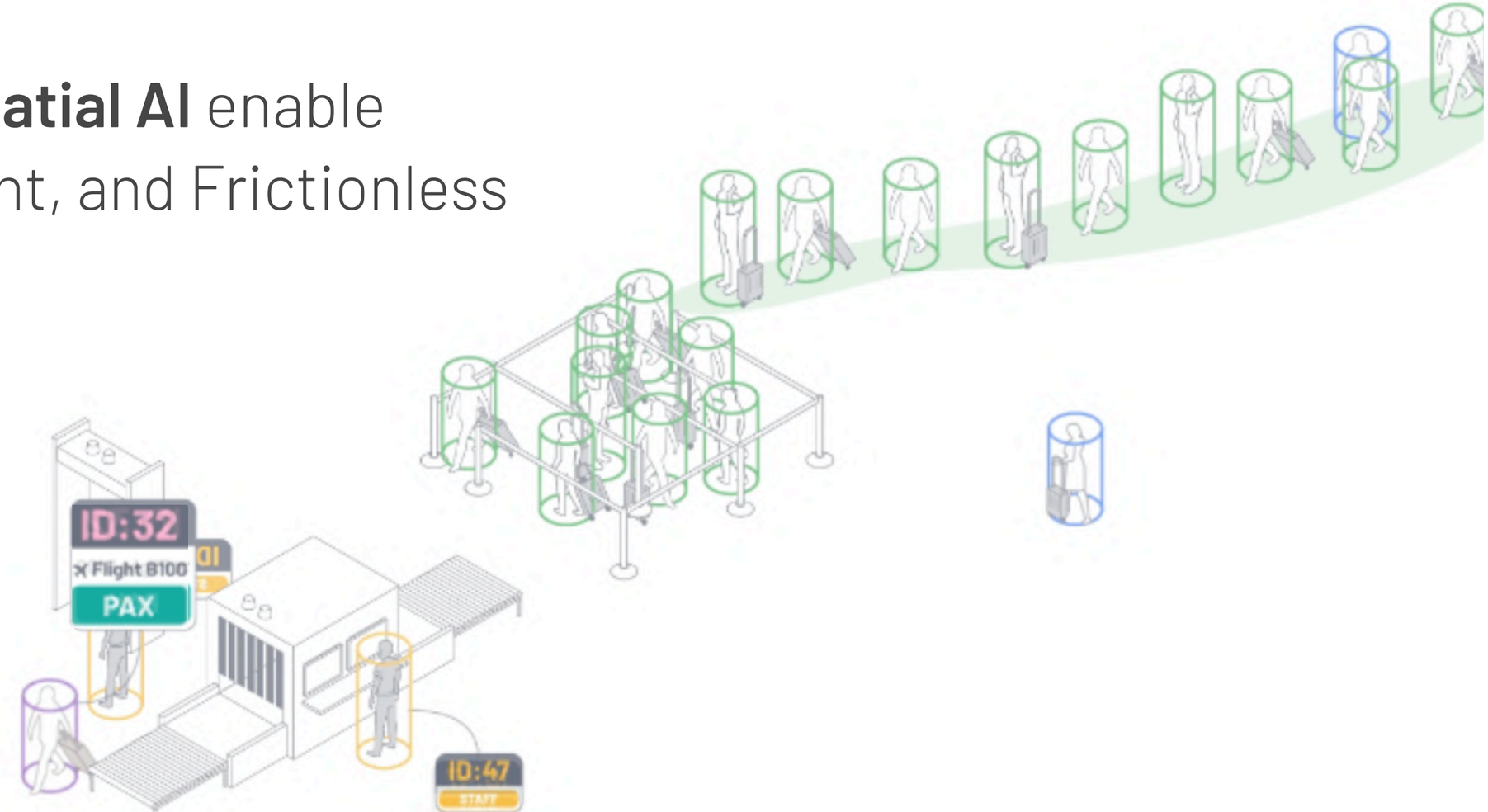
outsight

The EES-ready Airport

How **LiDAR** and **Spatial AI** enable Efficient, Compliant, and Frictionless Border Operations



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Executive Summary

As the European Union's Entry/Exit System (EES) transforms border control operations across Europe, **airports face unprecedented challenges in monitoring passenger flows**, managing queue dynamics, and demonstrating compliance—all while preventing delays during implementation.

Stereo-vision cameras mounted on the ceiling—a technology that was innovative 15 years ago—and CCTV struggle under these new operational realities. They falter in high crowd density and frequent layout modifications as airports adapt their infrastructure to accommodate biometric kiosks and registration stations.

LiDAR sensing combined with Spatial AI offers a fundamentally different approach, providing precise, continuous, and adaptable monitoring that maintains operational visibility and accuracy even as passenger volumes, queue structures, and physical environments change.

Outsight leads this space with large-scale deployments across four continents, demonstrating the resilience and reliability essential for the EES era.

This report examines **how modern 3D sensing capabilities provide the agility and accountability airports need** to transform EES from a compliance burden into an opportunity for operational excellence.

The challenge of EES for airports

Context

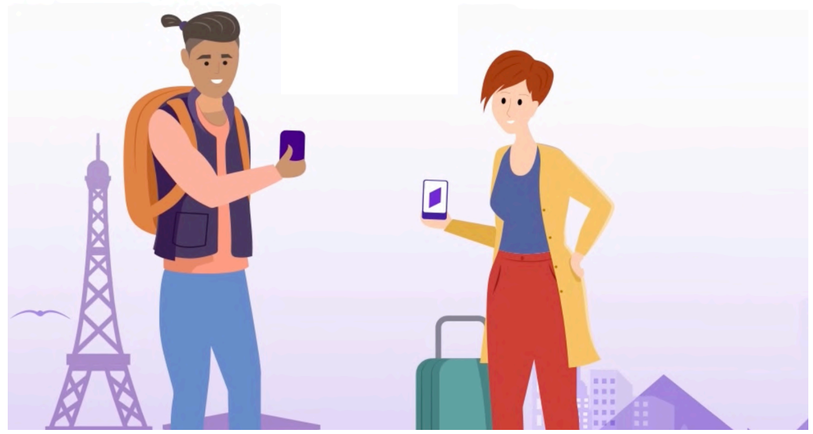
What is EES?

The Entry/Exit System (EES) became operational on October 12, 2025, with European countries introducing it progressively at their external borders.

Full implementation is expected by April 10, 2026.

The EES was created to modernise and secure border crossings within the Schengen Area. Its objectives are to:

- **Modernise and improve border management** through reliable electronic records and increased automation.
- **Enhance traveller experience** by gradually reducing waiting times through automated checks.
- **Prevent irregular immigration** by identifying overstayers and providing accurate entry/exit data.
- **Strengthen Schengen security** by preventing identity fraud via biometric verification and supporting law enforcement in tackling terrorism and serious crimes.



Operational complexity

Challenges for Airports

ACI Europe's guide explains that the operational implications of the EES will be significant for airports, air carriers and passengers with significant numbers of non-Schengen flights.

Managing New Border Control Realities

The EES has been in development for years, though its launch date has been repeatedly delayed. Despite being a European-wide policy with a centralized registration system, border control execution remains under national authority.

This has resulted in each country deploying EES through different hardware manufacturers and integration approaches tailored to their existing frameworks.

Concerns from airports about the central system's ability to handle peak traffic volumes led to an agreement on phased implementation, designed to prevent operational disruption during the rollout.

Navigating complexity

Risk of Saturation

EES dramatically extends border checkpoint processing times due to biometric registration requirements, creating cascading queue overflows that can block EU passenger lanes and disrupt subsequent flights

EES significantly increases processing times at border checkpoints:

1. The added biometric steps (photo, fingerprints, data entry) lead to **longer processing times per passenger**, especially for non-EU travellers.
2. **Process times for third-country nationals may be 1.5 to 3 times longer**, depending on airport setup.
3. **Queues can easily overflow and block all lanes**, including those dedicated to EU passengers not subject to EES. If many “first-time” travellers using EES arrive together, they can block border control areas for subsequent flights.
4. In extreme cases, **airports might need to keep passengers onboard aircraft** until the border control area is cleared.

Additional Roadblocks

Physical and Administrative Constraints

Airports face complex governance, space limits, and added staffing needs as EES rollout demands new biometric kiosks and accurate data for accountability.

Complex Governance

Border control zones operate under the authority of national police services rather than airport management.

While theoretical service level agreements exist—such as 30-minute targets for EU citizens and 45 minutes for non-EU nationals—actual performance frequently falls short of these benchmarks.

