

LiDAR for Automotive

(ADAS and robotic vehicles)

Patent Landscape Analysis

December 2025

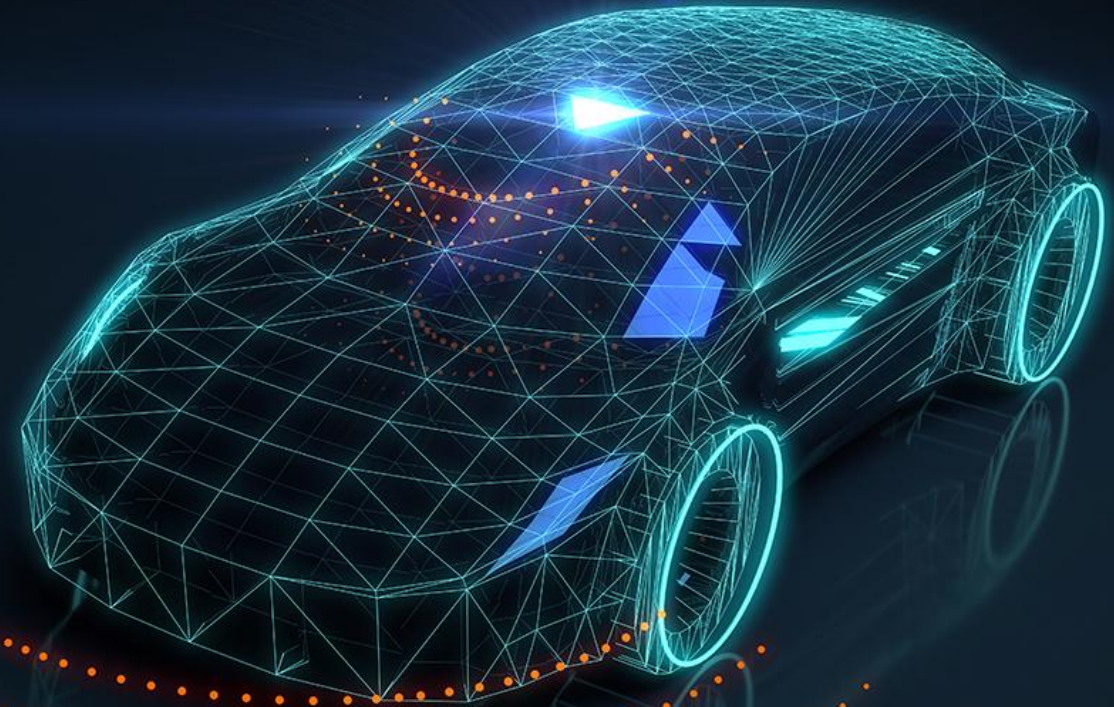


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INTRODUCTION

Context of the report

The automotive LiDAR industry has entered a decisive phase of industrial acceleration. After years of exploratory R&D, the technology is now strongly tied to the deployment of ADAS and robotic-vehicle systems across global OEMs and technology companies. According to Knowmade's *LiDAR for Automotive (ADAS and Robotic Vehicles) Patent Landscape Analysis 2025*, the global LiDAR patent landscape has reached an unprecedented level of intensity. As of October 2025, more than **62,900 individual patents grouped into over 36,000 patent families** have been published worldwide. This represents a dramatic expansion from the **11,900 families recorded in 2021**, highlighting a four-year period of exceptional and broad-ranging innovation.

Patent activity has risen at an estimated **27% CAGR** (compound annual growth rate) since 2020, signaling LiDAR's shift into a phase of fast, multi-domain IP expansion. Filings now cover almost every layer of the technology: emitters, receivers, scanning architectures, optical subsystems, packaging, calibration, interference mitigation, perception software, and full system-level integration. The technology's growing maturity and strategic relevance have driven participation from a wide variety of actors, including Tier-1 suppliers, LiDAR pure players, automakers, autonomous driving companies, photonics and semiconductor firms, and academic institutions. This broadening of contributors underscores the complexity and competitive density of today's LiDAR landscape.

