Intelligent lidar: A pragmatic approach for high-performance massively deployable systems for the automotive and industrial markets

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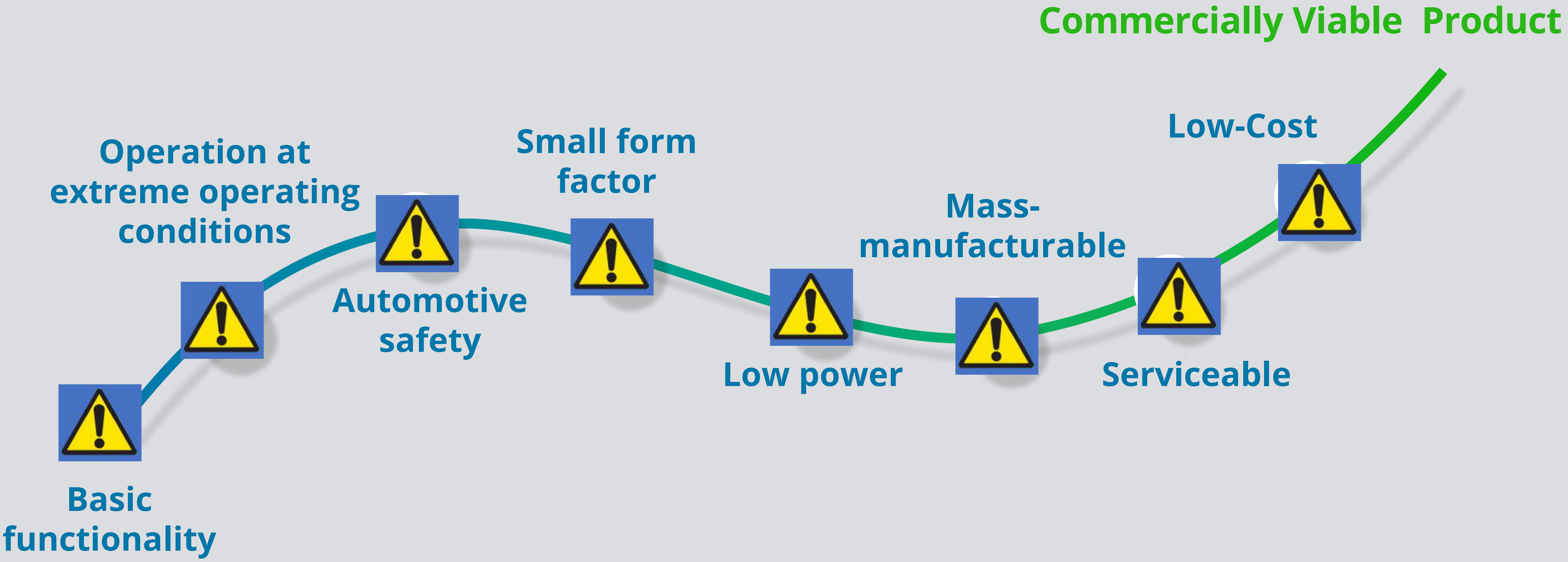
Agenda

1) The Path to a Truly-Mass-Deployable Automotive Lidar System
2) LiDAR System Architectures
3) AEye's Software-Configurable Intelligent Scanning
4) Performance Videos

1. The Long Path to a Truly-Mass-Deployable Automotive Lidar System



2. LiDAR Architectures: The Spinners

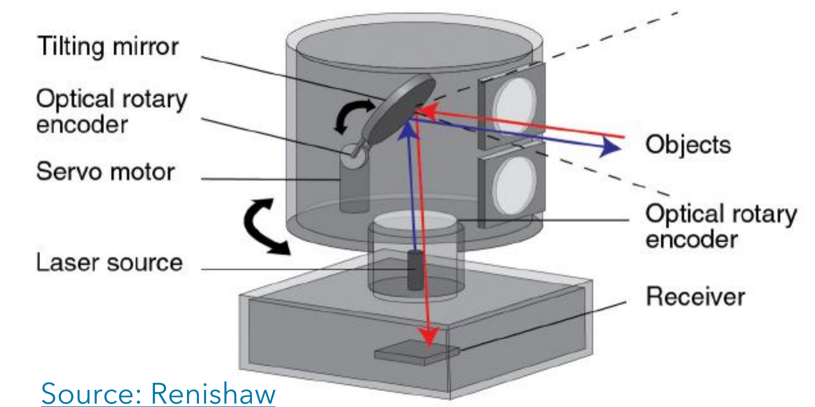
Rotating systems were the first popularized by students in the DARPA Challenge using off-the-shelf components

