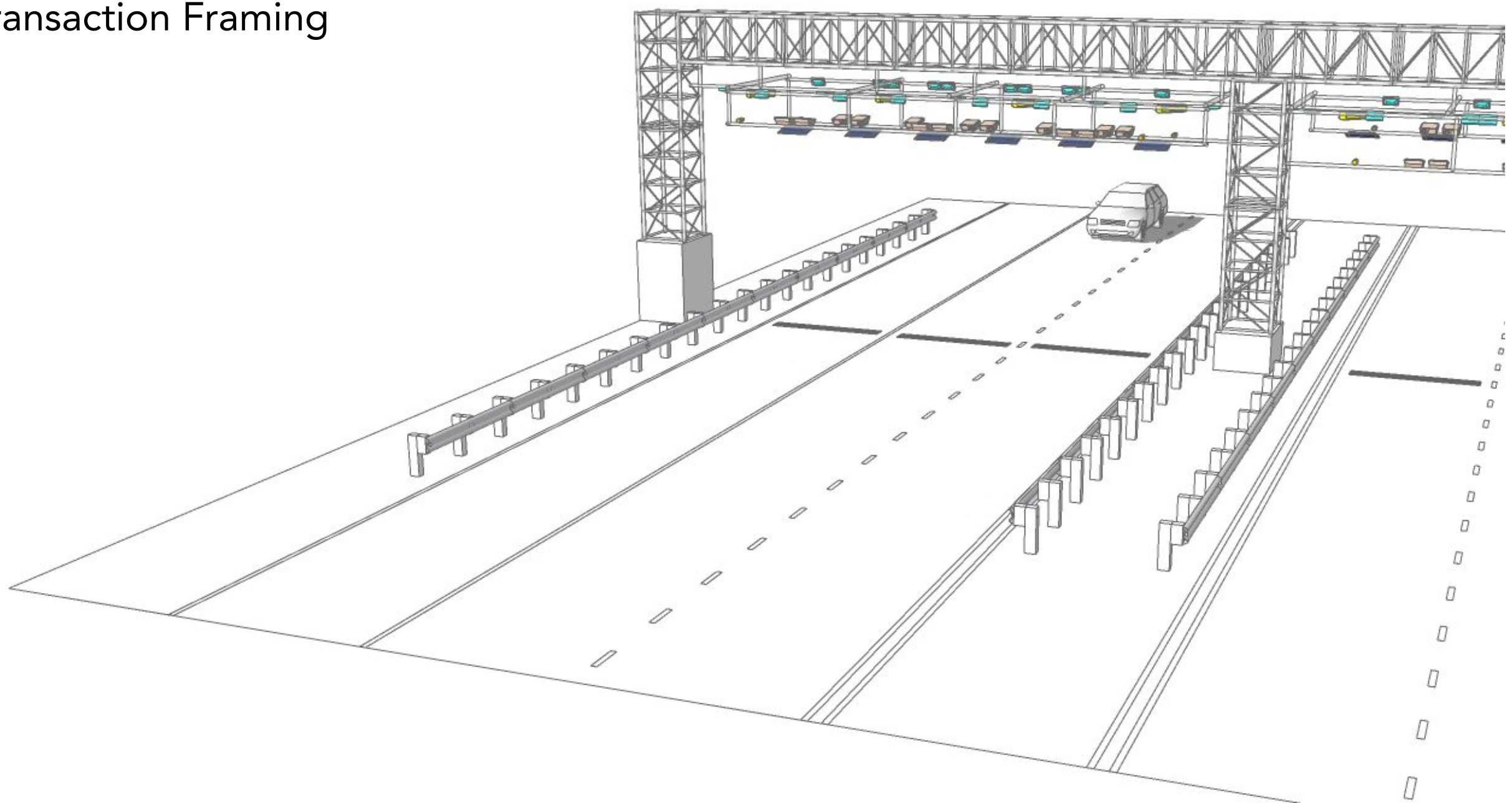
Tolling Equipment – [illegible] System



Equipment Field of Views – [illegible]



Equipment Field of Views and Transaction Framing



Operation and Maintenance Approach

Preserve Revenue, Ensure Accuracy, and Optimize Performance

- Redundancy and resiliency in design
- Scheduled and predictive maintenance
- Real-time self-monitoring and notifications
- Remote diagnosis and service restoration
- Analyze and optimize system performance
- Customer engagement when necessary to review performance, identify and update issues, and manage outstanding actions.

Deliver proactive O&M services and minimize interruptions!

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Impacts to the Travelling Public

1. Safety

   Elimination of toll plazas results in significant reductions in the rate of accidents (Florida's Turnpike Enterprise calculated a 45% reduction). The majority of accidents at toll plazas involve collisions with the toll plaza infrastructure, according to the Texas Turnpike Authority.

   Safety of Authority Personnel is greatly enhanced, both from the perspective of reduced injuries from attendants being hit by vehicles, and from lower risk of robbery due to the amount of cash handled at toll booths. Additional safety improvements are provided when AET systems use walkable gantries that allow maintenance teams to work on equipment without requiring lane closures.

Impacts to the Travelling Public

2. Environmental Impacts

In most cases, the removal of toll plazas results in reduction or elimination of stop and go traffic. This has the immediate benefit of reduced exhaust emissions leading to enhanced environmental safety. Studies have shown CO levels are reduced by as much as 37%, and diesel particulate emissions decreased by as much as 58%. Fuel economy is also improved significantly with the elimination of stop and go driving.

Impacts to the Travelling Public

3. Time Savings and Stress Reduction

AET implementation can save significant amounts of time on a daily commute, with up to 30 minutes of congestion eliminated by the removal of a single toll point in a high traffic volume area. The elimination of the traffic congestion and associated stresses provides additional intangible benefits.

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