5G-Enabled Real-Time Multi-Modal Traffic Monitoring System

bluecity.ai

Loop

Radar

Camera

Current traffic solutions require multiple technologies to address the cities data needs

- Extremely expensive to install and maintain
- Requires road closure
- Limited data about presence of cars
- No other type of road users
- Requires underground wiring

- Requires 4 sensors per intersection
- Requires road closure
- Limited data about presence of cars
- No other type of road users

- Unreliable under adverse weather and lighting conditions.
- Privacy concerns.
- Mainly used for planning/surveillance

Source: https://mntransportationresearch.org/

OVERVIEW

Reliable

Collect data in any lighting or weather conditions.

Multi-modal

On-board AI classifies your data between vehicles, pedestrians and bikes.

Non-Intrusive

Single-sensor solution to cover whole intersection.

Connected

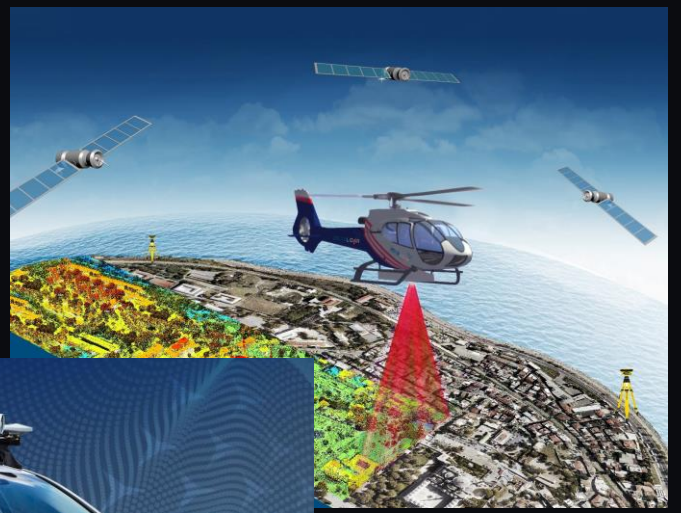
Powered by LTE/5G, Explorer delivers real-time access to your data.

Privacy-Protected

No privacy concerns

Lidar History: From Military to Commercial

Military



rborne

Very Expensive

Limited Availability

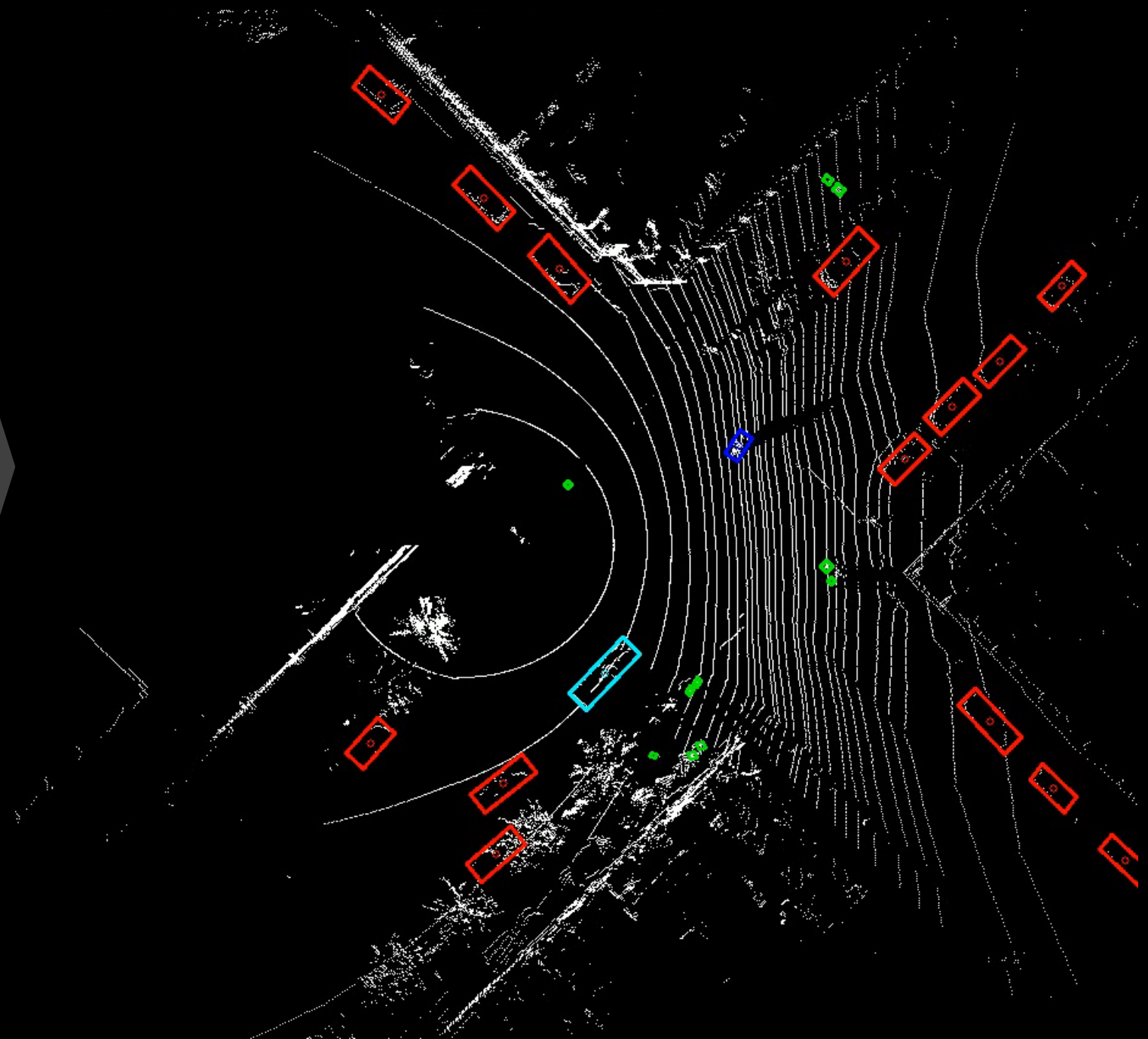
Drone

Mapping

ITS

How a single Lidar sees an entire intersection?

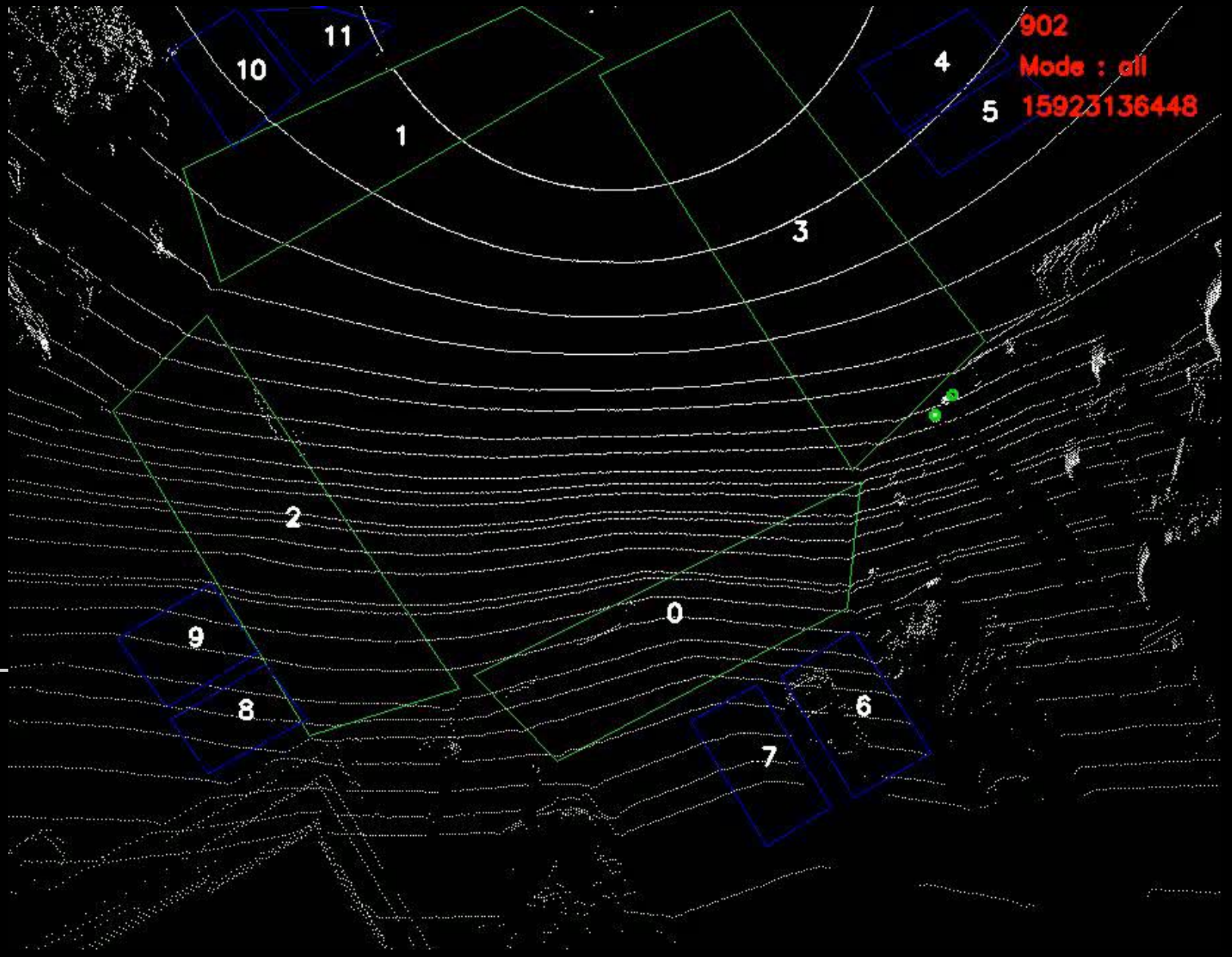
Real-time object detection, classification and tracking



