



Lidar Case Studies for ITS Use Cases

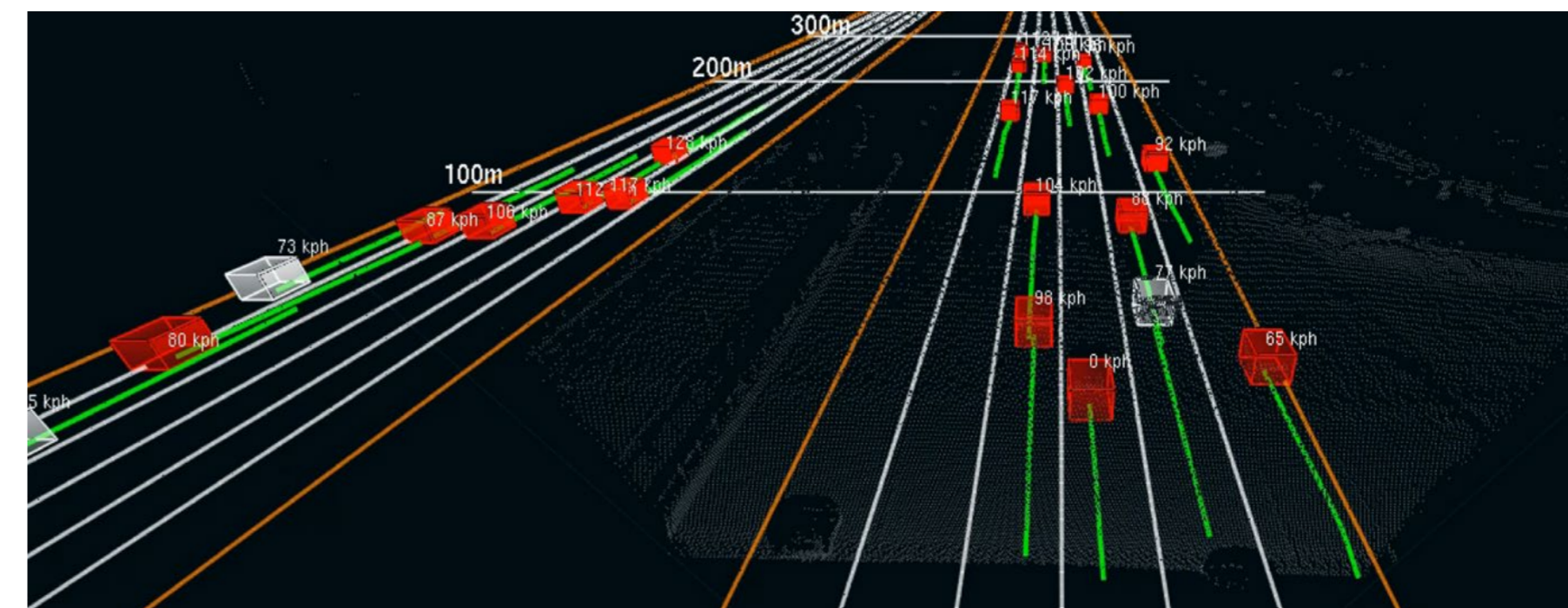
April 2025

Highway Monitoring & Automated Incident Detection (AID)

- **Target Customer:** Large Systems Integrator HQ in Europe
- **Geo Location:** I-66 Corridor in USA
- **Business Problem**
 - Highway Safety
 - Reliable, real-time monitoring and incident management
 - Traffic flow and congestion management
 - Improve response and clearing times
- **Existing Technology Gaps:**
 - Cameras and radars do not have the versatility to adapt to changing traffic, and environmental conditions
 - Lack ability to provide highly accurate data needed to detect traffic disruptions or incidents in real-time
- **Use Cases Adopted**
 - Wrong Way Detection
 - Stopped vehicles
 - Objects on roadway
 - Pedestrians/bicycles on roadway
 - Road congestion and occupancy level

Technology Solution: 4Sight™ provides accurate, high-quality road and traffic data in real time to support a diverse range of Automated Incident Detection (AID) applications.

