RAJANT
Velodyne Lidar
MOV.AI

Leverage AI and the Latest Technology Innovations to Improve Warehouse Efficiency and Safety

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Speaker Introductions

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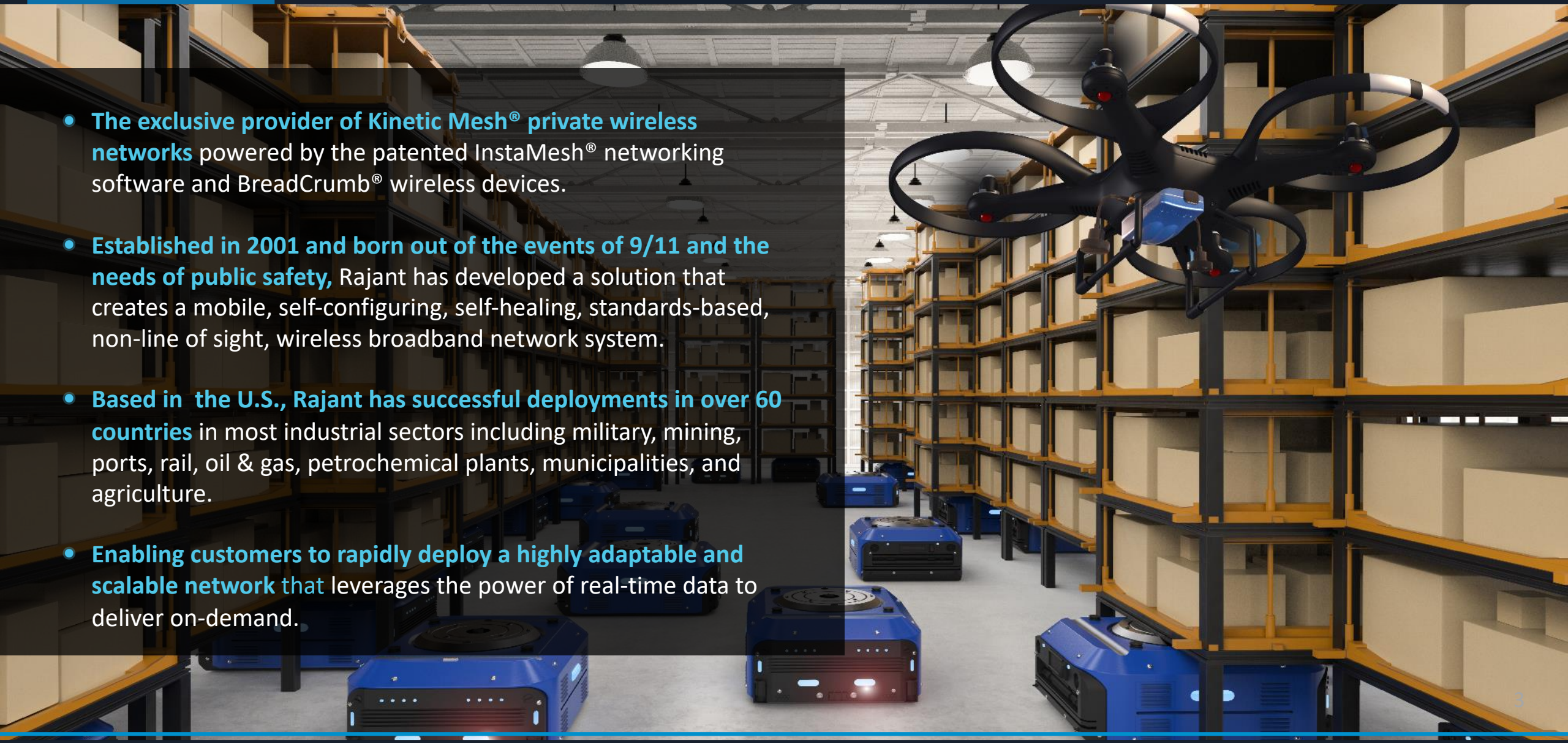
Company Brief – Rajant Corporation



- **The exclusive provider of Kinetic Mesh® private wireless networks** powered by the patented InstaMesh® networking software and BreadCrumb® wireless devices.
- **Established in 2001 and born out of the events of 9/11 and the needs of public safety,** Rajant has developed a solution that creates a mobile, self-configuring, self-healing, standards-based, non-line of sight, wireless broadband network system.
- **Based in the U.S., Rajant has successful deployments in over 60 countries** in most industrial sectors including military, mining, ports, rail, oil & gas, petrochemical plants, municipalities, and agriculture.
- **Enabling customers to rapidly deploy a highly adaptable and scalable network** that leverages the power of real-time data to deliver on-demand.