Market expectations help explain this acceleration. Yole Group forecasts the global automotive LiDAR market to reach **USD 3.56 billion by 2030**, supported by increasing adoption of L2 and L3 driver assistance systems and the push to integrate high-performance perception sensors into mass-market vehicles. The similarity between the **market CAGR** and the **patent CAGR** reinforces a clear strategic conclusion: **"The race to secure LiDAR IP is directly tied to the race for future market dominance."**

This 2025 edition also reflects a significant structural shift in competition. While the earlier 2022 patent landscape was still dominated by established Tier-1 suppliers and early LiDAR innovators, the updated dataset reveals the rapid rise of **LiDAR pure players**, companies whose R&D and product roadmaps focus almost exclusively on LiDAR technologies. These firms demonstrate faster iteration cycles, higher technical specialization, and more deliberate IP strategies. Between 2021 and 2025, many pure players have moved from peripheral positions into central roles in the IP leadership landscape, expanding their portfolios in solid-state architectures, beam steering, semiconductor receivers, optical assemblies, and system-level integration.

Geographically, the distribution of LiDAR innovation has shifted markedly. **China now contributes around 40% of global LiDAR publications**, surpassing the United States, with Europe, Japan, and Korea maintaining important but more focused roles. The combination of large domestic markets, strong industrial ecosystems, and government-backed ADAS/AV initiatives has propelled a surge of patenting activity from Chinese LiDAR companies and automotive groups, reinforcing China's role as the fastest-growing center of LiDAR innovation.

At the same time, innovation has diversified across technological domains. Beyond traditional pulsed ToF systems, patenting activity in **FMCW LiDAR, metasurface and OPA beam steering, silicon-photonics integration, 3D scene reconstruction, AI-enhanced perception, and multi-sensor fusion** has intensified. These developments mirror the industry's drive toward safer, more efficient, and more cost-effective sensing architectures capable of supporting next-generation ADAS and autonomous driving.

Against this backdrop of rapid growth, geographic realignment, and intensified competition, this report provides an updated and comprehensive analysis of the global LiDAR patent landscape, highlighting the key players, the emerging leaders, and the technological pathways that will shape the future of automotive perception.

SCOPE OF THE REPORT

- This report provides a detailed picture of the patent landscape for **LiDAR technologies dedicated to automotive applications (ADAS and robotic vehicles)**, covering the entire value chain (LiDAR components, LiDAR optical systems, LiDAR systems in vehicle, ADAS systems using LiDAR, 3D and environment mapping using LiDAR). It is an update to our [previous report](#) published in January 2022.
- For this new edition, we have selected and analyzed more than **62,900 patents** grouped into **36,200 patent families** (inventions) published worldwide up to **October 2025**, and with a focus analysis of **24,300 patent families** (inventions) published **from July 2021 to October 2025** relevant to the scope of this report.

Type of patents	In scope	Out of scope
Patents describing LiDAR driving systems	X	
Patents describing LiDAR systems for automotive applications (ADAS and robotic vehicles)	X	
Patents describing method for LiDAR-based driver assisted systems	X	
Patents claiming the use of LiDAR in ADAS systems, anti-collision, etc.	X	
Generic patents describing LiDAR devices with potential automotive applications	X	
Patents describing electrical or optical components for LiDAR device that may be implemented in automotive systems	X	
Patents describing non-embedded LiDAR for vehicle traffic surveillance		X
Patents describing LiDAR systems for consumer applications (AR/VR, 3D sensing, etc.)		X
Patents describing LiDAR systems for industrial applications (construction, logistics, factory automation, energy, smart building, security, smart agriculture, meteorology, etc.)		X
Patents describing LiDAR systems for defense and aerospace applications (including drones)		X
Generic patents describing laser, optical components, detectors, etc. and non-directly related to LiDAR applications		X

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INTRODUCTION

Objectives of the report

SAMPLE

Deliver a clear, structured and data-driven understanding of the **competitive and technological evolution** of automotive LiDAR from a **patent perspective**

➤ Identify and analyze the key IP players shaping the LiDAR ecosystem

The report highlights major patent assignees and their recent patent activities (2021-2025), focusing on: portfolio growth and legal status, core technical domains, strategic positioning along the LiDAR value chain. Compared with previous editions, this analysis concentrates on **recent patent dynamics**, offering an updated view of how each company is evolving today.

