

# LiDAR Industrial Application

## Overview

Keeping processes running smoothly, efficiently, and safely is a top priority for industrial applications across all sectors—from ports to warehouses to factories. However, many industries are facing both increasing productivity demands and growing labor shortages. These challenges are driving industrial facilities to increase their operational efficiency and reduce wasted costs, time, and materials. Meeting these goals requires cost-effective, accurate, and reliable automation and IIoT technologies like LiDAR.

## What is LiDAR?

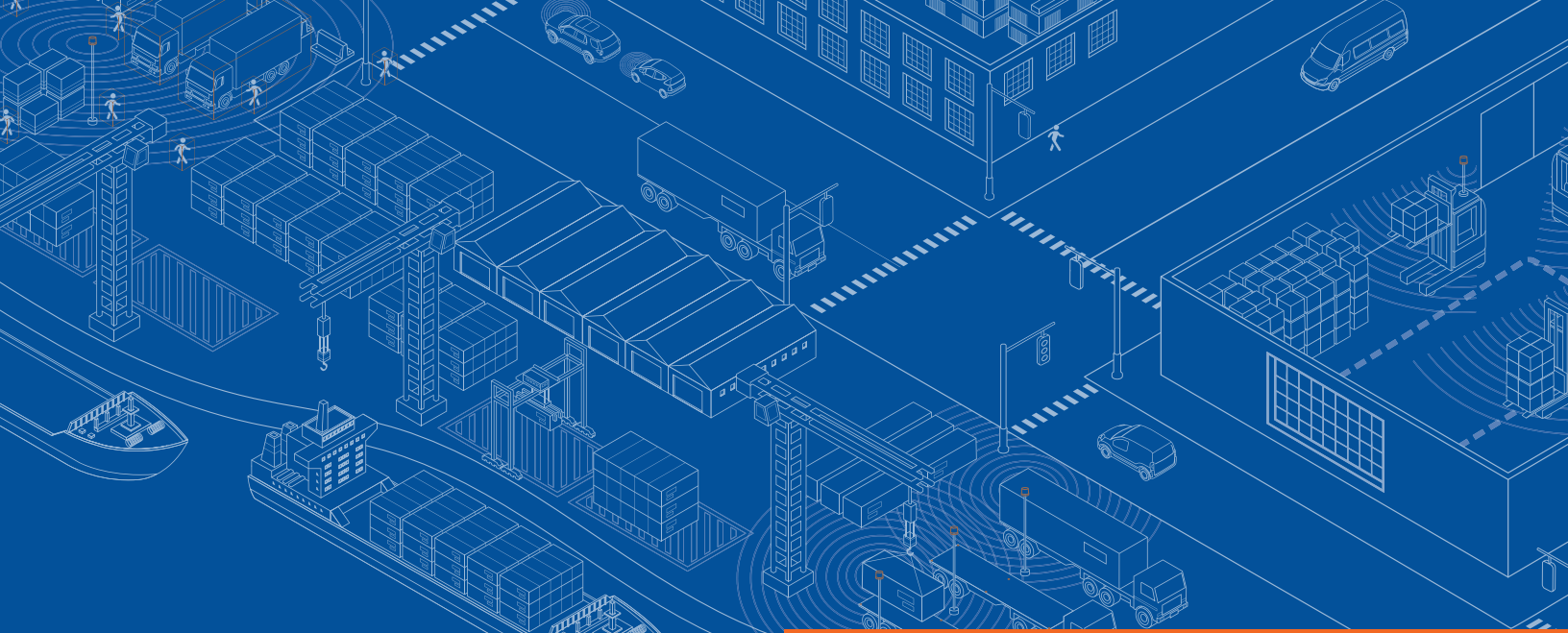
**LiDAR**, which stands for **L**ight **D**etection and **R**anging, is a time-of-flight sensing technology that pulses low-power, eye-safe lasers and measures the time it takes for the laser to complete a round trip between the sensor and a target. The resulting aggregate data are used to generate a 3D point cloud image, providing both spatial location and depth information to identify, classify, and track moving objects.

Quanergy's LiDAR platform is built on the highest-performing 2D and 3D LiDAR sensors for the industrial market. The LiDAR sensors provide precise measurement and ranging, as well as fast, accurate object detection. In addition, LiDAR technology enables navigation and collision avoidance for automated guided vehicles (AGVs), unmanned ground vehicles (UGVs), automated mobile robots (AMRs), automated inter terminal vehicles (AITVs), and forklifts—protecting individuals working around these vehicles.

