SOLID-STATE LIDAR FOR ADVANCED TRAFFIC MANAGEMENT & SAFETY APPLICATIONS

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APRIL 2018

LeddarTech®
MASTERING LIDAR SENSOR TECHNOLOGY

AGENDA

- Part 1 - Sensing Solutions in ITS
- Part II - Why LiDAR in ITS?
- Part III - The Problem with Today's Sensors
- Part IV - The Solution
- Part V - Solid-State LiDAR Used in ITS
- Part VI - Benefits of Flash Solid-State LiDAR
- Part VII - Conclusion

PART I -
SENSING SOLUTIONS IN ITS

So many sensor options for traffic management & safety… It's hard to know what's best for what, and what's outdated or not.

Induction Loops

Radar

Camera

Scanning LiDAR

A WHOLE RANGE OF SENSING TECHNOLOGIES

	Reliability	Performance	Detection robustness	Form factor	Cost	
CAMERA	✓	✓/✗	✗	✓	✓	**Low lighting condition** impact detections. Camera lacks efficient range.
RADAR	✓	✓/✗	✗	✓/✗	✗	Low detection rate on permeable surfaces (**pedestrians**). Low beam forming performance impacts ability to **discriminate objects & classify** them.
MECHANICAL SCANNING LiDARs	✗	✓	✗	✗	✗	Mechanical components and moving parts negatively affect system's **reliability, robustness and cost.**
SOLID-STATE LiDARs (SSL)	✓	✓/✗	✓/✗	✓/✗	✓/✗	Inefficiencies at emission and reception significantly reduce signal power, **limiting range** and **performance** or **increasing cost.**
FLASH SSL LiDAR FROM LEDDARTECH	✓	✓	✓	✓	✓	Leddar technology **significantly improves** LiDAR systems' **sensitivity & sensing**, for superior range and object recognition/tracking with less data, while leveraging solid-state LiDAR's **reliability** and **robustness.**

PART II -
WHY LIDAR IN ITS?

WHY LIDAR? WHERE IS IT USED?

Why LiDAR?

Robustness in all weather & lighting conditions

Long range capability

High detection rate & reliability

High resolution & object discrimination capability

Low cost

WHY LIDAR? WHERE IS IT USED?

LiDAR has been used for many years in ITS:

Presence, Proximity & Pedestrian Detection

Speed & Tracking

Distance Measurement

Accident Prevention

Vehicle & Object Profiling & Classification

Perimeter & Human Safety

PART III -
THE PROBLEM WITH TODAY'S SENSORS

So, what's the problem with current sensing technologies.

THE CURRENT PROBLEMS

Loops

Intrusive, high CapEx & OpEx costs, limited long term robustness

Camera

Difficult to operate in varying lighting conditions, limited in range, not good for counting, profiling, classification & speed measurement

Radar

limited ability to detect pedestrians, lack of resolution & beam forming capabilities means limited object discrimination & tracking

THE CURRENT PROBLEMS

Mechanical Scanning LiDAR

A mechanical scanning LIDAR uses one or multiple **collimated laser source(s)** as a solution to reduced signal intensity and concentrates the return signal on the **receiver detector through highly focused optics**.

By physically rotating the laser emitter & receiver assembly at the same time, the mechanical scanning LiDAR is able to collect data over a wide area (up to 360 degrees).

THE CURRENT PROBLEMS

Mechanical Scanning LiDAR

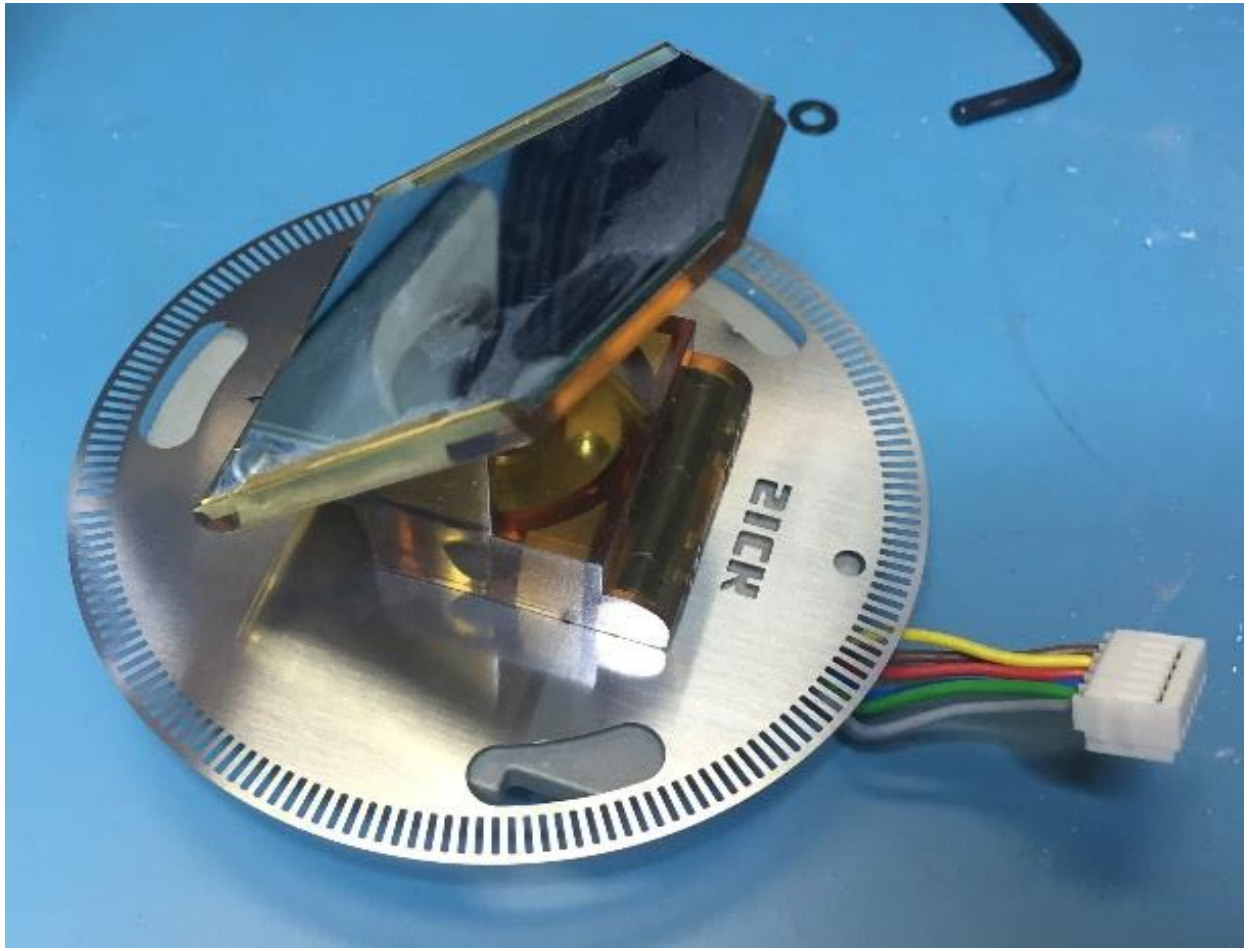
Bulky & large form factor - difficult to integrate in product designs