➤ Reveal newcomers and emerging innovators

A specific emphasis is placed on new entrants that have gained visibility in the 2021-2025 timeframe. The report analyses their technologies of interest, market orientation and potential impact on future competition.

➤ Track technology trends and fast-growing technical segments

Through a dedicated “Patent Segmentation” chapter, the report classifies inventions across almost all key LiDAR technologies: ToF, FMCW, phase-shift, MEMS, hybrid scanning, OPA, flash, integrated photonics, 1550 nm, VCSEL, SPAD/SiPM, APD, packaging, calibration, fusion and AI. For each segment, we highlight **segment definition, patent portfolio overview, main assignees, notable and illustrative patents**. This provides a technical map of where innovation is accelerating and which technologies are becoming strategically relevant.

➤ Benchmark patent portfolios to assess competitive strengths and weaknesses

The report provides cross-player comparisons based on: portfolio size and time evolution, active vs. expired families, geographical coverage, technical specialization. This enables a detailed understanding of leaders, challengers and IP trajectories from 2021 to 2025.

➤ Evaluate risks, constraints, and collaboration patterns

The analysis highlights: co-owned IP, areas of dense patenting activity, US litigation cases.

➤ Identify opportunities for partnerships, technology acquisition and licensing

The patent landscape helps reveal areas where collaboration is emerging, where white spaces remain, and which technologies may be strategically important for future ADAS/AV product lines.



Very complementary to market research

Give another point of view of the competitors, technologies and markets

Links between patents and

- Key market players
- Supply chain
- Technology Readiness Levels (TRL)
- Market product
- Emerging technologies/applications
- Forecast

INTRODUCTION

Reading guide: find the right information in the report

SAMPLE

Report sections



Your concern →
Information you get

PATENT LANDSCAPE OVERVIEW

- **Ranking of players** (enforceability, current activity, geo/tech coverage, prior-art contribution, etc.)
- **Patent filings dynamics per player**
- **IP collaborations** (co-filings, IPR transfers)
- **Patent litigation/oppositions**

SEGMENTS ANALYSIS

- **Patent filings dynamics per segment**
- **IP leaders per segment** (enforceability, current activity, blocking potential)
- **Notable patents per segment**
- **Recent patenting activity per segment**

IP PROFILE OF KEY PLAYERS

- **Patent portfolio summary** (portfolio size, IP activity evolution, patents legal status, geo/tech coverage, strengths/weaknesses, etc.)
- **Key patents**
- **Recent patenting activity**

	TECHNOLOGY <i>For R&D teams, engineers, scientists</i>	IP <i>For IP teams, patent attorneys</i>	MARKET <i>For executives, business developers</i>	PLAYER <i>Zoom in a competitor / partner</i>
Innovators	Main patent owners IP risks/opportunities	Ecosystem (competitors, newcomers, partners, clients) Main trends IP vs Market	IP position vs Market position Player relationships (collaborations/ dependencies)	
Technology trends Technology mapping	Blocking players IP risks/opportunities in each segment (FTO, litigation, licensing)	Benchmarking Markets of interest Future developments	IP position and level of investment in each segment Key IP developments	
Current R&D activities Technology roadmap	Blocking patents Geo/Tech coverage Link between patents and products	Future products Potential partners Potential targets	R&D investment level Key inventions Current IP activities Strengths / Weaknesses	

PATENT LANDSCAPE OVERVIEW

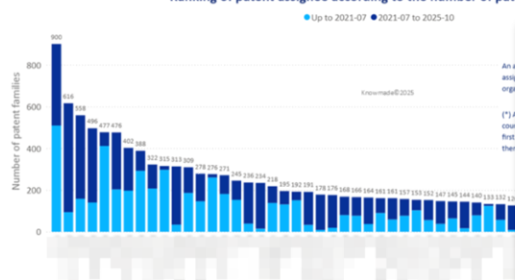
General trends, main patent assignees and new entrants

