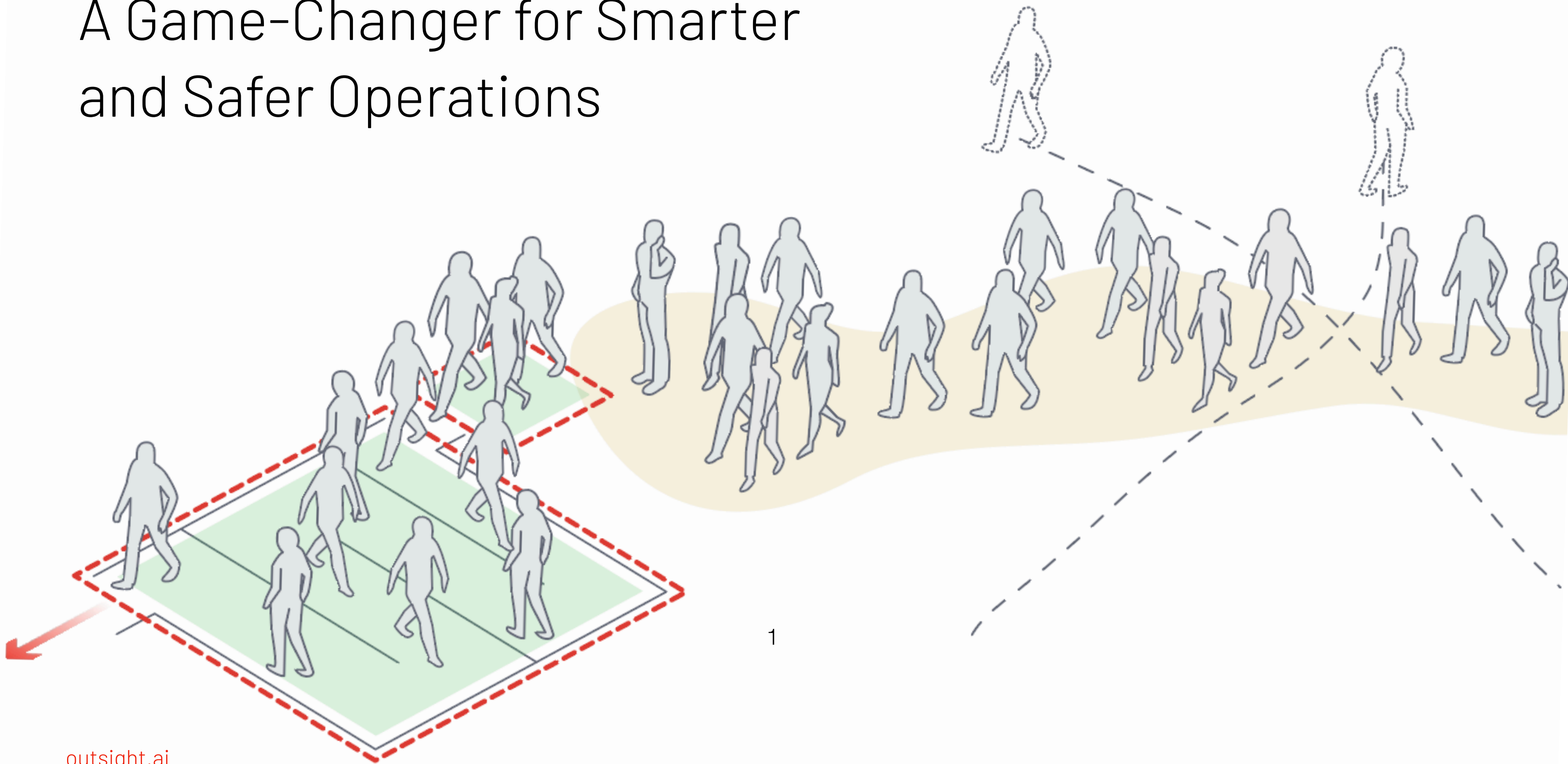


LiDAR in Airports

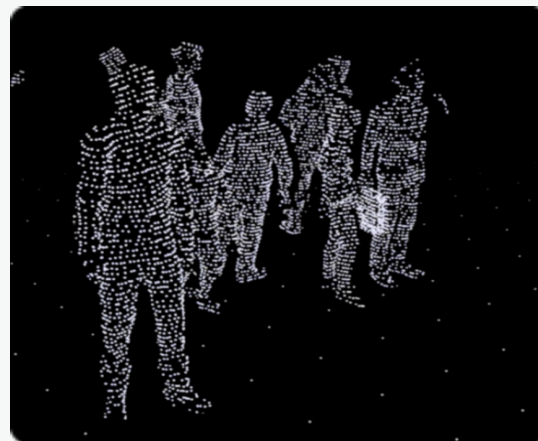
A Game-Changer for Smarter
and Safer Operations



What is LiDAR?

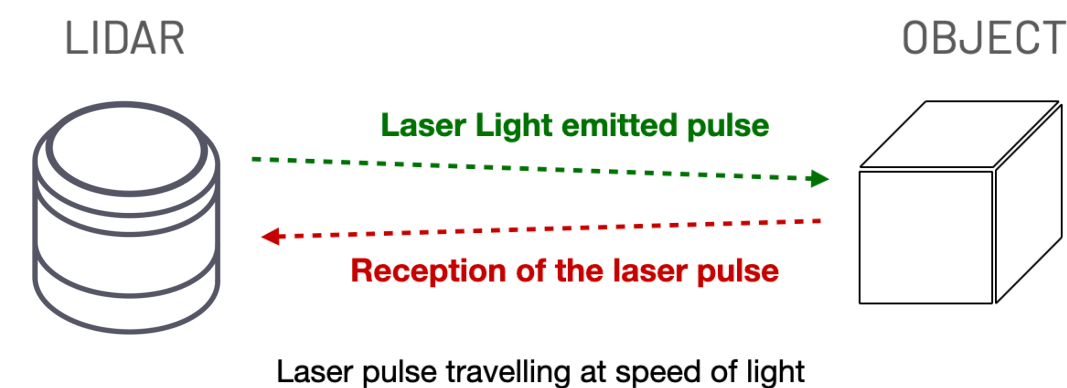
NASA initially developed LiDAR in the 1970s for use in space. It uses laser beams to create 3D vision for a computer to perceive its surroundings.

When deployed at scale, LiDAR offers an important nontechnical advantage: no personally identifiable information is ever captured.



Light Detection and Ranging, also known as LiDAR, is a technology for remote sensing that is used to measure distances in an environment.

This is accomplished by illuminating the environment in question with light that is invisible to the human eye and timing how long it takes for the light to reflect back.



Repeating this process millions of times per second gives computers an accurate portrayal of the environment that is being scanned, allowing them to "see" the world in three dimensions.

Unlike existing 2D-based perception technologies such as cameras, the 3D data from LiDAR produces highly detailed, accurate spatial measurements and works in a range of environments and contexts, such as during the night and under direct sunlight.

Thanks to multi-Billion Dollar investments in the context of Self-Driving Cars, customers in all other industries now have the choice of many different LiDAR manufacturers, all of them with specific strengths and weaknesses.

Only in the US, more than ten LiDAR Companies are public. The other continents have also several key players each, with some seven key players in Europe and a dozen more in Asia.

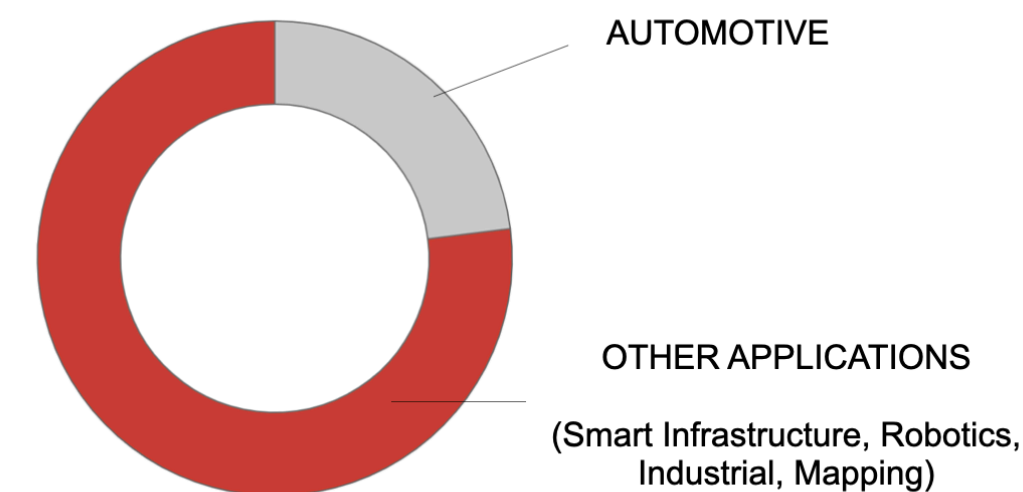
Beyond Automotive

LiDAR has been used for mapping for a long time, but recently it has gained attention in the automotive sector, particularly for self-driving cars research and development.