Kelowna Project

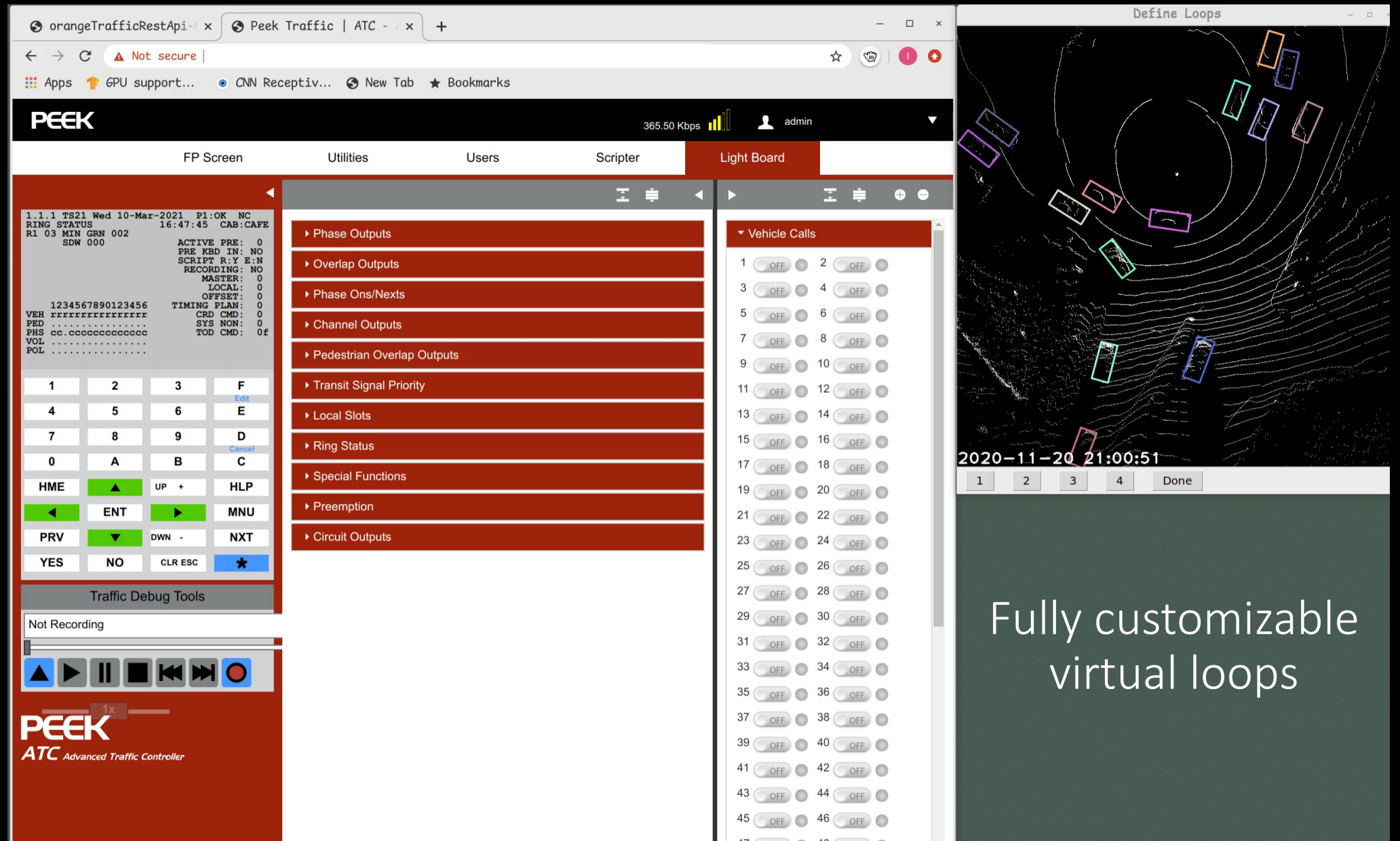
A replacement for costly to maintain technologies

Virtual loops for all road users



Kelowna Project

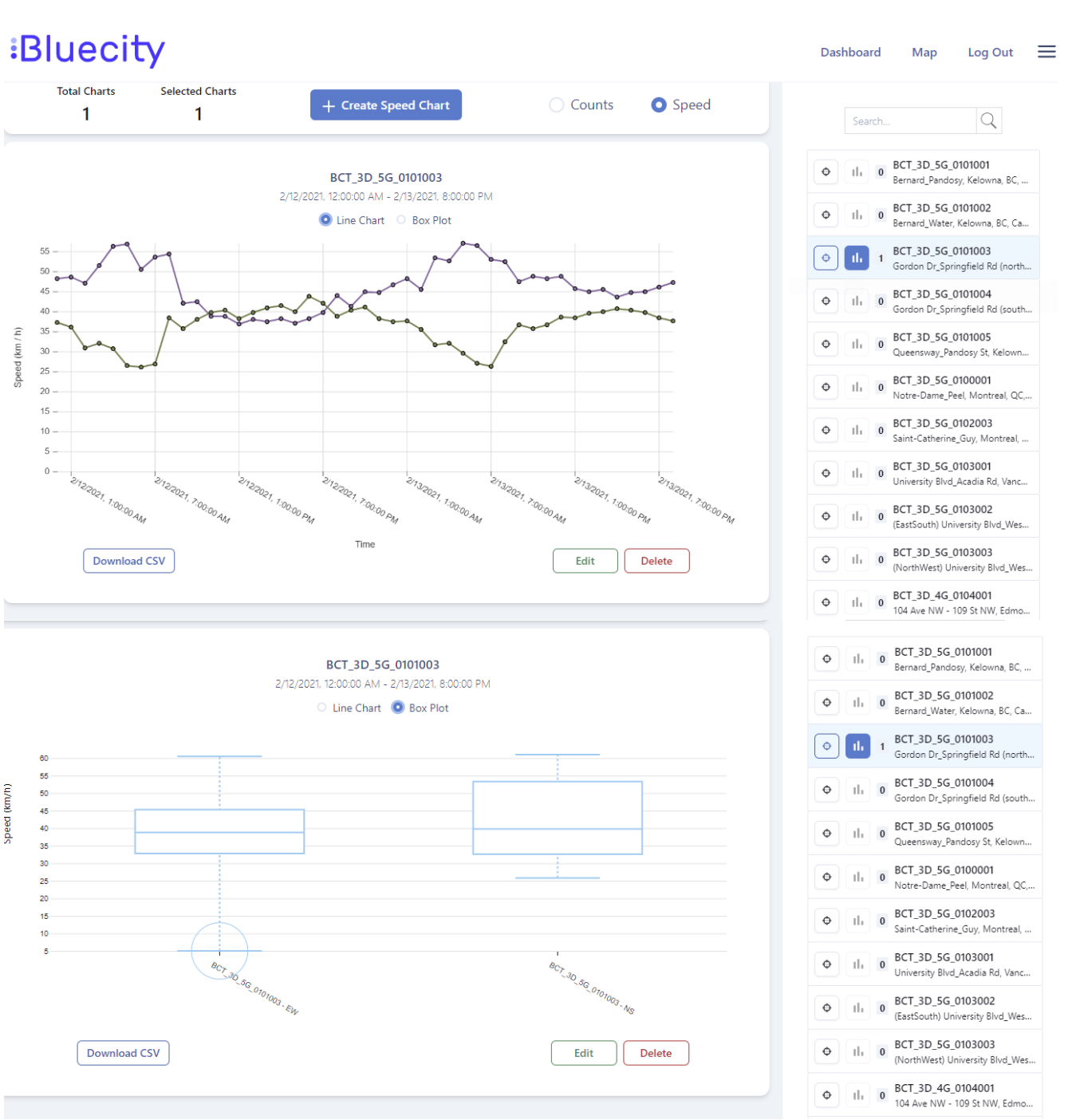
Real-Time Communication with Traffic Controller