Complex & expensive to manufacture

Limited vertical resolution by using stacked emitters/receivers

Reduced reliability & robustness due to mechanical parts and highly collimated emitter/receiver design

THE CURRENT PROBLEMS



What the ITS industry is about,

is improving safety, traffic & reducing cost of ownership of large road networks.

But the ITS industry is very competitive, margins are very important.

There is a need for innovative technologies that improve performance, can serve multiple applications at once & lower costs.

PART IV -
THE SOLUTION

The solution we propose
flash-based solid-state LiDAR.

INTRODUCTION TO SOLID-STATE LIDAR

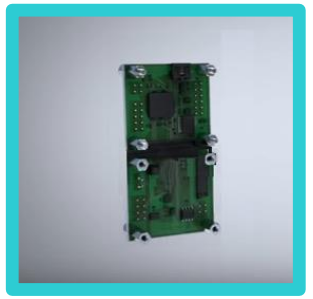
Solid-state LiDAR has no mechanical components.

Emitter
+ optics

+

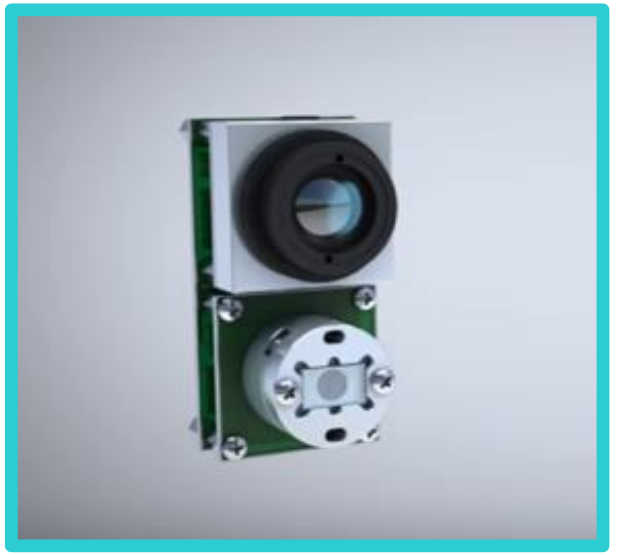
Receiver
+ optics

+



Processing
Electronics

=

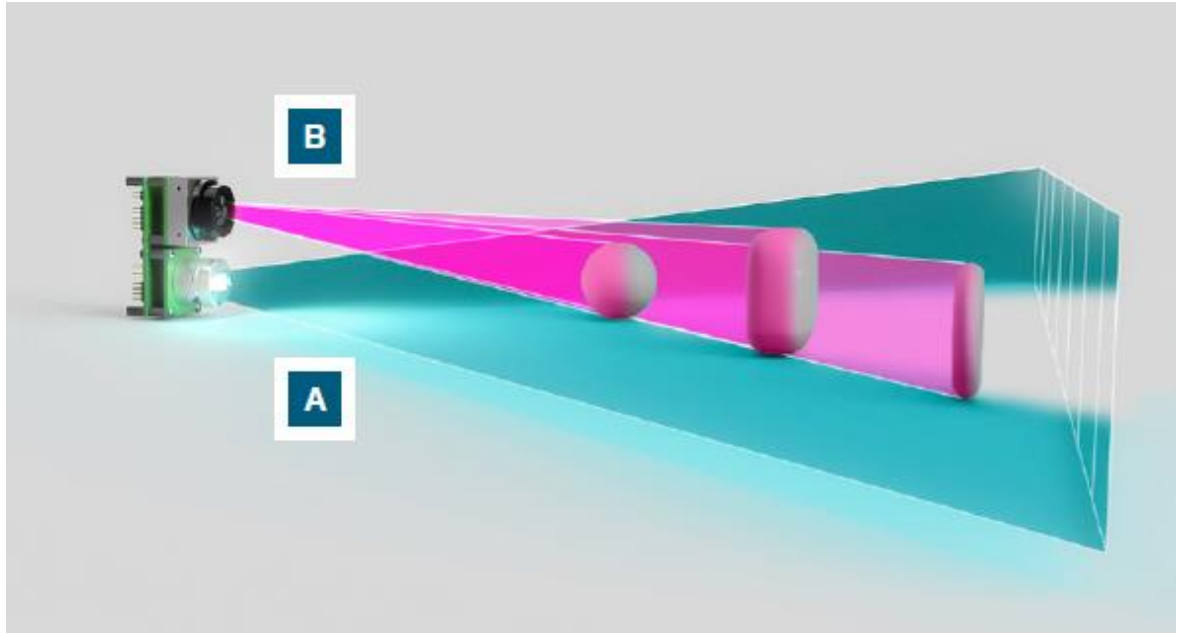


SSL LiDAR

INTRODUCTION TO FLASH LIDAR

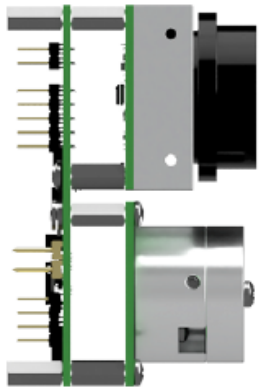
STEP A:

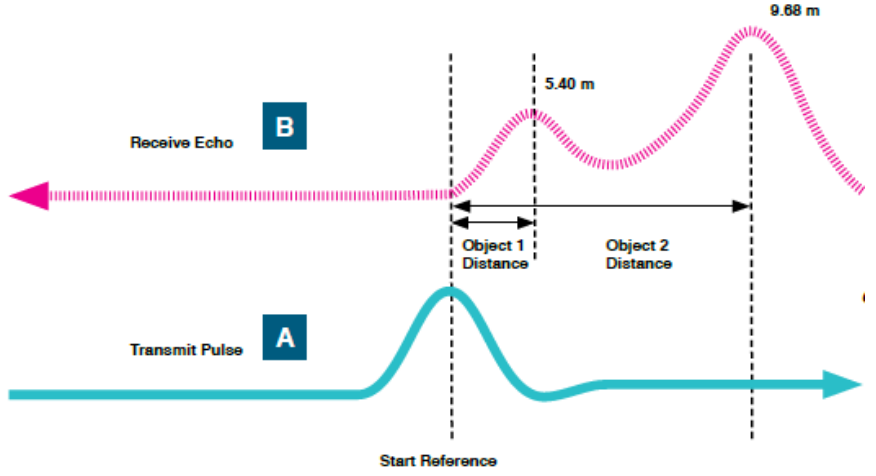
A flash LiDAR is similar in principle to a photography flash on a standard camera. But it sends over 50,000 repeated flash pulses per second. Each of these flash pulses illuminates the entire field-of-view, creating 100% light density. As such, compared to mechanical scanning LiDAR, there is no blind spot between laser scans.



STEP B:

After the light is reflected off of an object, time-of-flight calculations measures distance & provides the angular resolution of that same object using a solid-state photodiode array underneath the reception optics.





THE RESULT:

The result is a consistent & reliable high object detection rate at a high data rate, enabling applications that require speed, accuracy, robustness, complexity at low cost.

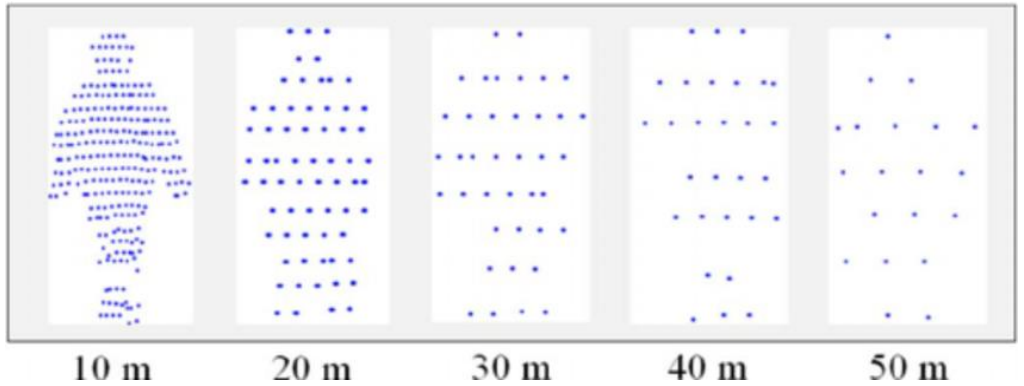
INTRODUCTION TO FLASH LIDAR

100% scene coverage
with LeddarTech's flash vs. 10% coverage provided with point-cloud mechanical scanning solutions

10x more coverage
with full scene illumination and return signal capture using the full surface of every object

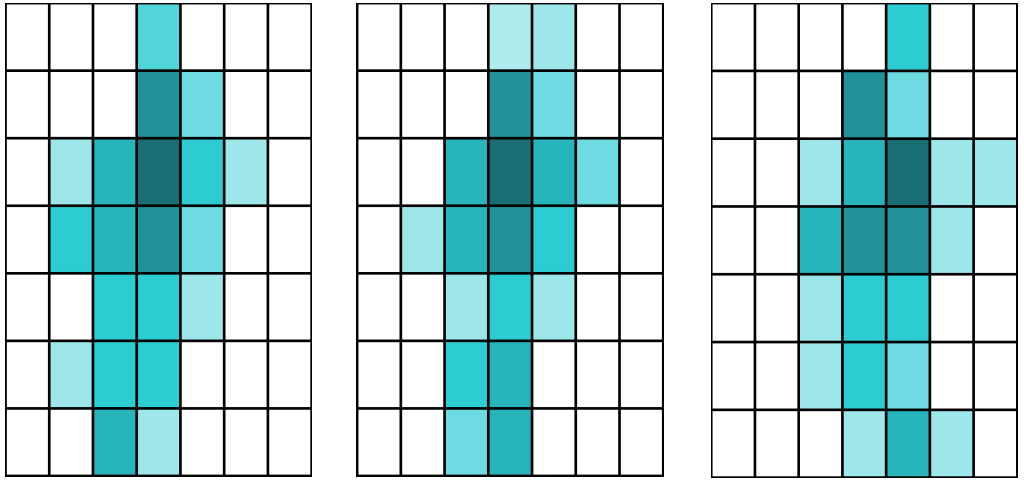
2x frame rate
enables more information, more often than competing point-scan solutions

= 20x more information



Kidono, K., Miyasaka, T., Watanabe, A., Naito, T. & Miura, J. (2011). Pedestrian recognition using high-definition LIDAR.. Intelligent Vehicles Symposium (p./pp. 405-410), : IEEE. ISBN: 978-1-4577-0890-9

LEDDAR (PEDESTRIAN @ 50M)