- ✓ **Ultra-long-range performance** – Up to 1km reliable range detection, the most advanced sensor technology to scale down existing sensing solutions.
- ✓ **Avoid development uncertainty** – Software-defined lidar sensor already optimized for AID application needs.
- ✓ **Easy to use and deploy** – Easy to operate, low maintenance cost, simple installation, and commissioning.
- ✓ **Flexible integration** – High versatility regarding sensor height, pitch angle, number of lanes, traffic density and type of data to extract.



Lidar AID KPIs – I-66 Virginia Deployment

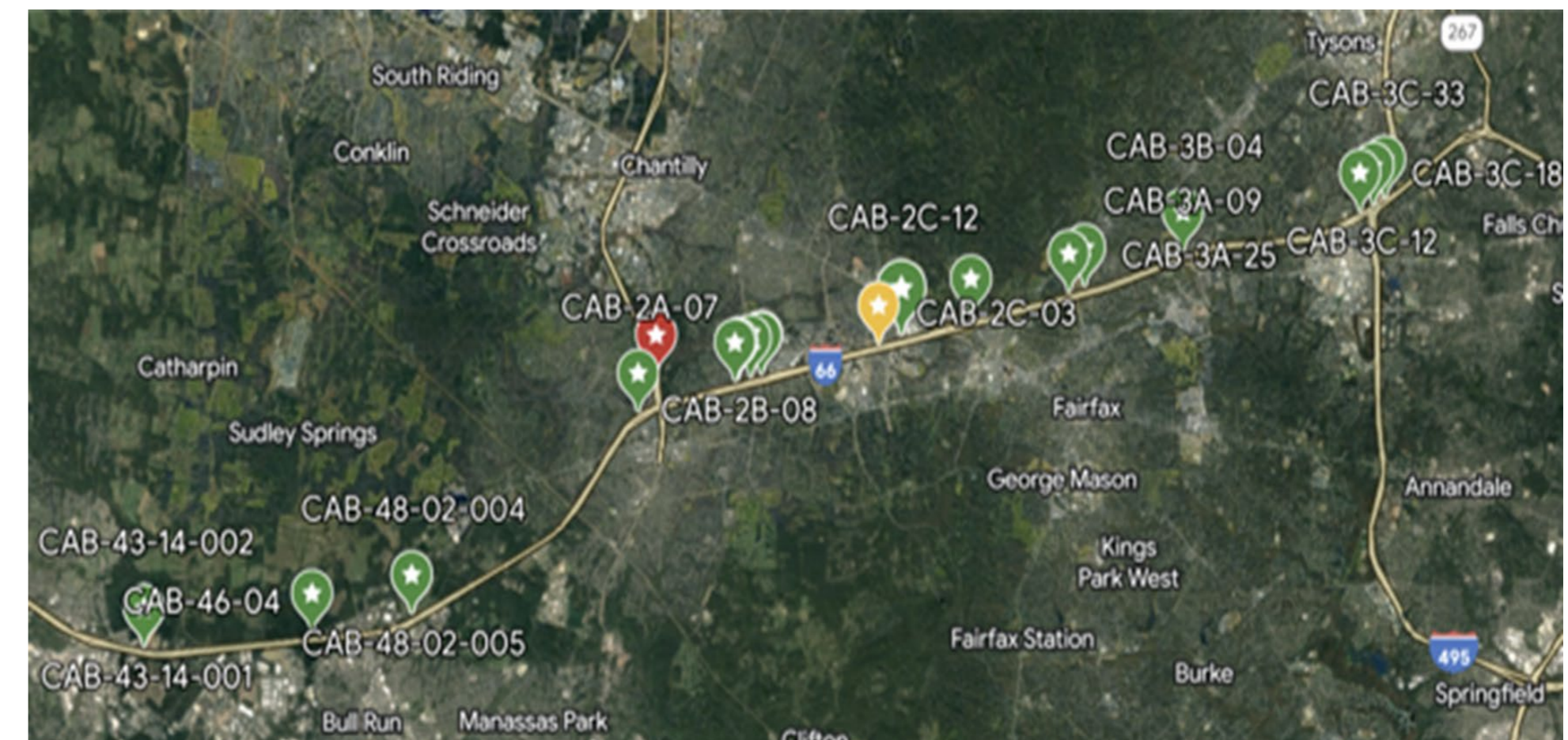
Testimonials:

“Our crews patrol the 66 Express 24/7, ensuring that help is always nearby. **We also monitor the lanes constantly with cameras and traffic sensors, which alert our team to incidents within a matter of seconds.**”

“With its combination of improved travel options, **multi-modal infrastructure**, significant economic impact, and no taxpayer burden, the 66 Express Outside the Beltway stands as a model of successful public-private collaboration. This transformative project continues to benefit drivers, businesses, and the broader community, ensuring a stronger and more connected future for Northern Virginia.”



Use Case	Detection Accuracy per range			
	100 m	150 m	200 m	250 m
Stopped vehicle on shoulder	99%	98%	95%	95%
Queue detection	99%	98%	95%	95%
Wrong way driving	99%	95%	95%	TBD
Pedestrian detection	99%	95%	N/A	N/A



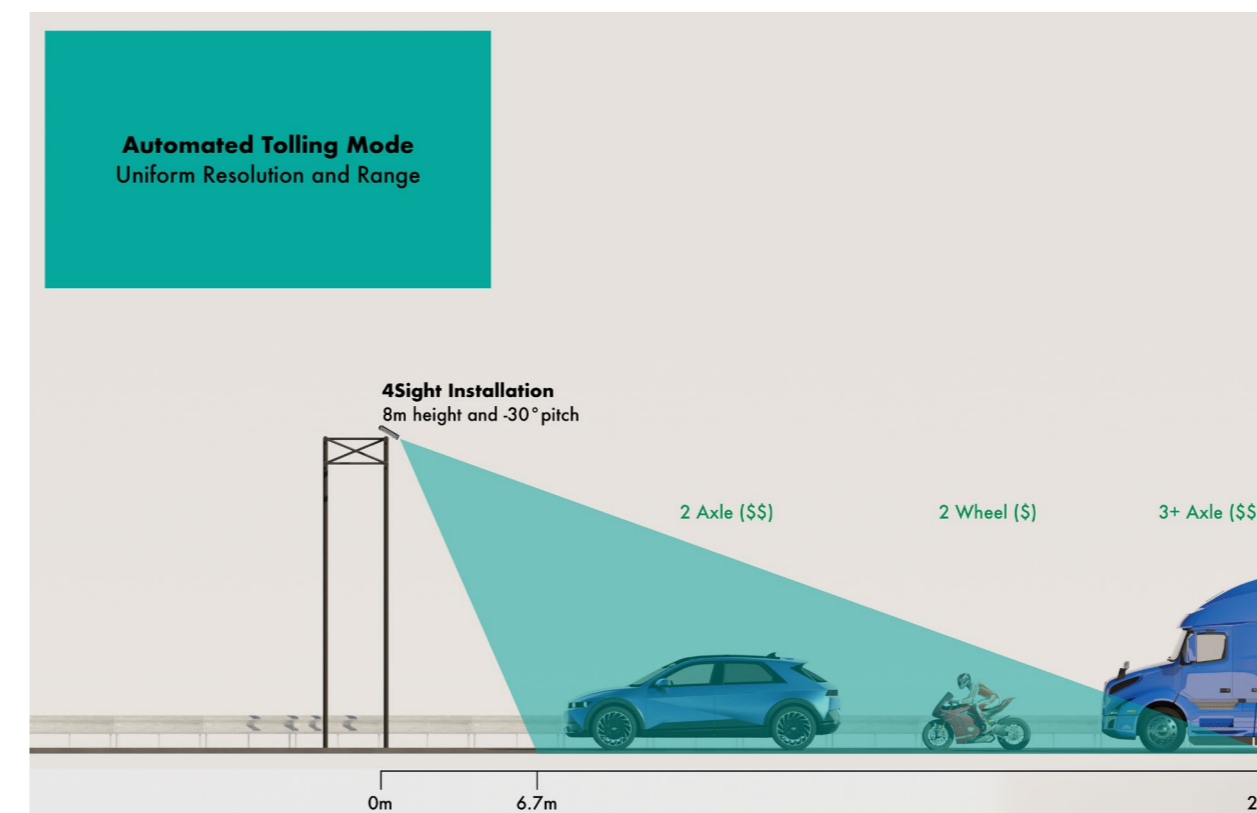
20 Lidars were deployed along the I-66 corridor outside of Washington DC to monitor newly commissioned express lanes