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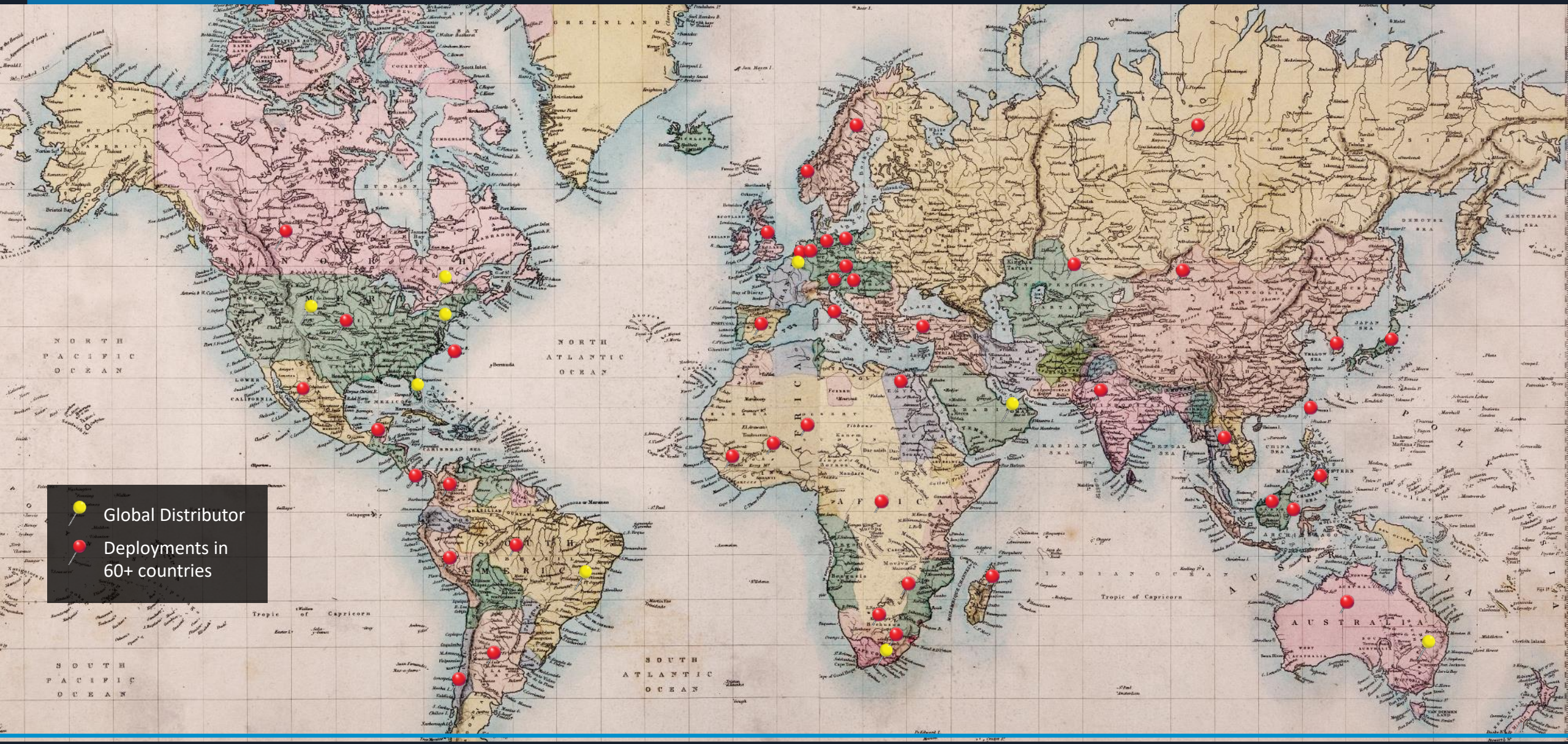
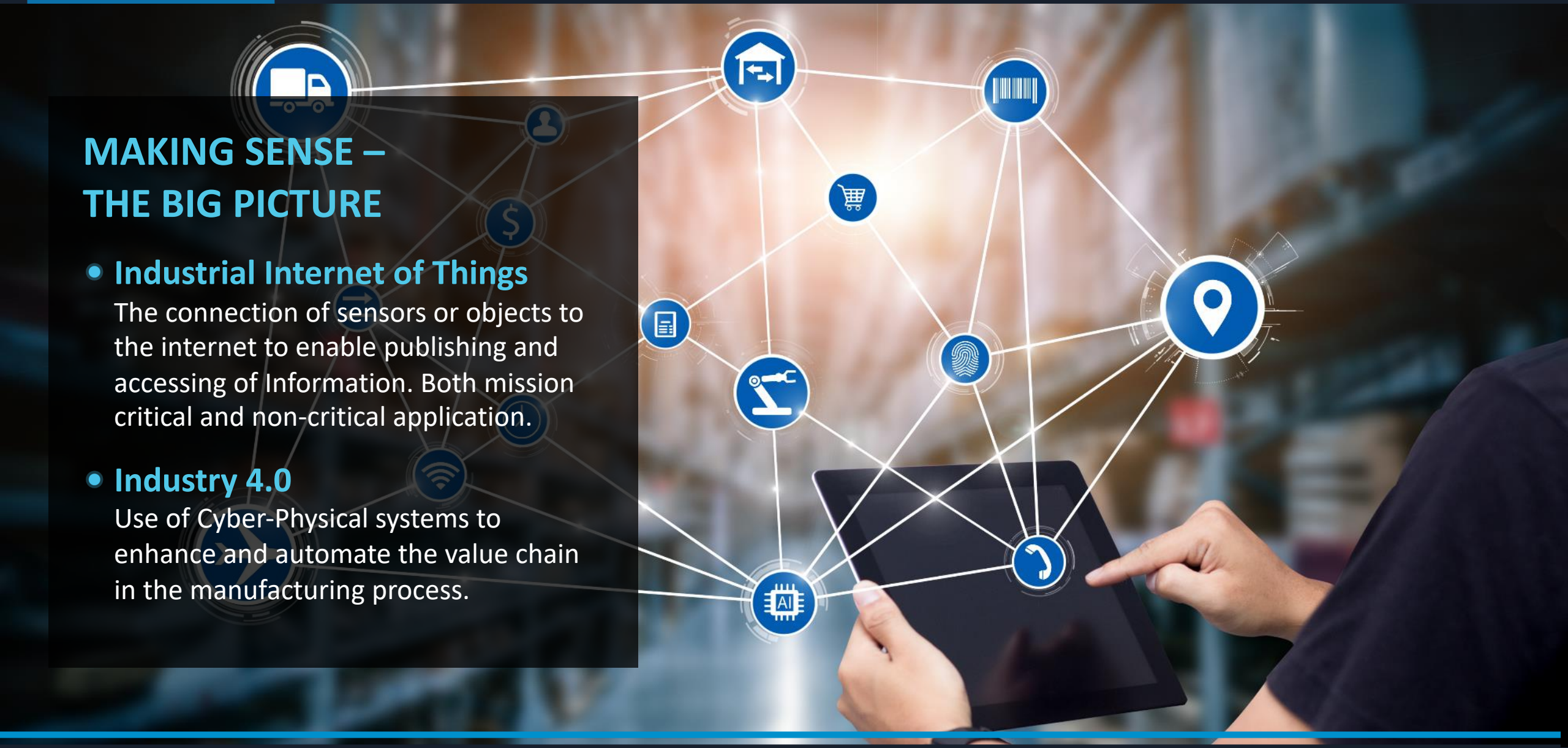


Rajant. Enables machine-to-machine communications and eliminates dead spots.

Review of IIoT 4.0

MAKING SENSE – THE BIG PICTURE

- **Industrial Internet of Things**
  The connection of sensors or objects to the internet to enable publishing and accessing of Information. Both mission critical and non-critical application.
- **Industry 4.0**
  Use of Cyber-Physical systems to enhance and automate the value chain in the manufacturing process.



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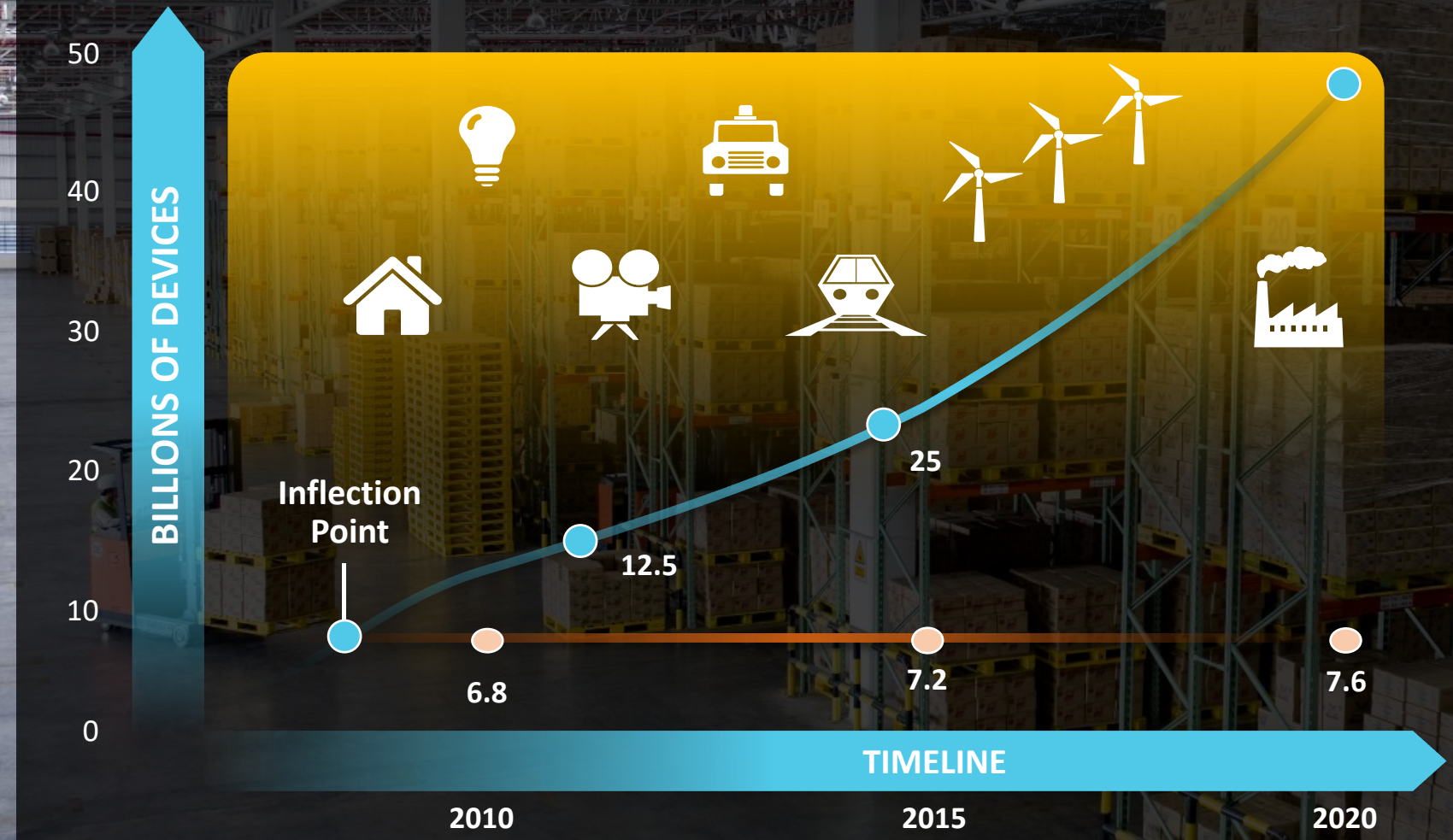
IoT Connecting the Unconnected