SAMPLE

EXECUTIVE SUMMARY

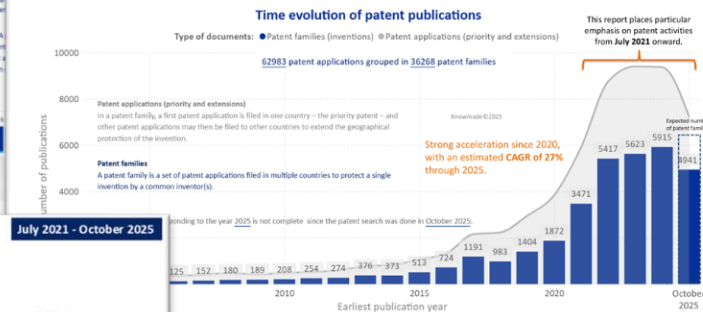
Main IP players according to the number of patent families

Ranking of patent assignee according to the number of patent families*



IP dynamics

A strong acceleration of patenting activity over the last 5 years



Time evolution of patent publications by countries

The current patenting activity is driven by Chinese, American and European markets

Time evolution of patent publication by filing countries



Main patent assignees

Top 60 IP players classified by typology



IP newcomers

First LiDAR patents published in 2022 or later

* The newcomers listed here own more than 20 patent families in this study (July 2021 - October 2025).

Patent Assignees	Chinese name	Value Chain Position	Creation date	Total patent families	Granted patents	Pending applications
		Autonomous driving / vehicle positioning solutions	2014	37	17	20
		LIDAR pure-player (3D perception for autonomous driving)	2017	34	18	18
		Autonomous-driving solutions	2021	34	4	30
		LIDAR / sensing hardware provider (SPAD chips, sensors)	2017	29	20	16
		Autonomous-driving solutions	2015	29	14	14

Main patent assignees classified by typology

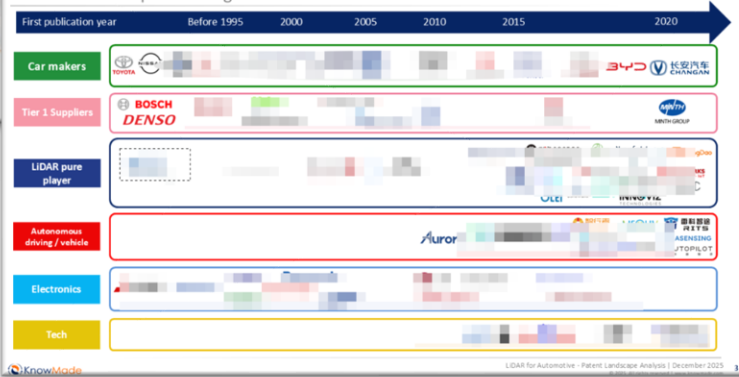
Overview

* The patent assignees listed here own more than 30 patent families (Top 100 IP players) in this study (July 2021 - October 2025).