Automated Tolling

- **Target Customer:** Large Systems Integrator HQ in Europe
- **Geo Location:** New Highway construction in Central Asia
- **Business Problem**
 - Reliable vehicle classification & tracking
 - Accurate counting & tagging of passing vehicles
 - Reliable in bumper-to-bumper traffic up to 200 kph
 - Multiple lane coverage with single sensor
 - High cost of maintenance for underground sensors
- **Existing Technology Gaps:**
 - Cameras lack the depth information for accurate vehicle classification, especially in low light and poor weather conditions
 - In free flow situations, cameras and radars cannot cover multiple lanes, and vehicles avoid paying a toll by switching lanes in the toll zone
 - Maintenance of underground inductive loops cause expensive lane closures and traffic disruptions
- **Use Cases Adopted**
 - Vehicle classification based on size
 - Unique ID per vehicle and tracking through the toll zone
 - Use of lidar to trigger license plate cameras
 - Vehicle Speed reporting

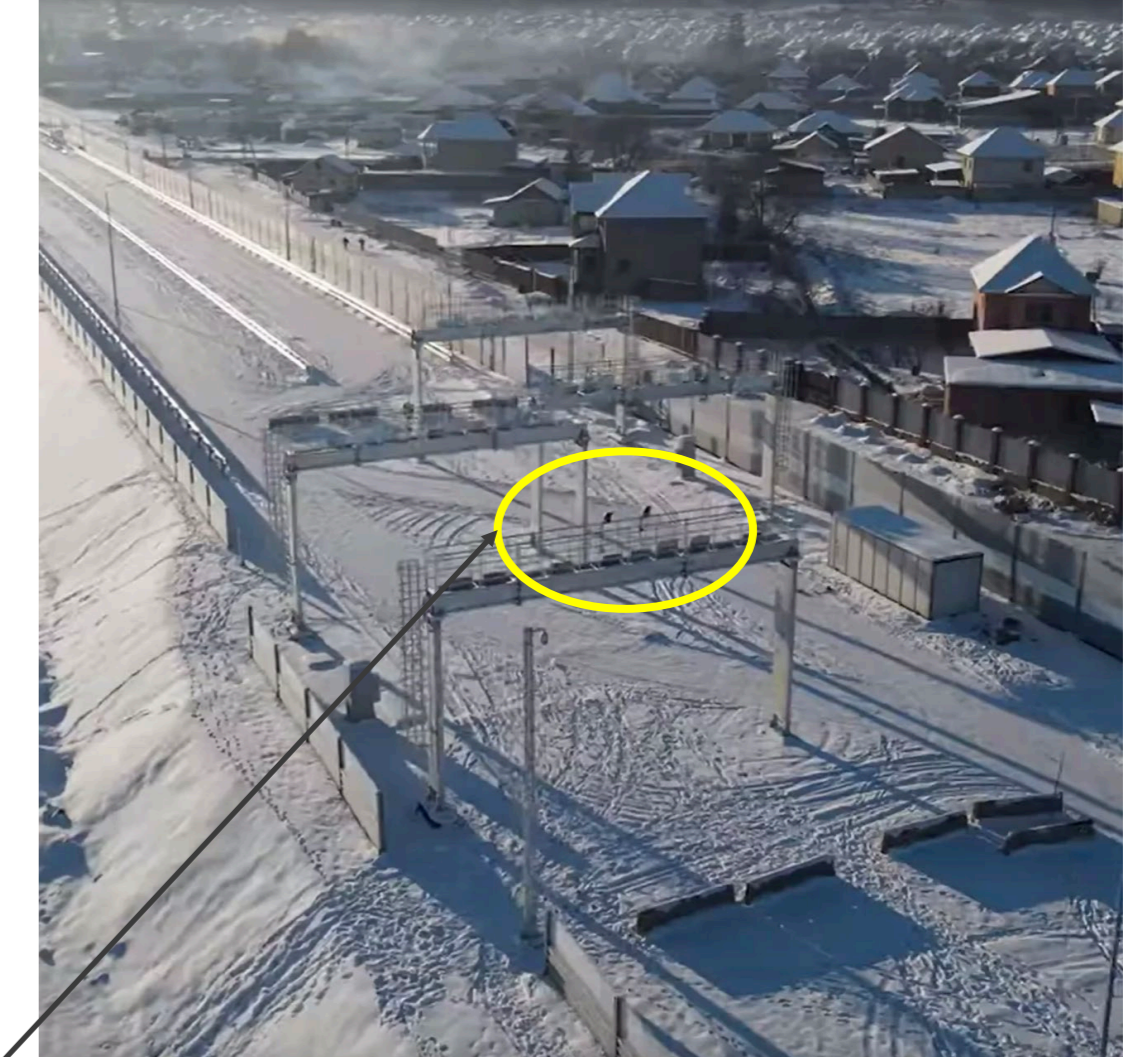
Technology Solution: 4Sight™ reliable lidar data enables perception, to better locate, identify and track objects over time. It is specifically designed to complement the use of existing cameras, radars, and loops in automated tolling