Non-automotive applications now represent a bigger opportunity for LiDAR*, and many sensor models with the right price-performance ratio are currently available

From smart cities to autonomous machines, companies in both the public and private sectors are increasingly utilizing 3D perception.

While the technology is still too expensive to be affordably deployed in an average consumer car, the competition among LiDAR sensor manufacturers is driving down the price and making it feasible for other markets such as security, mobile robotics, and industrial applications.



Airports are increasingly using 3D LiDAR to upgrade their camera-based technology and tackle previously impossible challenges. They are among the major industries already adopting this technology at scale.

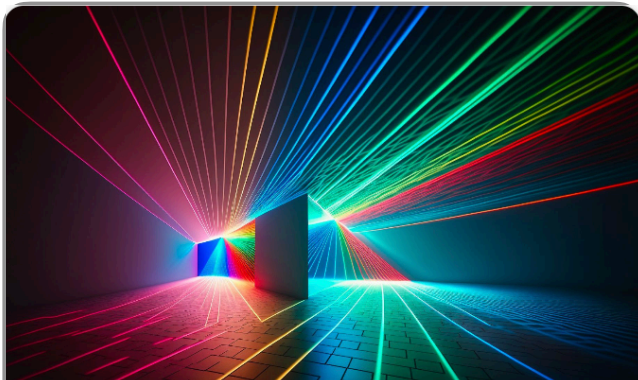
LiDAR-based solutions improve operational efficiency, safety, and passenger experience from the moment a passenger parks its car at the airport to takeoff.

This whitepaper aims to give a general overview of how LiDAR data is evolving into a transformative solution for the airport industry when processed and integrated with the appropriate software.

* Sources: LiDAR for Automotive and Industrial Applications, Yole Development, Outsight Research

Price and performance
are no longer barriers to
widespread adoption

Learn more in this article



TECHNOLOGY

Understanding the Basics of 3D
LiDAR Technology

Learn about the underlying technology
enabling a whole new level of 3D
Perception and Situation Awareness.

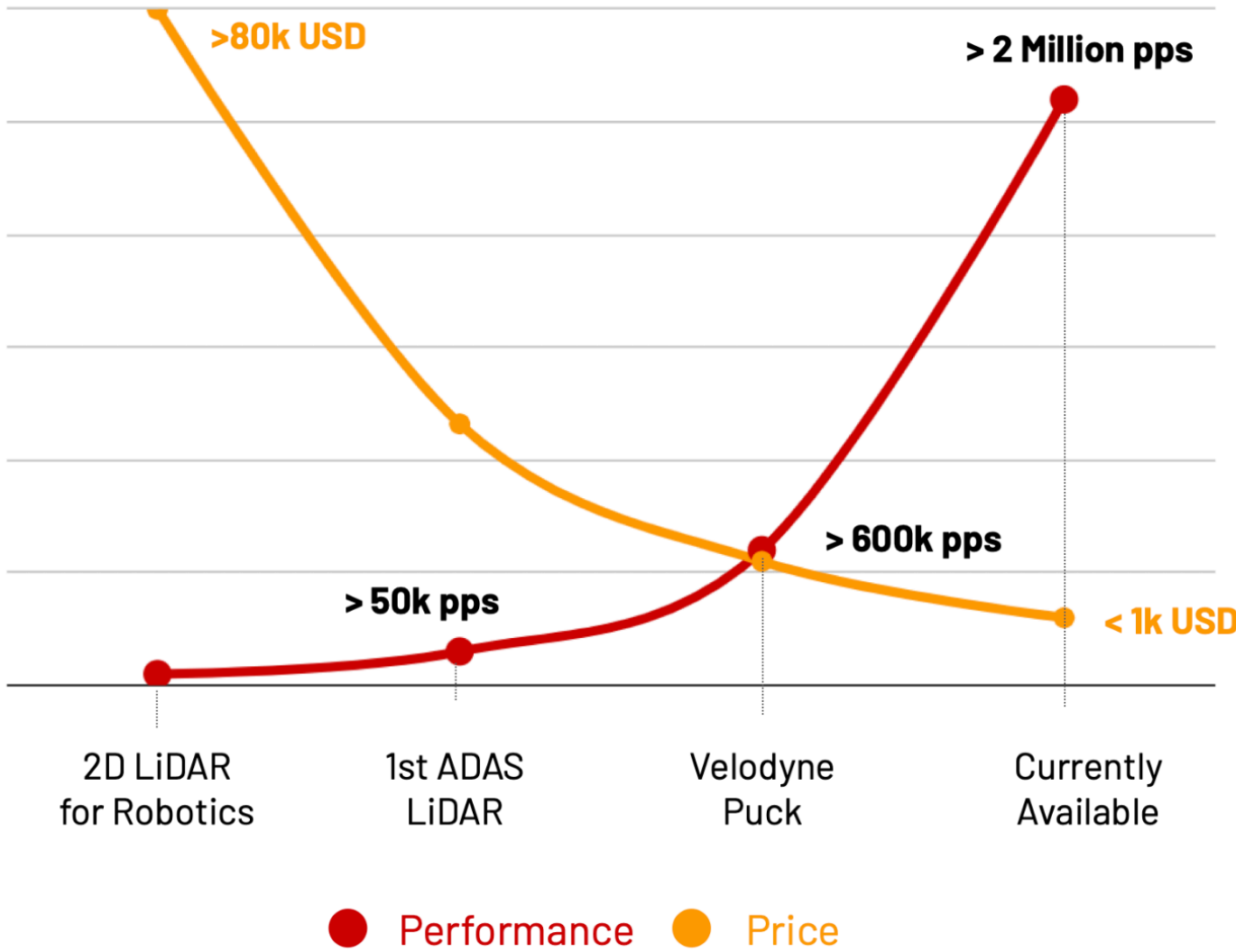
[Read the article](#)



Anne-Sophie Dubois

LiDAR Hardware is maturing and becoming more affordable.

There are many sensor models on the market right now with the right price-performance ratio, because, unlike automotive, prices in the tens of dollars are not an absolute requirement for deployment in most applications.



Similarly, performance is rapidly improving, with millions of points per second* becoming the norm rather than the exception.

This allows for use cases that were previously impossible with low-resolution models.

* In general, the higher the device's laser hits per second, the better its performance. Note that this is only a partial performance estimate; many other KPIs strongly influence which LiDAR to use.

Why LiDAR is a key enabling technology

Compared to legacy technologies like Camera-based perception, 3D LiDAR brings unique value.



Uninterrupted **Tracking***

Thanks to continuous tracking across the entire facility, you can view end-to-end traffic flow throughout the airport or detailed individual level data in any location.



You can cover **large areas**

Thanks to detection ranges of up to 300 meters, large areas like terminals can be covered by a few units, which translates into lower hardware & setup costs.



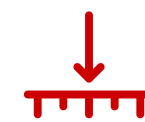
It emits **its own light**

It can function in complete darkness and is unaffected by changing lighting conditions because it is an active sensor (as opposed to a passive one like cameras).



It provides **Spatial Insight**

With the help of 3D native data, it is possible to gather important information like distance, size, volume, and speed, improving performance and providing new insights.



Centimetre-level **Accuracy**

Thanks to the use of Laser light, the high precision is constant regardless of the distance, which is crucial for tracking in wide areas.



Privacy by design

It is not possible to identify specific people using LiDAR data. Therefore, tracking is completely anonymous; no need to record facial information.



Multi-Purpose

It's not only about tracking passengers: the same LiDAR infrastructure can be used for a variety of purposes, from managing parking lots to streamlining tarmac operations.

* Requires a processing Software Solution, see Page 9

The unique benefits of LiDAR for Airports

When processed by the right Software, LiDAR brings a set of highly-valuable benefits for Airports

Elevate **Passenger Experience**

Get higher airport ratings, increase time step in retail and reduce missed flights.



How?

Reducing bottlenecks and wait times with real-time and accurate data on queue lengths and wait times for dynamic adjustments.

Improve **Operations & Forecast**

Manage increased traffic with the same or lower resources through better allocation & optimal staffing.