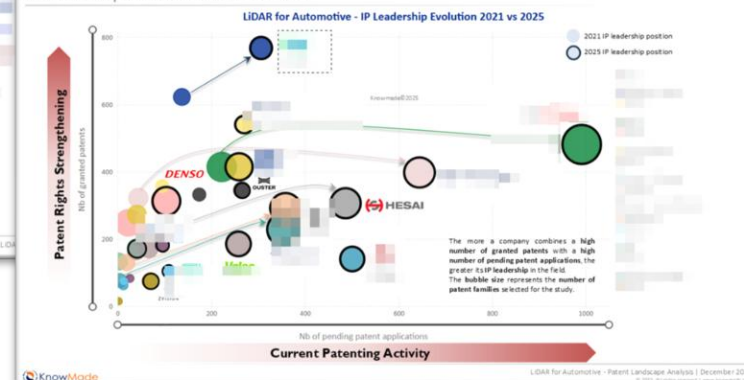
Main patent assignees

Timeline of main patent assignees



IP leadership of patent assignees

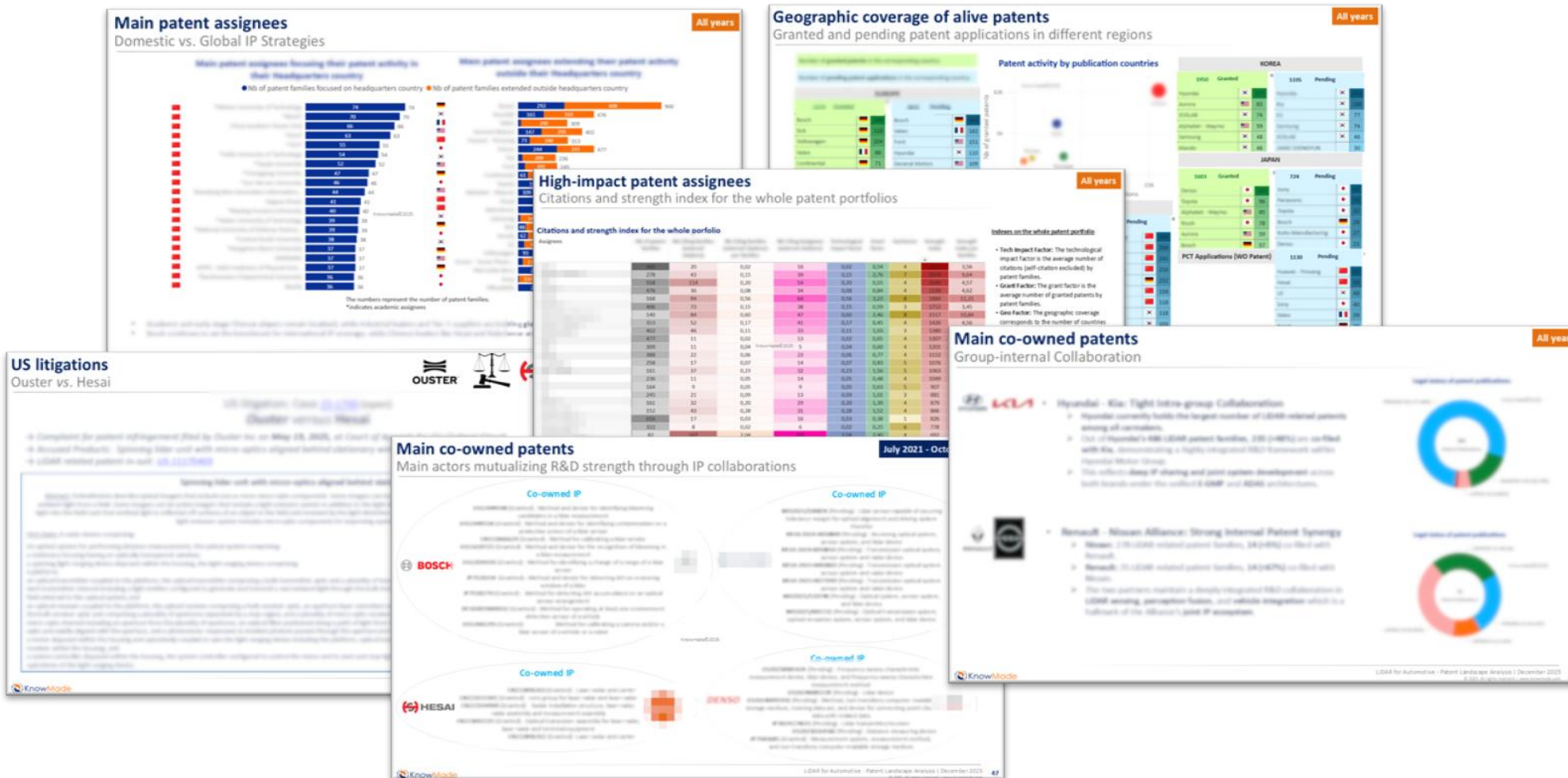
IP Leadership evolution 2021 vs 2025



PATENT LANDSCAPE OVERVIEW

IP leaders, IP strategies, IP collaborations, licensing agreement, litigations

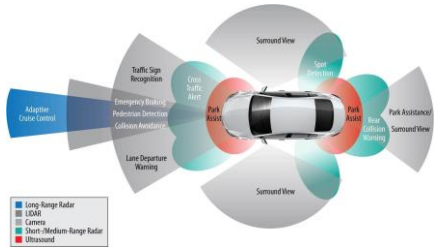
SAMPLE



PATENT SEGMENTATION

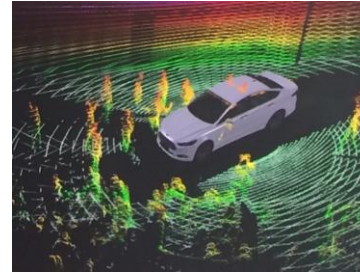
Applications and Technology Segmentation