They cover 360° whether needed or not

They trade-off range for frame rate

Vertical resolution is achieved by packing more lasers in the rotating head, making them expensive

Mechanical gears typically first to fail and susceptible to vibration and shock



[Source: Renishaw]

2007

2020

Spinners offer limited resolution at a high cost with low reliability

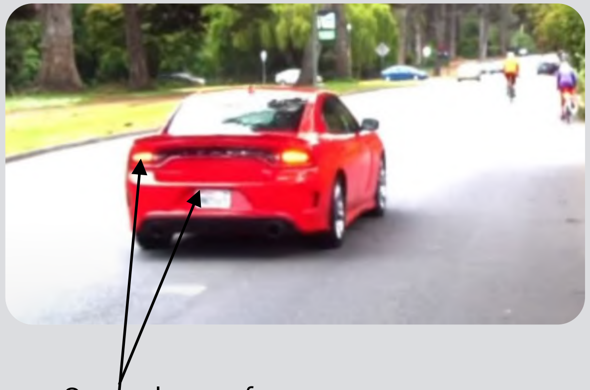
Imaging the Field-of-View: The Gazers

Gazing or Flash lidars simultaneously illuminate and image the whole field of view

While having no moving parts, these systems suffer from 3 fatal flaws:

1. **They illuminate the whole FoV with the power needed to image the dimmest, farther object, thus wasting huge amounts of power (and $$)**
2. **They image a relatively large FoV with fine resolution, thus requiring very expensive optics and large detector arrays**
3. **By illuminating and imaging a very-high-dynamic-range scene at once, they are susceptible to stray light, e.g., blinding by specular reflectors**

Bloom from tail-lights & license plate



Specular surfaces

Gazers offer a simple architecture but with inferior cost, power consumption and size

Scanning Mirrors – Monostatic Architecture

Coaxial optical chain:

AQ scanning mirror steps a pencil beam across field-of-view

Echoes directed through same mirror to detector

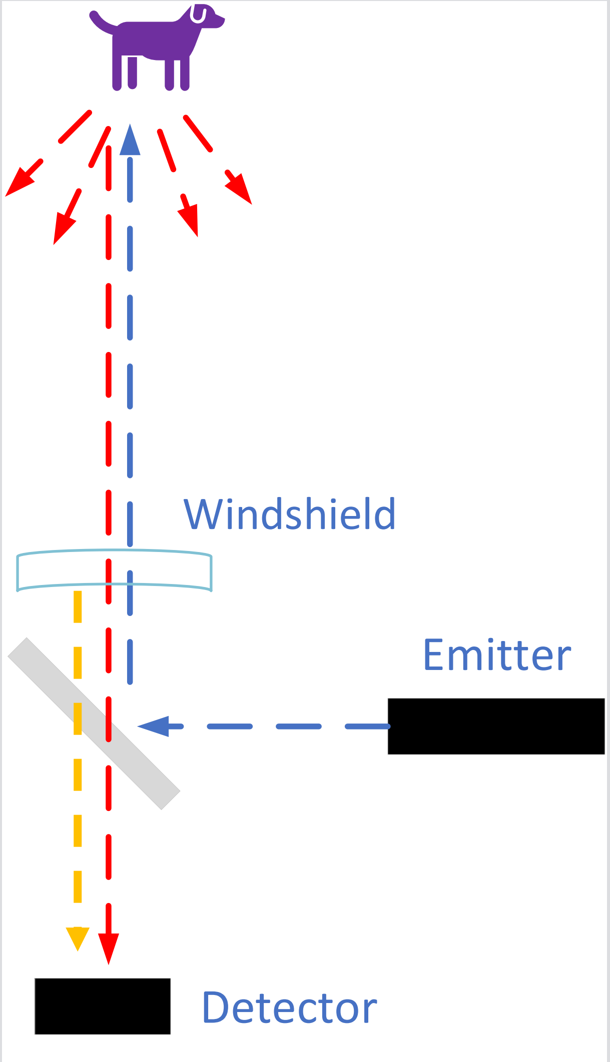
Maximizing signal collection efficiency requires a large mirror