50 Billion

"Smart Objects"

Rapid Adoption Rate of Digital Infrastructure:

5X Faster

than electricity & telephony

World Population

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Business Drivers & Challenges

eCommerce

Safety

Cybersecurity

Robots & Automation

Security

COVID-19

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A Closer Look at Kinetic Mesh® Technology

- Coverage
- Interference
- Mobility
- Bandwidth
- Latency
- Jitter

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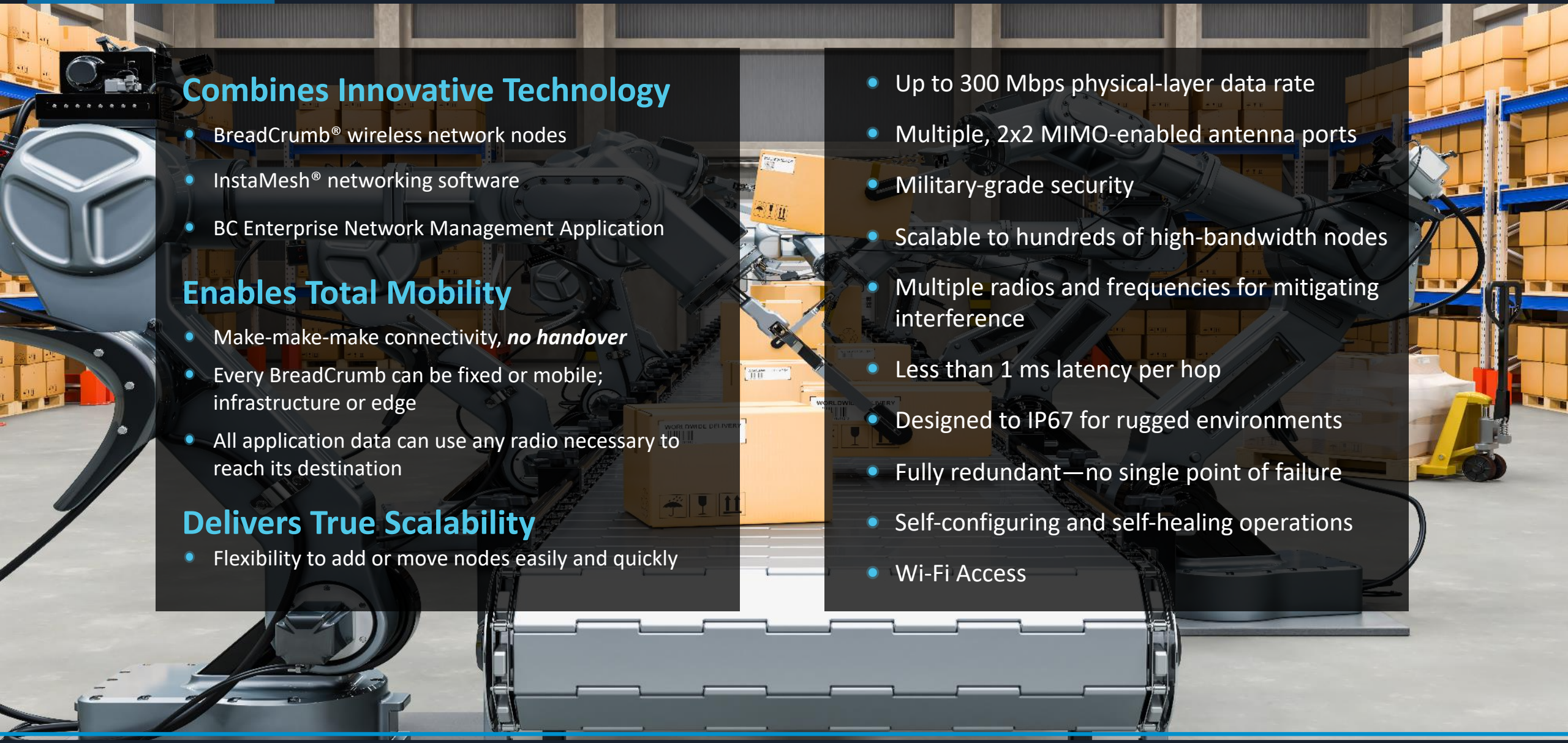
A Closer Look at Kinetic Mesh® Technology



Combines Innovative Technology

- BreadCrumb® wireless network nodes
- InstaMesh® networking software
- BC Enterprise Network Management Application

Enables Total Mobility

- Make-make-make connectivity, ***no handover***
- Every BreadCrumb can be fixed or mobile; infrastructure or edge
- All application data can use any radio necessary to reach its destination

Delivers True Scalability

- Flexibility to add or move nodes easily and quickly

- Up to 300 Mbps physical-layer data rate
- Multiple, 2x2 MIMO-enabled antenna ports
- Military-grade security
- Scalable to hundreds of high-bandwidth nodes
- Multiple radios and frequencies for mitigating interference
- Less than 1 ms latency per hop
- Designed to IP67 for rugged environments
- Fully redundant—no single point of failure
- Self-configuring and self-healing operations
- Wi-Fi Access

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A Closer Look at Kinetic Mesh® Technology

INCREASED EFFICIENCY

INCREASED PROFITABILITY

ENHANCED PRODUCTIVITY

IMPROVED SAFETY

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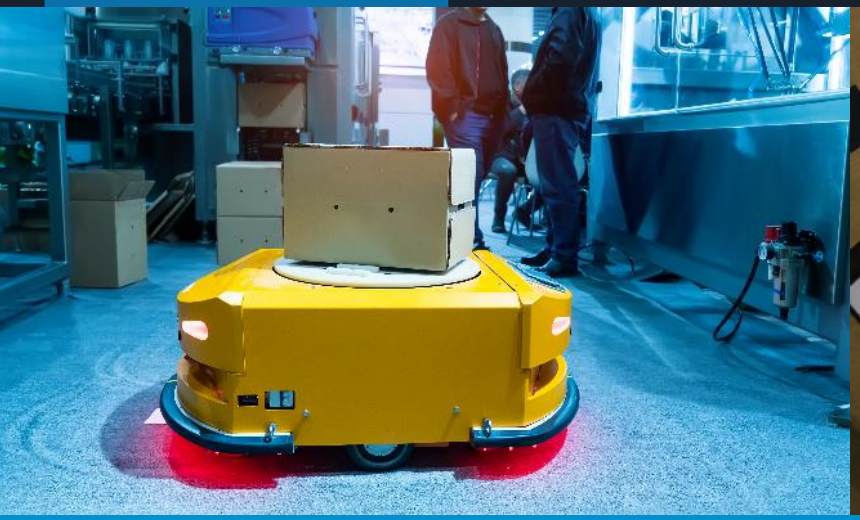
Applications



Autonomous Mobile Robots

Automatic Identification & Data Capture

Automated Sortable Solutions

Automated Guided Vehicle

Automated Storage & Retrieval System

Automated Material Handling

M2M Communication Eliminates Dead Spots

Continuous Wireless Connectivity throughout the Entire Warehouse

- Telemetry
- Vehicle Health Monitoring
- Power Management
- CCTV
- Autonomy

The Net Effect

- Improves Efficiency
- Reduces Expenses

Rajant. Enables machine-to-machine communications and eliminates dead spots.

Voice First Interface for Knowledge Workers

AI based Voice Recognition Plug-in

- Speech Recognition
- Speech Synthesis
- Intent Handling

Benefits

- Allows for hands free communication in a busy work environment
- Talk to the robots and the robots can talk to you, ie: “Excuse me Jim! I’m here to pick up the new Apple Watch 6.0 in blue, part number XYZ123.”