Fully customizable virtual loops

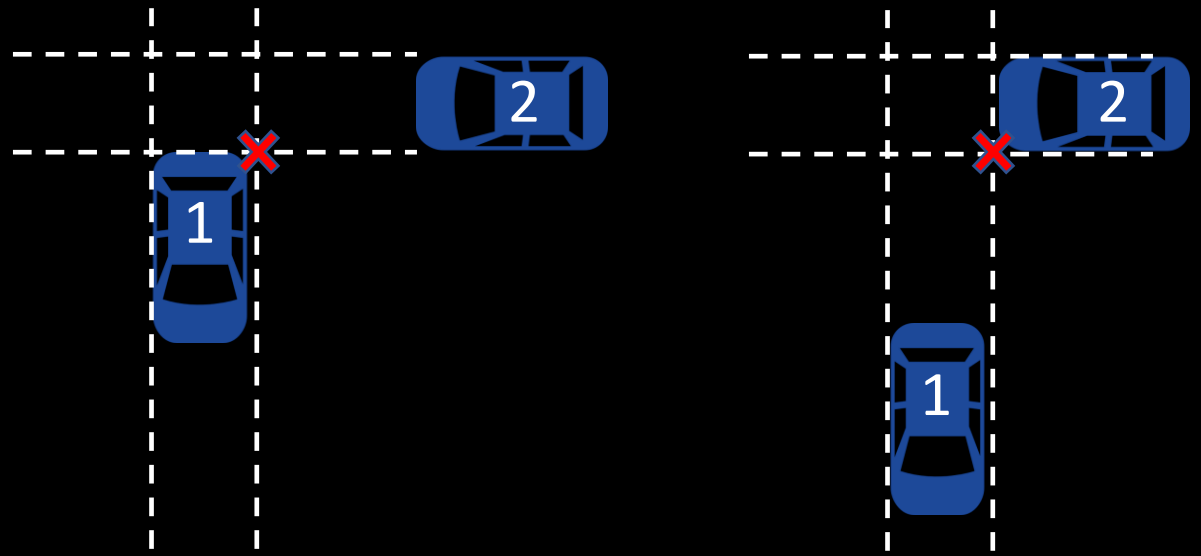
Speed Analysis

- Use Cases:
  - Driver Behavior Analysis
  - Traffic Light Timing Efficiency
  - Effect of weather/lighting conditions on speed distribution
  - Monitor over speeding



Conflict Analysis

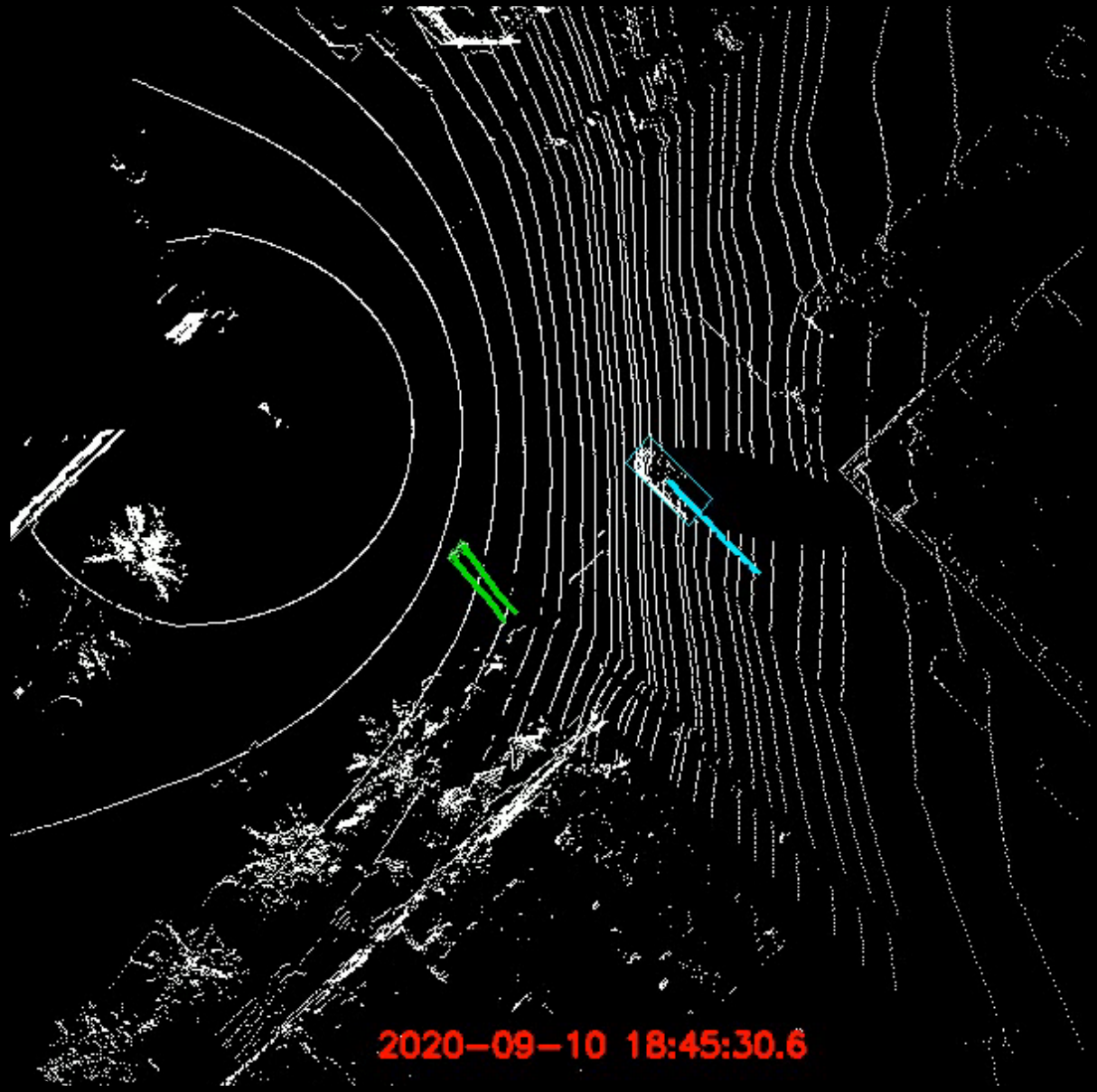
Near miss detection
PET estimation



Situation at t_1

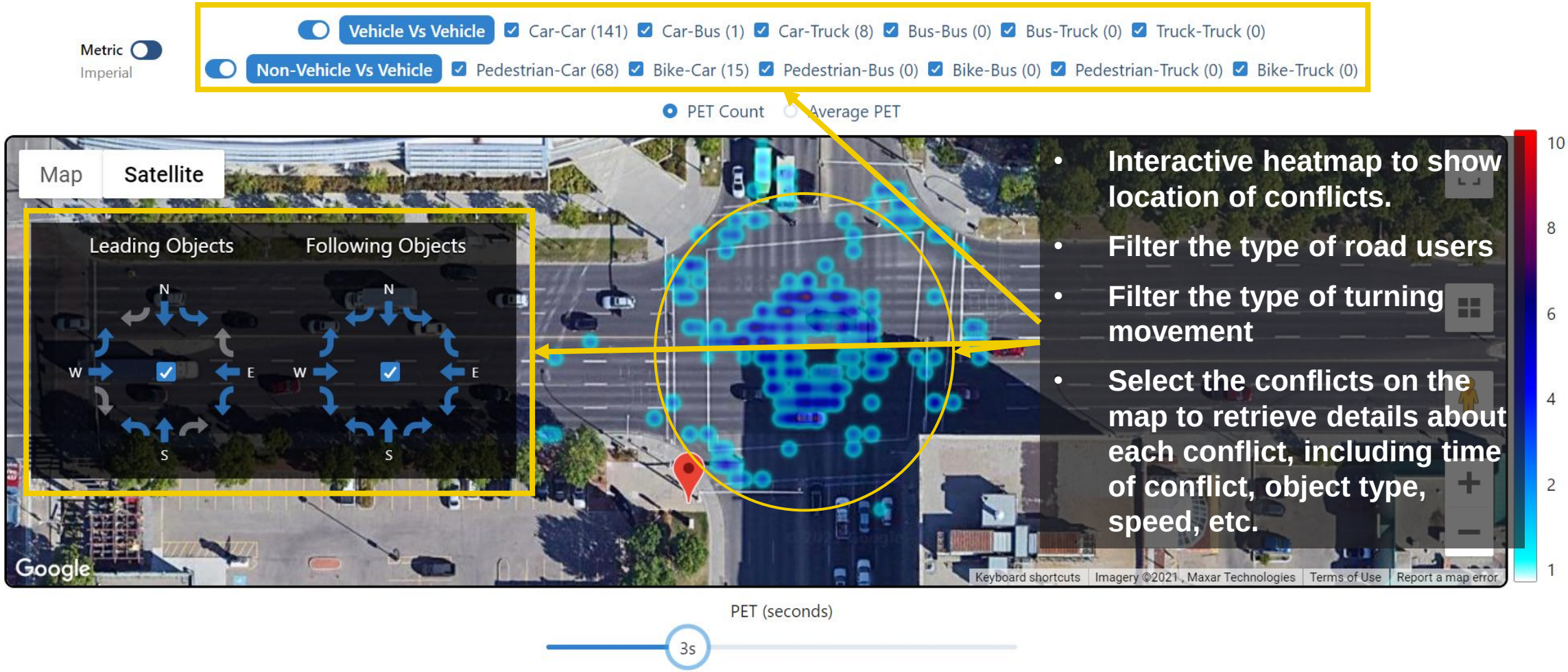
Situation at t_2

PET = t_2 - t_1



PETs less than 4 seconds are considered as **unsafe** conflict
PETs less than 2 seconds are considered as **critical** conflict