LiDAR developments are mainly driven by automotive development. However, LiDAR system and requirements change in function of the final application.



Mass Production (ADAS LiDAR)

- Focus on cost, size, and manufacturability
- Standardization + integration (VCSEL, MEMS, APD, Packaging)
- Performance trade-off acceptable
- Range: 10m-150m, FOV: 30°-100°



High-Performance Autonomy (Robotaxi / L3+ LiDAR)

- Requires ultra-high resolution, Doppler, long range
- Emerging tech: FMCW, OPA, Photonic LiDAR
- Higher complexity and cost acceptable
- Range: 150m-300m+, FOV: 120°-360°

Core Ranging & Imaging Principles

Optical & Photonic Components

System & Algorithmic Intelligence

Bottom-layer structural innovations (9 segments)

Ranging (3 segments)

- Pulsed ToF
- FMCW (incl. solid-state, micro-comb)
- Phase Shift

Beam Steering (4 segments)

- MEMS (quasi solid-state)
- Hybrid Scanning
- OPA (true solid-state)
- Flash (true solid-state)

Advanced Beam Steering (2 segments)

- Metasurface / Nanophotonics
- Photonic Integrated LiDAR

Middle-layer enabling technologies (4 segments)

- **1550 nm Laser Source**
High-power, eye-safe laser sources for long-range applications.
- **VCSEL Array Emitter**
Compact vertical-cavity laser arrays ideal for flash or short-range LiDAR.
- **SPAD / SiPM Detector**
Single-photon detectors offering high sensitivity and precise ToF detection.
- **APD Detector (CMOS-Compatible)**
Avalanche photodiodes with cost-effective integration potential.

Top-layer intelligent & integration innovations (5 segments)

- **Solid-State Packaging & ASIC Integration**
Combines optics, electronics, and signal processing into compact chips.
- **Fusion with Camera and Radar**
Combines LiDAR with other sensors.
- **AI-Based 3D Perception**
Leverages deep learning to interpret LiDAR point clouds in real time.
- **Self-Calibration & Compensation Algorithms**
Auto-alignment and error correction.
- **Anti-Interference & Multi-LiDAR Coordination**
Prevents crosstalk and enables coordination across multiple LiDARs.

TECHNOLOGY

IP PROFILE OF PLAYERS

IP portfolio summary, IP strategy, key patents and recent patenting activity

This report provides a structured and data-driven IP profile analysis of **30 influential LiDAR patent assignees**, selected according to their IP leadership and recent activity from 2021 to 2025. To reflect the structure of the ecosystem, companies are grouped into four categories: LiDAR pure players, Tier-1 suppliers, autonomous-driving/vehicle companies and car makers.

- A detailed, in-depth analysis is conducted for **7 major LiDAR pure players: Hesai, RoboSense, Ouster (Sense Photonics), VanJee, Seyond, Zvision, Aeva.**



- An additional **16 LiDAR pure players** are presented through portfolio overviews: **Leishen Intelligent, Sick, Benewake, SOSLAB, Oradar, Luminar, SiLC Technologies, Innoviz, MicroVision, Ibeo Automotive, Mobiltech, Infoworks, Blickfeld, OLEI, LiangDao, Aeye.**