But a large mirror cannot be stepped quickly and requires long settling times

=> Usually uses fixed, pre-set scan patterns regardless of the scene

Must wait for most distant echo before moving to next point => limits resolution

Nearby barriers, e.g., windshield will reflect back to the detector => external install only



Monostatic systems have limited cost- and size-scalability and suffer from back-reflections

Scanning Mirrors – Bistatic Architectures

A <u>scanning</u> emitter mirror and a <u>static</u> receiver lens – biaxial signal chain

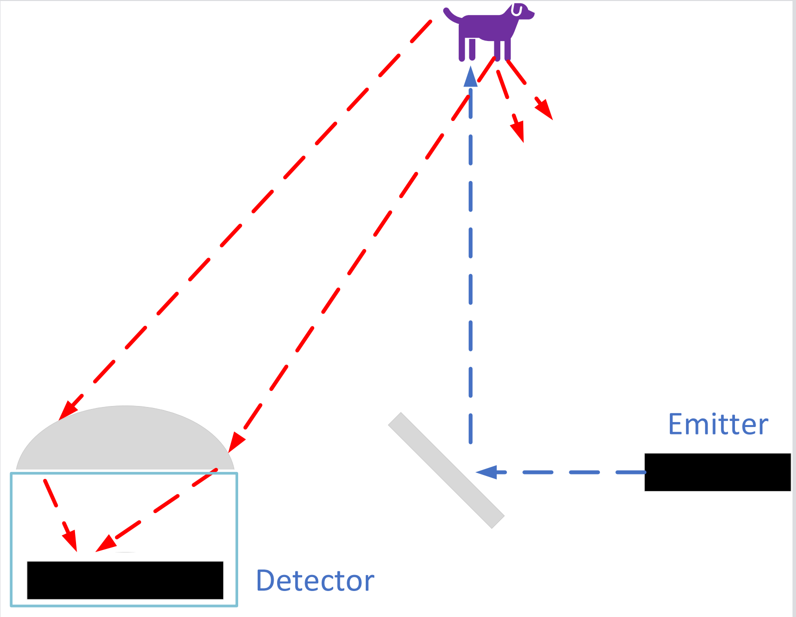
No need to wait for echo before beam moves => more 3D points per second

This also enables more flexibility in scan patterns

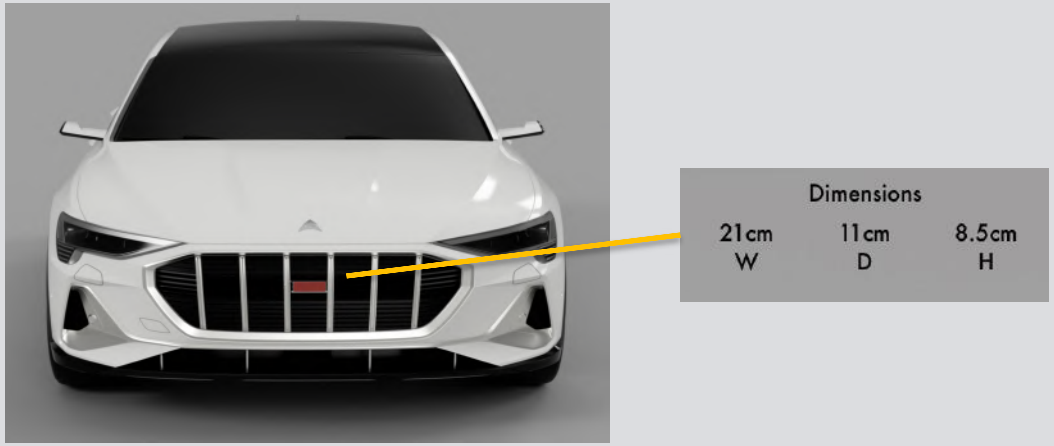
Larger lens allows to collect more of the collected light => lower laser power