Velodyne Lidar®

Industrial Automation

Jon Barad
Vice President of Business Development
jbarad@Velodyne.com

YOUR SAFETY DRIVES US

We Are the First Mover and Market Leader

2005

- **Invented Real-Time 3D Lidar**

2007

- **Began World's First Commercial Production of Real-Time 3D Lidar**

TODAY

- **Leading Lidar Technology**

HIGHLIGHTS

- Dominated the market for 13 years
- Broad product portfolio
- Cumulative sales of over $570 million(1)
- 300+ customers, including major OEMs and leading Tech companies
- Global sales and mass scale manufacturing
- 25+ new market segments outside automotive
- Backed by industry-leading strategic investors, including Ford, Baidu, Nikon and Hyundai Mobis

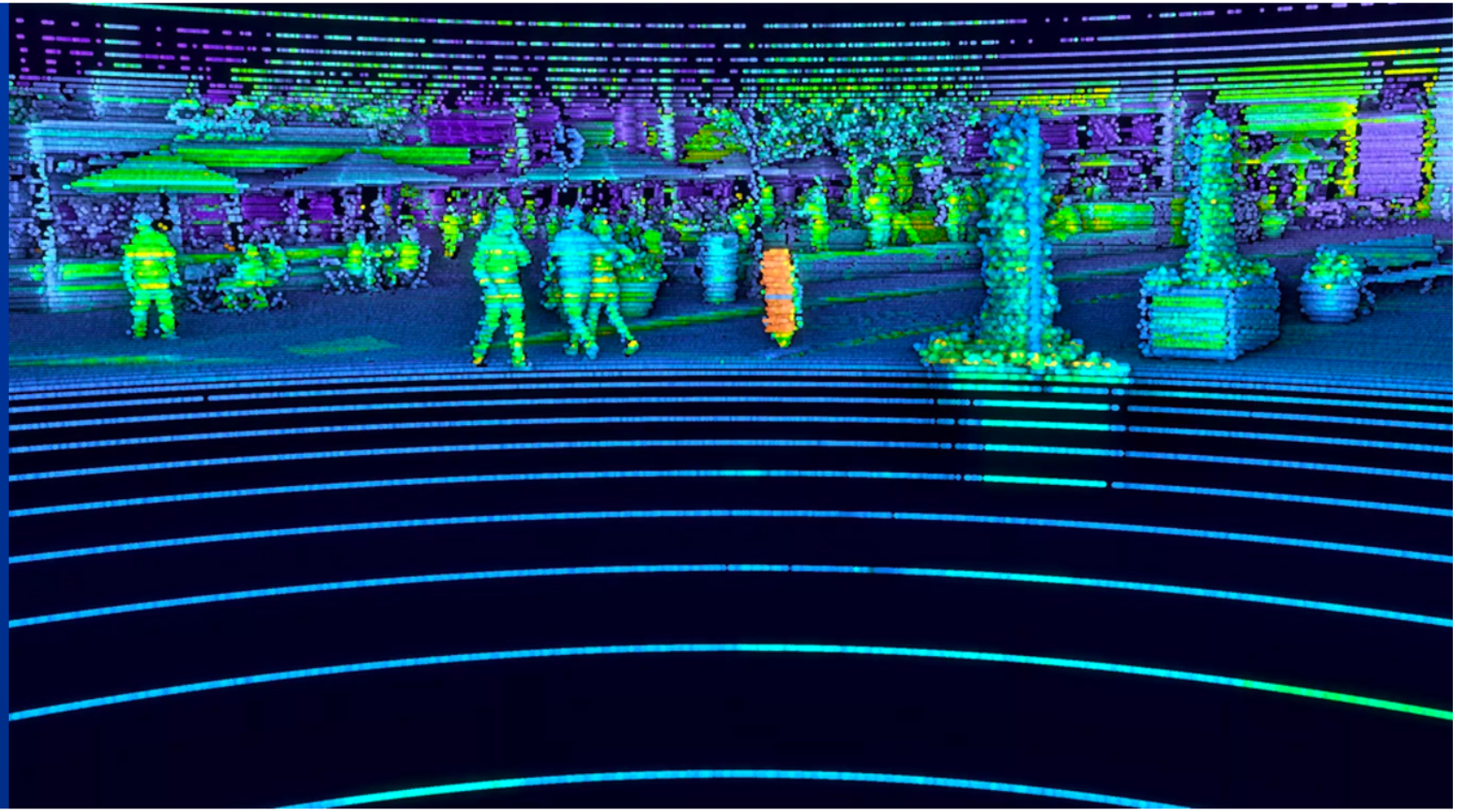
Velodyne Today

WORLD CLASS R&D AND MANUFACTURING

Lidar: Light Detection and Ranging

Lidar technology uses eye-safe laser beams to create a 3D representation of the surveyed environment. Lidar offers strong performance in a wide variety of lighting and weather conditions.

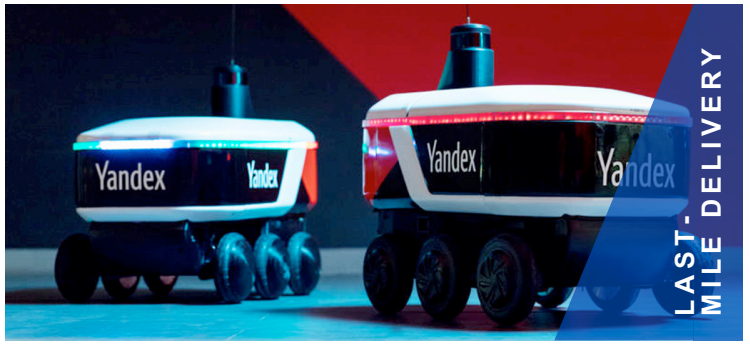
A typical lidar sensor emits pulses of invisible light into the surrounding environment. Repeating this process millions of times per second creates a precise, real-time 3D map of the environment. An onboard computer can utilize this map for safe navigation.

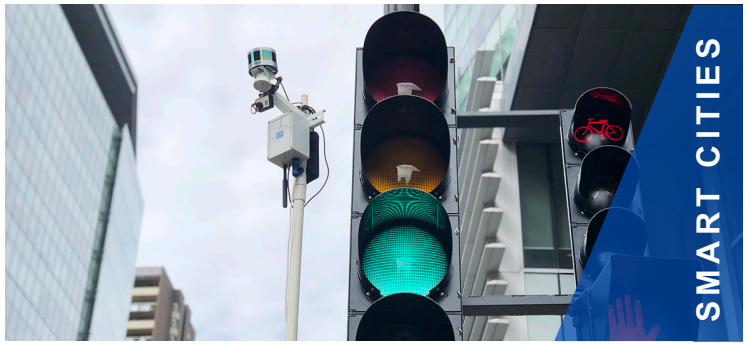


Velodyne Alpha Prime

- The Alpha Prime delivers unrivaled combination of field-of-view, range, and image clarity
- Optimal long-range sensor for autonomous mobility
- Detects roadway objects with reliability and precision
- 28 channel lidar
  - 2.4m points per second in single return mode
  - 4.8m points per second in dual return mode
- 245m range