- ✓ **Multi lane coverage** – Up to 6 lanes covered per sensor, with flexible mounting configurations, significantly reducing total system costs
- ✓ **Improved perception** – Enables faster, more accurate and reliable perception to complement existing sensing solutions, in all lighting and weather conditions
- ✓ **Integrates with existing sensors** – Augments existing tolling sensors and can trigger license plate cameras to minimize vehicle miscounts
- ✓ **Accurate vehicle speed and classification** – Ensures the highway authority gets the most accurate traffic and vehicle information

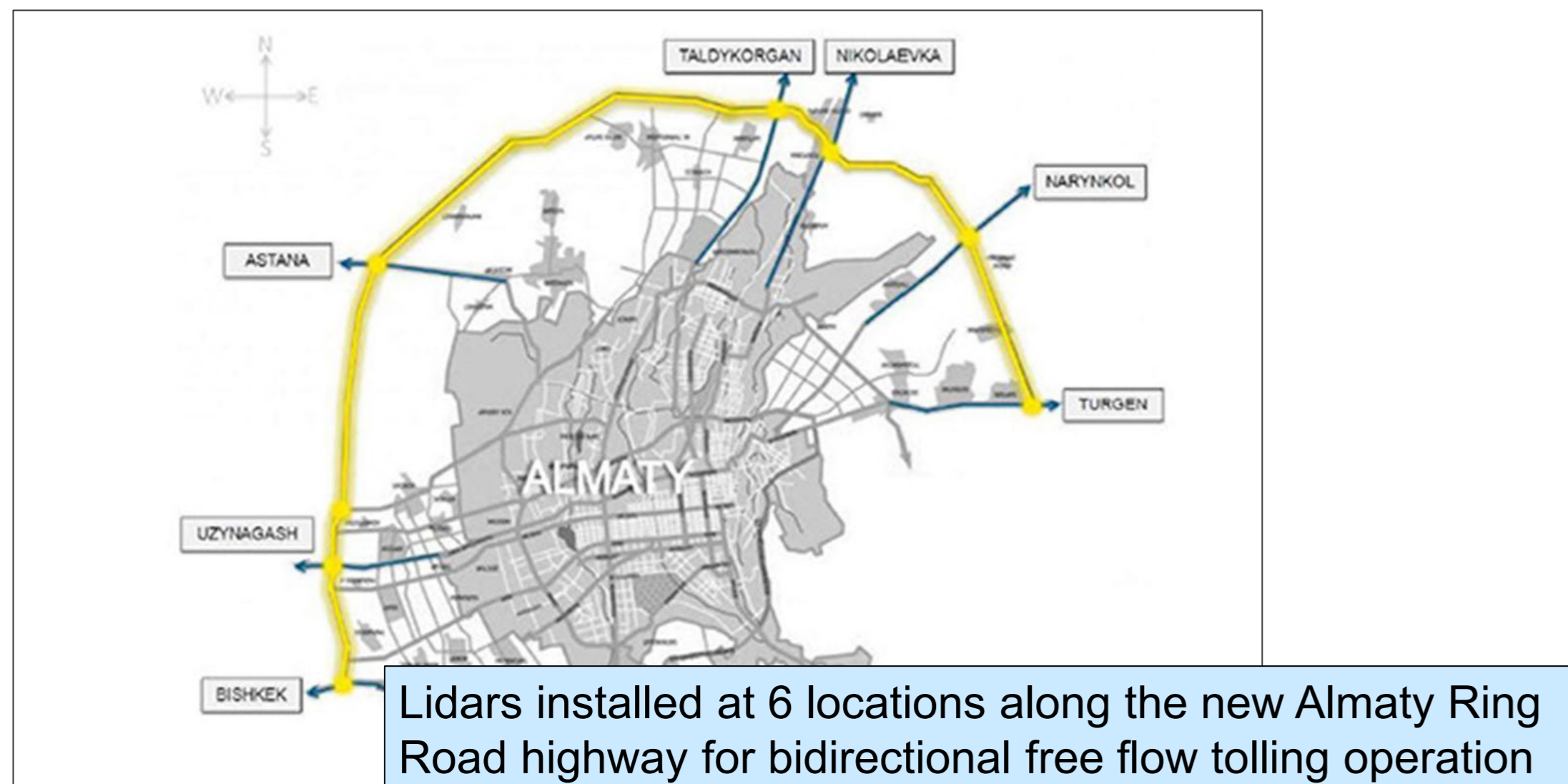


Lidar Tolling KPIs – Almaty Ring Road Deployment

- › > 99% vehicle detection accuracy
- › Accurate vehicle type classification
- › Performance in all lighting and weather conditions
- › Reliable triggering of front and rear ANPR cameras
- › Integration with highway authority data & analytics center



Testing & installation of lidar units for tolling



Intersection Management

- **Target Customer:** Systems integrators and Departments of Transportation
- **Geo Location:** Pilot testing in cities across the United States
- **Business Problem**
 - Traffic and pedestrian safety on city roads
 - Creating a digital twin of traffic intersections
 - Accurate transportation analytics and efficient planning
 - Migration to “smart infrastructure” and V2X systems
 - High cost of maintenance for underground sensors
- **Existing Technology Gaps:**
 - Camera systems struggle in poor lighting and weather conditions
 - Radar resolution supports limited classification options and has challenges detecting stationary objects
 - Many cameras needed per intersection to support use cases
 - Maintenance of underground inductive loops cause expensive lane closures and traffic disruptions
- **Use Cases Adopted**
 - Stop bar detection
 - Pedestrian and Vulnerable Road User detection and tracking
 - Advance vehicle detection
 - Real-time traffic actuation