Managing this complexity requires objective and accurate data sources to drive accountability and improvement.

Space and Infrastructure constraints

The self-service EES kiosks had to be installed in already constrained areas, sometimes in corridors. Airports will need new equipment -self-service kiosks, biometric capture- and possibly more space.

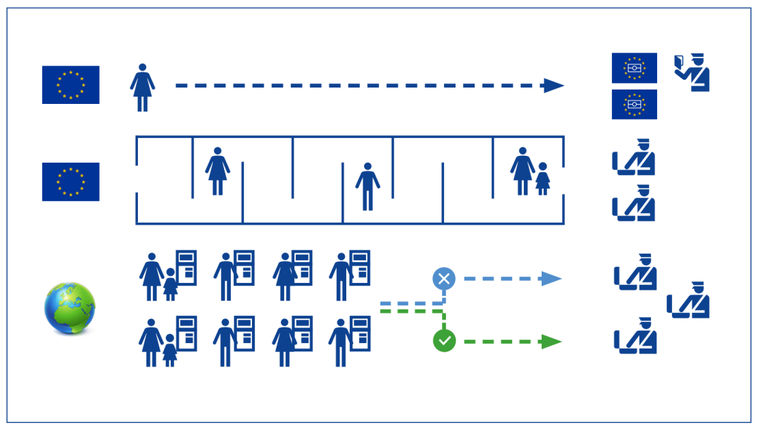
Because identity verification is critical to prevent “tailgating,” the process requires additional staff to monitor kiosks—creating an operational constraint.

Limitations of the existing queue measuring solutions

Limitations of legacy technologies

Lack of continuous tracking capabilities

When the EES regulations came into effect, existing queue measurement solutions, based on 15-years' old Stereo-vision technology, began to show their limitations, as they lacked the robustness to handle dynamic queue configurations and therefore failed to deliver accurate KPIs.



The Example of an European Airport, customer of legacy technology

The queues were originally separated into four passenger typologies:

- Priority passengers (business class)
- EU passengers with children under 12, not eligible for automated gates.
- EU passengers with children over 12 and certain associated countries, eligible for automated processing.
- Non-EU passengers

Due to the restricted space, **the non-EU queue frequently became saturated**, while the EU lines moved swiftly. In these moments, airport staff would initiate what they called a "PAX release" — temporarily opening part of the EU area to allow non-EU passengers to use the available booths.

> But a hidden issue remained: the stereo camera system could count and time passengers within fixed zones but couldn't continuously track those moving between queues.

The result: artificially short waiting times reported for passengers who started in the congested non-EU queue but finished processing in the EU zone.

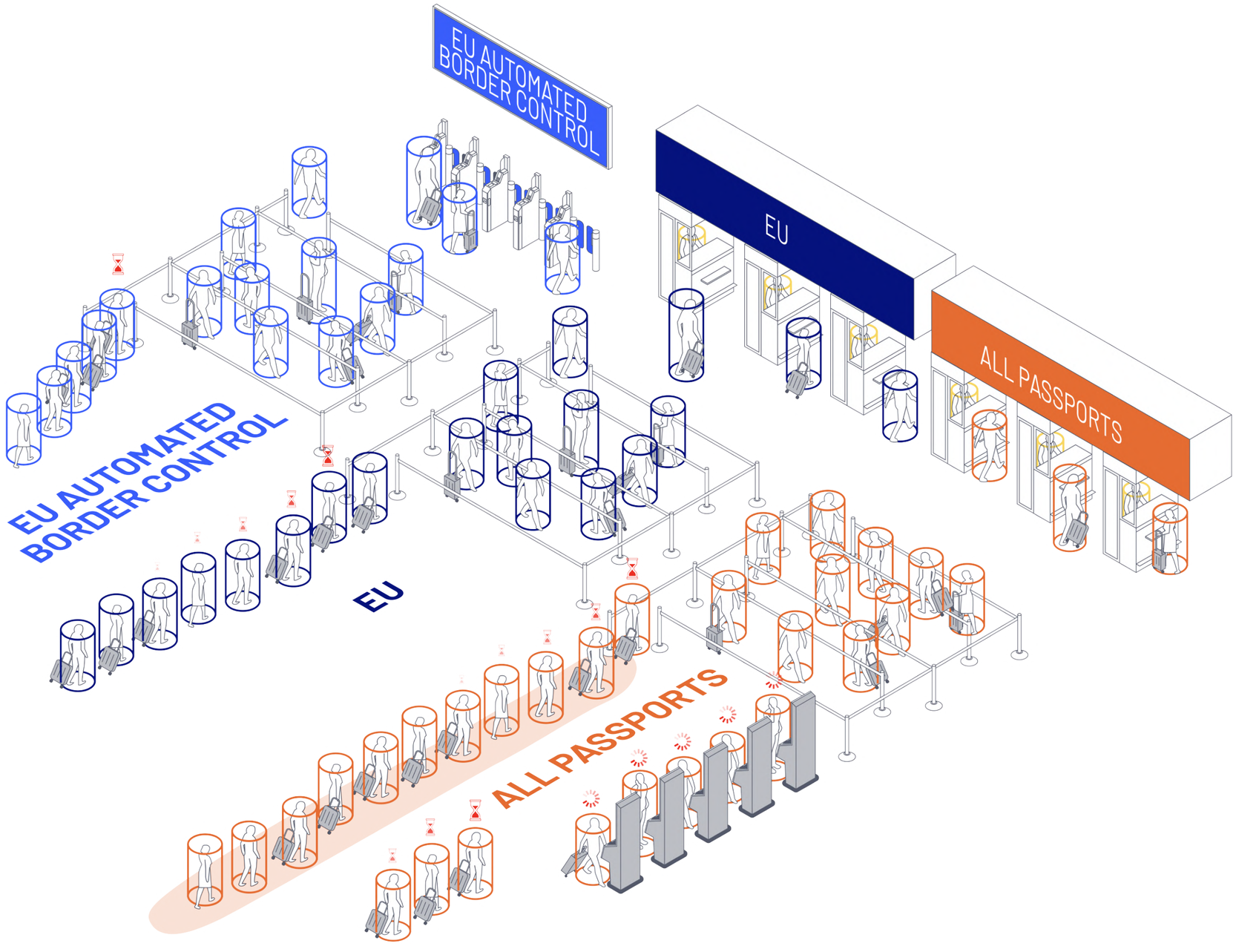
This experience revealed a critical insight: **without continuous passenger tracking across zones, even the most sophisticated counting systems can misrepresent the real passenger experience** — especially under EES conditions where dynamic queue management is essential.

The Limits of Stereo Camera Systems for EES (i)

Initial Queue Saturation:

Following the arrival of a long-haul flight, the border area becomes overcrowded with passengers, overwhelming legacy stereo-camera-based monitoring systems.

These systems often fail to capture extended and dynamique queue overflows, particularly around EES biometric registration points.