Surrogate Safety Analysis – Proactive Approach on Safety



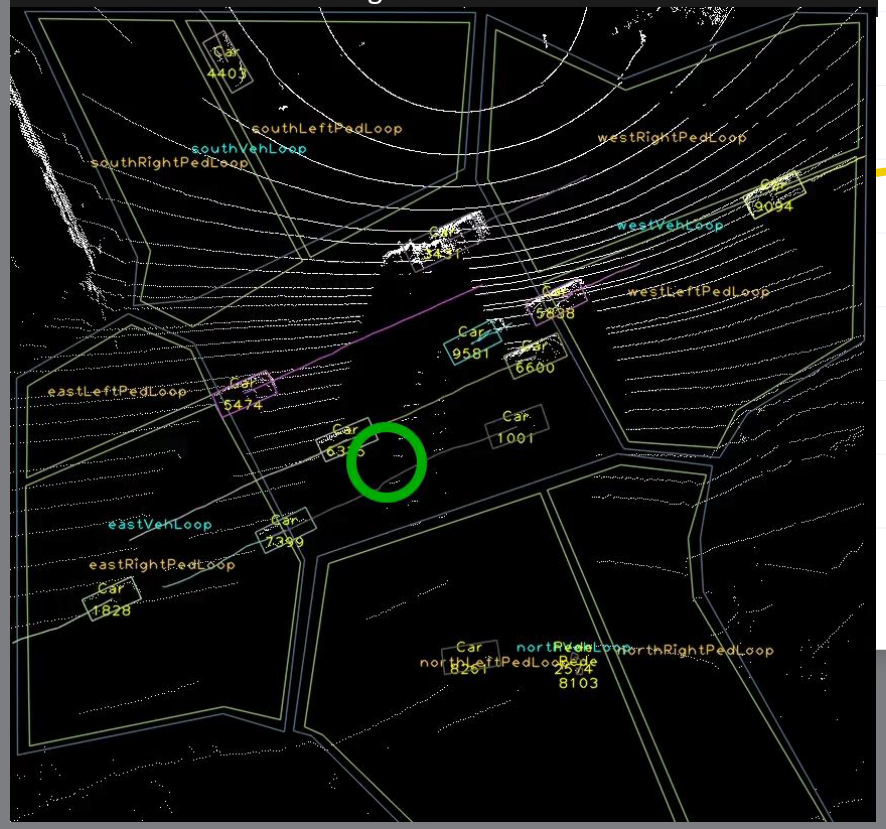
- Interactive heatmap to show location of conflicts.
- Filter the type of road users
- Filter the type of turning movement
- Select the conflicts on the map to retrieve details about each conflict, including time of conflict, object type, speed, etc.

IndiGO iQ

Monitor Critical Conflicts

Validate it with watching a 10-second video clip

Recording of selected conflict



BCT_3D_4G_0104001

Bicycle - Passenger Vehicle

Passe

PET value in seconds

Speed of leading object

Location of the conflict

Date/Time that conflict happened

PET Details

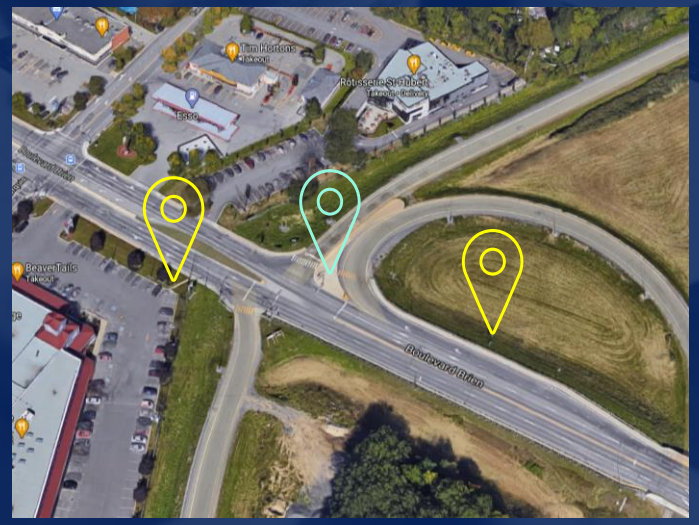
Sensor: BCT_3D_4G_0104001 **Location:**-113.50848°, 53.54626°

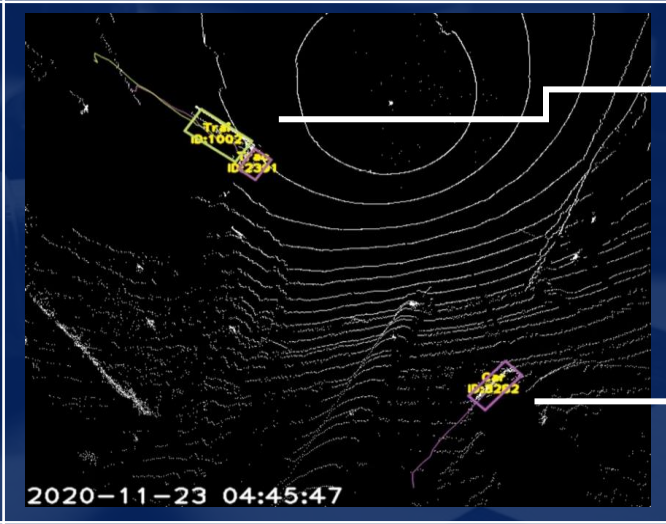
PET VALUE (s)	SPEED (km/h)	VIDEO CLIP	FOLLOWING OBJECT	LEADING OBJECT	FOLLOWING MOVEMENT	LEADING MOVEMENT	TIMESTAMP
2.3	20.2	Play MP4	Car	Car	WN	EW	4/27/2021, 11:12:31 AM
3.5	22.1	Play MP4	Car	Car	WN	EW	4/27/2021, 1:44:20 PM
1.9	23.6	Play MP4	Car	Car	WN	EW	4/27/2021, 4:25:52 PM
2.9	18.6	Play MP4	Car	Car	WN	EW	4/27/2021, 4:36:43 PM
1.8	22.8	Play MP4	Car	Car	WN	EW	4/27/2021, 6:02:50 PM
3.4	22.5	Play MP4	Car	Car	WN	EW	4/27/2021, 9:07:34 PM
1.9	17.7	Play MP4	Car	Car	WN	EW	4/28/2021, 8:16:26 AM
1.6	19.8	Play MP4	Car	Car	WN	EW	4/28/2021, 9:42:37 AM
2.4	19.5	Play MP4	Car	Car	WN	EW	4/28/2021, 12:19:16 PM
1.9	22.3	Play MP4	Car	Car	WN	EW	4/28/2021, 5:08:05 PM

Close

425 ft x 425 ft Area

Case Study 1 : Comparison of lidar and camera data



	Bluecity	Competitor
Sample screenshot		
Install footprint	1 Lidar	2 cameras
Data accuracy	98.7%	96.1%
Consistency	All weather/lighting	Proper weather/lighting

City: Repentigny, QC.

Consulting partner: CIMA+

Case Study 2 : Comparison of lidar and loop

City: Edmonton, Canada.