How?

Streamline your operations with an unprecedented level of insights on People Flow, Passenger Behaviour and Resource Utilization.

Higher **Security & Safety**

Minimize financial losses and reputation harm from emergencies. Ensure regulatory compliance.



How?

Accurately manage risks ranging from unauthorized access to overcrowding, both indoor and outdoors.

Increase **NAR**

Higher revenues through better passenger flow understanding and resource allocation.



How?

Leverage passenger behaviour's profiling and extended time in Retail zones & accurate understanding of shoppers journeys.

Accurate **Infrastructure Planning**

Enables strategic, data-driven investments leading to improved utilization of space and resources.



How?

Extensive historical data for trend analysis and simulation. Make informed decisions on terminal layout and new constructions.

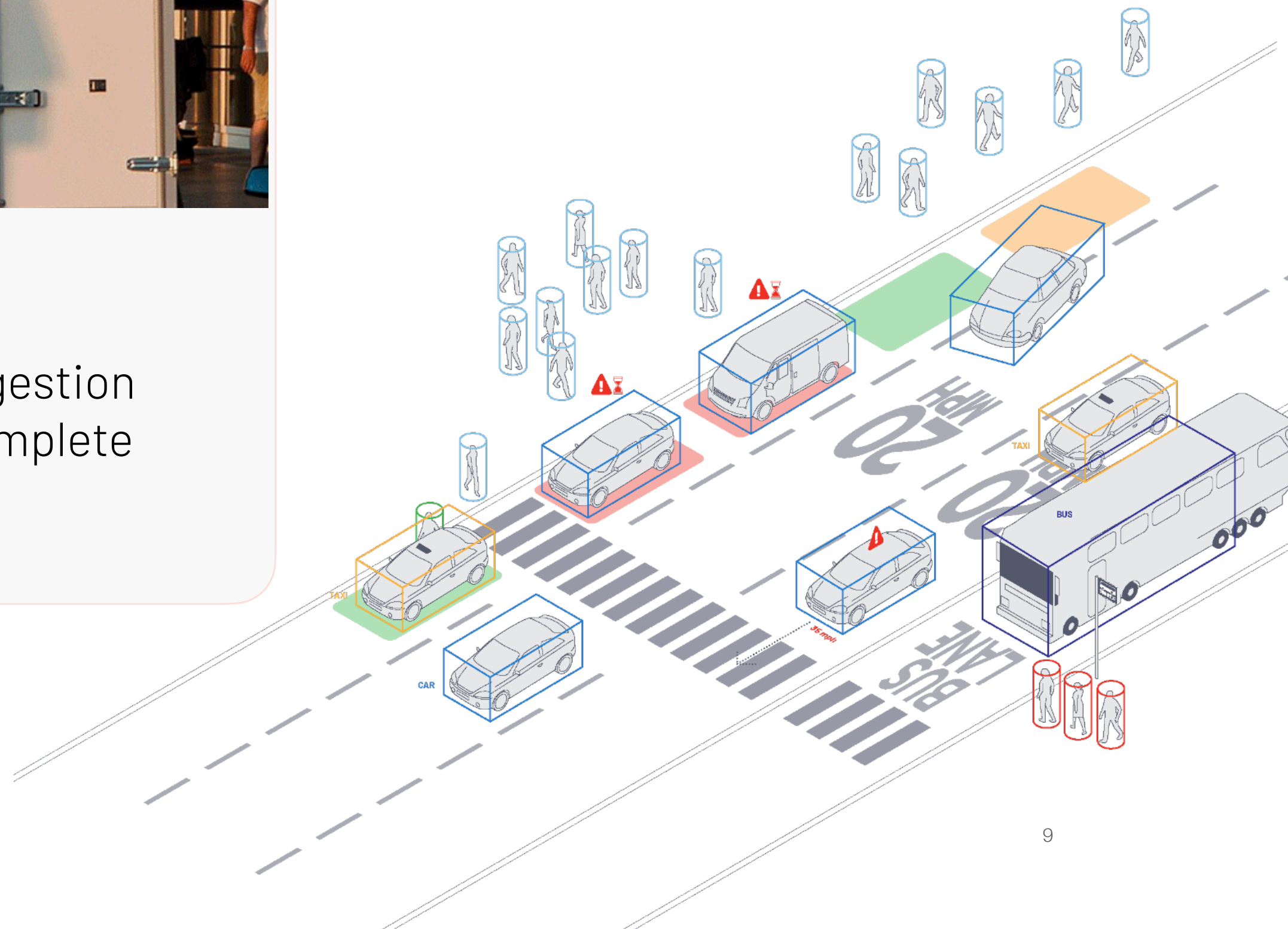
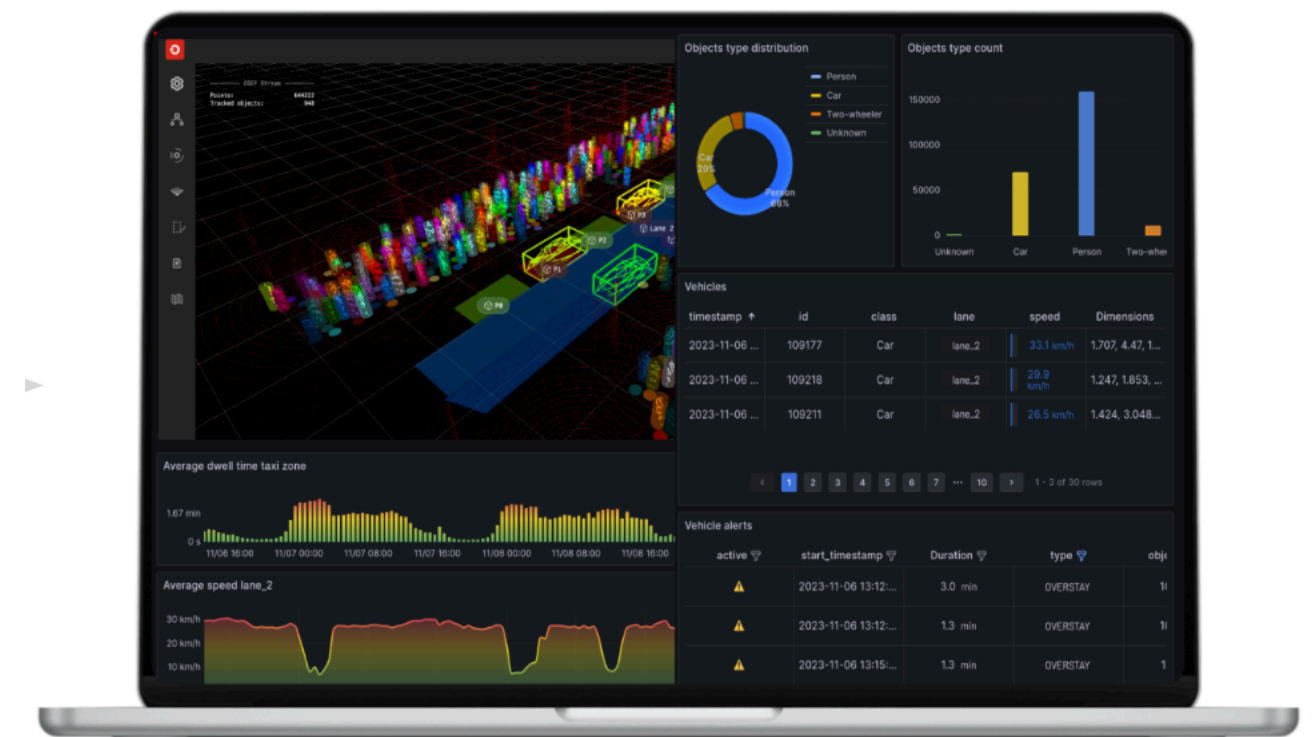
Curbside & Parking Monitoring

Monitor mixed traffic (vehicles + people), enabling end-to-end PAX journey tracking and gathering key insights.



How?

Optimize operations, reduce congestion and related costs. Elevate the complete passenger journey.