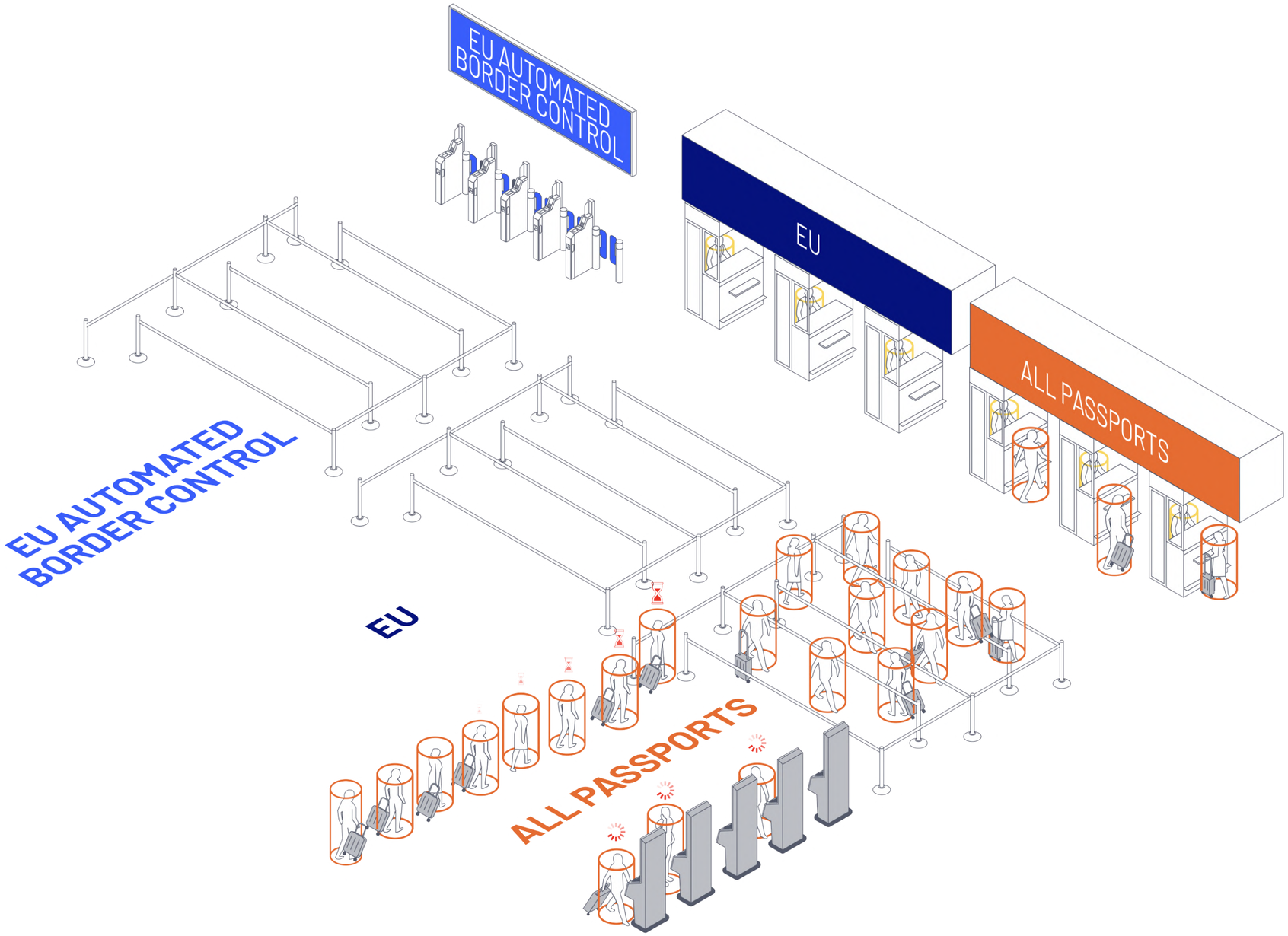


The Limits of Stereo Camera Systems for EES (ii)

Persistent Non-EU Congestion:

EU passenger queues clear quickly, but slower EES processing and biometric registration for non-EU travelers cause persistent overflows in areas outside the view of stereo cameras.

Because they lack the flexibility to cover these zones regardless of ceiling height, they fail to provide full operational visibility.

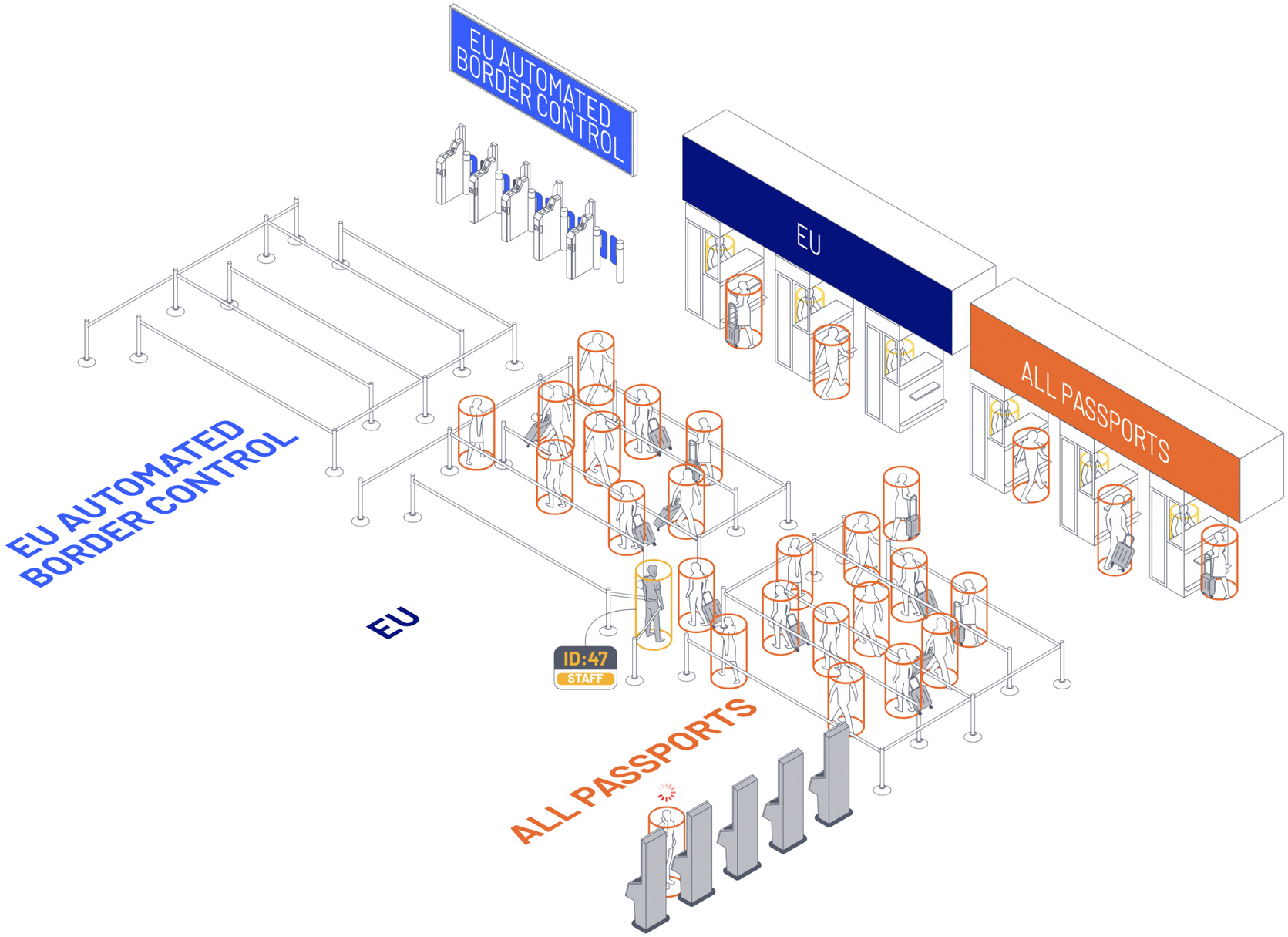


The Limits of Stereo Camera Systems for EES (iii)

Dynamic Queues & PAX Release:

To avoid delays for subsequent arrivals, staff often open EU booths to process non-EU passengers, creating split passenger flows that traditional stereo-camera systems cannot track.

These legacy systems can count and time passengers within fixed zones but fail to continuously follow their movement between queues, leading to inaccurate wait-time estimations.