Rapid Adoption of Velodyne Lidar Across Industries



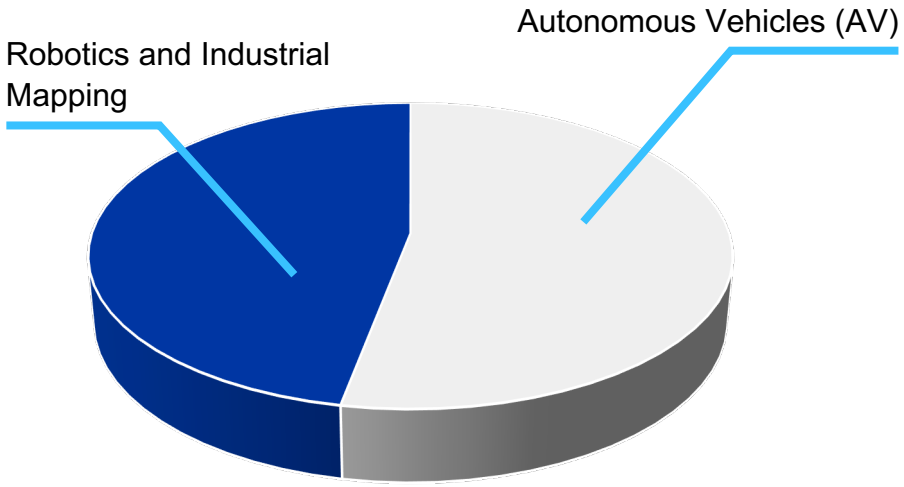


The “Automated with Velodyne” Ecosystem

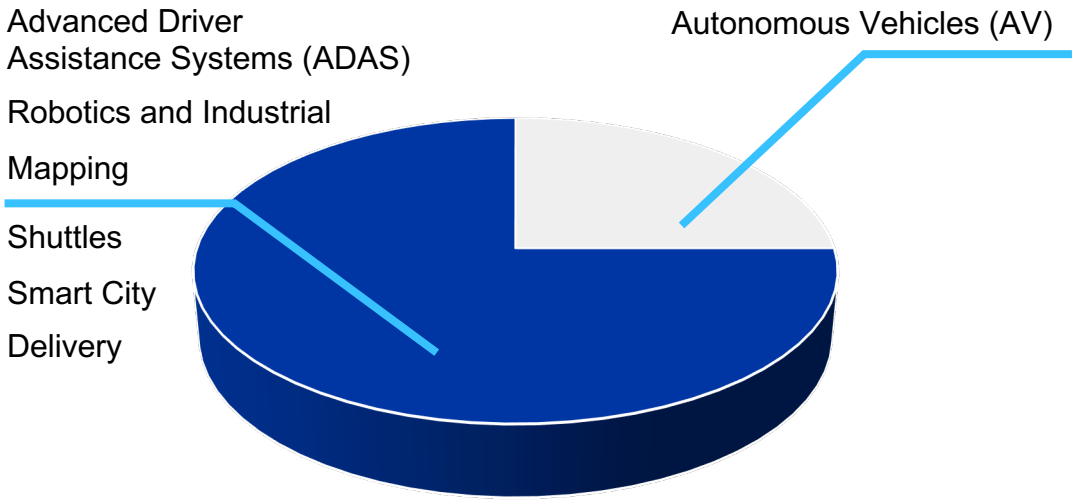
We Are Much More Than an Autonomous Vehicle Company

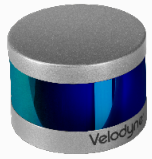
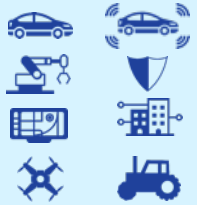
ADAS & OTHER APPICATIONS COMPRISE MAJORTIY OF REVENUE

2017



TODAY

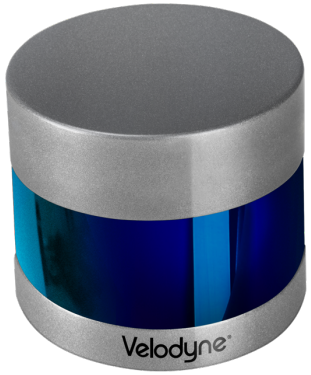


Lidar 2017	**Very expensive**	**Limited form factors**	**Developing durability**	**Limited applications**	
	$$$		✓		
Lidar Today	**Highly affordable**	**Many form factors**	**Proven durability**	**Many applications**	
	$		✓✓		