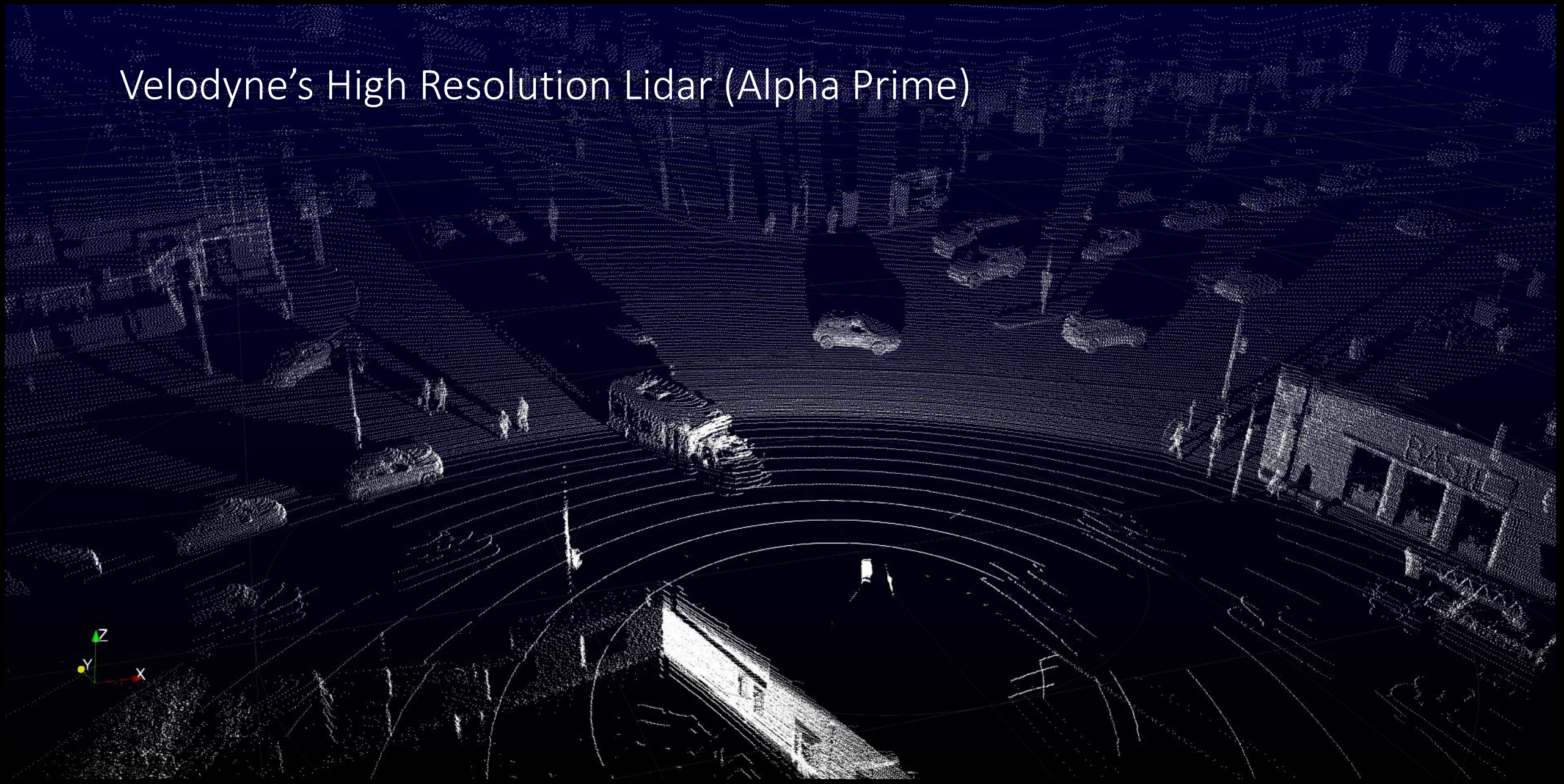
Count Comparison

Date	ISD	Blue City	Difference	Difference (%)
2021-05-03	11,734	12,161	427	4%
2021-05-04	11,936	12,326	390	3%
2021-05-05	12,314	12,740	426	3%
2021-05-06	12,463	12,889	426	3%
2021-05-07	12,199	12,526	327	3%
2021-05-08	9,476	9,623	147	2%
2021-05-09	8,281	8,418	137	2%
Grand Total	**78,403**	**80,683**	**2,280**	**3%**

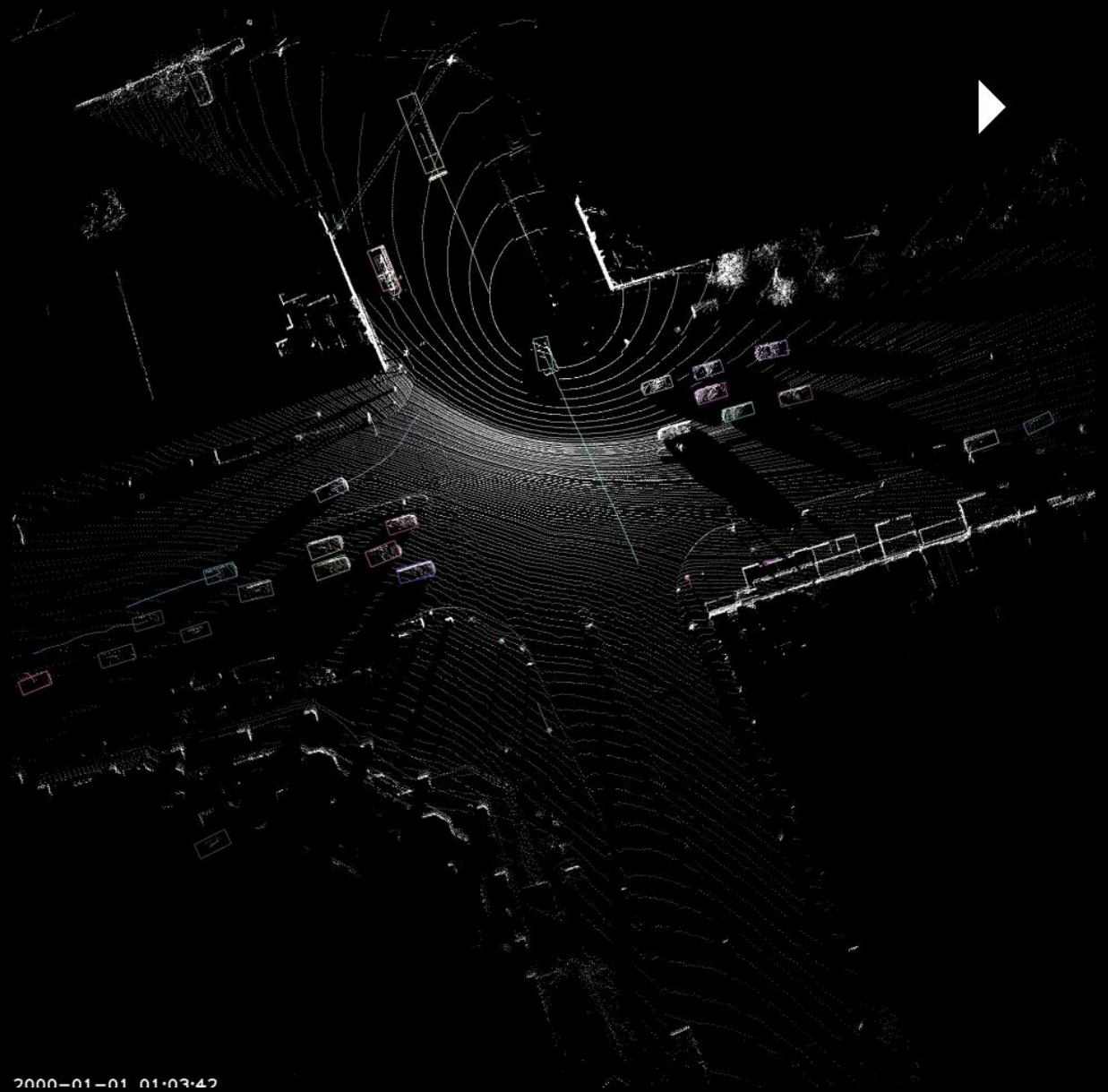
Speed Comparison

Date	ISD	Blue City	Difference (km/h)	Difference (%)
2021-05-03	39.4	40.3	0.9	2%
2021-05-04	39.2	40.1	0.9	2%
2021-05-05	39.7	40.5	0.8	2%
2021-05-06	39.0	40.3	1.3	3%
2021-05-07	38.6	39.7	1.1	3%
2021-05-08	36.2	37.8	1.6	4%
2021-05-09	38.5	39.6	1.1	3%
Average	**38.7**	**39.8**	**1.1**	**3%**

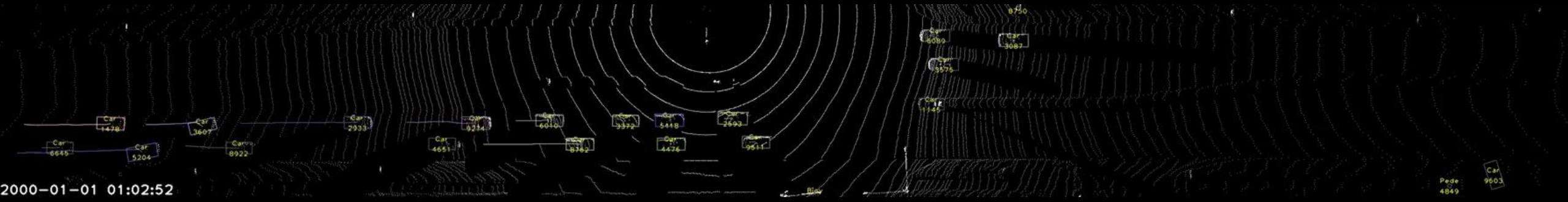
Velodyne’s High Resolution Lidar (Alpha Prime)



Velodyne
High Resolution Lidar
(Alpha Prime)
Integrated with
Bluecity’s Perception
Software