The Modern Approach: Spatial AI and LiDAR Technology

The modern approach

Spatial AI powered by 3D LiDAR sensing

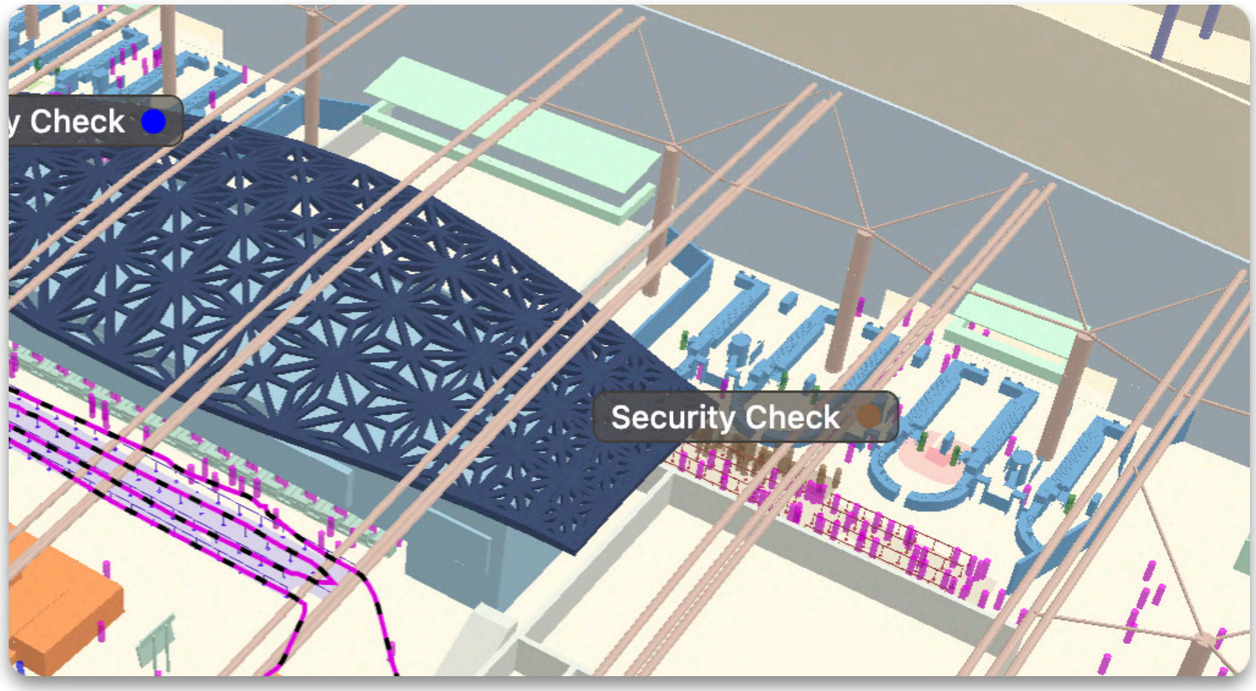
Unlike traditional stereo-camera solutions, which depend on fixed visual perspectives, Outsight's LiDAR technology perceives and interprets the spatial dynamics of every scene.

This inherent understanding of 3D space ensures resilient, future-proof performance — even in the most complex and constantly changing operational environments.

Outsight's LiDAR-based Spatial AI doesn't just detect — it understands motion in space.

Rather than relying on visual imagery, it builds a detailed volumetric model of the environment, capturing every individual and object in three dimensions.

The result is precise, anonymous data that remains reliable under any lighting condition or sensor position.

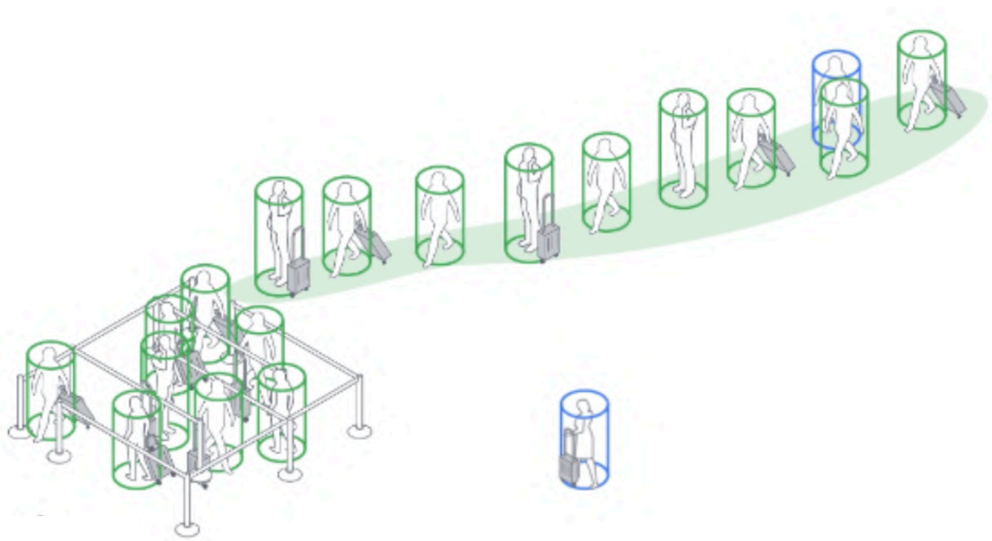


When airport layouts evolve — with new kiosks, barriers, or queue configurations — **the system adapts instantly**. No manual recalibration, no blind spots, no loss of accuracy.

The modern approach

Comprehensive and Smart Queue Management

Outsight's Spatial Intelligence platform is built to intelligently manage every type of queue configuration — from structured lines with overflow areas to unstructured or dynamically evolving layouts.



Powered by advanced **3D Spatial AI and real-time LiDAR-based perception**, the system continuously tracks the movement of each passenger with high precision and full privacy compliance. This enables consistent, reliable KPI generation regardless of queue geometry, density, or behavioral variability.

Beyond static configurations, the platform seamlessly manages dynamic and multi-queue scenarios — situations where a main queue area leading to multiple resources (e.g., check-in counters, security lanes) naturally splits into several sub-queues.

The number, shape, and routing of these sub-queues can change over time — for instance, three in the morning and two in the afternoon — as passenger demand and operational conditions evolve.

Each sub-queue can dynamically differ in:

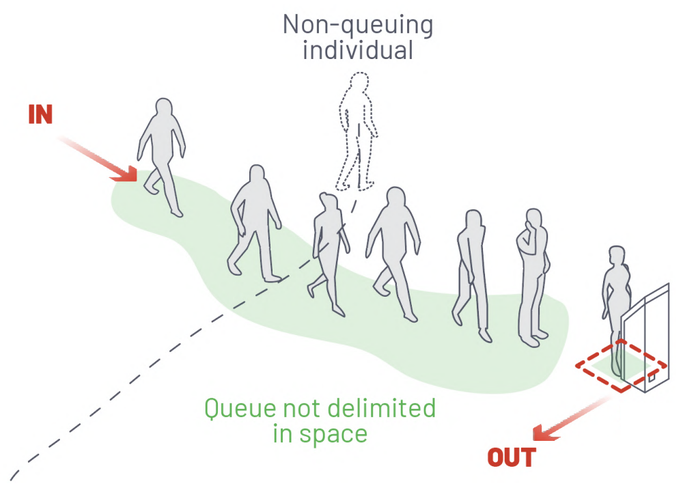
- Number and spatial distribution
- Size and shape
- Internal routing (linear, serpentine, or adaptive)
- Entry and exit points
- Associated resource (e.g., counter, gate, or security booth)

By continuously perceiving and interpreting these spatial dynamics, Outsight's Spatial Intelligence platform delivers robust, self-adapting performance — ensuring operational continuity even in the most fluid and complex airport environments.

The modern approach

A Three-Stage Approach to Dynamic Queue Management

Outsight's Spatial Intelligence platform dynamically detects, links, and classifies sub-queues in real time, providing precise, airline-specific passenger flow insights.



1. Identify Sub-Queues

Using continuous passenger tracking and spatial analysis of inter-passenger movements, Outsight's Spatial Intelligence platform detects in real time the formation and evolution of sub-queues within the main queue area. **Each passenger is automatically assigned to the specific sub-queue** they are actually queuing in.

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2. Link Sub-Queues to Resources

By analyzing passenger trajectories within each sub-queue, the platform determines which resources (e.g., check-in counters, security lanes) each sub-queue leads to. **This enables precise mapping between passenger flows and operational endpoints**.

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3. Link Sub-Queues to Airlines or Services - *Optional*

Through seamless integration with the airport's dynamic Airline, Flight, and Services Allocation system (via AODB), **each resource is automatically mapped to its corresponding airline** (e.g., KLM) and/or service type (e.g., Business Class) based on the current schedule.

Because resources are already linked to sub-queues via step 2, **each sub-queue is therefore dynamically associated with the relevant airline or service**, ensuring accurate, real-time insights into queue composition and performance.

The benefits of modern technology

From Dynamic Queues to Real-Time Operational Efficiency

Outsight's Spatial Intelligence platform transforms dynamic queues into real-time operational insights, boosting efficiency and passenger experience.

By intelligently managing dynamic and coexisting sub-queues, Outsight's Spatial Intelligence platform empowers airport operators to make faster, smarter decisions that directly enhance performance and passenger experience.

This capability enables them to deliver a smoother, more efficient journeys through proactive flow management:

Generate reliable KPIs regardless of queue geometry or behavioral variability.

Prioritise service for high-value or time-sensitive passengers.

Prevent SLA breaches by dynamically predicting reallocating counters or security lanes.