By combining 3D LiDAR sensors with AI-powered QORTEX Aware™ and QORTEX DTC™ perception software, Quanergy provides complete, integrated hardware and software solutions that increases the accuracy, efficiency, and safety of a wide range of industrial applications.

## LiDAR vs Competing Technologies

	LiDAR	Camera	Radar	Ultrasonic
<b>Sensing Dimension</b>	2D/3D	2D	1D	1D
<b>Range</b>	●	◐	●	◐
<b>Range Accuracy</b>	●	◐	◐	◐
<b>Field of View</b>	●	◐	◐	◐
<b>Object Classification</b>	●	◐	◐	◐
<b>Adverse Weather</b>	◐	◐	●	◐
<b>Night Vision</b>	●	◐	●	●
<b>Small Object Detection</b>	●	◐	◐	◐



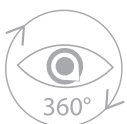
## LiDAR Industrial Application

### Benefits of Quanergy LiDARs for Industrial Markets



#### Mid- to Long-Range Sensing Capabilities

Depending on the model, LiDAR sensors from Quanergy provide up to 200-meter range to support a wide variety of industrial applications, including reliable navigation and collision avoidance for mobile equipment.



#### 360° Horizontal Field of View

The wide field of view provides complete coverage of scanned areas and provides flexible installation.



#### High Accuracy and Precision (High Point Cloud Density)

LiDAR sensors from Quanergy generate exceptionally clear and detailed 3D point clouds by capturing up to 1.3 million data points per second—more than double the volume of data captured by competing solutions. The high point cloud density ensures accuracy and precision.



#### Fine Angular Resolution

A market-leading angular resolution of 0.033-0.132 degrees enables the sensor to reliably detect and identify objects with pinpoint accuracy.



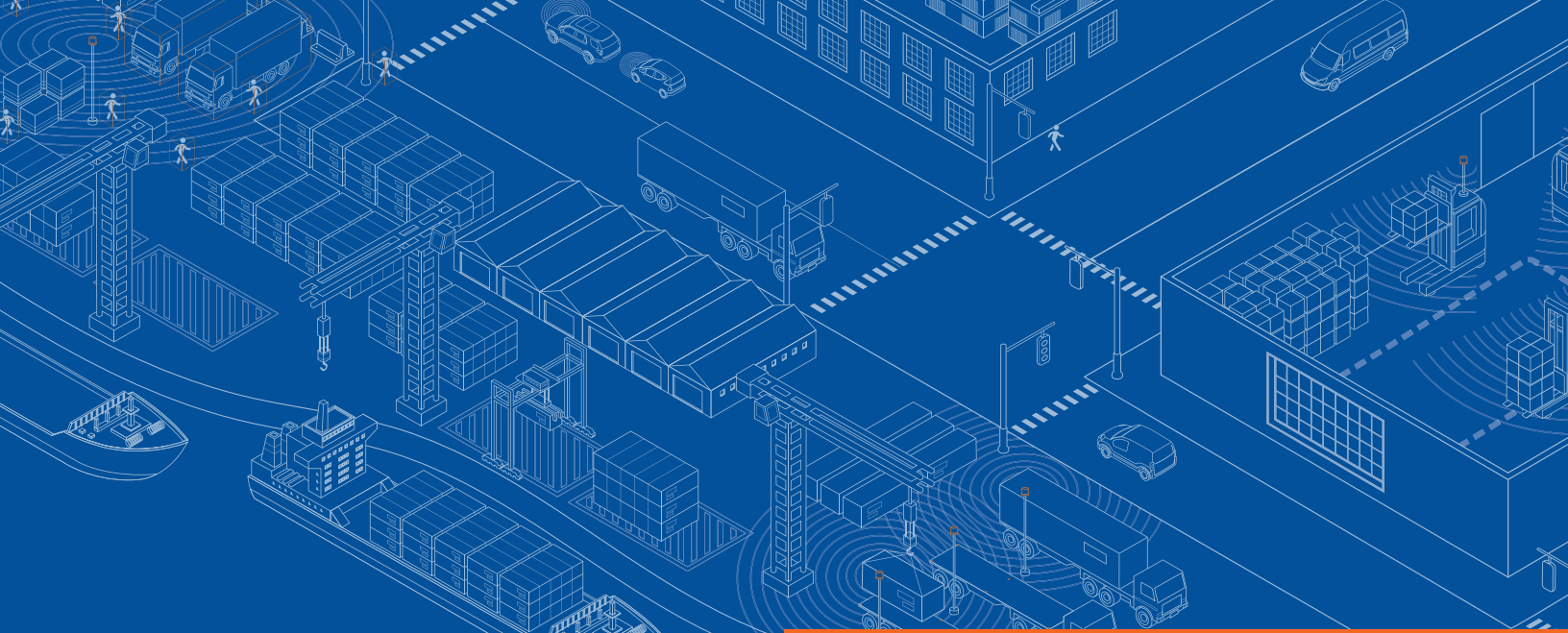
#### Reliable Performance in Harsh Industrial Environments