Velodyne Products

Smart, Powerful Lidar Solutions for Autonomy and Driver Assistance

Alpha Prime™

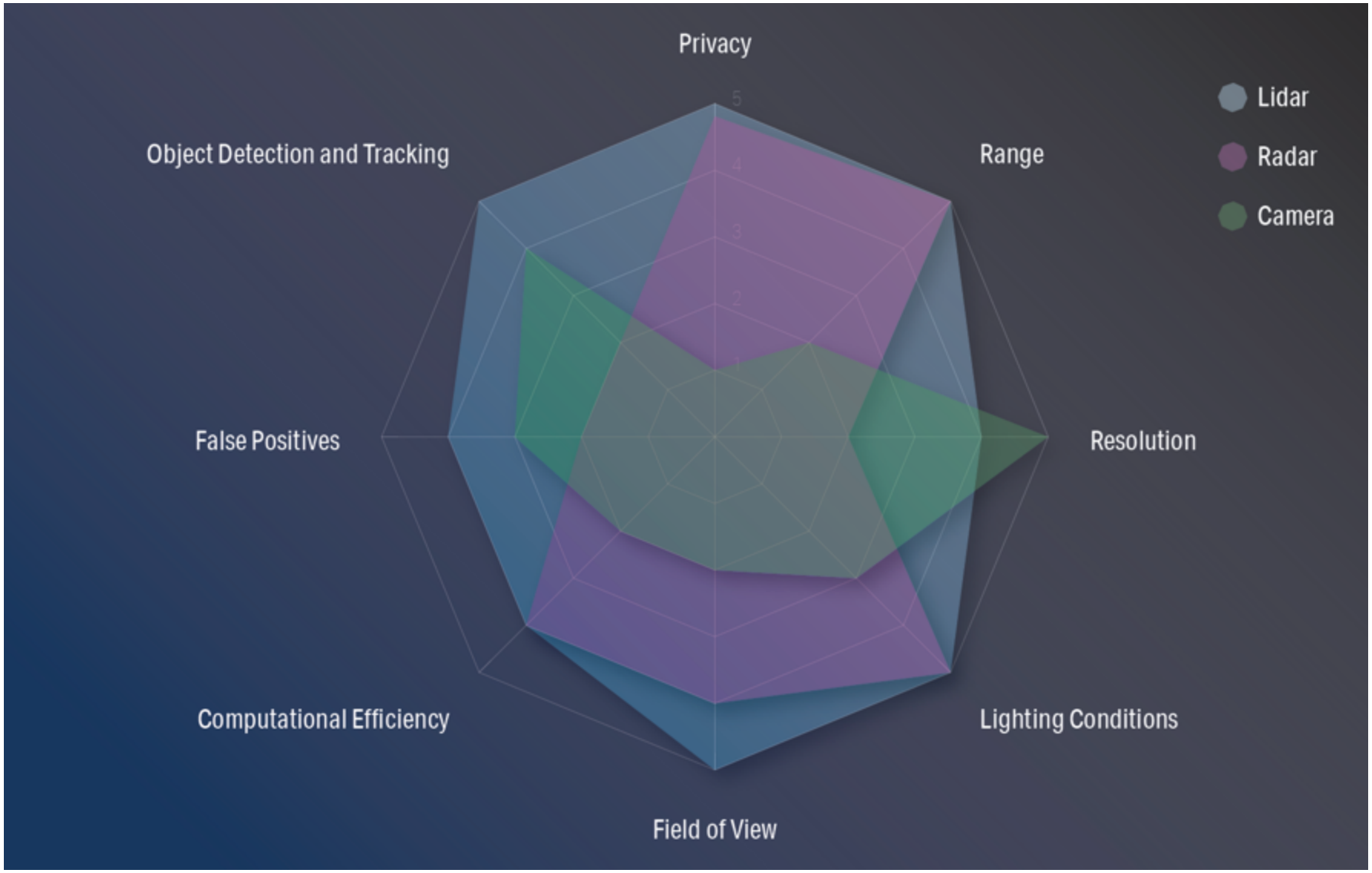


Ultra Puck™

Puck™

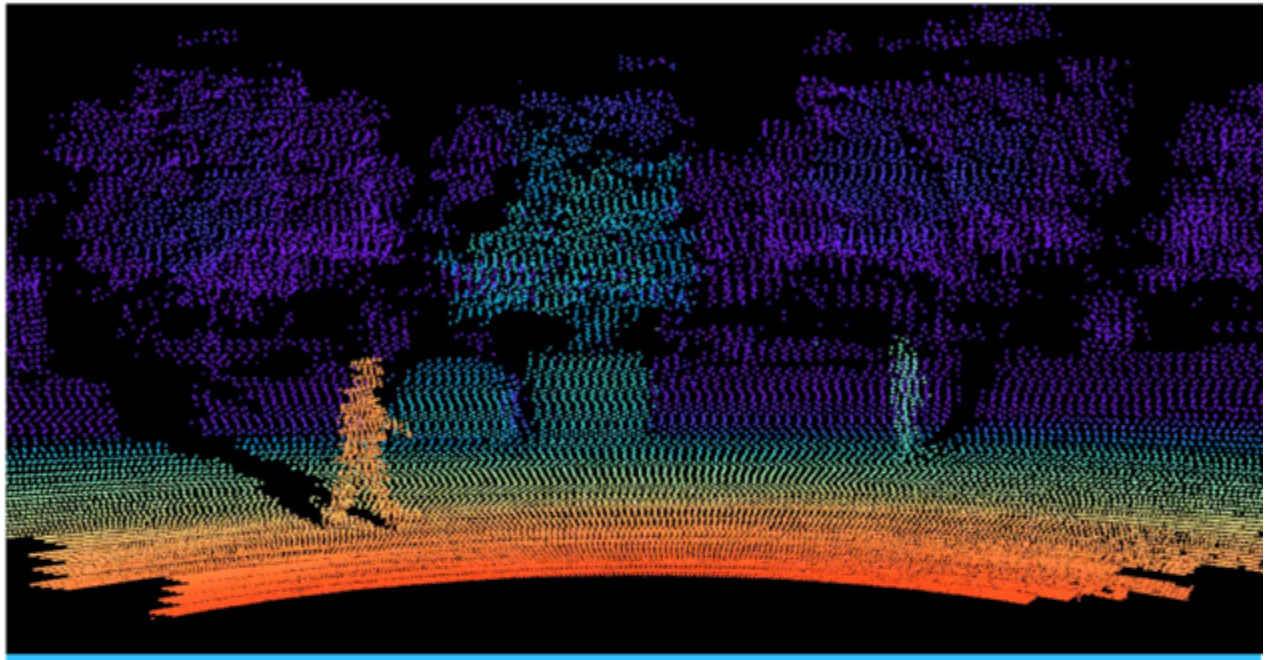
Velarray™

Sensor Type Comparison



Pedestrian Detection at Night

AUTOMOTIVE-GRADE
2D CAMERA



VELODYNE
3D LIDAR SENSOR

Data collected at 10:30 pm using an automotive-grade global shutter camera and Velodyne's Velarray lidar sensor. Camera and sensors were installed on a vehicle, which was parked in a private parking lot with some streetlights lit and vehicle's headlights turned on low beam. Two pedestrians were captured walking in front of the parked vehicle.

How Lidar Data Works: Tracking and Classifying

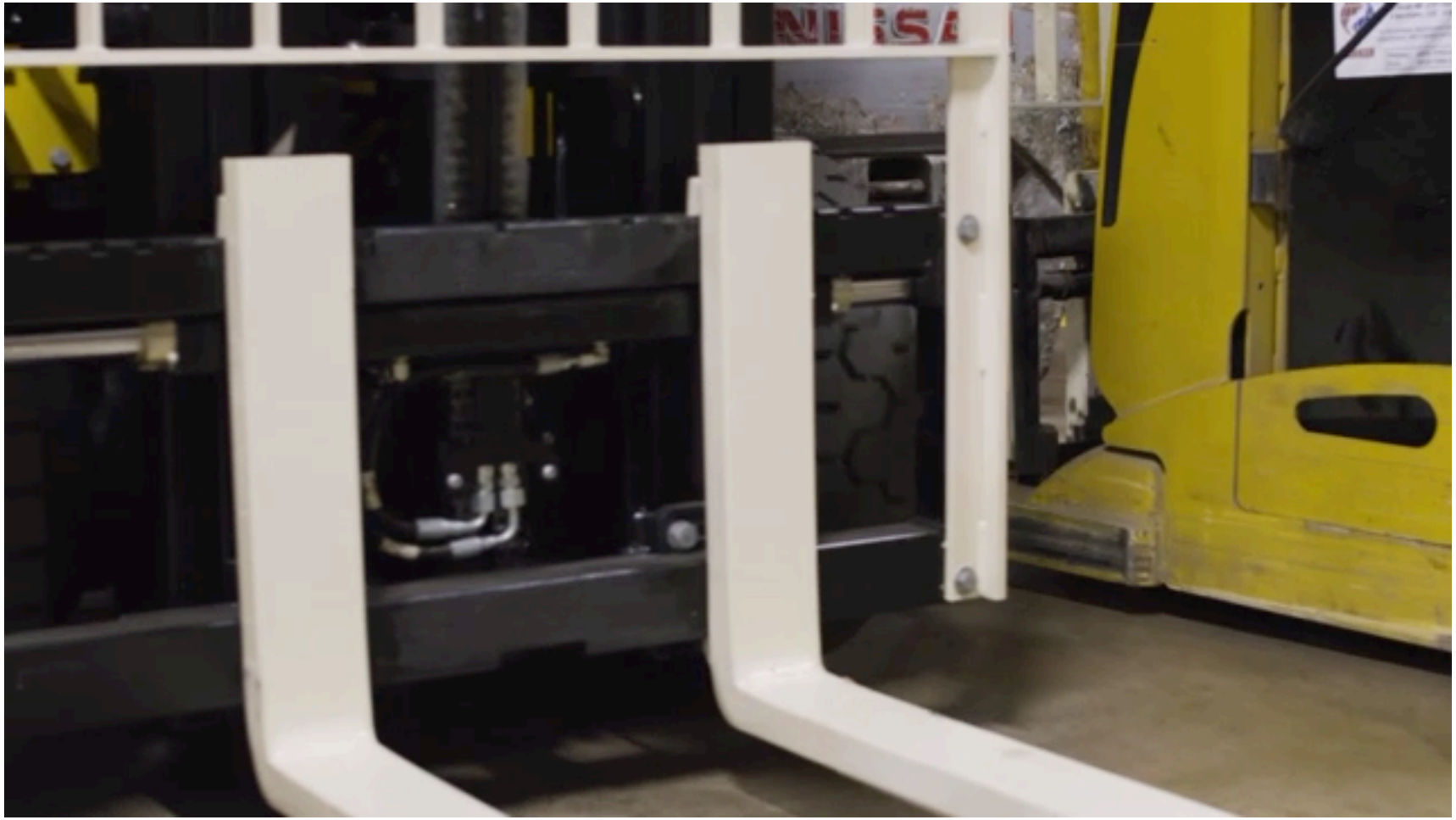
Smart lidar uses AI and tracking algorithms to not only **identify** people, bicyclists, vehicles, but **predict** where they are going and watch for potential collisions.


Yale
Yale
Yale
2 forklift accidents per day
100 deaths per year
- OSHA


Average cost: $48k per incident
$1.4M per death
- OSHA

Forklift Safety

Fork Alert by MechaSpin



Safety

Vision IQ is a solution developed by The Marsden Group, designed to increase safety and understand human behavior in relation to operational environments.

The solution gives oil & gas drillers the ability to monitor live operations to mitigate dangerous incidents and also review procedures to better understand the human/ equipment interaction in a way that can increase efficiency.