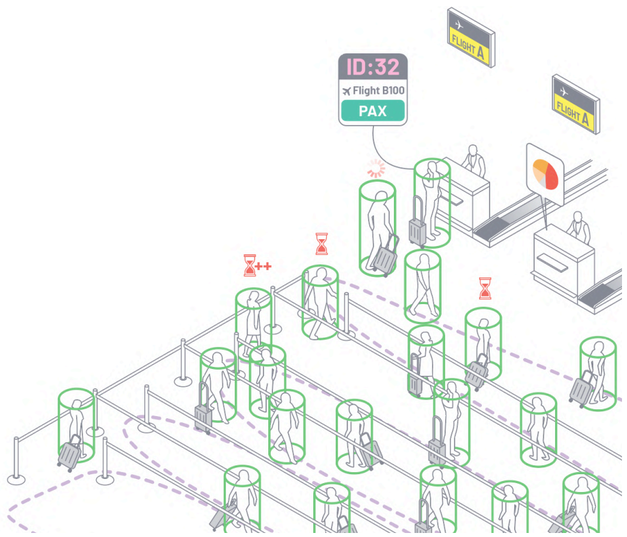
Continuously monitor evolving queue structures without manual intervention or outdated technology

In short, what once required manual observation and adjustment (or unreliable measuring by legacy technology) is now automated, data-driven, and continuously optimized — transforming complex, shifting queues into a source of actionable operational intelligence.

A Future-ready solution

End-To-End Passenger Journey Intelligence

Outsight Spatial Intelligence Platform leverages real-time 3D LiDAR perception to measure and analyze key performance indicators (KPIs) related to passenger movement and asset utilization — such as self-check-in kiosks, police booths, and security lanes — across the entire airport terminal.



By continuously tracking every individual from curbside to gate, Outsight's Spatial Intelligence platform provides a complete and privacy-preserving view of the passenger journey through user-defined touchpoints including check-in areas, security checkpoints, immigration halls, boarding gates, and commercial or service zones.

It enables both end-to-end visibility and detailed operational insights across three complementary levels:

1. **Process-Level Monitoring:** Tracks queues and resource usage in real time, delivering KPIs such as waiting times, queue lengths, flow rates, and staff presence to support optimal queue and service-point management.
2. **Zone-Level Monitoring:** Measures occupancy, dwell time, and flow patterns within defined areas (e.g., check-in, security, lounges), helping prevent congestion, optimize layouts, and improve overall passenger distribution.
3. **Journey-Level Monitoring:** Provides continuous, end-to-end passenger tracking (e.g., curb-to-gate), enabling detailed journey reconstruction, travel-time analysis, and airline- or flight-specific insights.

Together, these capabilities transform raw movement data into actionable operational intelligence — empowering airport operators to enhance efficiency, compliance, and passenger experience at every stage of the journey.

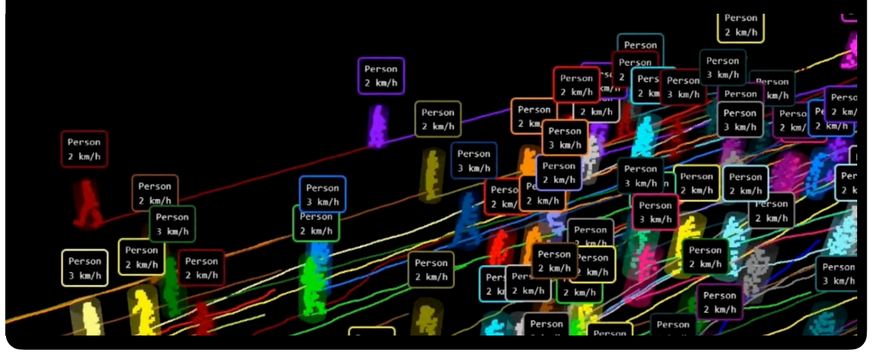
Generating value across the board

Unique Benefits

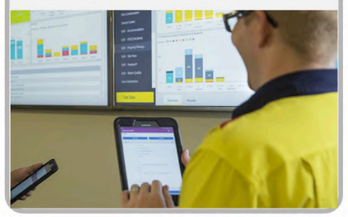
Transforming invisible movement patterns into actionable insights represents one of the greatest opportunities for value creation in Airports.

Rather than serving a single purpose, Outsight's platform-based approach enables different stakeholders to extract value tailored to their specific needs.

See Annex A for more details on how Outsight, as a market pioneer and leader, is helping top international Airports worldwide achieve these outcomes.



Improve Operations



Operational Excellence

- Identify and prioritize bottlenecks
- Align workforce with demand
- Optimize service providers' operations
- Understand resource usage
- Plan premises modifications
- Manage risks and compliance

Elevate Customer Experiences

Brilliant experiences

- Reduce wait times
- Enables seamless circulation
- Provide reliable journey times
- Improve staff-customer interactions
- Personalize service based on needs
- Provide a safe environment

Ensure Security & Safety

Increased Security & Safety

- Improve regulatory compliance
- Prevent & Respond quickly to emergencies
- Detect unauthorized access
- Create safer environments
- Ensure operational continuity
- Protect brand reputation

Optimize Retail Activities

Retail Revenue Optimization

- Profile potential customers
- Detect missed conversion opportunities
- Optimize & Objectivize digital advertising
- Improve layouts & displays
- Enhance shopper-associate engagement
- Make informed rental adjustments

Conclusion

The introduction of the Entry/Exit System (EES) is redefining border control operations across Europe, compelling airports to manage unprecedented levels of complexity, variability, and accountability. **As EES reshapes passenger processing, airports need technologies that evolve as fast as their operational environments do**.

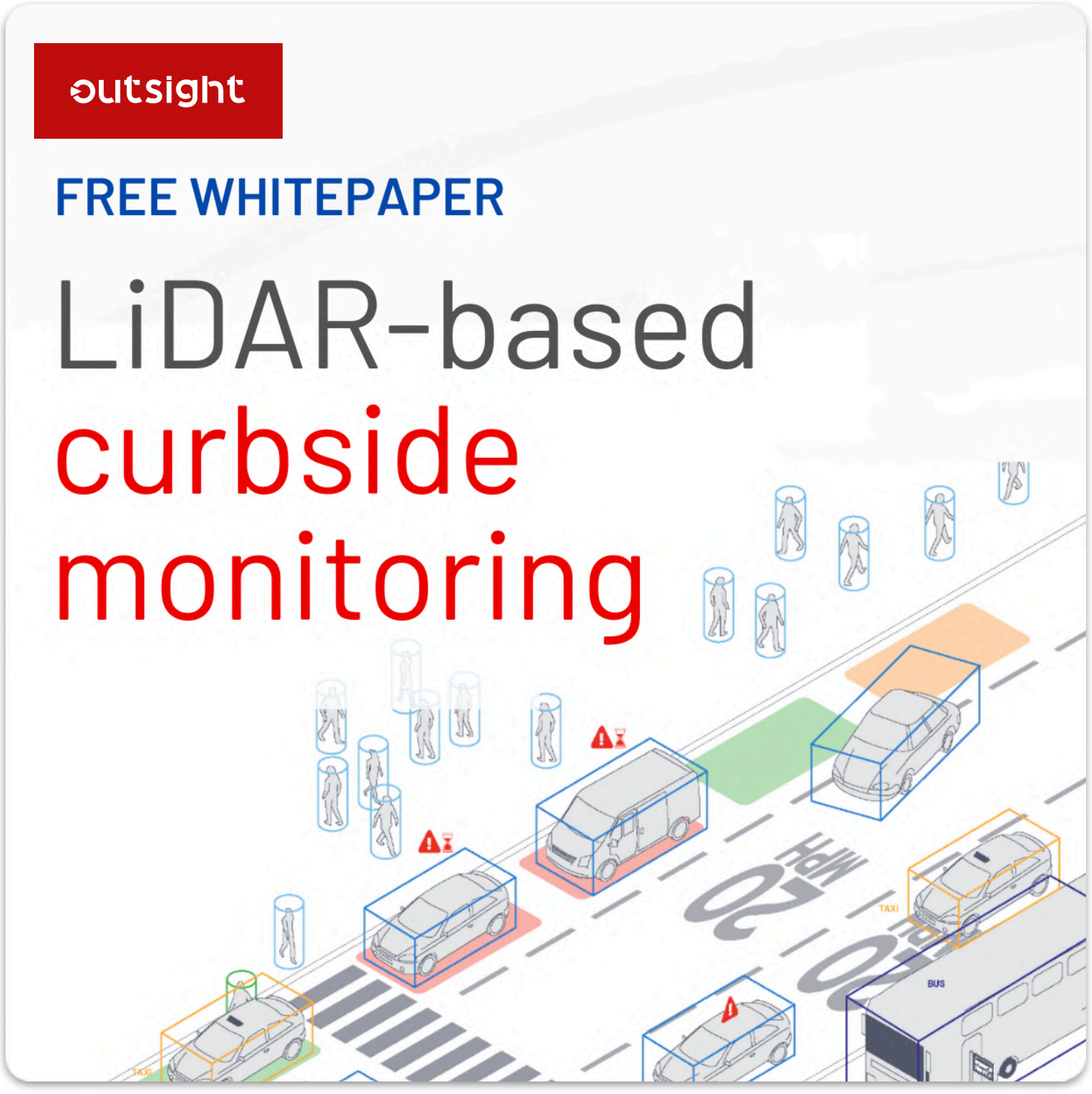
However, **most airports still rely on obsolete stereo-vision systems — a legacy technology introduced more than 15 years ago — which struggles to cope with the new realities of EES**. Designed for static environments and limited spatial perception, these systems cannot reliably handle changing layouts, high passenger volumes, or the level of precision now required for compliance and efficiency.