Mirror can be small => cheaper and not susceptible to vibration or shock

Physical separation between emitter and receiver can provide immunity to near-field reflections, such as from windshield or dirt



Continental's HRL-131
Using AEye's Bistatic Technology



The Need for Intelligent Scanning

Imaging at the highest resolution everywhere wastes system resources or under-samples the scene

Functionally-safe, real-time allocation of system resources delivers high-resolution data where it is needed

A bistatic architecture enables the shift of system complexity to software, where this intelligence can be flexibly implemented

Traditional systems illuminate in all directions with high peak-power

AEye illuminates the scene intelligently

Note: Range + resolution + FOV + Frame Rate are expensive since laser power is the square of range & resolution and scales linearly with FOV.

Scene adaptation can be tough...

Unpredictable Objects

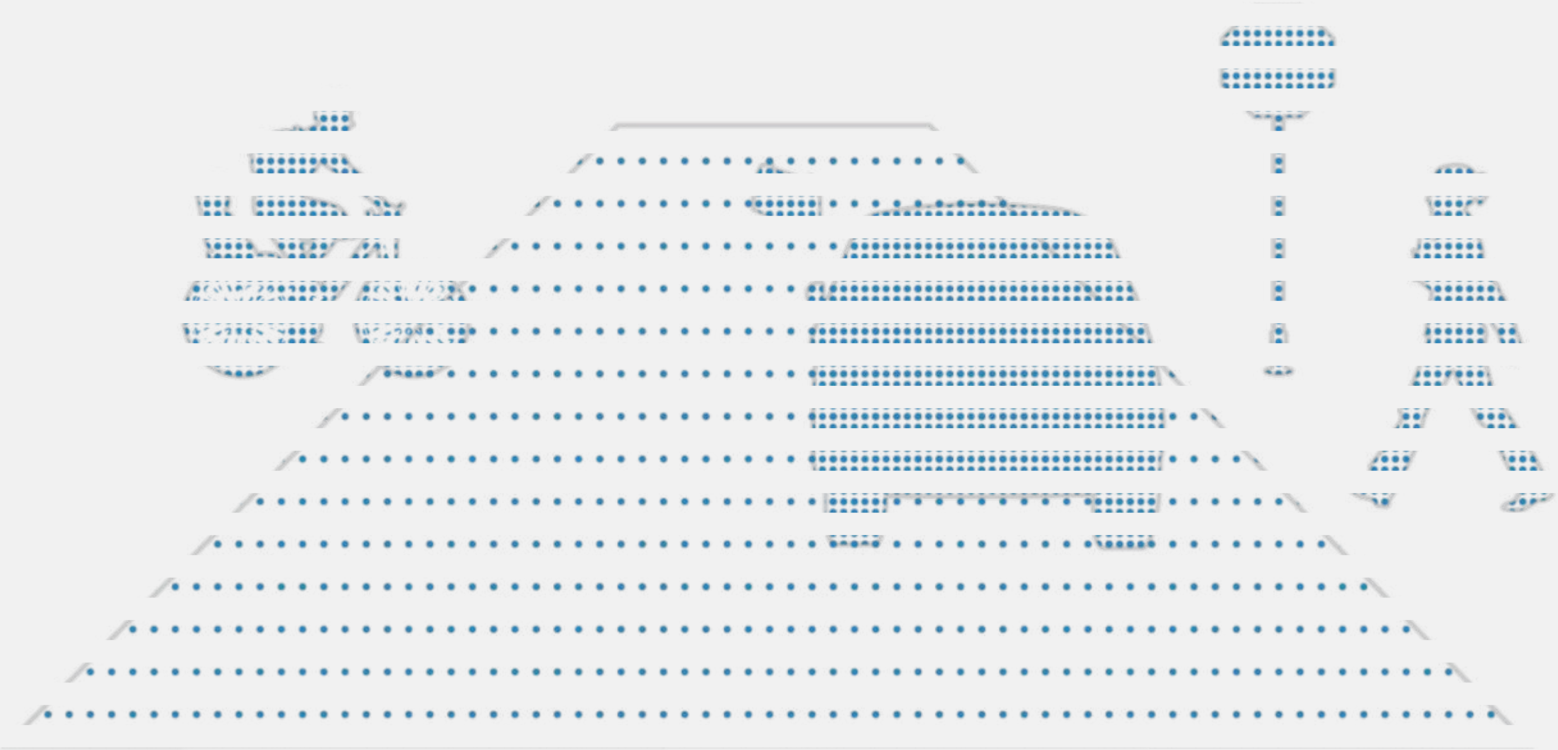
Roadway Obstacles

Adverse Weather

...so AEye performs a software-configurable low-power scan

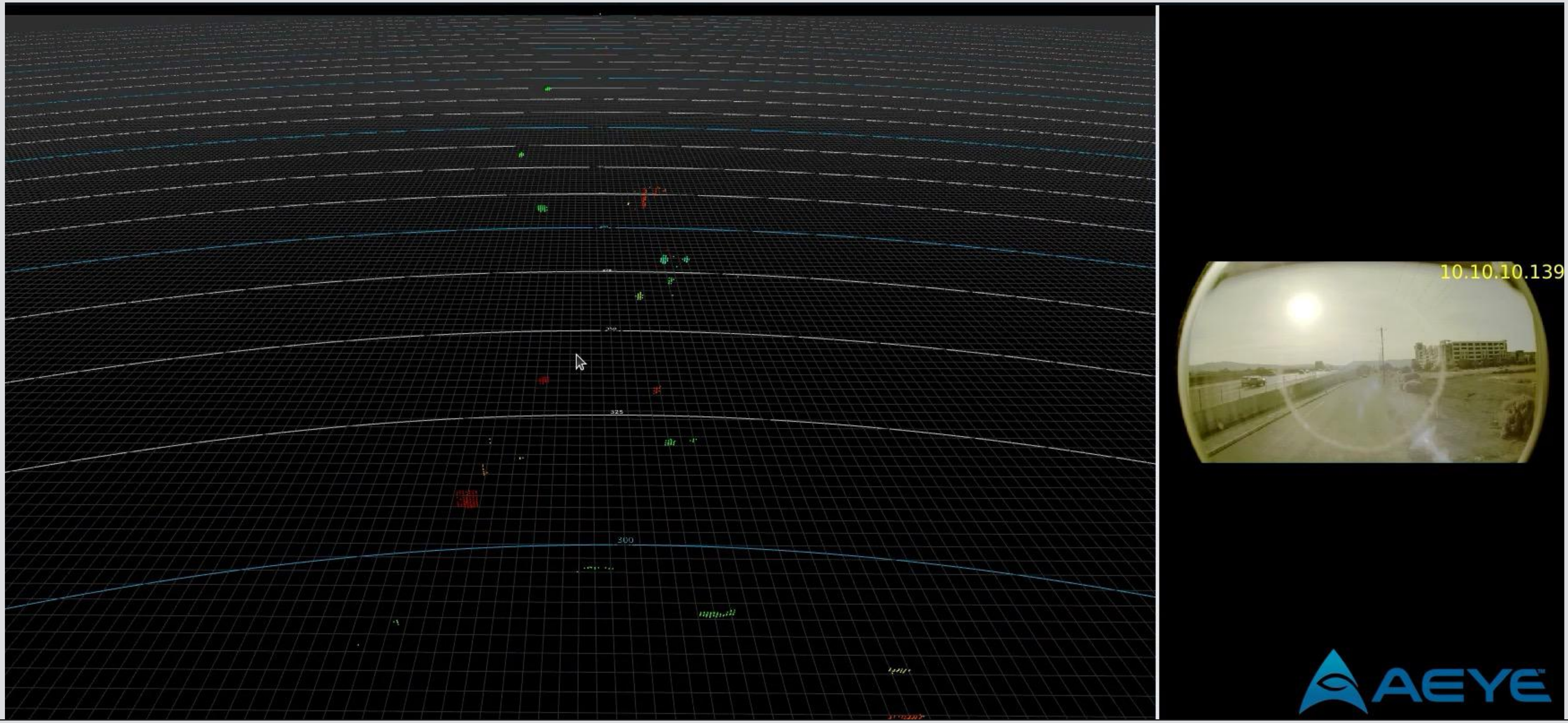
...then optimizes the acquisition of information-rich regions