LiDAR operates in any weather and/or lighting conditions as well as indoor or outdoor. M-series LiDAR sensors from Quanergy are IP69K certified. 100% true solid-state S-series LiDAR sensors have high reliability with no moving and vibrating parts, providing ten years MTBF.



#### Intuitive Application Programming Interface (API)

An easy-to-use API enables seamless integration of the LiDAR sensor into the overall solution and is essential to the success of the application.



## LiDAR Industrial Application

### LiDAR Solutions for Industrial Markets

#### Material Handling & Logistics

LiDAR is a powerful solution for a broad range of automation and logistics applications. The fine angular resolution enables high accuracy for critical measurement applications like package profiling and fill level monitoring. In addition, LiDAR provides high accuracy at long ranges and 360-degree field of view, ideal for pallet storage and retrieval applications. LiDAR can also be mounted on AGVs and AMRs to provide collision avoidance and navigational capabilities by reliably detecting objects that cross its path. Combined with QORTEX AWARE software, Quanergy's LiDAR sensors safeguard against collisions and optimize navigation throughout the warehouse to efficiently transport goods and material from one location to another.

#### Key Applications

- AGVs & AMRs
  - Automatic Storage & Retrieval Systems (ASRS)
  - Positioning & Localization
  - Collision Avoidance
  - Packaging
  - Navigation
- Profiling & Measurement
  - Conveying & Sortation
  - Object classification
  - Dimensioning
  - Fill volume