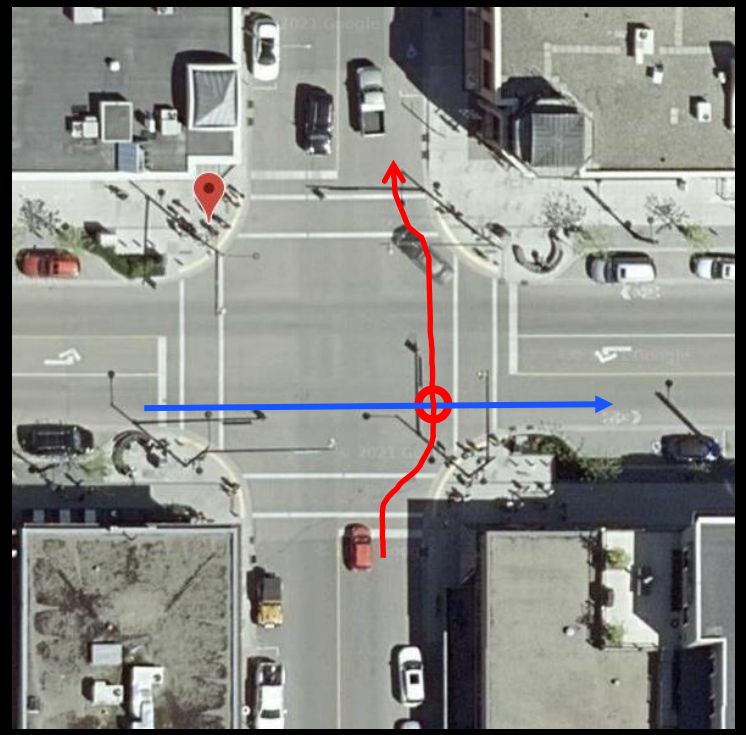


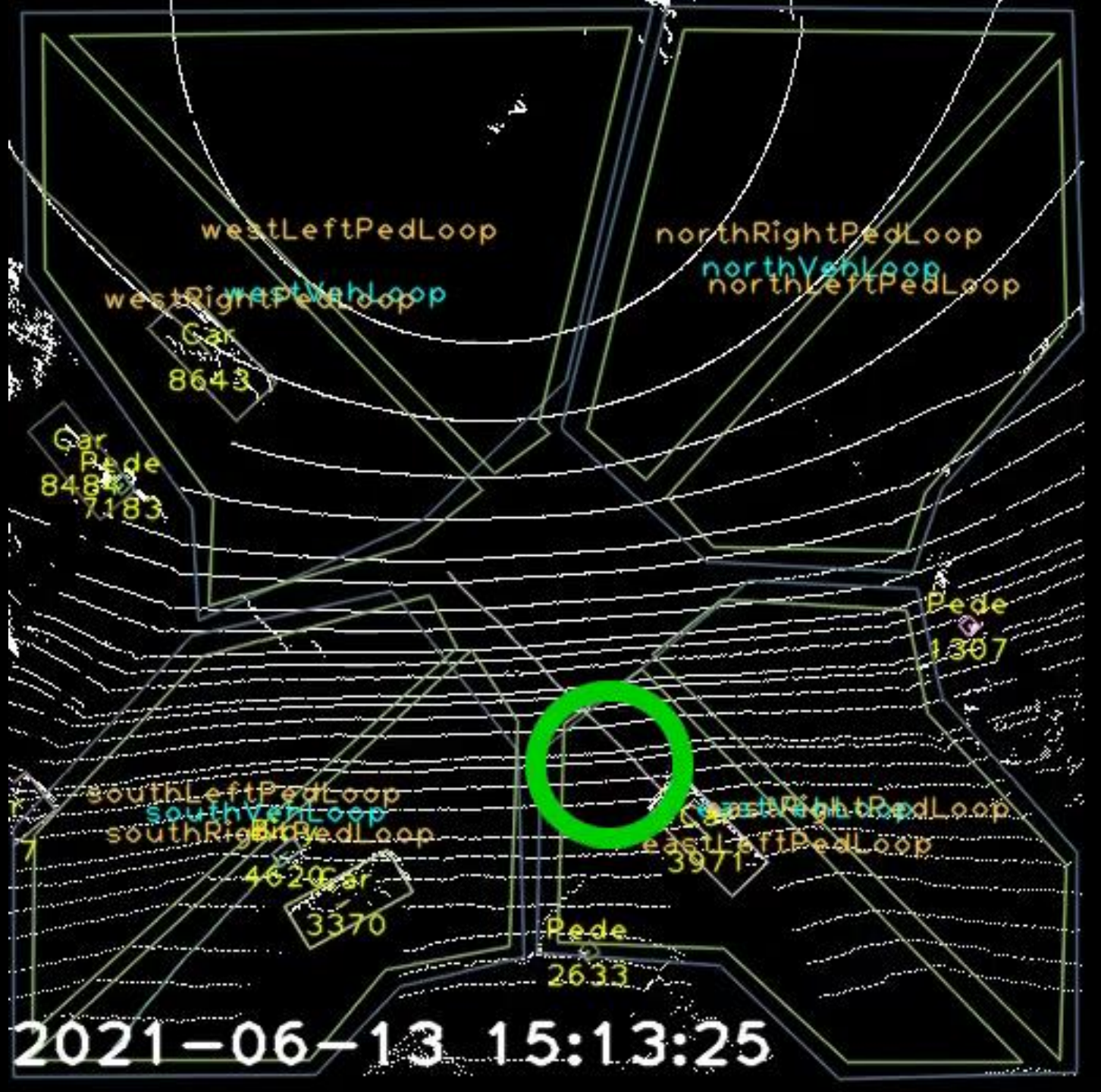
Alpha Prime 128 Pixel Lidar
Integrated with Bluecity's Perception Software
260m (850ft) coverage with a single sensor and real-time detection



Case 1: Red Light Running / Near-Miss

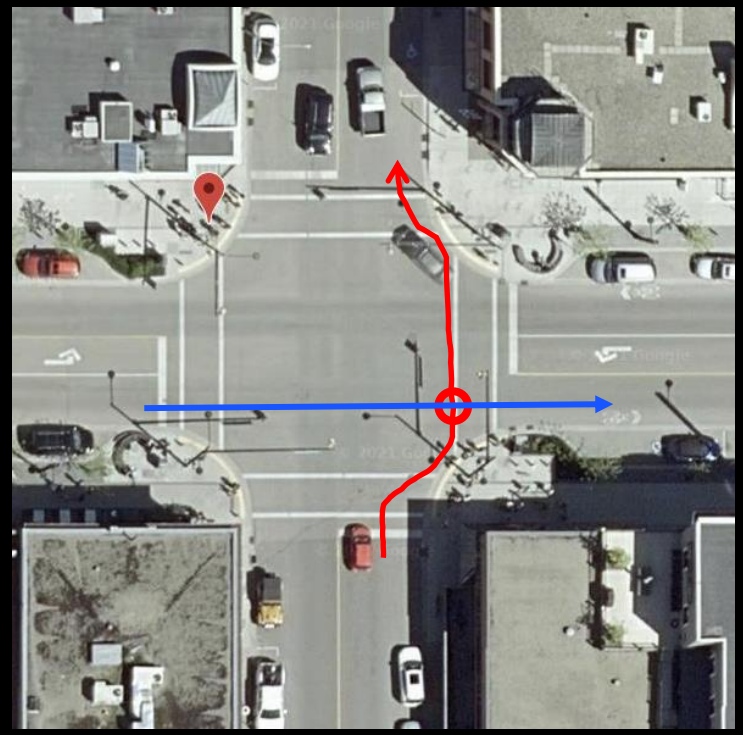
- PET: 0.9 seconds
- Object 1: Bike
  - Direction: South to North
- Object 2: Car
  - Direction: East to West
  - Speed: 35km/h