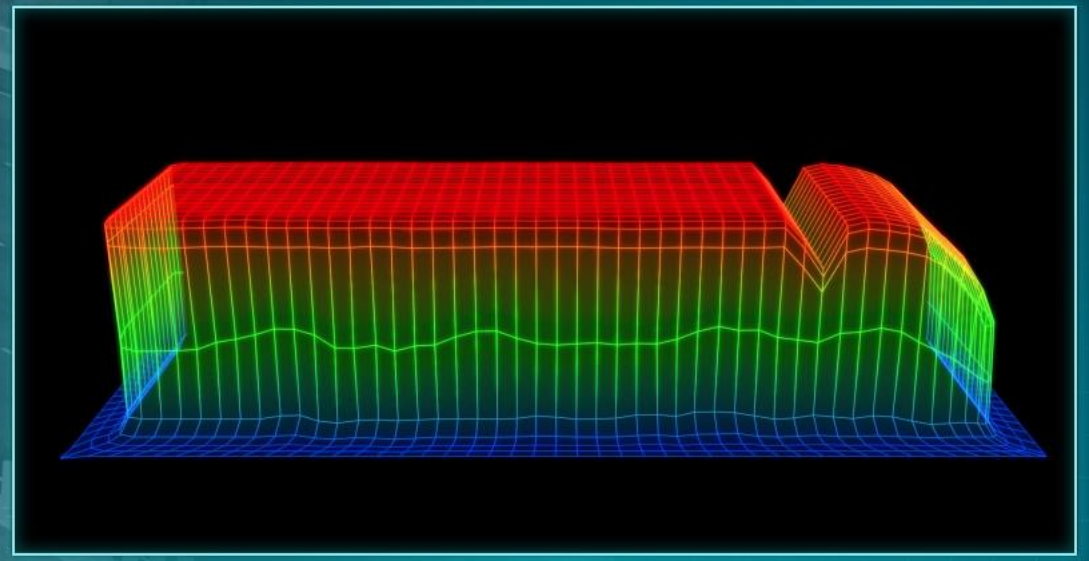


3 consecutive frames on pedestrian at 50m, showing high signal coherence/consistency and pedestrian displacement to the right

PART V -
SOLID-STATE LIDAR USED IN ITS

AVI & AVC IN ELECTRONIC TOLL COLLECTION (ETC)