Outsight's modern LiDAR-based Spatial Intelligence platform rises to this challenge by providing precise, continuous, and adaptable monitoring under real-world conditions. Unlike camera-based or stereo-vision systems, Outsight's technology remains unaffected by lighting variations, layout changes, or passenger density — maintaining consistent accuracy, privacy protection, and operational visibility. By combining this reliability with centimeter-level precision and real-time adaptability, **it empowers airport stakeholders to make data-driven decisions that enhance efficiency, passenger experience, and regulatory transparency.**

This inherent resilience makes Outsight's Spatial Intelligence platform a future-proof investment for airports seeking both EES compliance and operational excellence. **In essence, Outsight transforms EES from a regulatory challenge into an opportunity for innovation and tangible operational value.**

Other resources

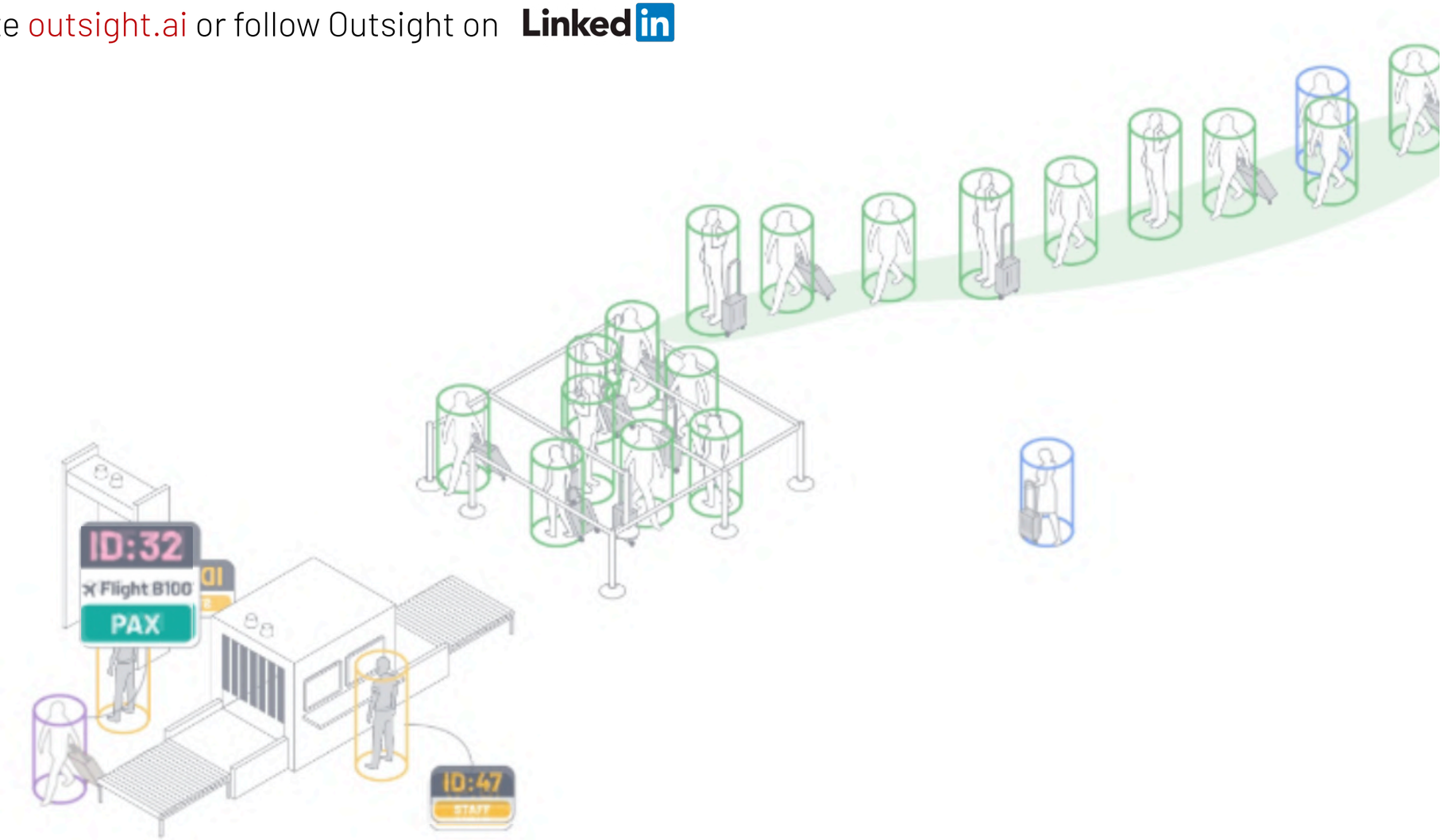
Download our latest whitepapers here: www.outsight.ai/resources/whitepapers



The EES-ready Airport

How **LiDAR** and **Spatial AI** enable Efficient, Compliant, and Frictionless Border Operations

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



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Annex A

Outsight's Spatial Intelligence solutions leverage Spatial AI and 3D native sensors such as LiDAR to empower infrastructure operators by continuously monitoring the movement of people and vehicles in real time—enhancing efficiency, improving customer experiences, and strengthening security.

This Spatial Intelligence is made accessible to both Operators and AI Agents through Motional Digital Twins.

As the most experienced and awarded team in the industry, we lead the deployment of Spatial Intelligence solutions worldwide, operating from our offices in San Francisco, Paris, and Hong Kong.

outsight

WHY OUTSIGHT

Pioneers and Leaders of 3D software solutions

The most experienced team in the industry by far.

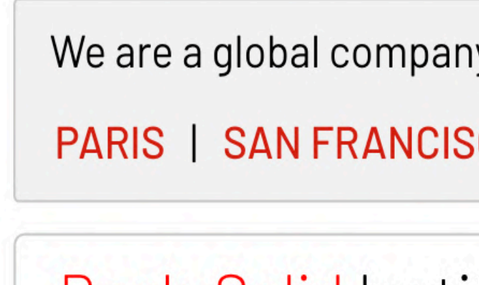
We are a global company:

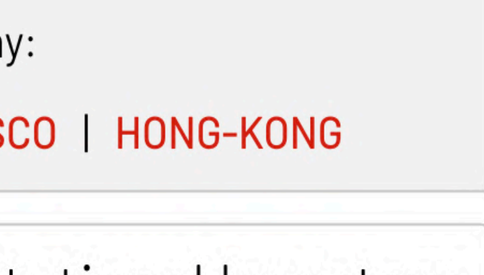
PARIS | SAN FRANCISCO | HONG-KONG

Rock-Solid Institutional Investors

Energy Innovation Capital · bpifrance · BNP PARIBAS · SPDG Ventures · DEMETER PARTNERS · GROUPE ADP · SAFRAN · FORVIA

Recognized 7 times by Gartner as Category-Defining Emerging Leader:





37 Patents, +100 FTE Expert team, +5 years development

OUR SOLUTION

We deliver **Spatial Intelligence**

Our Spatial AI Software Platform converts raw 3D LiDAR data into actionable insights **by continuously tracking every individual across the entire premises.**

We're compatible with all relevant LiDAR hardware models and manufacturers and can get input from other sensors like Cameras

SHIFT
SPATIAL AI PLATFORM

Our Software runs in real-time and delivers unique Spatial Insights (KPIs), for Past, Present and Future events

API

The output is delivered as a user-friendly Digital Twin and Dashboard or an API

SPATIAL INTELLIGENCE CREATES UNIQUE VALUE

Transformative benefits

Elevate Visitors Experience

Reduce bottlenecks, waiting times and create a seamless journey for your shoppers, visitors or passengers.