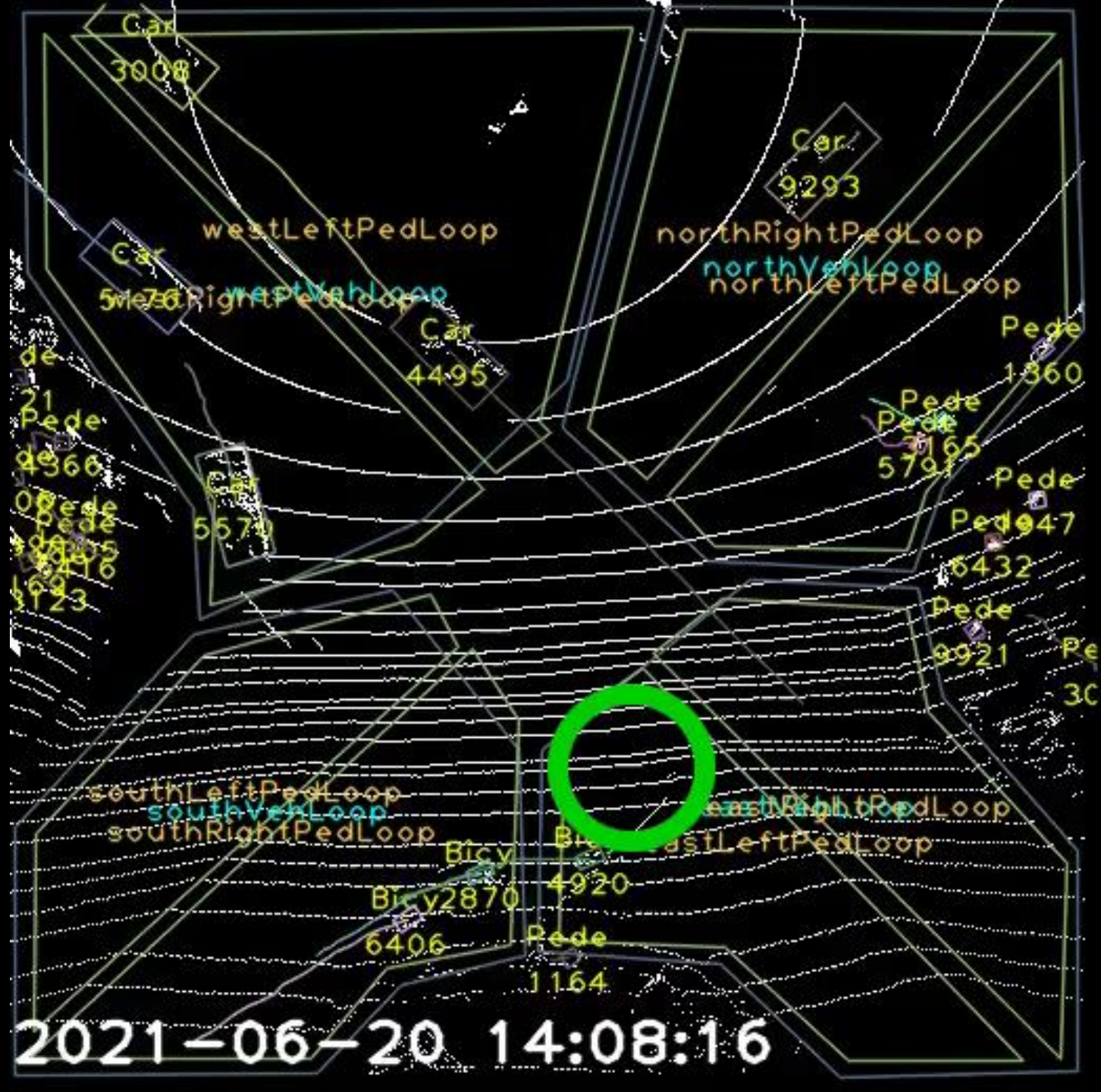




Case 2: Red Light Running / Near-Miss

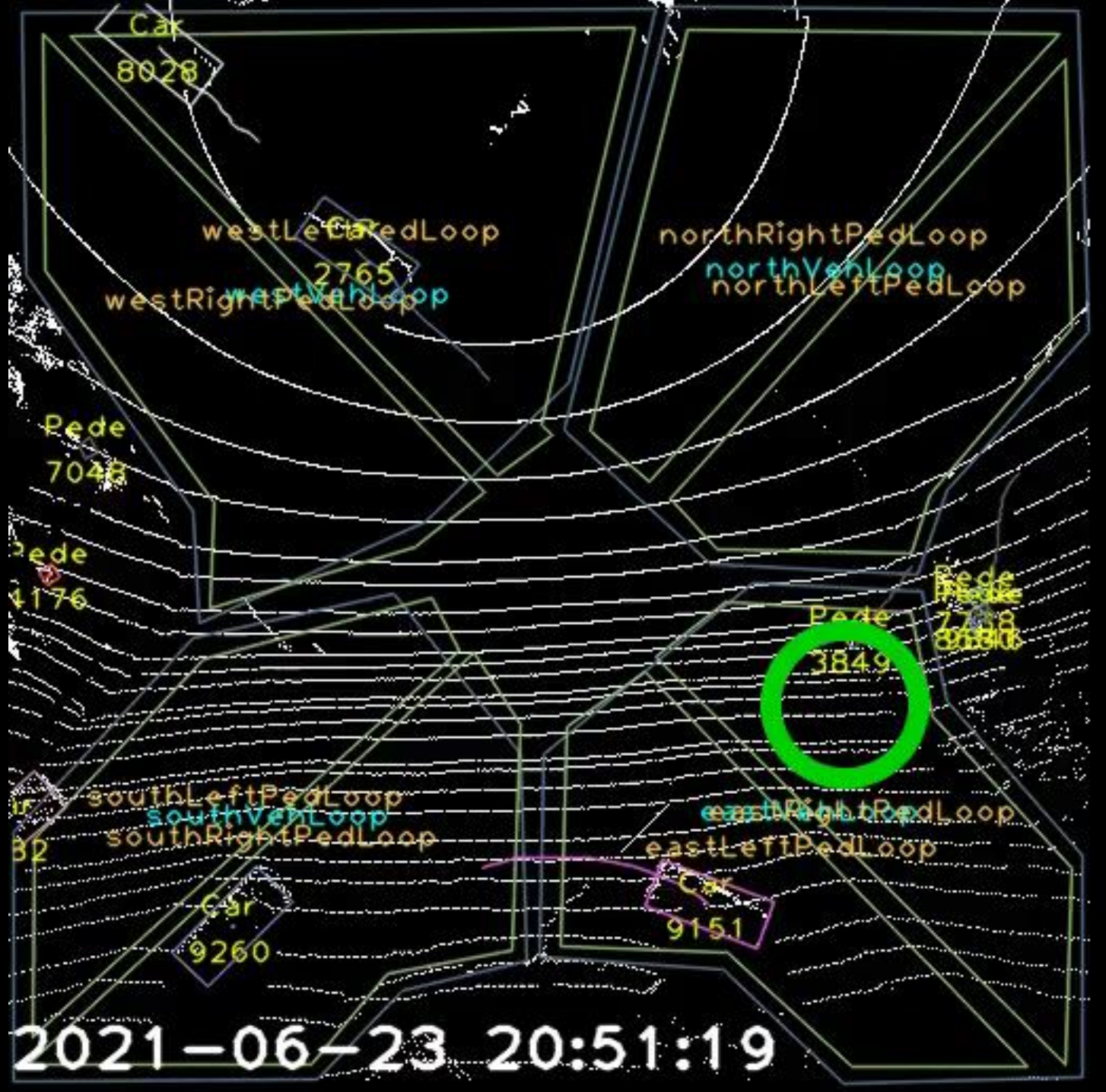
- PET: 1.3 seconds
- Object 1: Bike
  - Direction: South to North
- Object 2: Car
  - Direction: East to West
  - Speed: 28km/h