Meet the 3rd Generation of People & Vehicles Counting Technologies

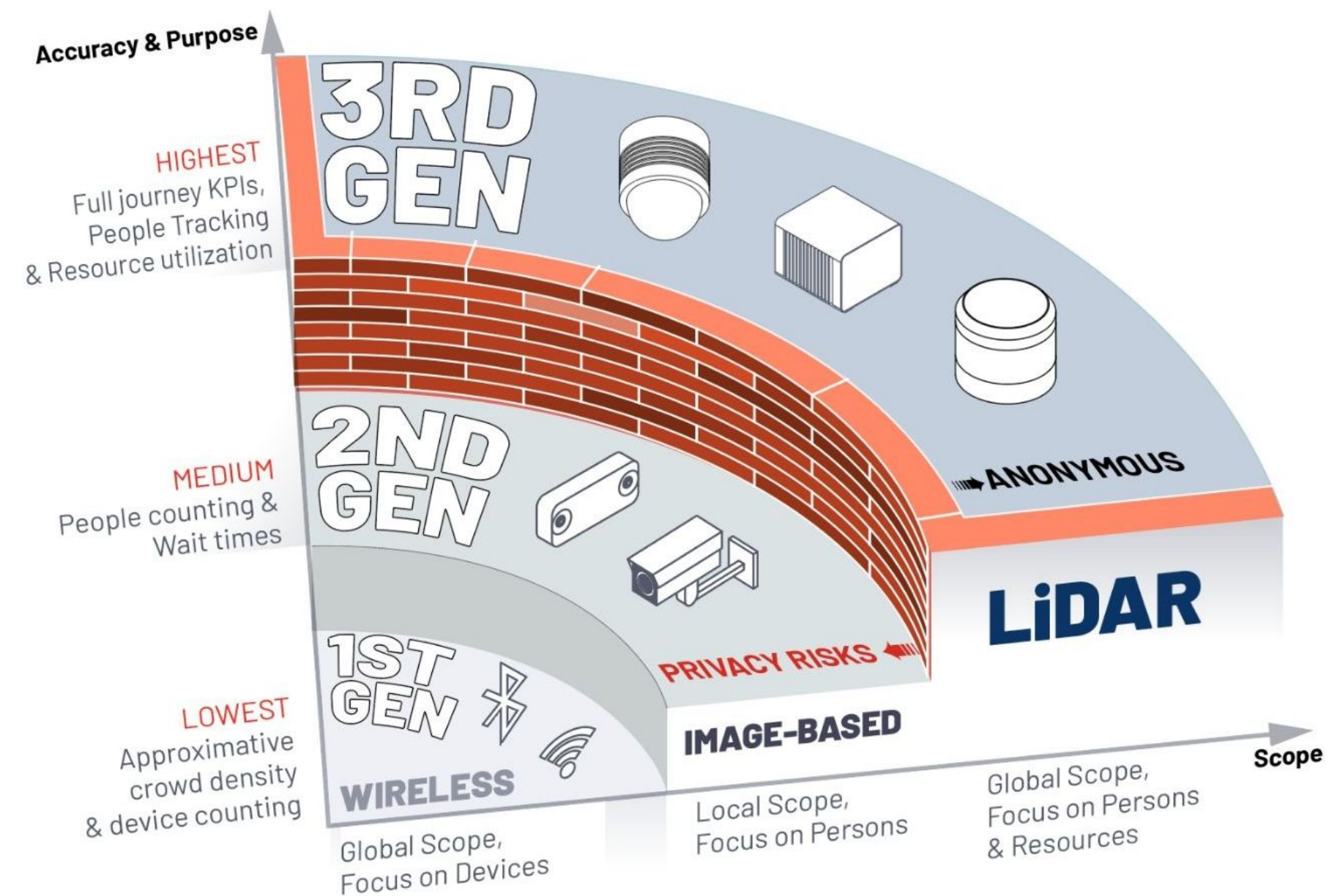
From rudimentary People Counting to encompassing Spatial Intelligence, two evolutionary leaps have been made.

Technological evolution is not a linear or uniform process. Significant improvements in performance and capabilities, which open up previously impossible possibilities, typically follow quantum leaps or technology generations.

The transition from approximate People Counting solutions to comprehensive Spatial Intelligence, based on continuous People Tracking, involves not just one, but two generational steps.

This evolution simultaneously also spans two axes, Performance and Scope, as summarized in the figure below and explained in more detail in this article.

LiDAR Technology is the key enabler of the 3rd technology Generation.



Key Use Cases

The operations in the Terminal have the greatest potential to add value for airport operators in the short term.



Visitor satisfaction

- Dwell time, current & predicted
- Flow Management (Groups & Individuals)
- Asset utilization



Business Intelligence

- Traveller / asset interactions
- Traveller Journey - Sankey chart
- Building occupation planning



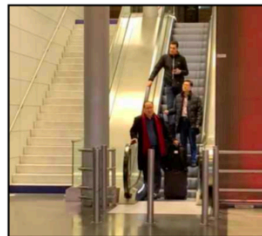
Safety & Compliance

- Crowd density measurement
- People distancing monitoring
- Gathering detection
- Outlier itinerary detection

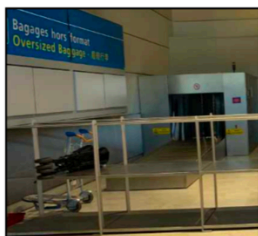


Operations optimisation

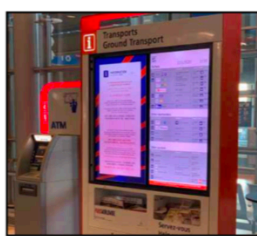
- Queue Detection & Management
- Waiting time
- Reaction to unusual events
- Assets and service providers' management



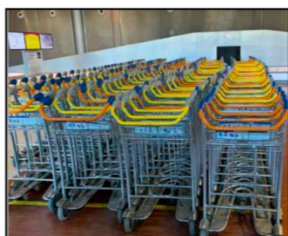
People flow from escalators to exit



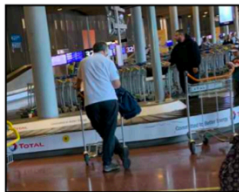
Oversized baggage zone usage



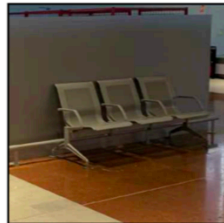
ATM & Ground transportation info



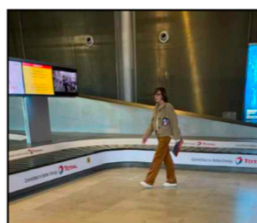
Trolleys usage ratio vs. occupied area



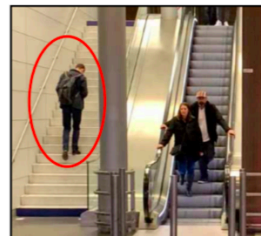
Waiting time on Luggage belts



Seat occupancy



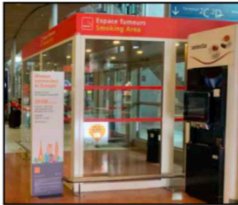
Luggage belt optimisation per flight



Stairs vs. Escalators, Upstream flow detection



Tracking Alone vs. Group situations



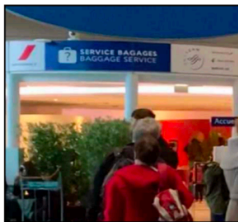
Smoking Area



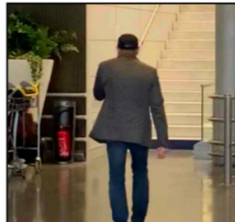
Restroom usage & flow from entry/exit



Suppliers & Operations monitoring



Lost baggage zone flow monitoring



Abnormal trajectory / behavior detection



With/without baggage attribute



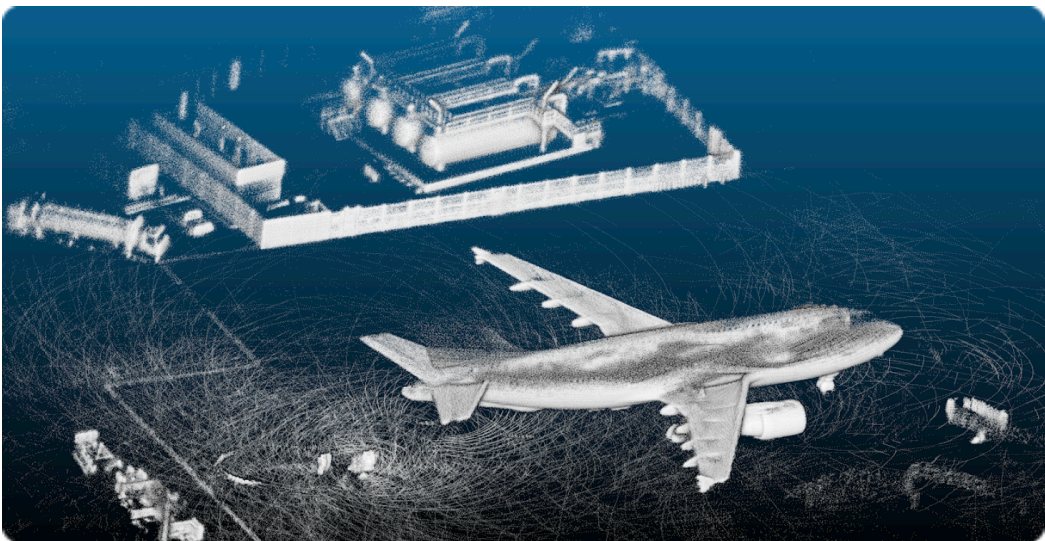
Usage of other assets

As an example, in the Luggage claim zone alone you can find dozens of use cases

Outside the Terminal

The 3D Situation Awareness provided by LiDAR, in any lighting and most weather conditions, enables many other uses that will be put to use in the near future.