Search **Acquire** **Act**

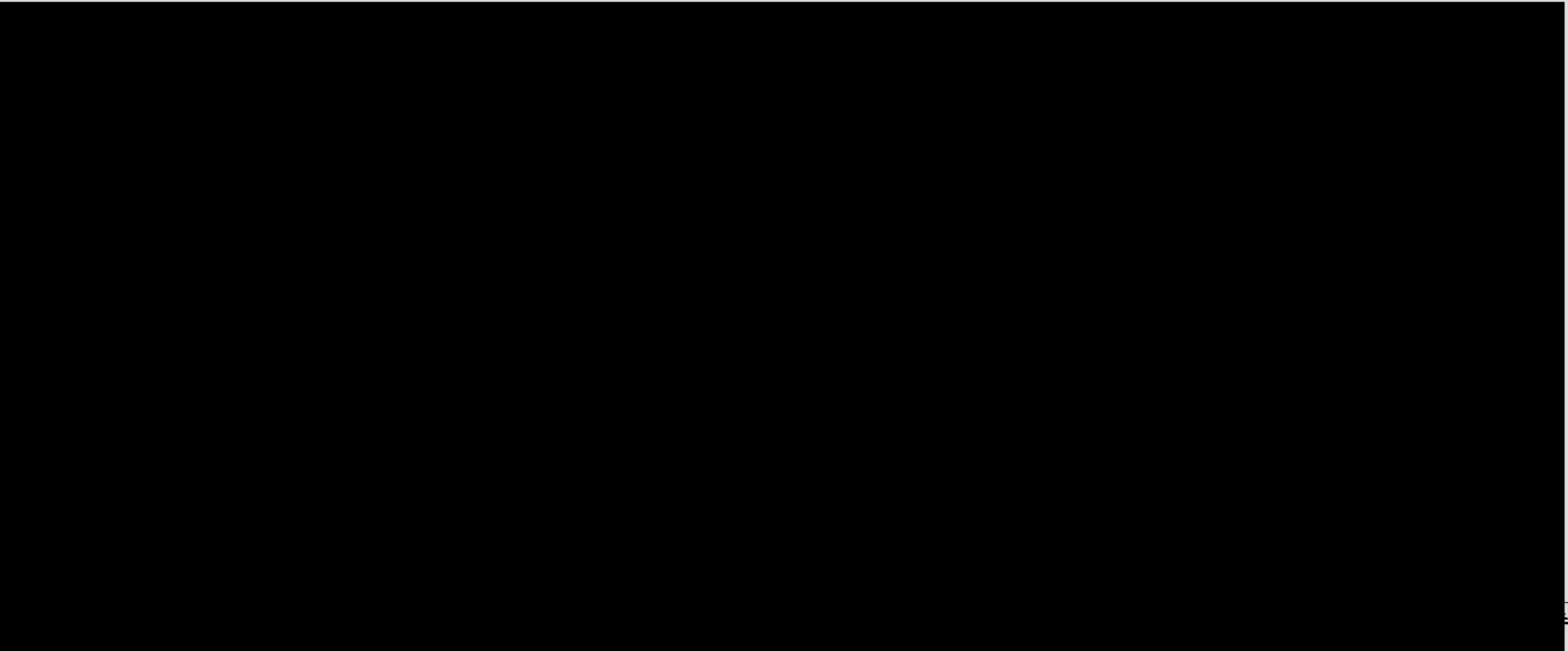



ACM
FWY

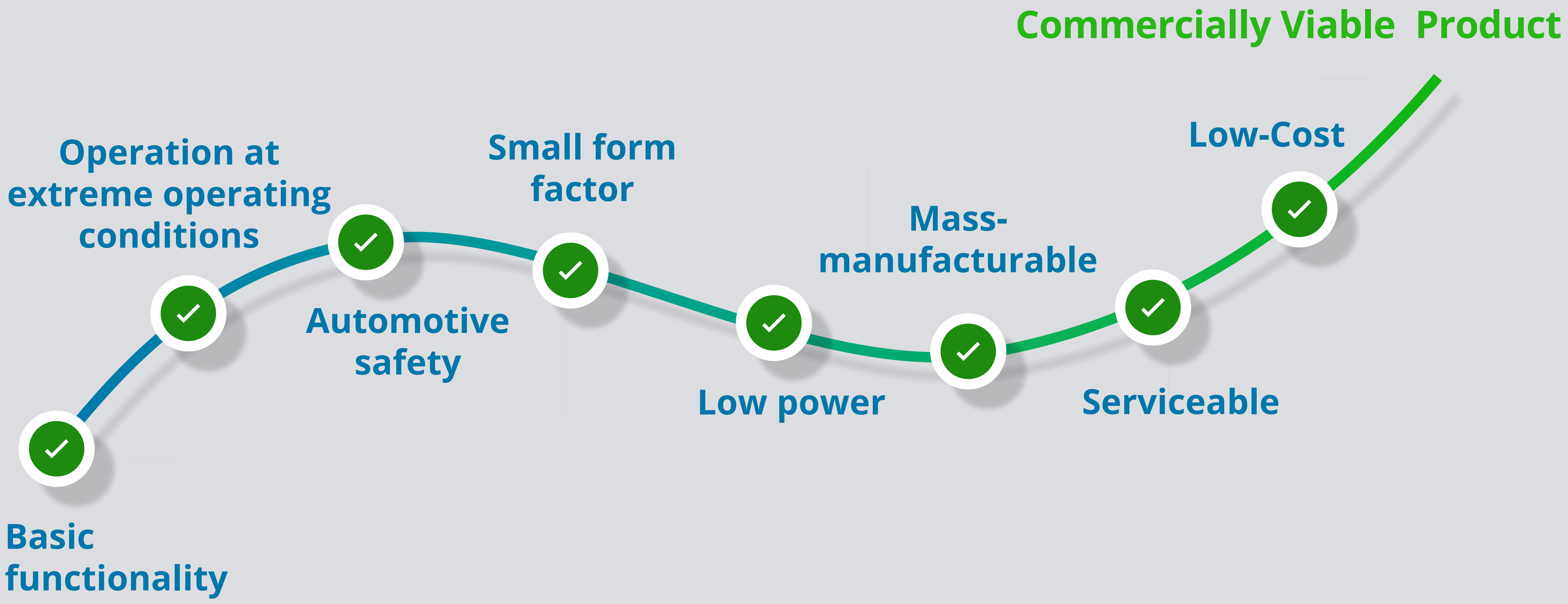
High-Ambient Performance



Intelligent Transportation



Intelligent Lidar with Bistatic Software-configurable Scanning



Summary

LiDAR sensors must deliver reliable data across challenging conditions in a small form-factor, low-power and low-cost product

Various architectures try to address this challenge but they all deploy system resources independently of the scene, resulting in expensive or underperforming products

AEye intelligently invests system resources where information exists, in order to provide actionable 3D point clouds

AEye's bistatic design enables software-controlled deterministic scanning algorithms in a mechanically-robust cost-efficient system

The system is being deployed in automotive, smart-infrastructure and industrial applications

Driven by

Thank You