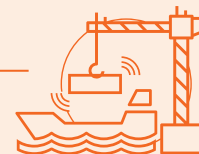


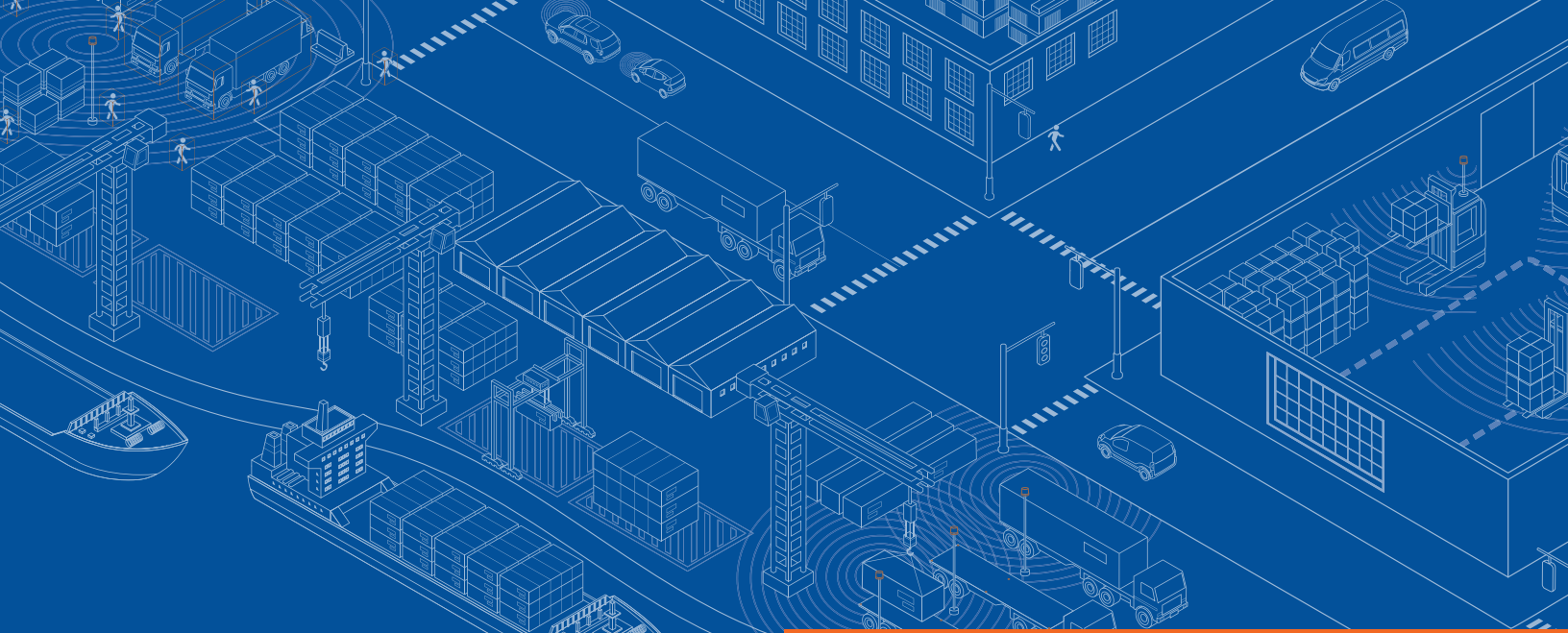
#### Port & Terminal Automation

With its long range, high angular resolution, and resistance to the full range of ambient weather conditions, the M-Series LiDAR sensor from Quanergy provides reliable operation—day or night—to ensure safe, efficient ports and terminals. For example, LiDAR can be mounted on the poles to accurately detect the position of ships, trucks, and containers for safe docking and loading/unloading materials. In addition, LiDAR can be placed on the legs of cranes to prevent collisions with other cranes, vehicles, and personnel at the port. LiDAR also enables accurate measurement of bulk materials like coal and ore. LiDAR can provide real-time data on how much material is being moved and how much remains by continuously scanning the pile of material and using a backend software to calculate the volume of the remaining pile.

#### Key Applications

- Ship-to-Shore
  - Bulk Material & Conveyor Belt Profiling
  - Container Profiling & Soft-landing
  - Crane-to-Ship, Anti-collision
  - Crane Boom Anti-collision
  - Optimizing ship docking
- Gantry Cranes
  - Rubber Tire Gantry (RTG) Crane
  - Anti-Truck Lifting
  - Truck Positioning
- AGVs & AITV
  - Object Detection
  - Collision Prevention
  - Navigation
- Security & Safety
  - Perimeter Security
  - Intrusion Detection
  - Pathway, Cross-travel Collision Prevention





## LiDAR Industrial Application

### Agriculture, Construction & Mining

In agriculture, construction and mining applications, LiDAR provides advanced situational awareness for heavy equipment and vehicles, as well as navigation, localization, and path planning. LiDAR can be paired with a warning system to protect the safety of workers on the ground. In addition, LiDAR enables rich point cloud data and high accuracy for bulk material measurement, 3D mapping for surveys, and more. With a rugged design and reliable operation in any weather or lighting condition, LiDAR sensors from Quanergy can withstand the rigors of the mining industry and deliver dependable results in even the most punishing environments.

#### Key Applications

- Warning system
- Autonomous hauling
- Situational awareness of vehicles
- Navigation, localization & path planning
- Bulk material measurement
- Mapping for survey
- Harvest Automation
- Farm Automation