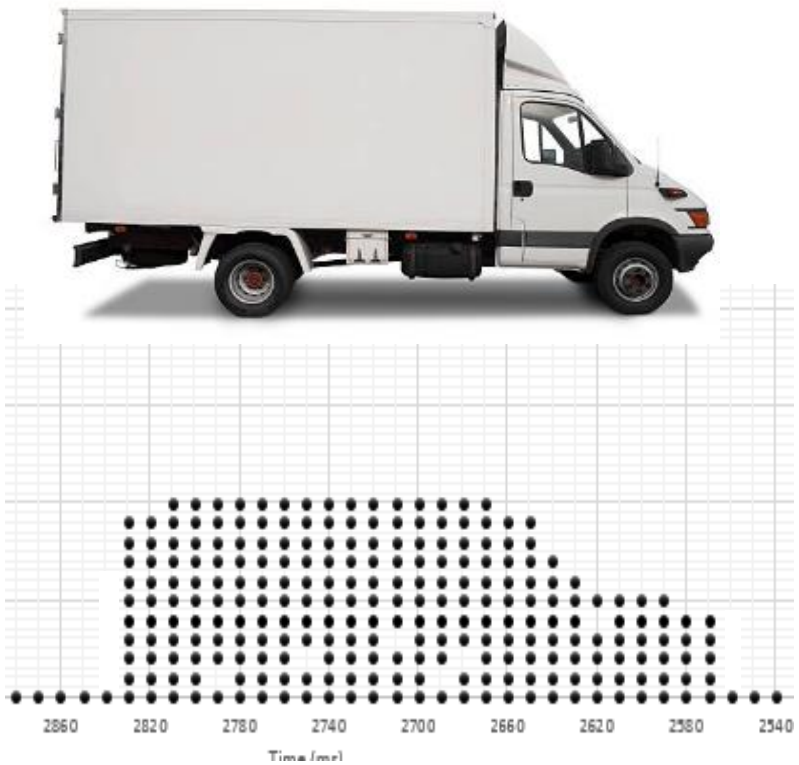
PROFILING
SUCCESSFUL

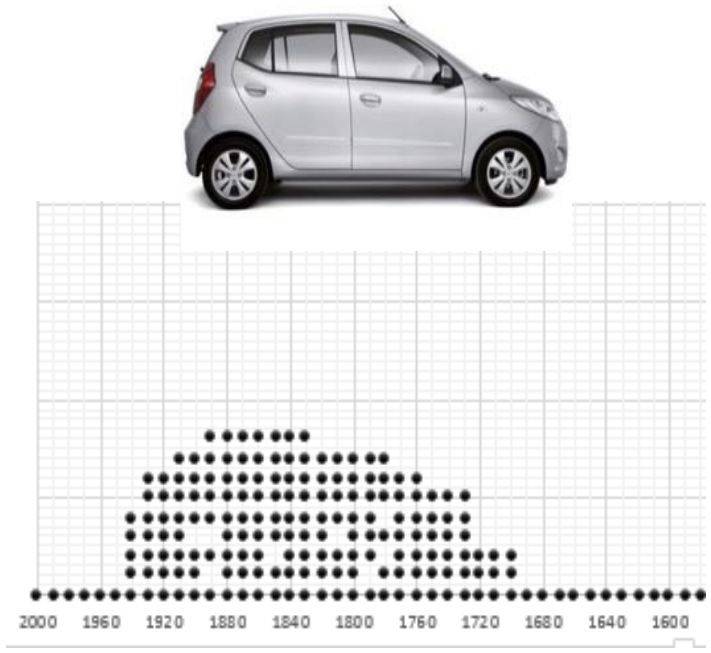


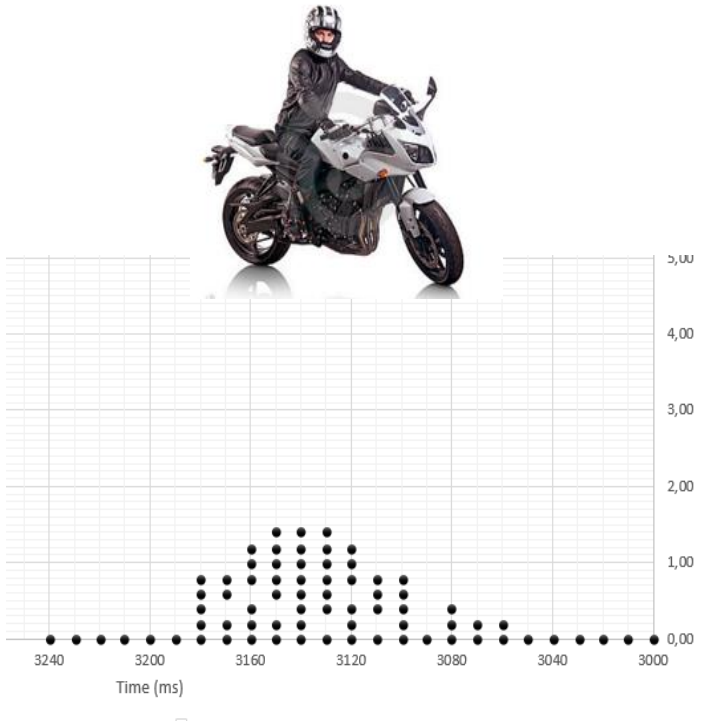
Vehicle profile

Length: 12.5 m	Vehicle class: 5	Location: Highway 10
Width: 2.44 m	Time: 14h42	Direction: South-west
Height: 4.25 m	City: Montreal	

ROADSIDE VEHICLE MEASUREMENT, PROFILING & CLASSIFICATION





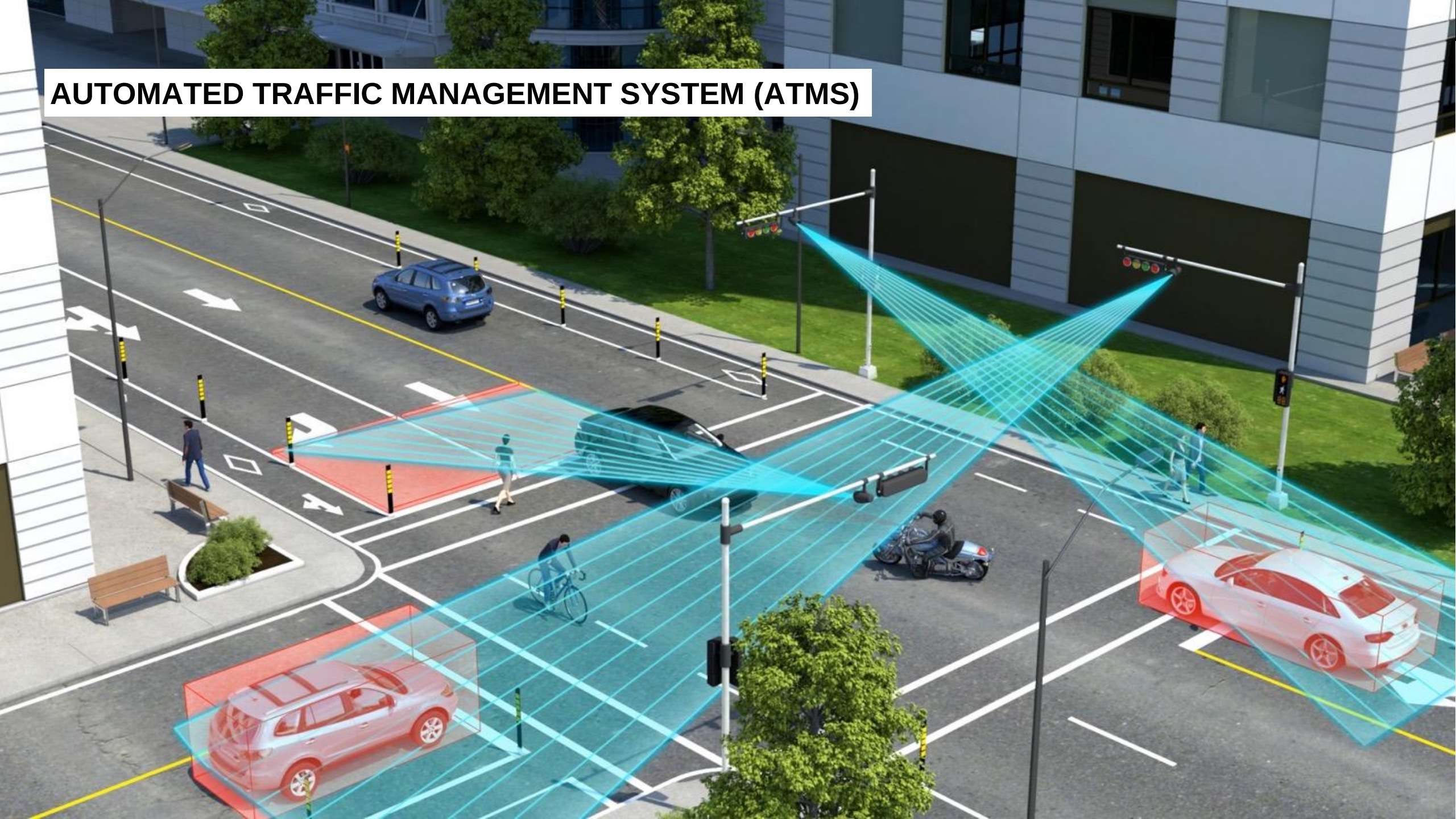


Roadside LiDAR captures a precise measurement matrix providing distinctive vehicle signature for high-speed, multi-lane traffic.

SPEED ENFORCEMENT & AVERAGE SPEED

Roadside LiDARs placed at a distance from each other, trigger ALPR cameras and allow for calculation of vehicles' average speed.