Improve your Operations

Streamline your processes and optimise Workforce efficiency based on accurate spatial insights.

Increase Security & Safety

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

Grow Revenue

Improve throughput in queueing and check-in so visitors spend more time in retail and concession areas.

Accurate Infrastructure Planning

Trend analysis and simulation with historical data that leads to better data-driven investment decisions.

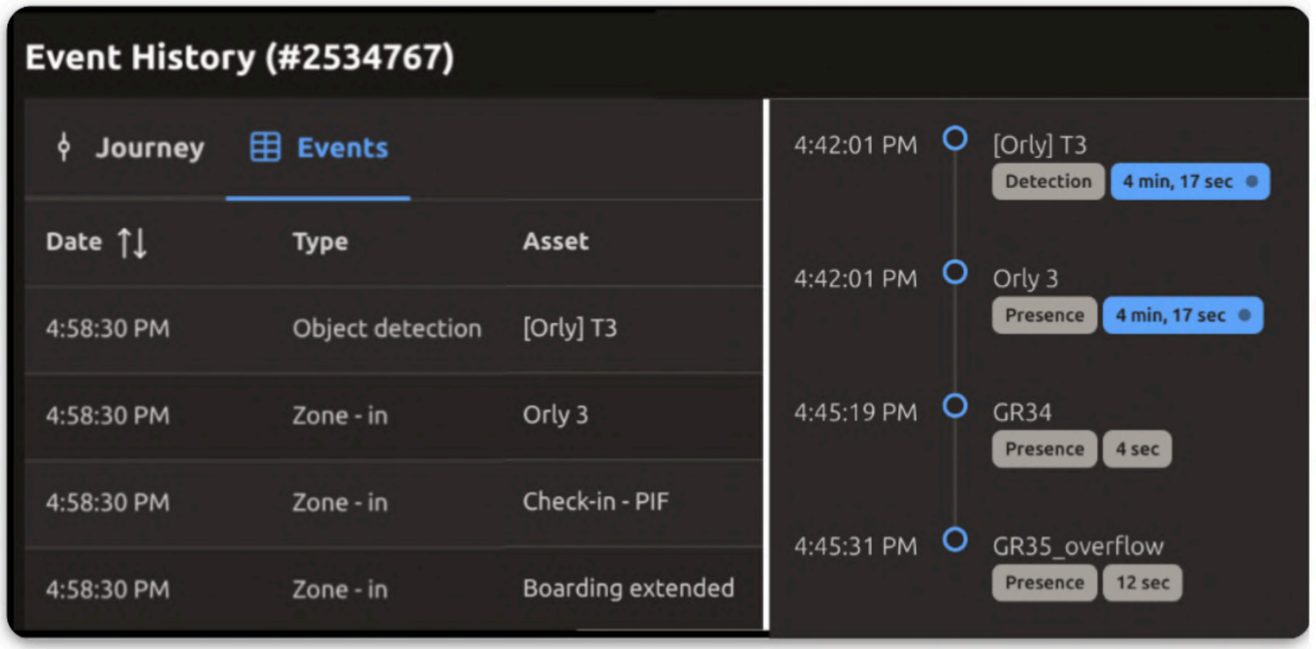
Enjoy Privacy by Definition

Experience the simplicity of GDPR compliance: LiDAR sensors never capture personal identification data.

UNIQUE CAPABILITIES

Premises-wide **Continuous Tracking**

We provide **the most advanced solution able to continuously track the complete customer/passenger journey at scale**, generating unparalleled insights about the behaviour, interactions (events) and resource utilization across the entire premises.



WHY OUTSIGHT ?

Partner with the best

Our team, with over two decades of expertise, is by far the most experienced in the business of LiDAR real-time processing.

Fast & Easy deployment

Working in hours, not weeks. **Deployment made simple** with auto calibration & synchronisation.

Use the right LiDAR sensor

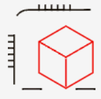
With our software and tools you can use the best combination of sensors and manufacturers for your needs.

Achieve world-class performance

Independent third-party audits have verified an impressive accuracy rate of up to 99% in critical metrics

Optimise cost & energy

Our Edge & Cloud architectures minimise processing, network and setup costs while ensuring scalability.



Leverage the most advanced tools

We've built the most advanced set of tools, including **the first Multi-Vendor 3D LiDAR Simulator**.

Future proof

Our solution grows with you, with OTA updates and ensuring hardware availability over time.

Annex B

Light Detection and Ranging, also known as LiDAR, is a technology for remote sensing that is used to measure distances in an environment. Unlike legacy 2D-based perception technologies such as cameras, the 3D data from LiDAR produces highly detailed, accurate spatial measurements and works in various environments, contexts and changing lighting conditions.

These unique characteristics unlock new possibilities, enabling seamless tracking, enhanced safety, and precise monitoring of movements in complex environments, offering capabilities that were previously unattainable with traditional technologies.

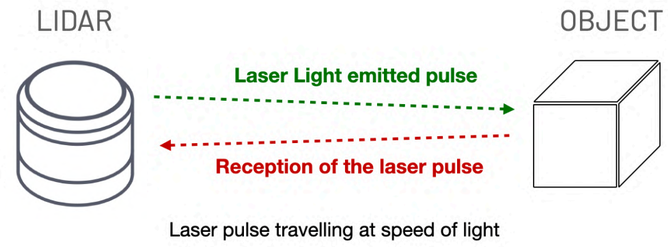
What is LiDAR?

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.

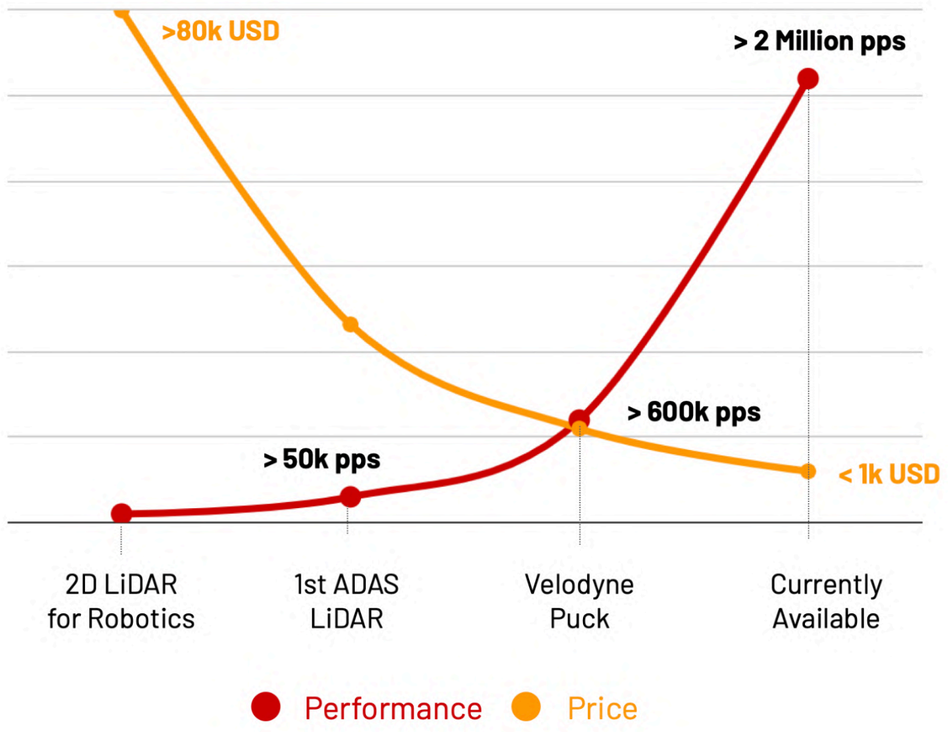
Thanks to multi-Billion Dollar investments in the context of Self-Driving Cars, customers in all other industries now have the choice of many different LiDAR manufacturers, all of them with specific strengths and weaknesses.

> Only in the US, more than five 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.

Price and performance are no longer barriers to widespread adoption

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.

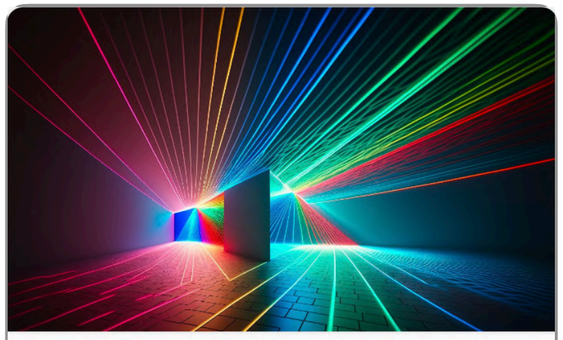


Similarly, performance is rapidly improving, with millions of points per second* becoming the norm rather than the exception.