Due to the expertise of LiDAR software providers like Outsight in other industries, this will be made easier (Defense, Road safety, Industry)



Smart Tarmac

- Turnaround time reduction
- Service vehicles Localisation
- Foreign object debris identification
- Guiding Autonomous Vehicles
- Fluid spreading detection



Security & Safety

- Perimetric security
- Wildlife detection
- Service vehicles & people safety
- Parked aircraft security
- Runway monitoring



Curbside monitoring

- Manage parking lots utilization
- Prevent congestion
- Optimize pick-up and drop off
- Ensure visitors' safety
- Track complete traveller's journey from ground transportation (train, bus, car) to plane

From Perception to Spatial Business Intelligence

LIDAR raw data is a key enabler but doesn't provide *per se* the information that is required in any application or business case.



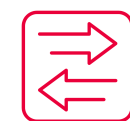
Fusion & Processing

A virtual 3D Sensor is created combining data streams from various manufacturers and processed in real-time.



Turn-key Solutions

The output is transformed into pertinent KPIs, in a user-friendly dashboard. Including real-time event-triggered alarms and aggregated data analytics.

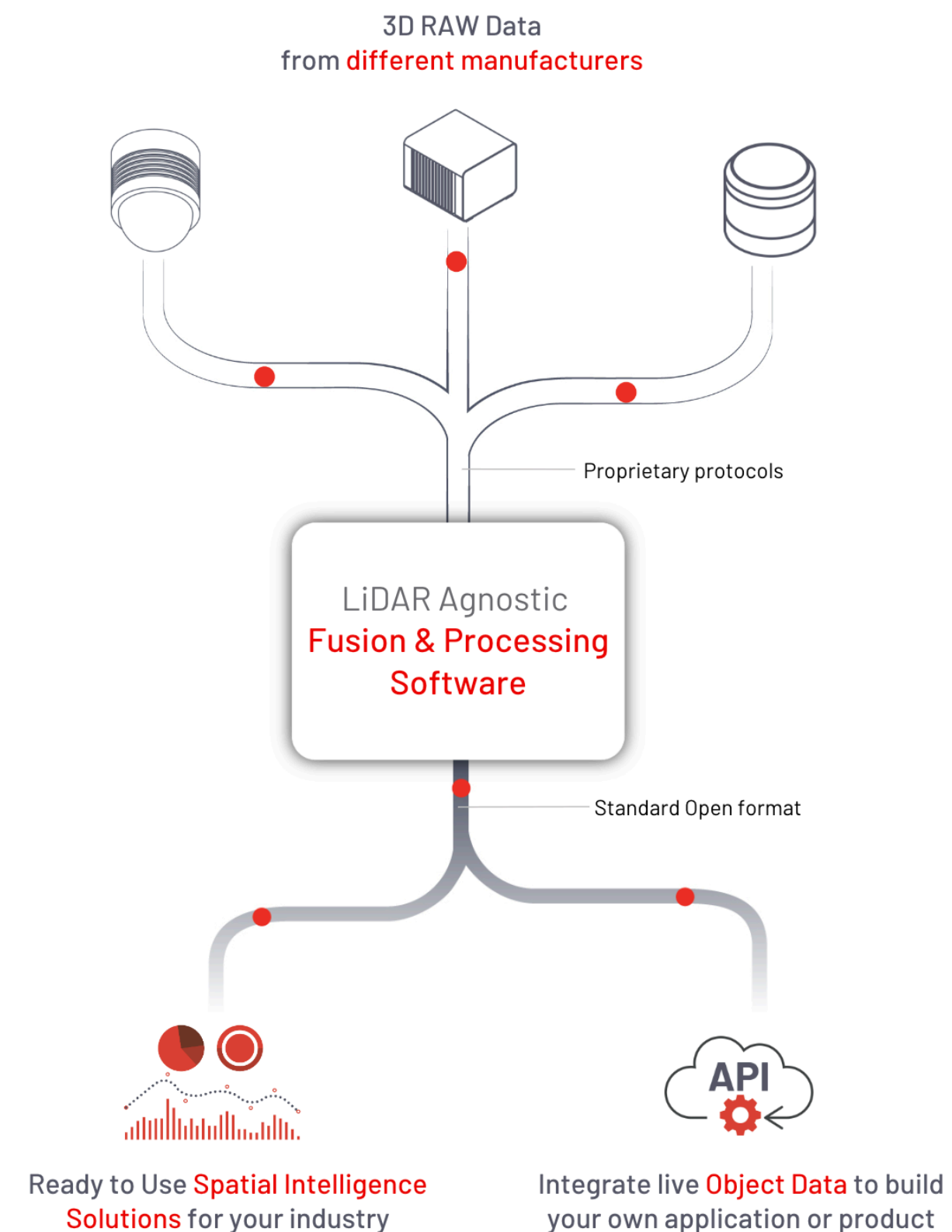


API for developers

You can also build your custom application thanks to the API and an open standard data format, regardless of the proprietary hardware input protocol.

LiDAR Software Solutions like Outsight's SHIFT Perception and Analytics turn RAW Sensor data into actionable insights.

It fuses many sensors from different manufacturers, processes the data, and delivers it as a KPI Dashboard for Users or a lower-level API for Integrators.



The Benefits of a LiDAR Software Solution



Fast & Easy deployment

Single LiDAR solution working in minutes. Hundreds of LiDARs in hours, not weeks.

Deployment made simple with seamless calibration & synchronisation as well as user-friendly interface, free of framework dependencies.



Achieve world-class performance

As a pure player we're focused on delivering you the best software solutions.

Our team has been pioneering LiDAR real-time processing for two decades and served hundreds of customers in the most demanding industries.



Leverage the most advanced tools

From planning to deployment and maintenance, we got you covered.

It's not all about processing software, we've built the most advanced set of tools for each step of the solution lifecycle.



Use the right LiDAR Sensor(s)

We're hardware agnostic: you can use the best combination for your needs.

What we care about is the global performance and cost of our customers' solutions: most of the time this requires combining different manufacturers.



Optimize Cost & Energy

Light-weight Edge processing.
Low network and hardware requirements.

Our architecture was created to minimize hardware and setup costs., including the LiDAR(s) hardware, CPU and network aspects.



Future Proof

Built-in Hardware resilience through multi-sourcing and Scalability

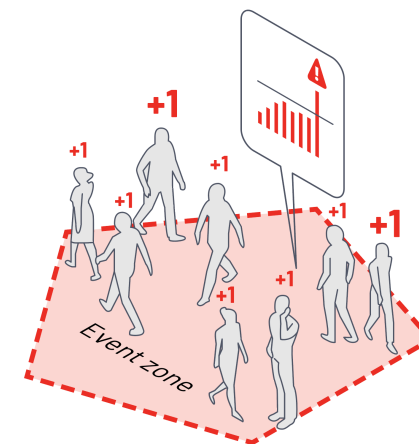
Our solution grows with you and adapts to changes in the future, including supply-chain issues with hardware and large-scale deployments.

Actionable KPIs

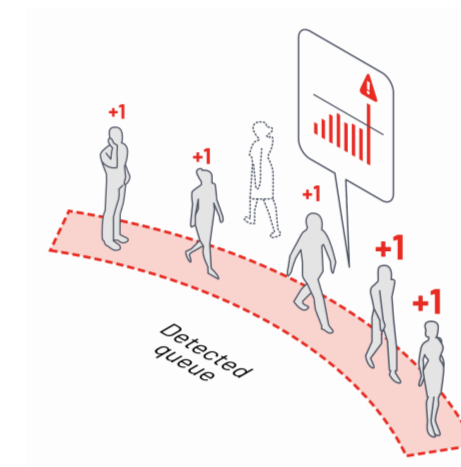
The Key Performance Indicators (KPIs) module is a critical component of Airport Spatial Intelligence solutions like Outsight's.