AUTOMATED TRAFFIC MANAGEMENT SYSTEM (ATMS)



SPEED MEASUREMENT & ENFORCEMENT

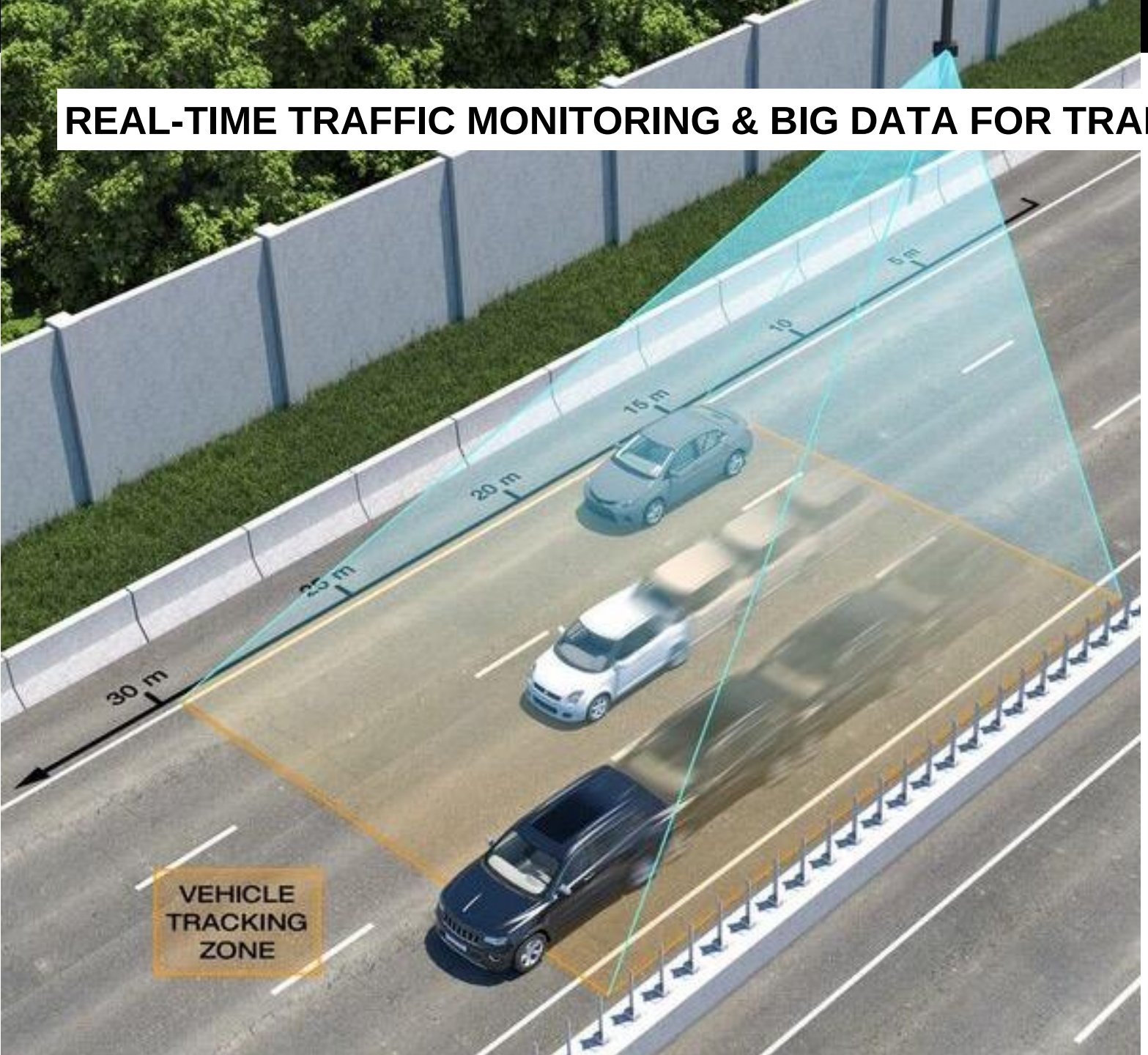
Traffic Logix deploys roadside LiDAR speed enforcement systems in North America, India, Southeast Asia & South America.

- **Facing rear of outgoing traffic, 2 m high**
- **Homologated at <3% error margin**
- **0 to 180 km/h**
- **NO RADAR INVOLVED**

"An accurate and virtually undetectable technology using LEDs, no radar involved. Detect, measure speed, trig camera, all with one sensor…"