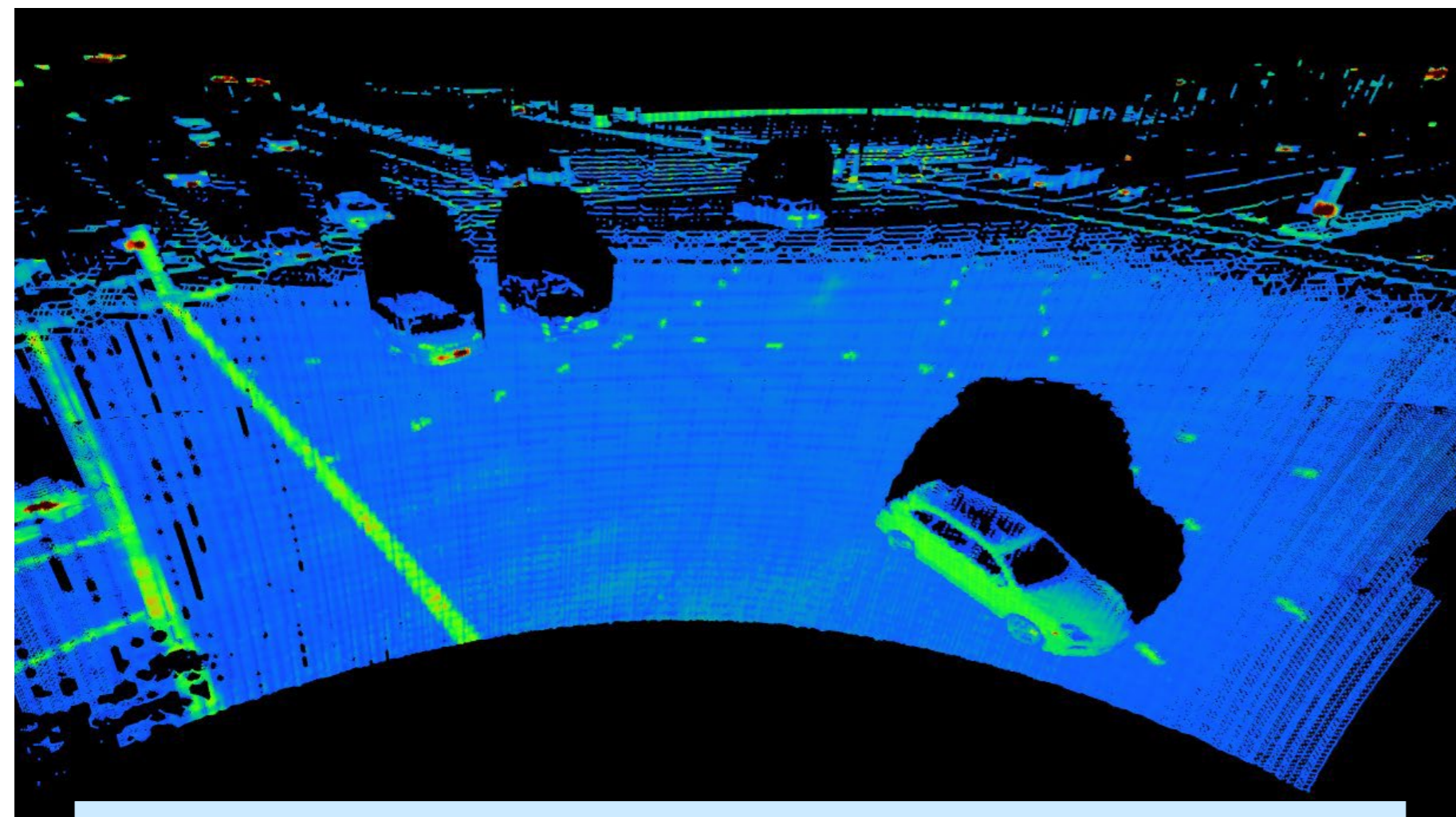
Technology Solution: 4Sight™ provides accurate, high-quality road and traffic data in real time to support critical use cases in urban intersection management.

- ✓ **Complete coverage with only 2 lidars** – Critical intersection management use cases are covered by just 2 lidars due to a wide 120° horizontal FOV per lidar as well as 250m+ long range detection
- ✓ **Real-time reliable data analytics and traffic actuation** – Enables more efficient traffic flow and safety, in all lighting and weather conditions
- ✓ **Flexible integration** – Easy to install with high versatility regarding sensor height and pitch angle
- ✓ **Inherent Privacy** – Lidar provides high resolution point cloud data on road users while maintaining personal privacy