Efficiency

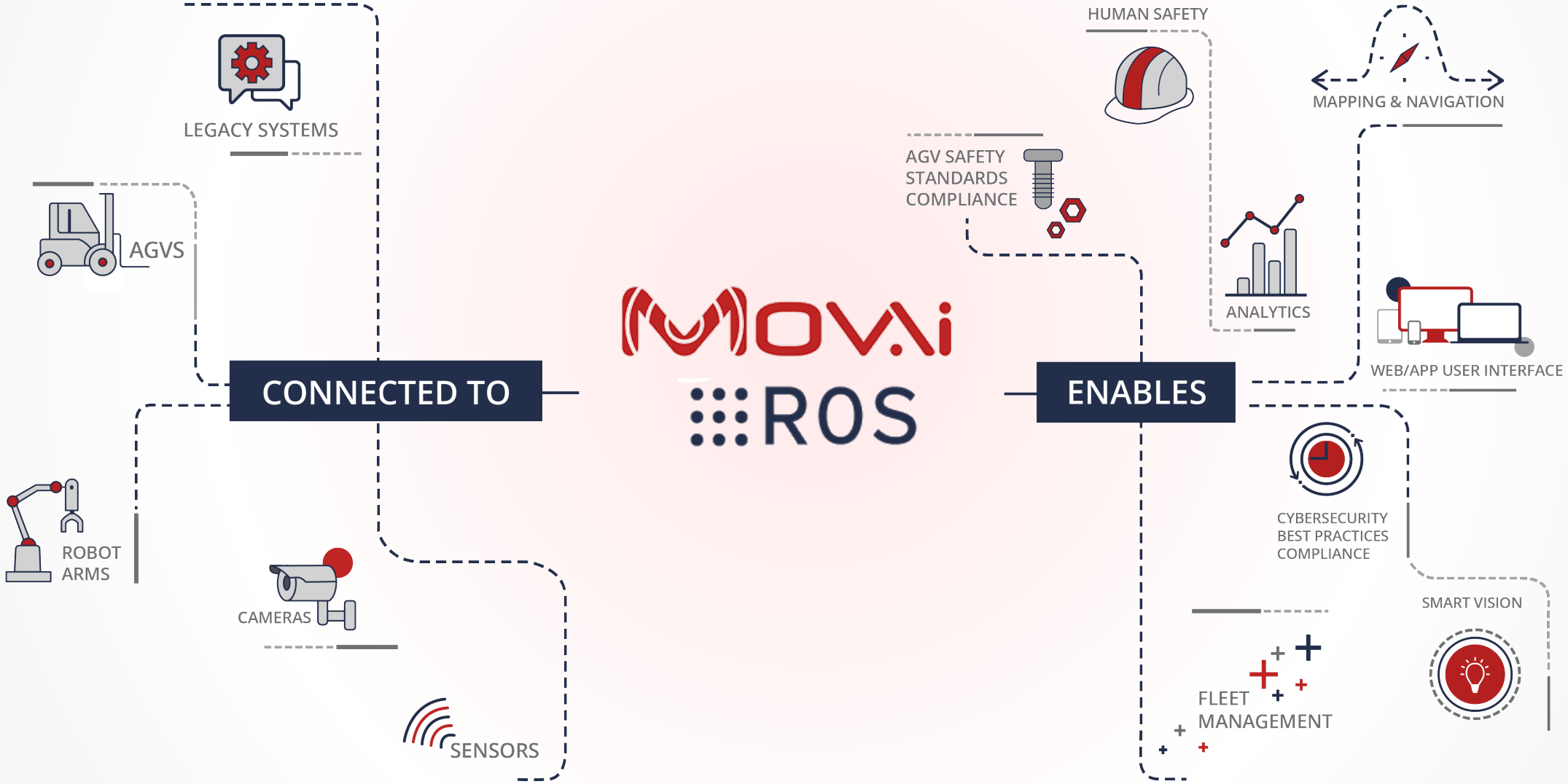
The 3D image data generated by Velodyne sensors is optimal for industrial applications requiring precise measurements, object-tracking and movement.

With a compact form factor and robust data set, our sensors can be embedded on mobile machinery to enable safe navigation or mounted on equipment to bound safety zones.

Operating System For Collaborative Robots

MOV.AI lets autonomous robots work safely together with people and other robots in any environment at any scale.

MOV.AI - O/S for Robots



One software for different robots

Hako

POWERHANDLING

RPM - to be released in Q4 - A ground-breaking price/performance autonomous pallet mover collaboration with PowerHandling (USA)

MATTRO

Bock - to be released in Q2 - An all-weather heavy duty cart pulling robot collaboration with Mattro GmbH

RoboSavvy

Tugbot - in production - 400kg cart pulling AMR by RoboSavvy Ltd. - expected sales of 200 units in 2020