Ahuva Basch
VP Engineering, Traffic Logix

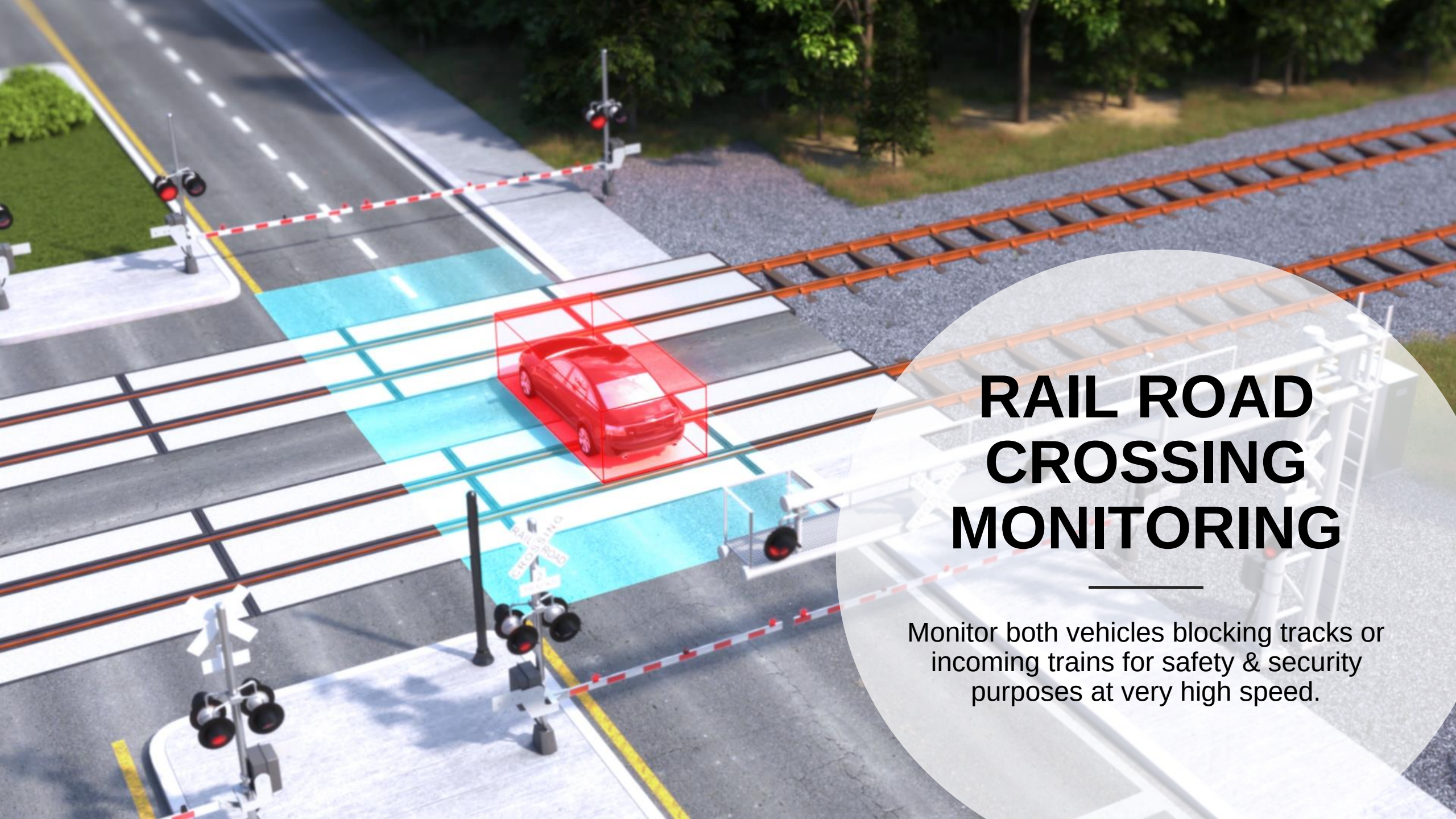
REAL-TIME TRAFFIC MONITORING & BIG DATA FOR TRAFFIC MANAGEMENT PLANNING



A roadside LiDAR compiles data thousands of times per second, tracking vehicles simultaneously on all traffic lanes:

- **Counting vehicles for traffic density**
- **Measuring speed for traffic flow**
- **Profile & classify vehicles for traffic type**

Collect big data using a single sensing technology, from the roadside, for up to 4 lanes, no gantry needed.