These KPIs measure and track various passenger queue wait times, flow volumes, trends, and the live asset utilization metrics at the Airport Terminal such as Check-In & Bag Drop kiosks, Security & Immigration lanes.

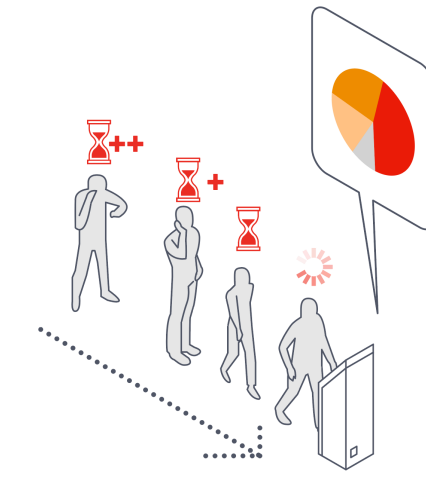
A complete solution must be able to deliver dozens of different KPIs, the most important ones can be classified in the following categories:



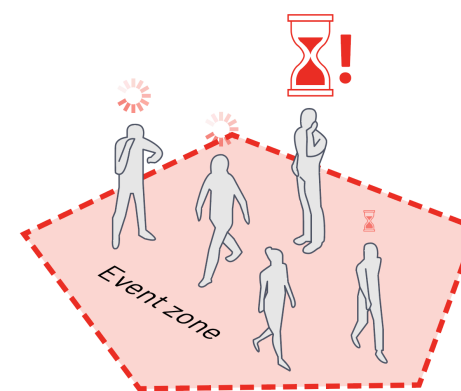
People occupancy in a Zone



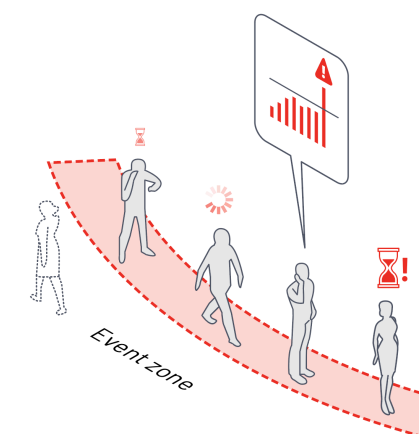
People occupancy in a Queue



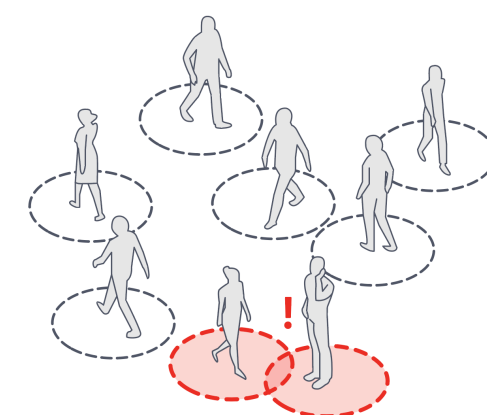
Usage of Resources



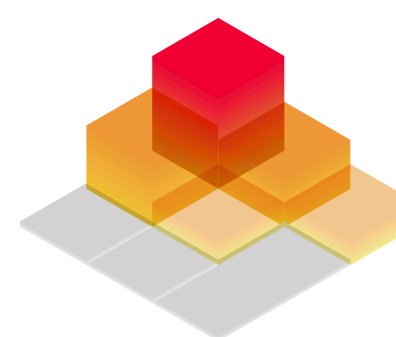
Waiting time in a Zone



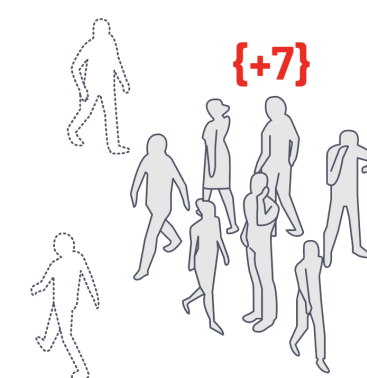
Waiting time in a Queue



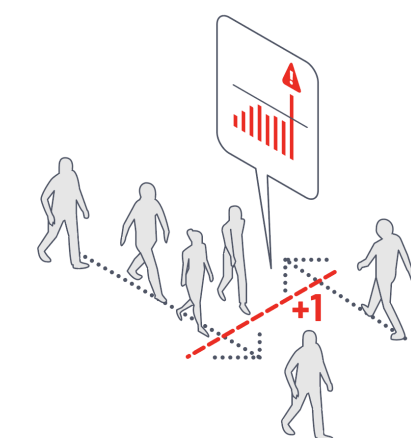
Safe distance detection



Premises-wide 3D Heatmap per KPI



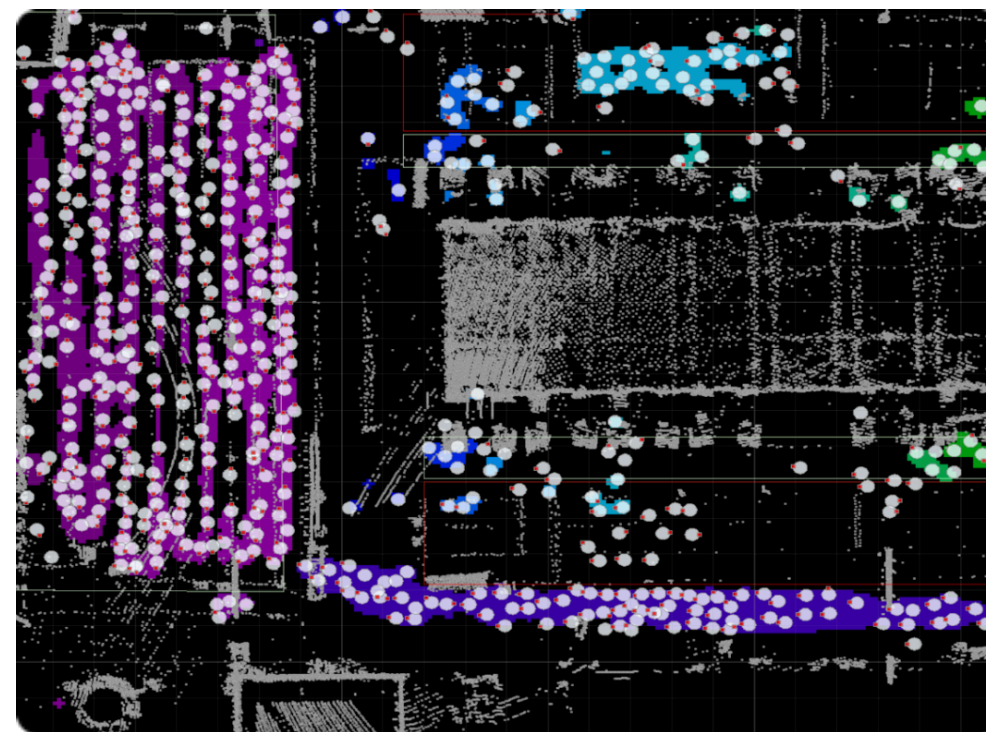
Cluster of people detection



People flow across a line

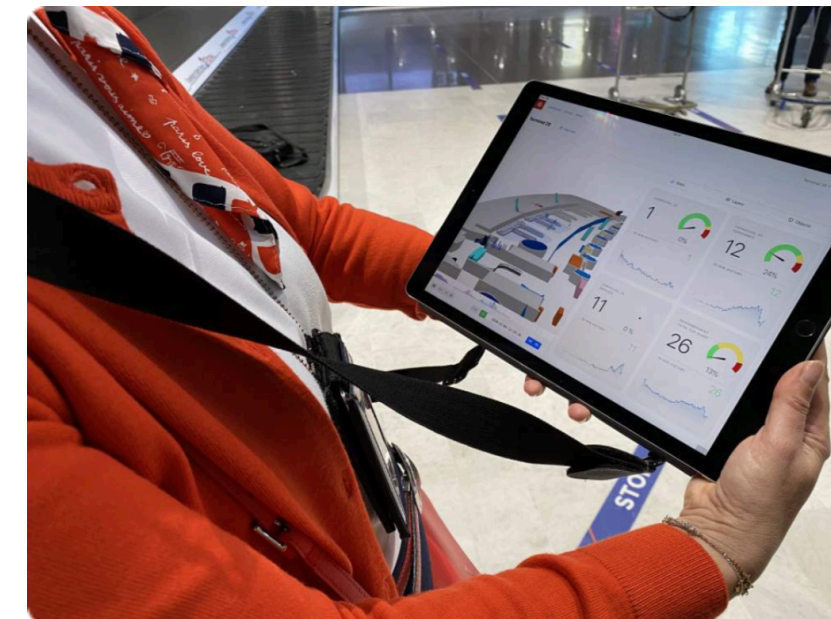
Advanced Analytics

Outsight Spatial Intelligence Software for Airports is a leading solution that can track thousands of people and objects simultaneously and provide insightful Dashboard KPIs.