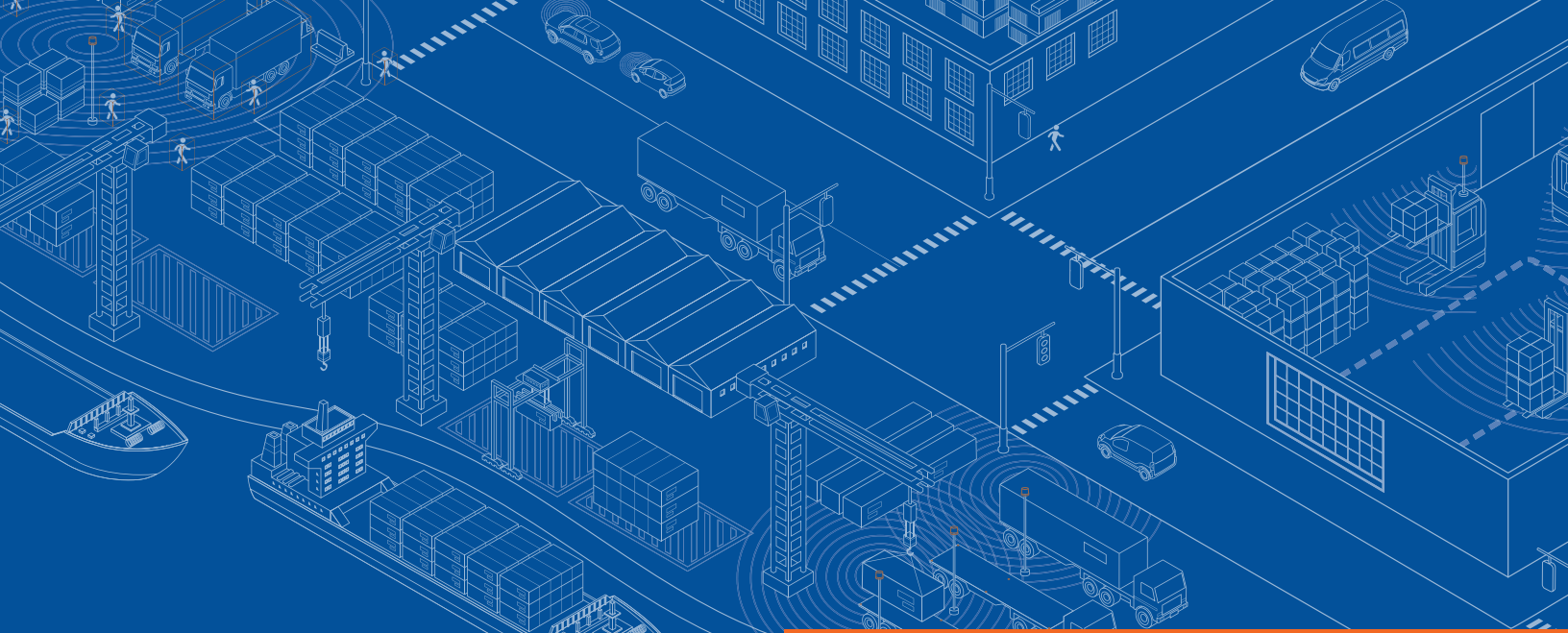
### Railway & Roadway

LiDAR sensors ensure safety and efficiency in railways and roadways. The advanced situational awareness enables LiDAR to reliably detect obstacles like fallen debris, rocks, and other objects on railway tracks so they can be safely cleared. In addition, LiDAR can be used to monitor the flow of traffic on roads and intersections, and the data can be used to identify infrastructure modifications that increase efficiency and protect pedestrian safety. LiDAR also provides accurate people counting capabilities to monitor traffic flow, monitor for security threats, and enforce occupancy limits at transportation hubs like bus or train stations.

#### Key Applications

- Grade / level crossing (put a sensor to notify a vehicle crossing)
- Detection of fallen debris, rocks, other objects on railway tracks
- Platform & Track safety awareness (monitoring)
- Occupancy counting
- Tolling & Vehicle classification
- Intersection safety
- Tunnel safety





## LiDAR Industrial Application

### Work Flow Management & Security

Quanergy's AI-powered 3D LiDAR flow management platform provides a modular, scalable, and advanced perception platform to enable real-time analysis for detection, tracking, classification, people counting, and more. When using QORTEX DTC, the inputs from multiple LiDAR sensors will be sent to a QORTEX DTC server to process the sensor point cloud information to detect, track, and classify objects. Object information is then published in a serialized format over the network for visualization and action in Security Center.

### Key Applications

- Work Flow Management
  - Direction of movement
  - Wrong way detection
  - Object Classification
  - Enhanced safety
  - People Counting
  - Time on Station
- Site Security
  - Intrusion detection
  - Occupancy
  - Perimeter



## LiDAR Provides Accurate Real-Time 3D Insights to Industrial Applications



### Workforce Optimization

Monitoring personnel to enable ergonomic best working practices without compromising identity.