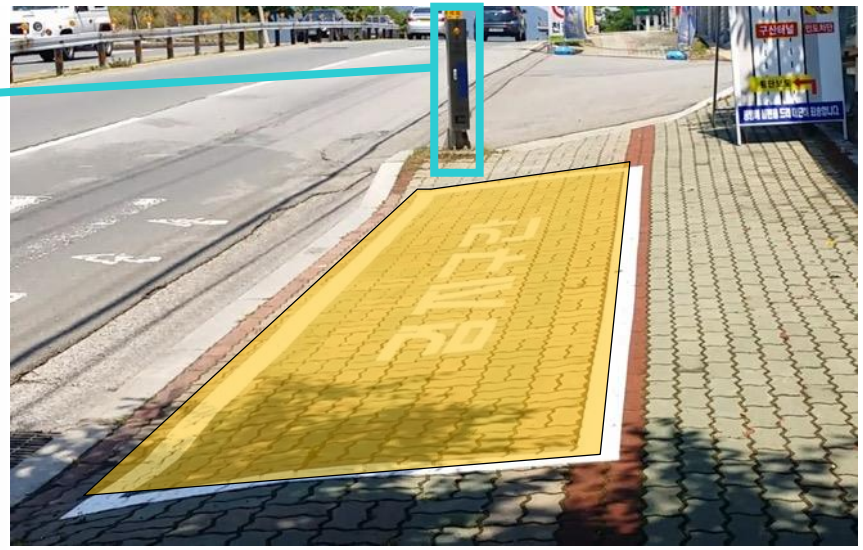


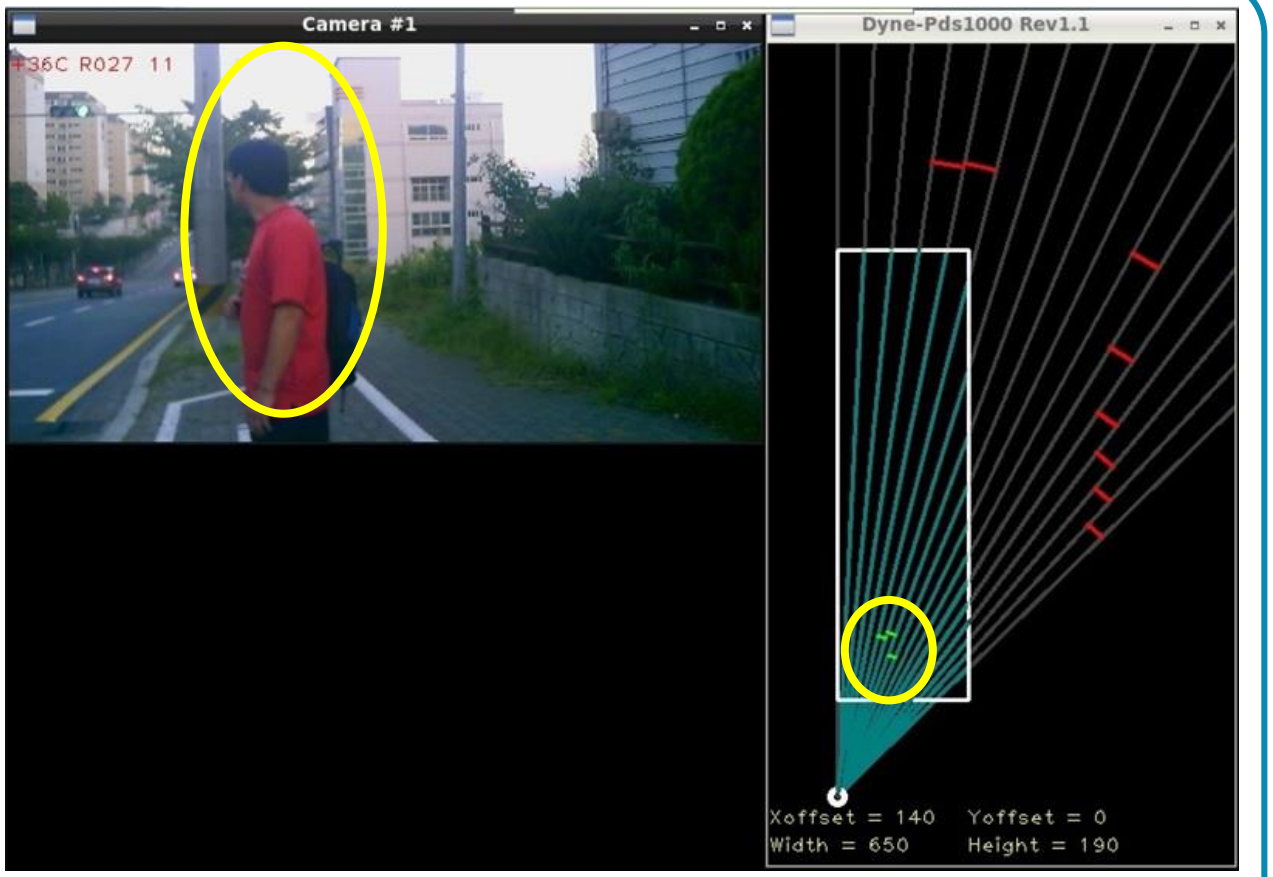
RAIL ROAD CROSSING MONITORING

Monitor both vehicles blocking tracks or incoming trains for safety & security purposes at very high speed.

OVER HEIGHT MONITORING

PEDESTRIAN & BICYCLE STREET CROSSING AUTOMATIC DETECTION

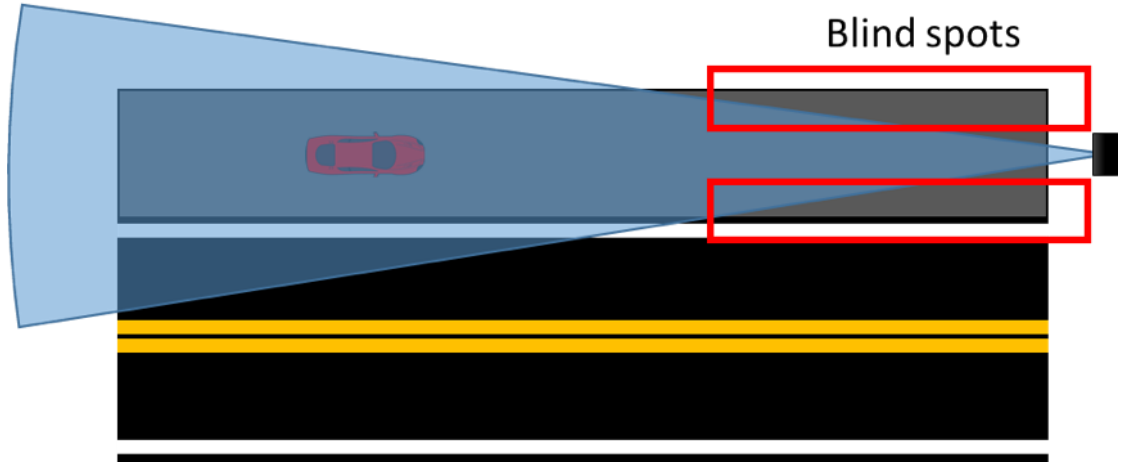




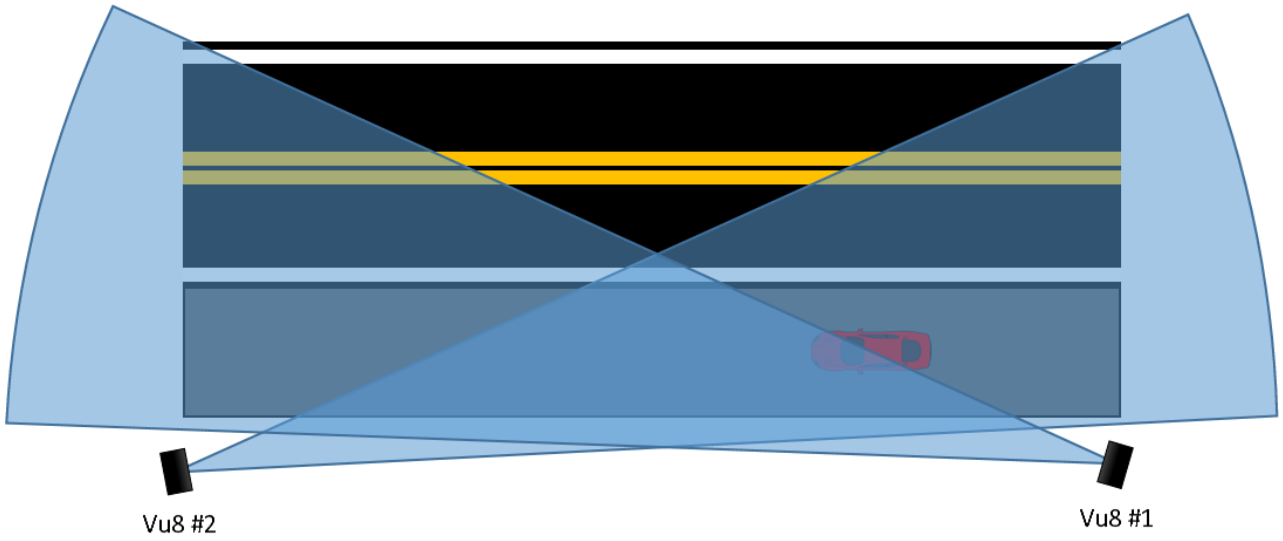
Automatic detection area triggers the traffic lights in all weather and lighting conditions

MONITORING OF SENSITIVE/RESTRICTED AREAS

Single LiDAR configuration



Dual-LiDAR configuration



PART VI -
BENEFITS OF FLASH SOLID-STATE LIDAR IN ITS

A sensing solution that:

- ✓ **Can perform multiple functions at once without the need for a gantry system but from a roadside installation**
- ✓ **Can cover multiple lanes at once**
- ✓ **Is robust & reliable to the point of being installed in cars**
- ✓ **Has the highest detection rate at high speeds**
- ✓ **And costs a fraction of other technologies**

Thank you!

Any questions?

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