Real-time Alerts

Custom thresholds for all relevant KPIs alert you to unexpected events instantly. React using precise spatial information to locate incidents.



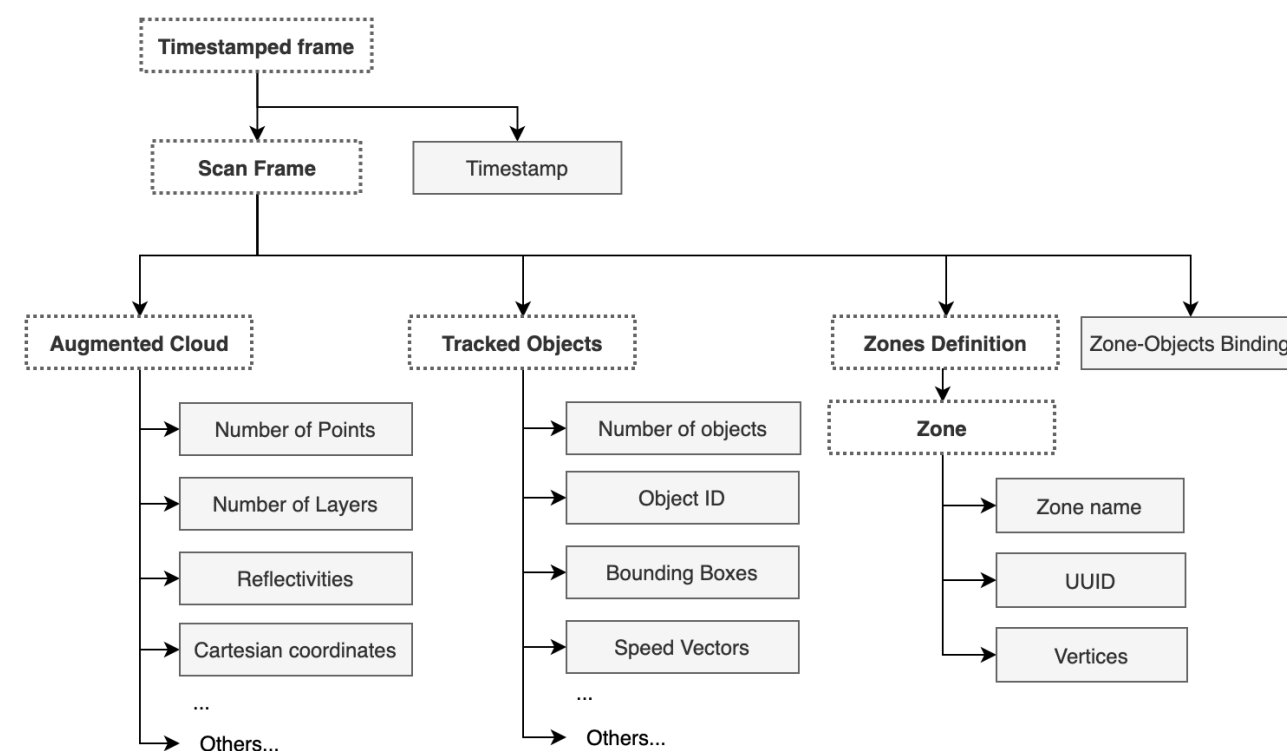
Aggregated data & Statistics

Understand trends and navigate the timeline across months and years. Instantaneously compute new KPIs based on historical recordings, for both individuals or aggregated data.



A data format scheme that grows with your needs

In order to avoid vendor lock-in and facilitate integrations with third party systems through an API, a Spatial Intelligence Software solution must work with a standard and open data format.



Outsight software delivers its output using OSEF, a serialization binary format, based on [TLV-encoding](#).

For each processed LiDAR Frame —typically at 20 fps— the structure of the OSEF data is a tree that contains the timestamp information and all its attributes.

An open & standard data format

LiDAR proprietary data formats and protocols made sense when this emerging technology first appeared since it shortened the time to market of new hardware products delivering raw data. The burden of decoding each specific format was on the user.

For an Lidar-based software solution for Airports to accomplish its purpose, it must provide an open data representation system with at least the following characteristics:

- **Open**: no proprietary IP or dependencies
- **Simple**: parsing it must be straightforward and efficient
- **Robust**: data elements can be placed in any order inside the message body
- **Backwards-compatible** so new features and data fields can be seamlessly added over time without compromising already-deployed applications (e.g., able to safely skip older or unknown elements)
- **Efficient**: to minimize both processing time and bandwidth
- **Adaptable**: must be able to react to user requests without changing its structure and decoding patterns, so only relevant data is sent
- **Flexible**: should be usable both for simple and small-sized data (e.g., the computed position of the sensor) and mass amounts of 3D information (e.g., the retransmitted point-cloud and associated attributes for maintenance purposes)

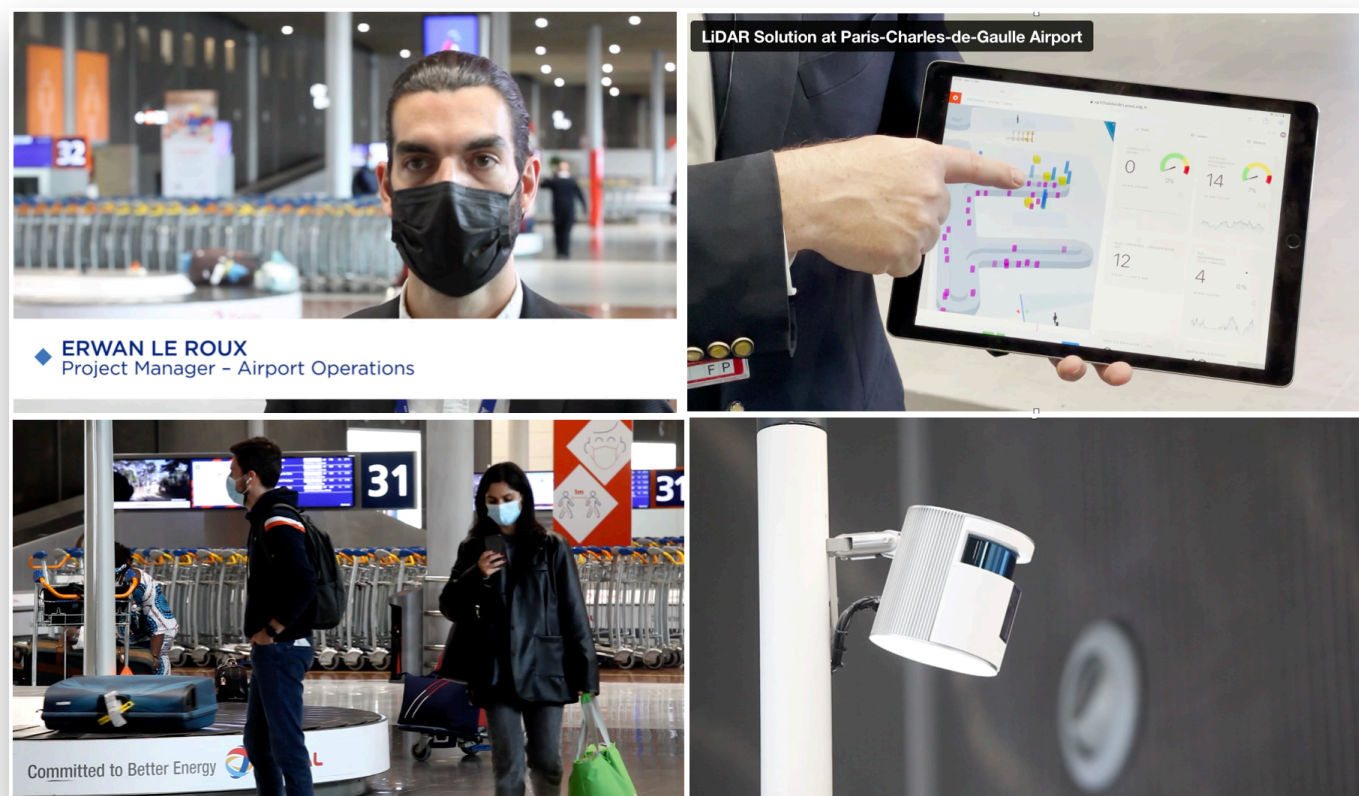
Other resources

Do you want to know more? Schedule a live demo with one of our Product Specialists at www.outsight.ai or take a look at other available resources on-line