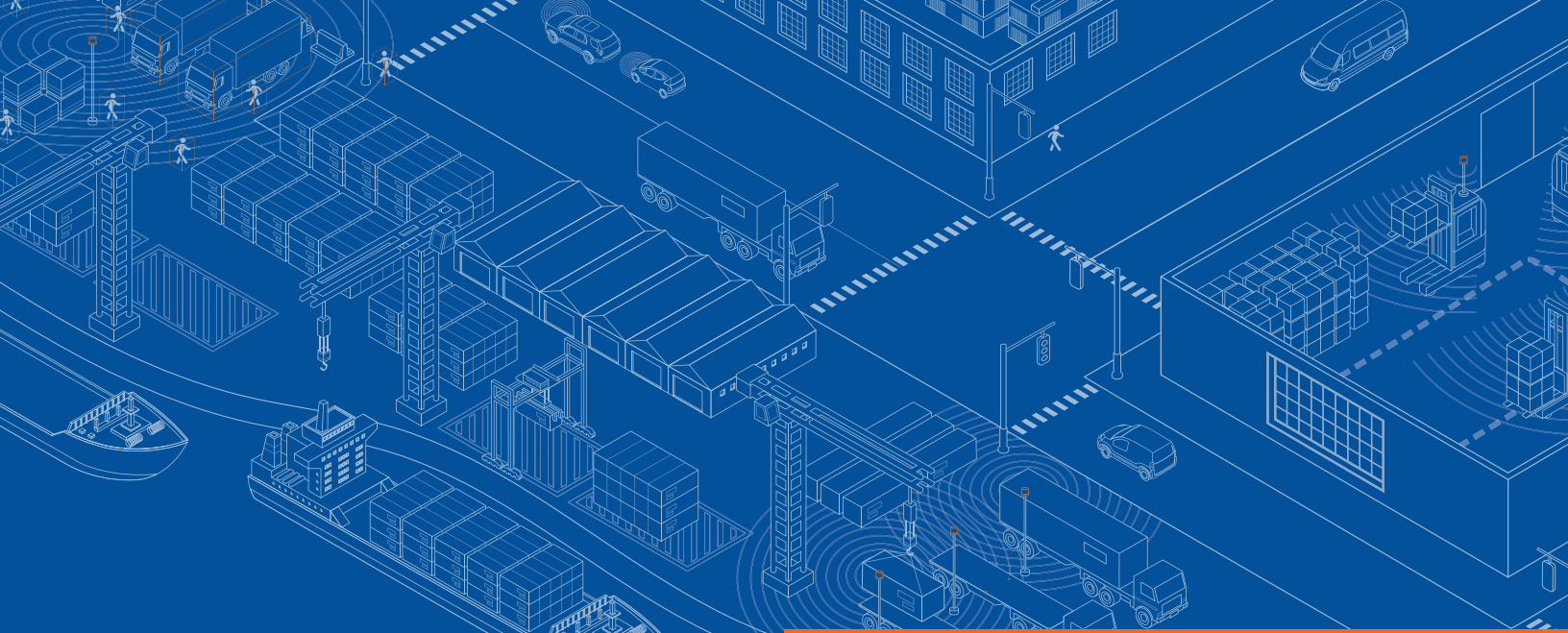
### Workplace Safety

Deliver object classification and environmental awareness providing real-time safety alerts.



### Superior Accuracy

Quanergy 3D LiDAR provides 95%+ detection accuracy and 24/7 reliability in all lighting & atmospheric conditions.



# LiDAR Industrial Application

## Product Offering

PRODUCT	MAX RANGE	RANGE ACCURACY (1σ at 50m)	FRAME RATE (Update Frequency)	ANGULAR RESOLUTION	FIELD OF VIEW (FOV)	# OF RETURNS	SOFTWARE	DIMENSION
M1-Core	100m (80% ref.) 35m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3		2D
M1-Plus	150m (80% ref.) 53m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3		2D
M1-Ultra	200m (80% ref.) 70m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3		2D
M1 Edge Core	100m (80% ref.) 35m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3	QORTEX Aware™ 1.0	2D
M1 Edge Plus	150m (80% ref.) 53m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3	QORTEX Aware™ 1.0	2D
M1 Edge Ultra	200m (80% ref.) 70m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360°	1 or 3	QORTEX Aware™ 1.0	2D
M8-Prime Core	100m (80% ref.) 35m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360° Vertical: 20° (+3°/-17°)	3	QORTEX Aware™ 1.0	3D
M8-Prime Plus	150m (80% ref.) 53m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360° Vertical: 20° (+3°/-17°)	3	QORTEX Aware™ 1.0	3D
M8-Prime Ultra	200m (80% ref.) 70m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360° Vertical: 20° (+3°/-17°)	3	QORTEX Aware™ 1.0	3D
MQ-8 PoE	200m (80% ref.) 70m (10% ref.)	<3cm	5-20Hz	0.033° - 0.132° dependent on frame rate	Horizontal: 360° Vertical: 20° (+3°/-17°)	3	QORTEX DTC™	3D