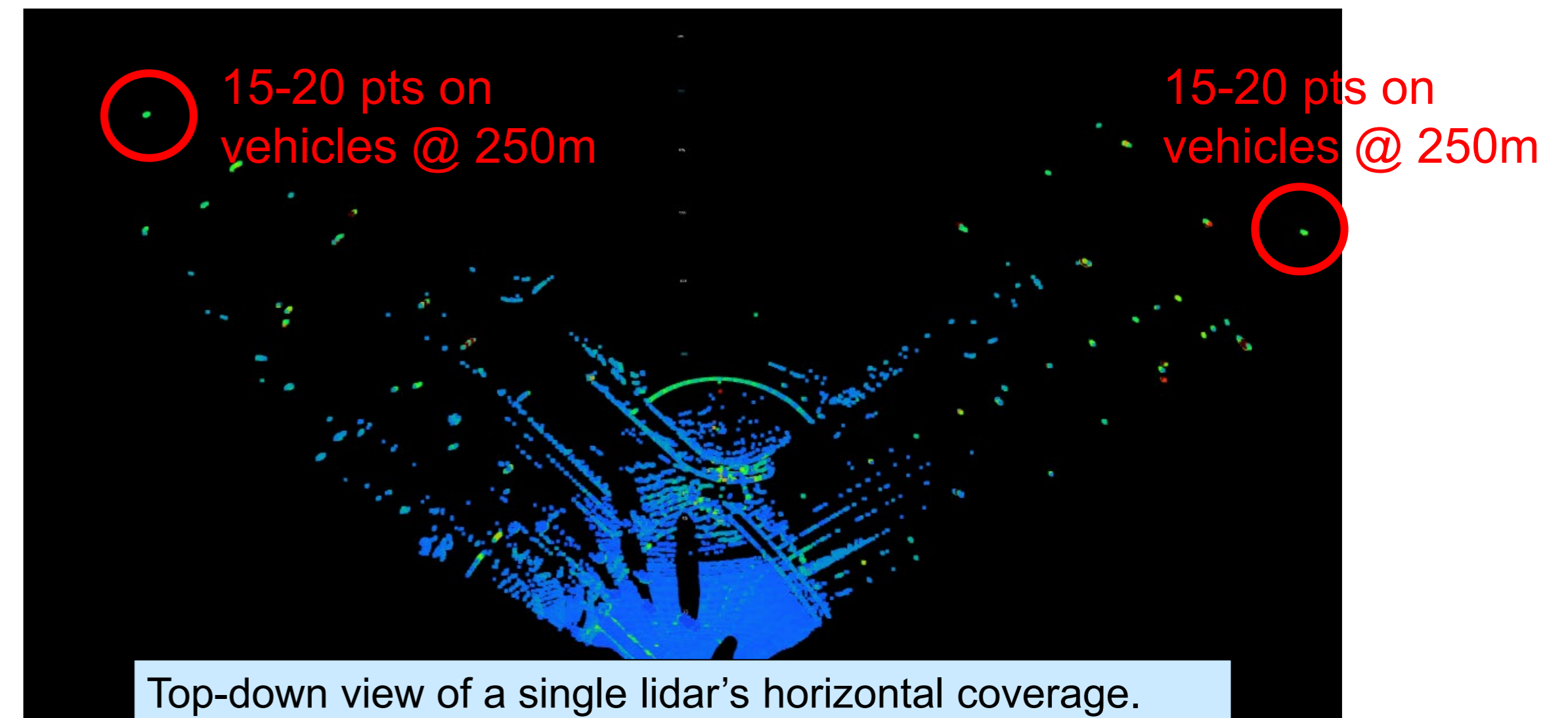


Intersection Management Pilot Projects

- › PoC testing at intersections in Michigan and CA
- › 120° horizontal Field of View enables entire intersection coverage with just 2 lidars, while detecting incoming traffic from all directions
- › Incoming detection of vehicles from 250m away with consistent 15-20 points
- › High resolution point cloud ensures reliable depth and position data of vulnerable road users and pedestrians



View from a single lidar at a test intersection in California



Top-down view of a single lidar's horizontal coverage. Incoming vehicles are detected at 250m+