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.

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

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*

Meet the 3rd Generation of People & Vehicles Counting Technologies

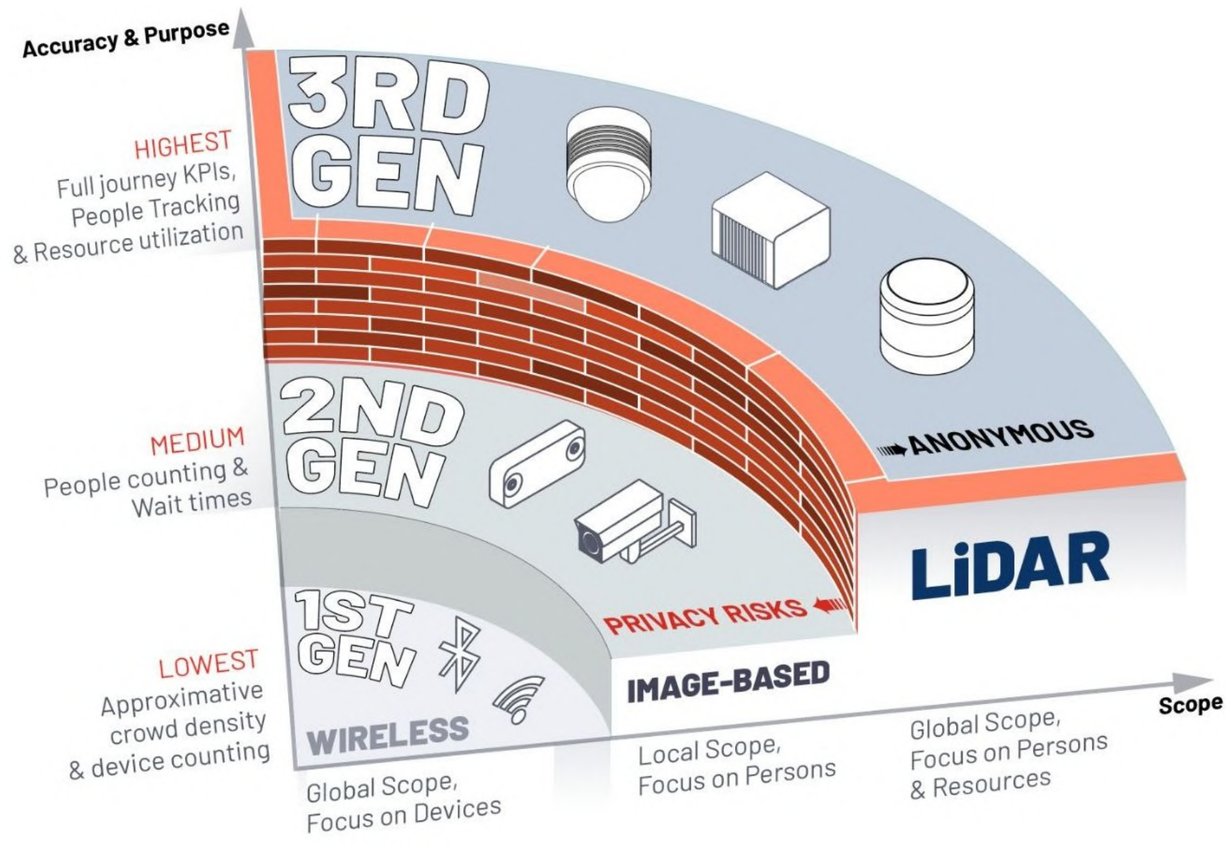
From rudimentary People Counting to encompassing Spatial Intelligence, two evolutionary leaps have been made.

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.



People counting technologies

Comparative Table

	Light-emitting	Image-based		Radio signals	
	Lidar	CCTV	Stereovision	Wifi/Bluetooth	Radar
Position Detection Rates	Very high	Moderate	High	Low	Moderate
Unique ID Tracking	Premises-wide	Low	Locally	Low	Low
cm-level Precision	Yes	No	No	No	No
Choice of HW manufacturer	High[1]	Very high	Low	Very high	Moderate
Flexible mounting	Yes	Moderate	No	No hardware	Moderate
Real-Time Views	Yes	Yes	Yes	No	No
Cost of Processing	Low (CPU[2])	High (GPU)	Moderate	Low	Moderate
Lightning interference	None	Yes	Yes	None	None
Reliability	Very high	Moderate	High	Low	Moderate
Devices per sqm	Few	Many	Many	No hardware	Several
Installation & Maint. Cost	Low	Low	High	No hardware	Low
Sensor Cost	Moderate	Low	Moderate	No hardware	Moderate
Privacy risks	None	Significant	Significant	Significant	None

Other resources

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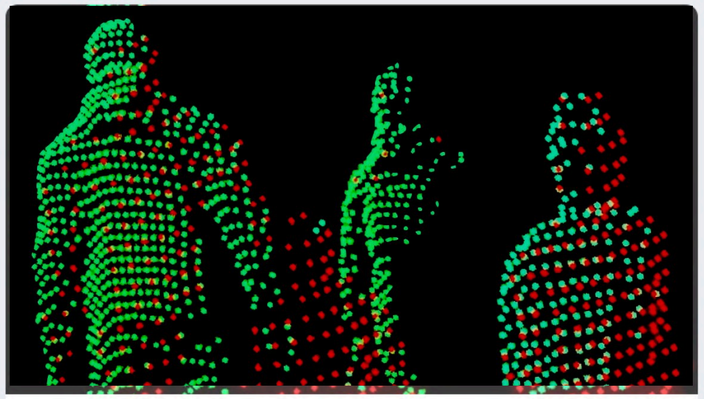
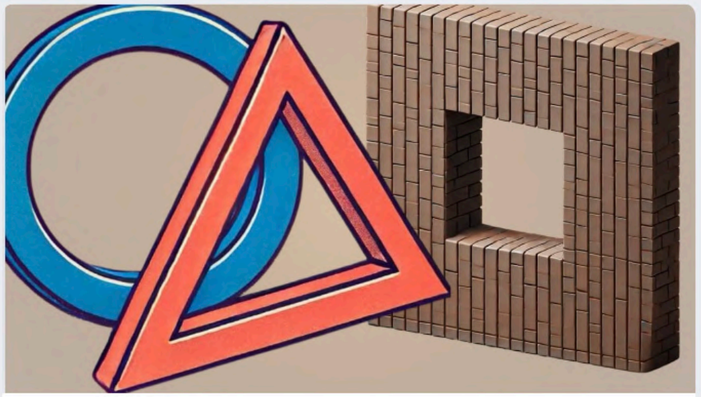


TECHNOLOGY

Understanding Shadowless 3D Perception

Unlike cameras, which perceive reality from a single point of view, 3D native data from LiDAR opens up new possibilities.

Jun 17, 2024
Charlotte Simon

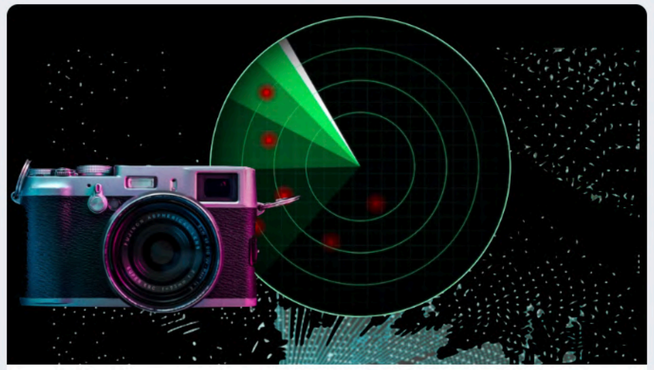


TECHNOLOGY

Why All LiDAR Sensors Aren't Created Equal

This article explores LiDAR differences and why customers use multiple vendors to meet their needs.

Jun 14, 2024
Anne-Sophie Dubois



TECHNOLOGY

An in-depth comparison of LiDAR, Cameras, and Radars' technology

This article explores the capabilities and limitations of each type of sensor, to provide a clear understanding of why LiDAR has emerged as a strong contender in computer vision tech race.

Jul 31, 2023
Anne-Sophie Dubois