Customer Case



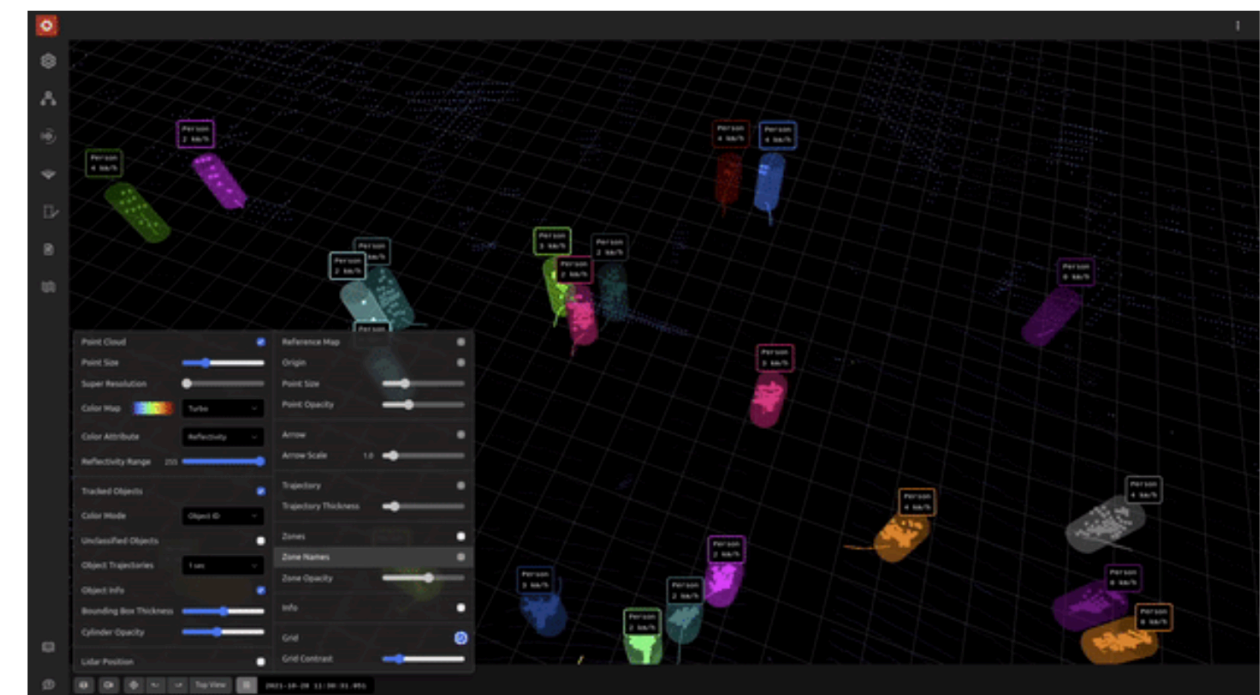
Aéroports de Paris
Charles-de-Gaulle and Orly Airports



Read our latest article [here](#):

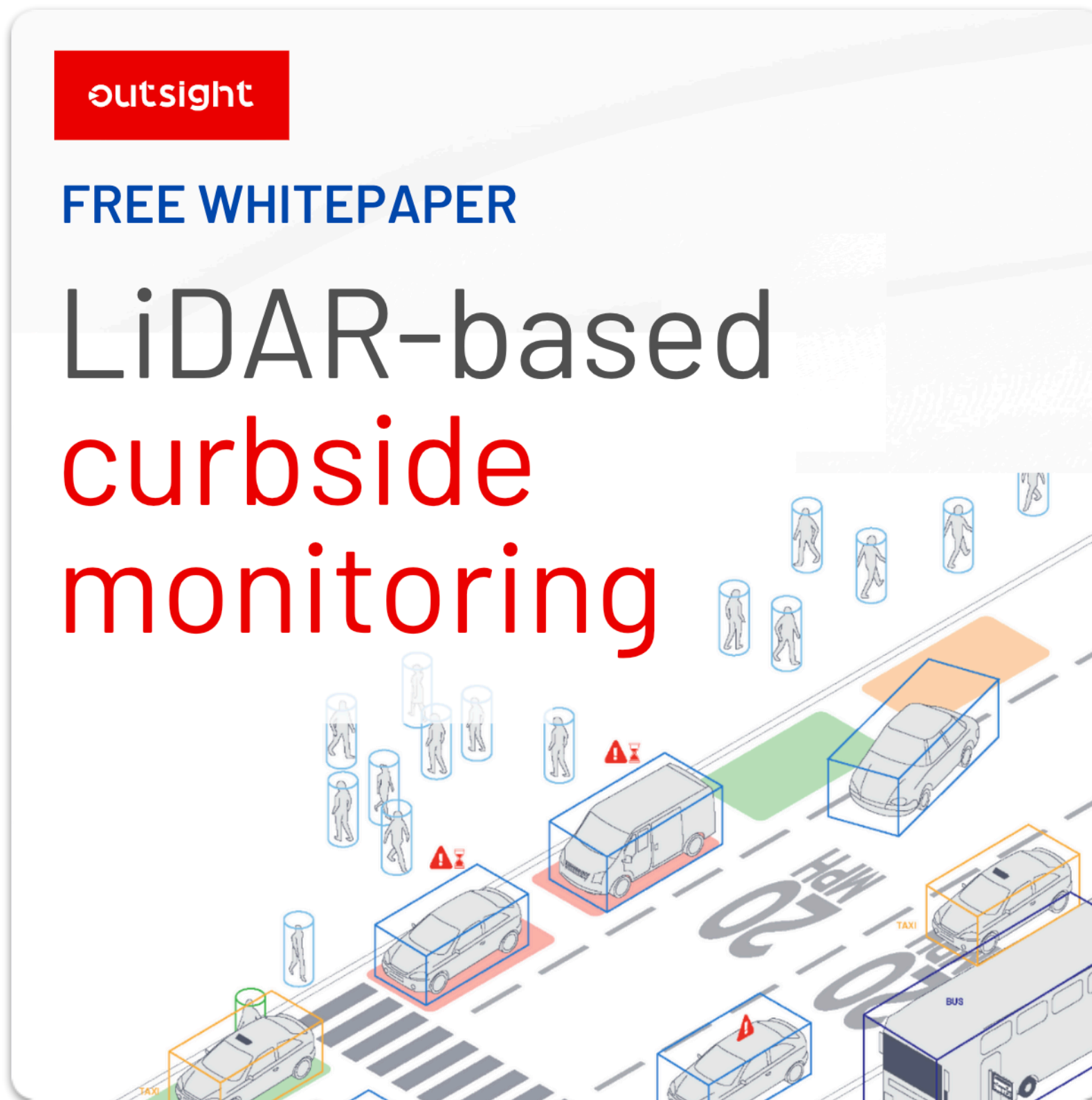
LiDAR Software helps airports manage increased traffic

Published on September 16, 2022 [Edit article](#) | [View stats](#)



Other resources

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Spatial Intelligence with Laser Precision

Our Spatial AI Software Platform delivers unique insights that optimize operations, enhance visitor experiences and boost safety, thanks to the accuracy and complete privacy of 3D LiDAR sensors.



Outsight's team has been pioneering real-time LiDAR processing for two decades, building transformative solutions in many customers' applications and contexts and filing over 70 patents, arguably becoming one of the most experienced software pure players globally.

Outsight's software solutions track and digitizes the motion of People and Vehicles using 3D LiDAR data.

Operators of transportation hubs like airports, train stations but also sport venues, road infrastructures and industrial sites get access to accurate and anonymous Spatial Intelligence data, in order to improve operations and increase security.

Our international team of scientists and engineers drive the development of our solutions from Paris, San Francisco, and Sophia-Antipolis (Nice). To support our global outreach, we also operate commercial offices in the UK, Belgium, Spain, Hong Kong, and Singapore.

We believe that accelerating the adoption of LiDAR technology through robust and scalable software solutions will significantly contribute to making the world smarter, safer and more sustainable.

LiDAR in Airports

A Game-Changer for Smarter and Safer Operations

To learn more, visit our website outsight.ai or follow Outsight on **LinkedIn**