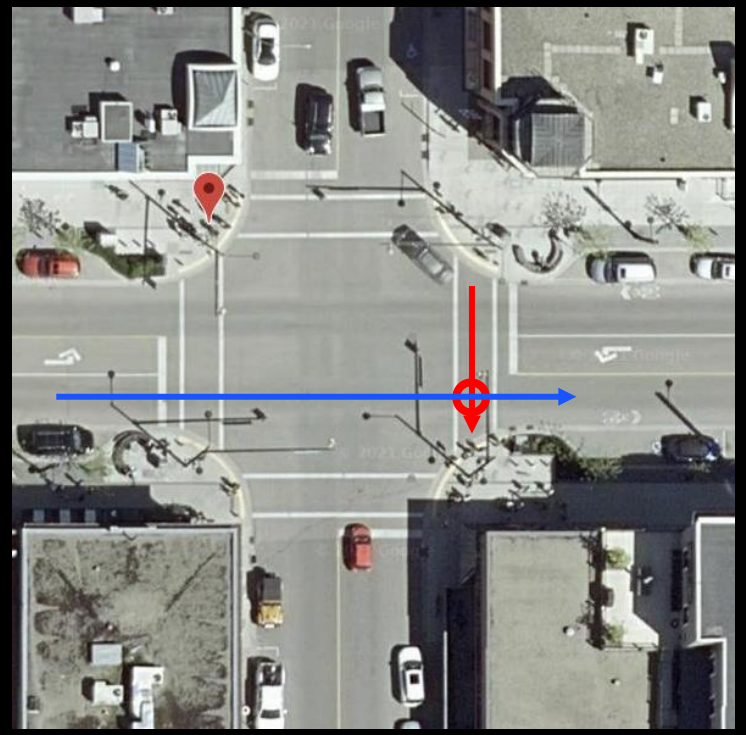
Case 3: Jaywalking / Near-Miss

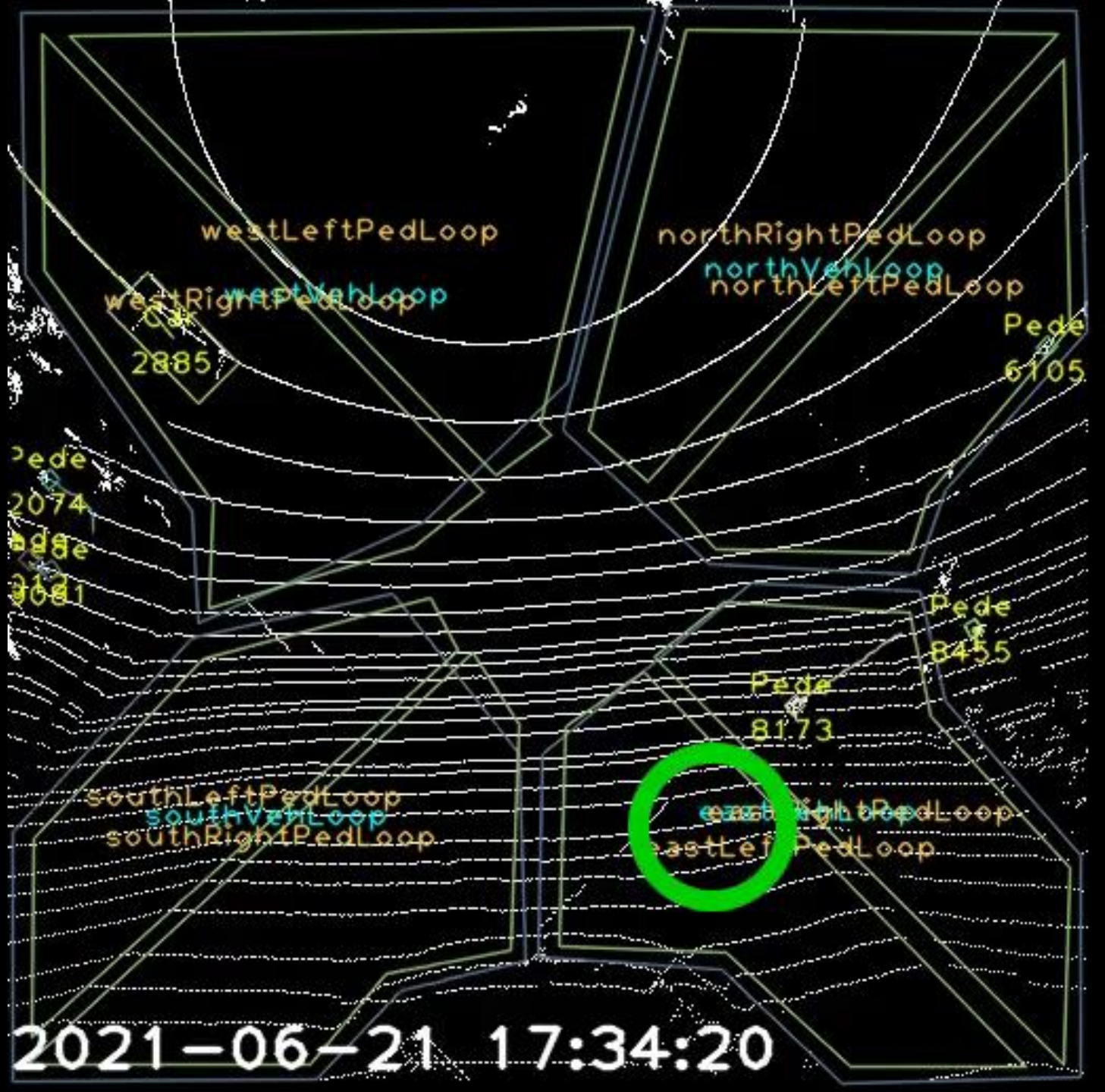
- PET: 1.3 second
- Object 1: Pedestrian
  - East Approach
- Object 2: Car
  - Direction: East to West
  - Speed: 25km/h



Case 4: Jaywalking / Near-Miss

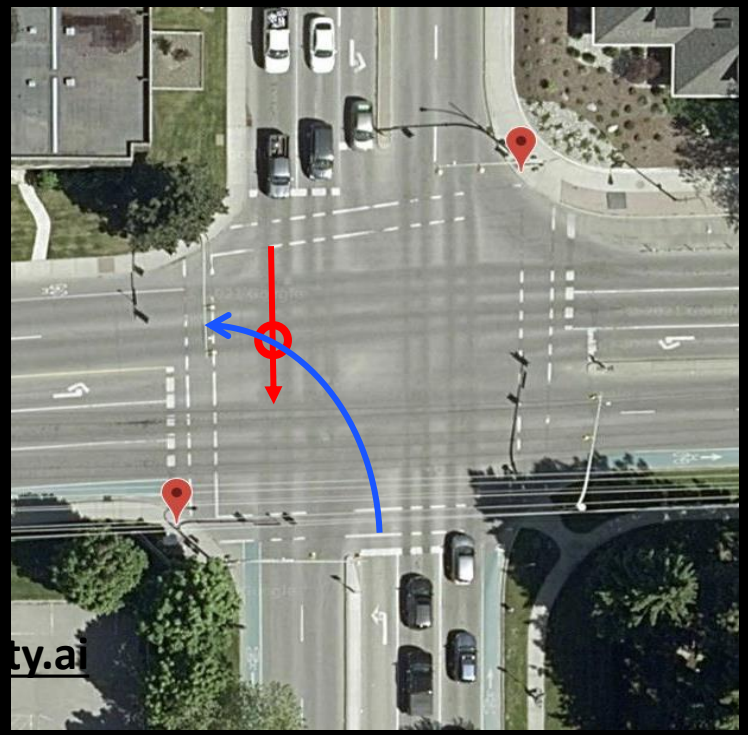
- PET: 1.7 second
- Object 1: Pedestrian
  - East Approach
- Object 2: Car
  - Direction: West to East
  - Speed: 30km/h

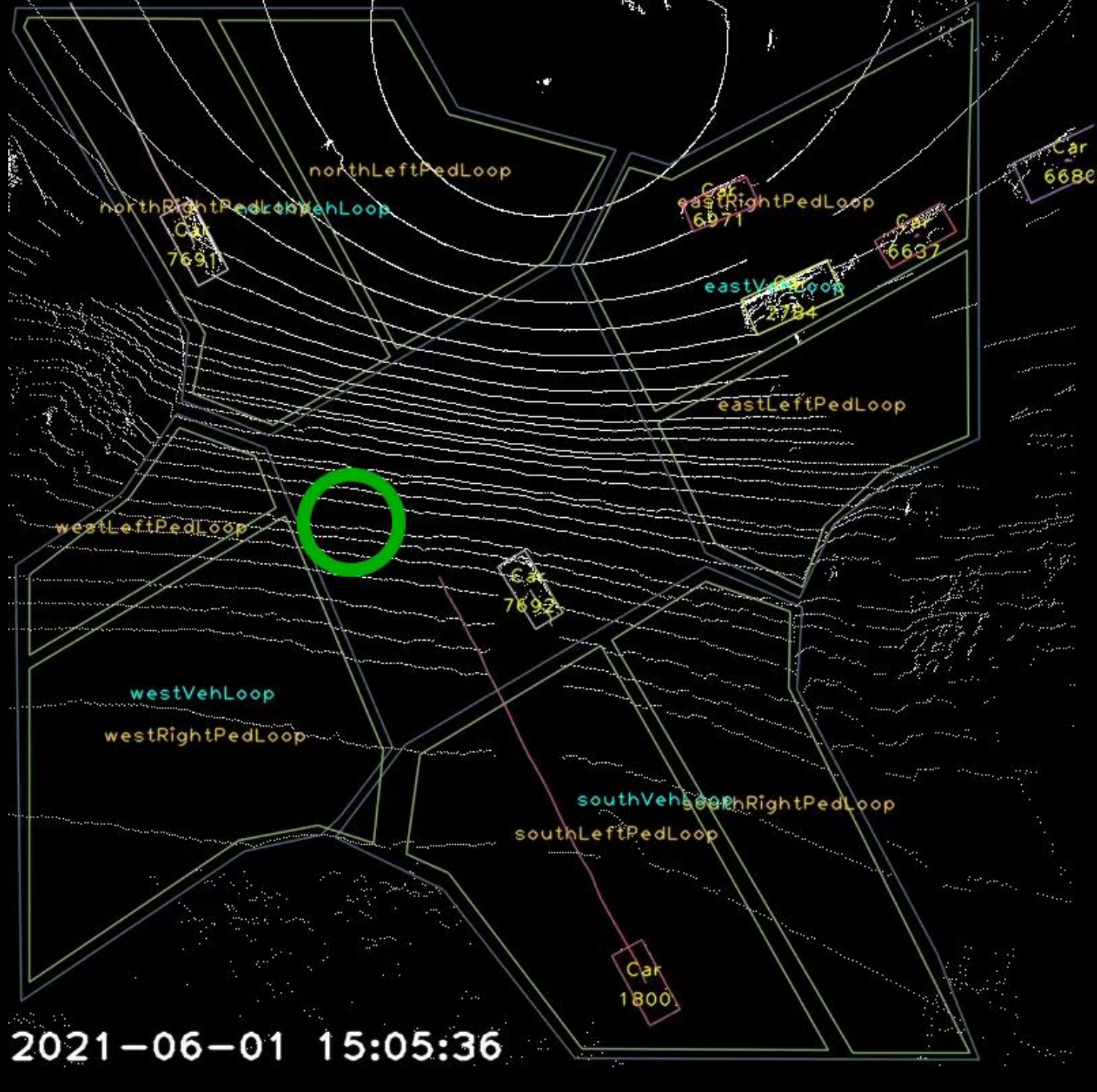




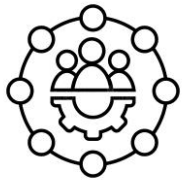
Case 5: Near-Miss

- PET: 1.2 seconds
- Object 1: car
  - Direction: North to South
  - Speed: 40 km/h
- Object 2: Car
  - Direction: South to West





AI + Lidar + 5G



Open API

Connected Vehicle

Accessibility

Emergency

Latency

Reliability

Bandwidth

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