zalando

ctt

Hirschvogel Komponenten

SNCF

Carrefour

BÖWE SYSTEC

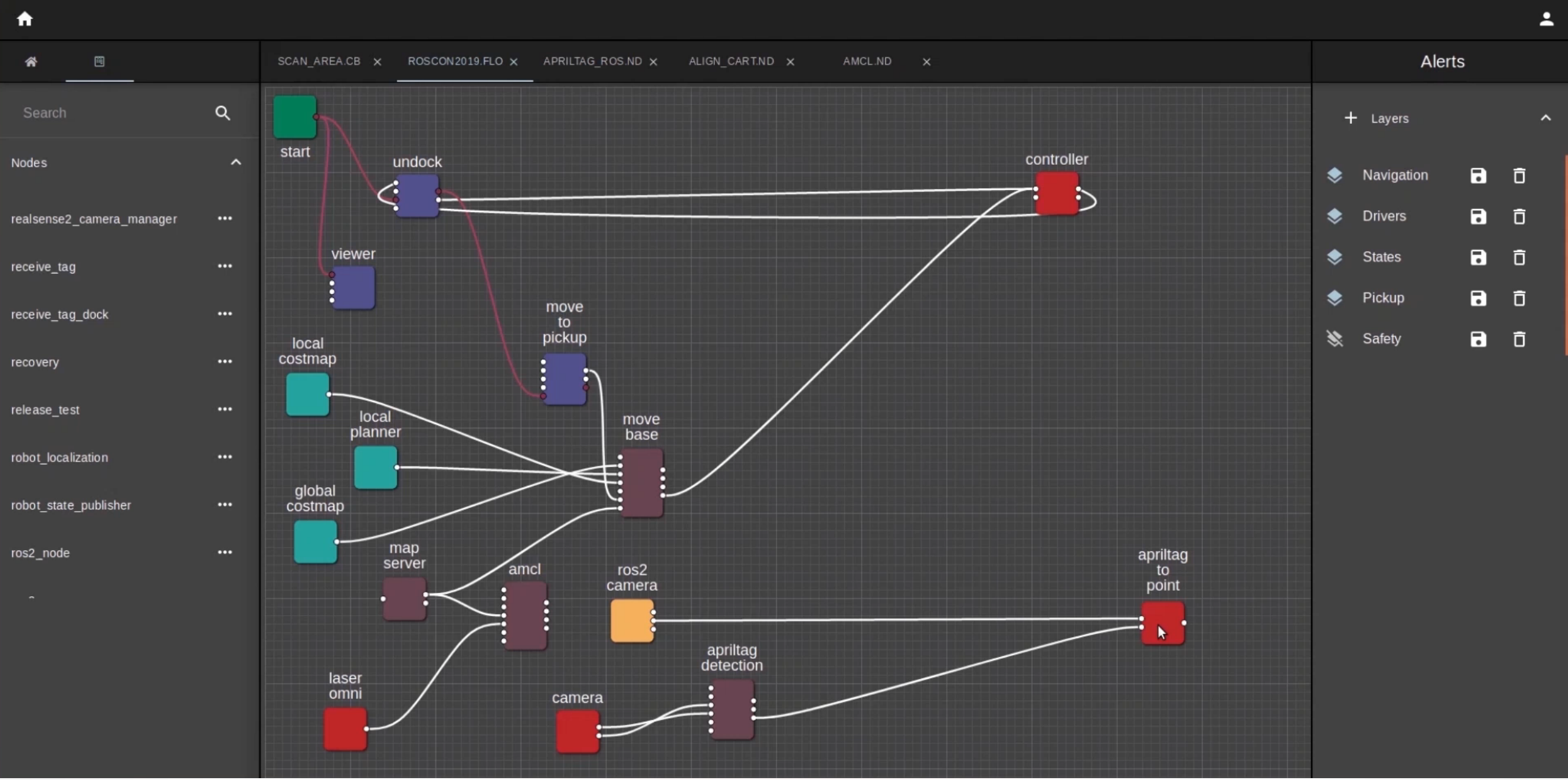
BENTLEY

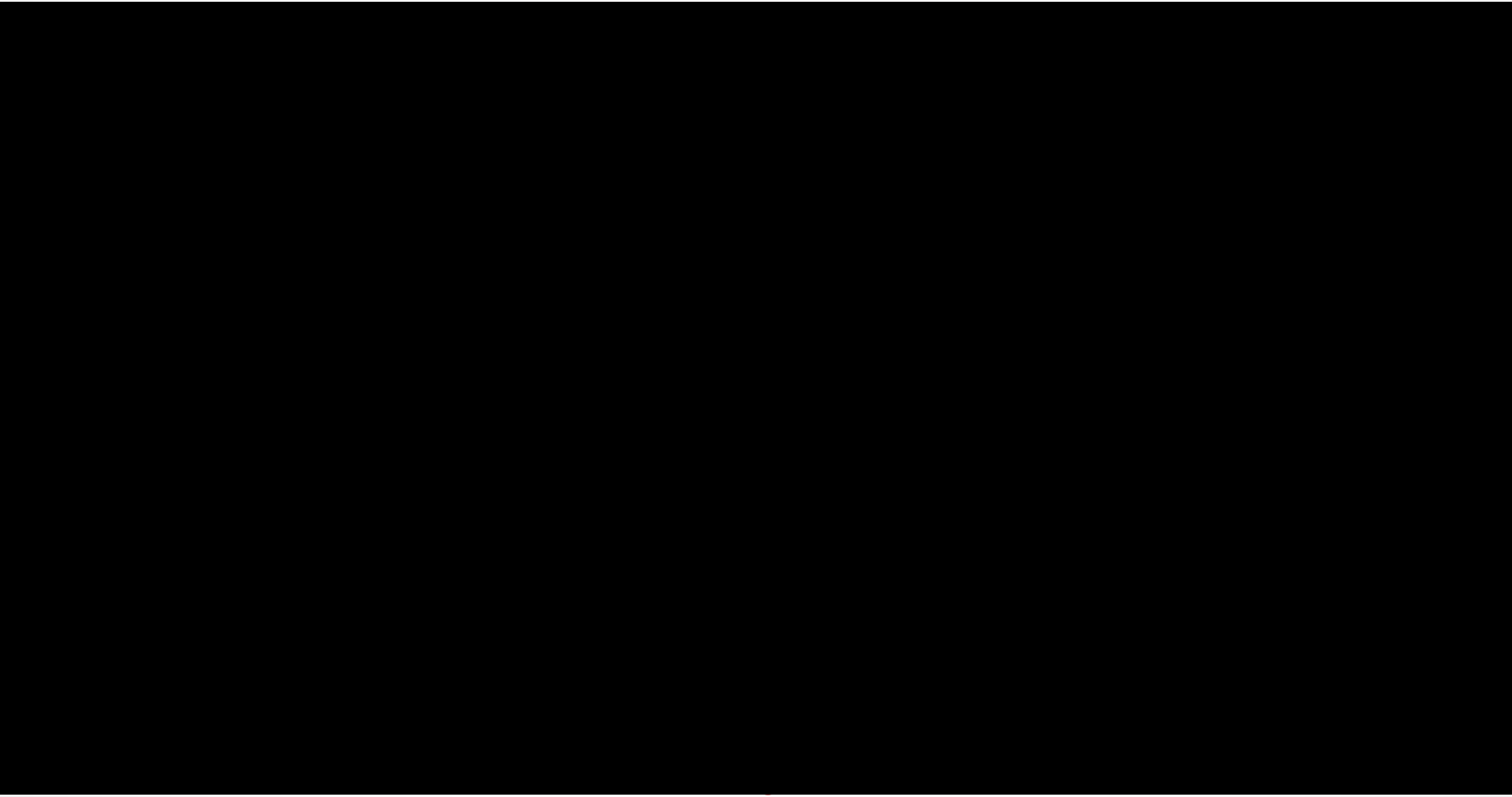
MARINA BAY Sands SINGAPORE

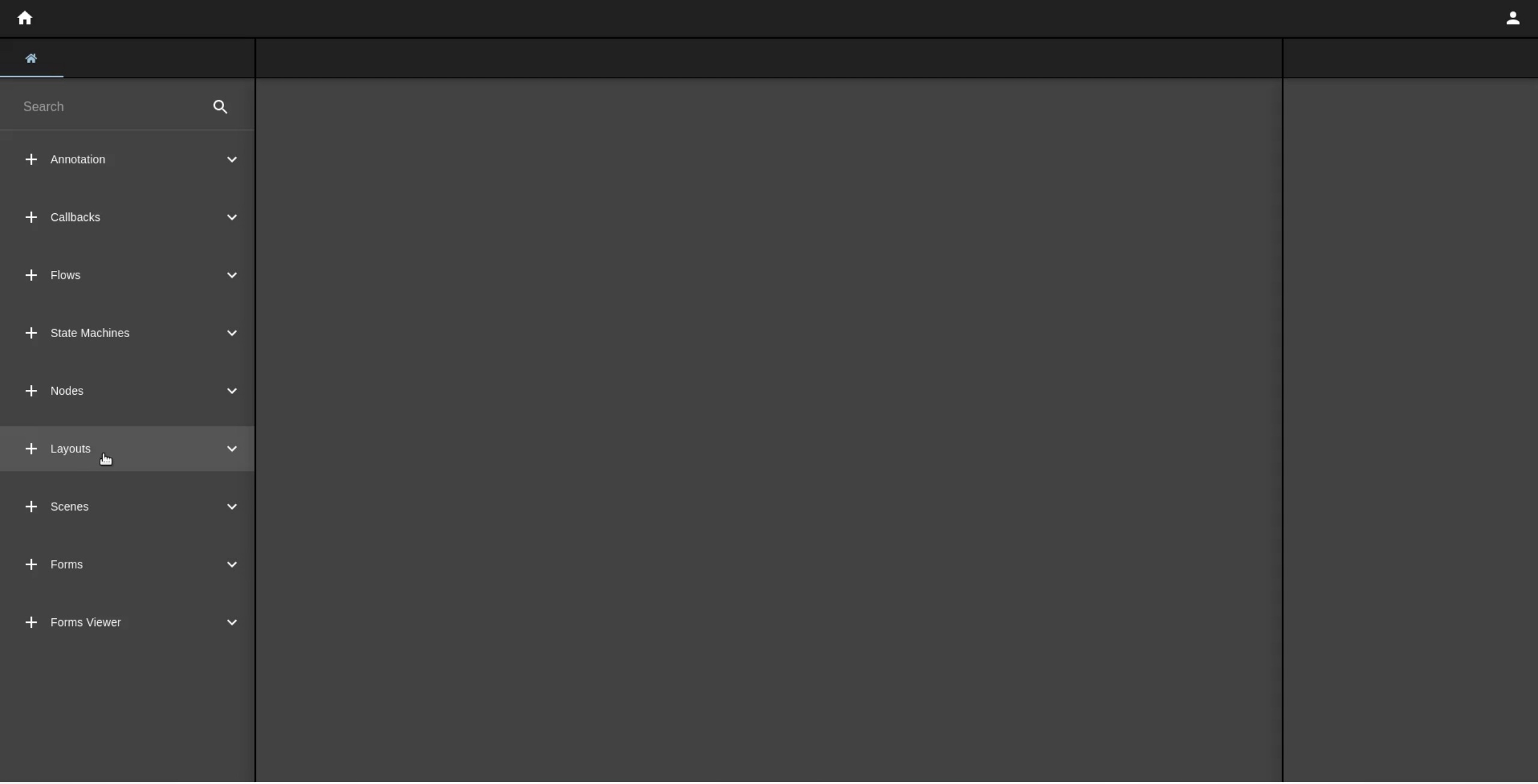
HAWE HYDRAULIK

Royal Mail

UNIPART GROUP







thank you!

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