- Tier-1 Suppliers: Bosch, Huawei-Yinwang, Valeo**



- Autonomous Driving / Vehicle Players : Aurora, Alphabet-Waymo**

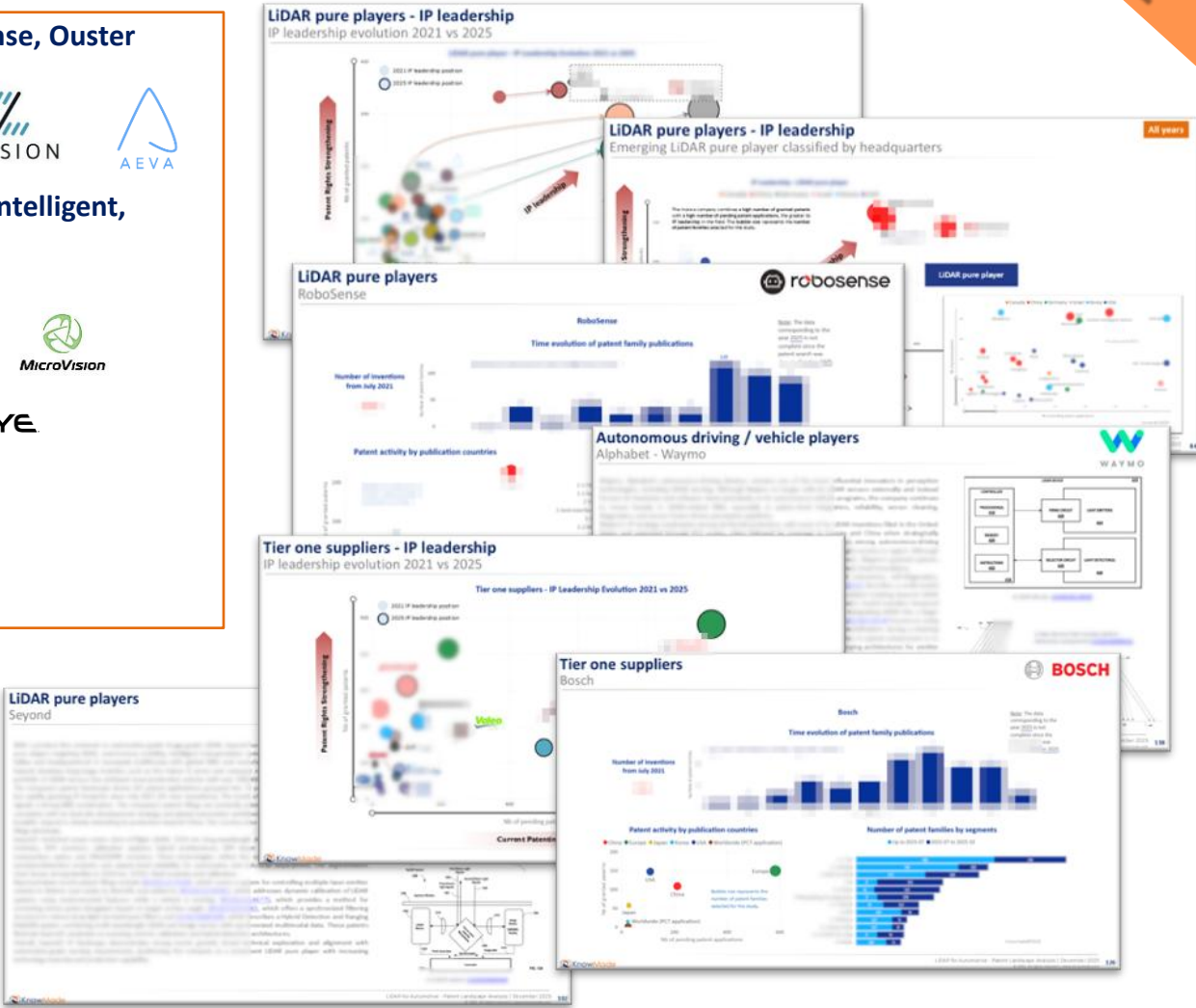


- Car Makers: Hyundai, General Motors**



IP Profile

- 2021-2025 leadership evolution
- IP dynamics
- Geographical coverage
- Technical segmentation
- Recent patent activities



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LiDAR for Automotive

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4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take

reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

5. FORCE MAJEURE

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

6. PROTECTION OF THE SELLER’S IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

- Information storage and retrieval systems;

- Recordings and re-transmittals over any network (including any local area network);

- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;

- Posting any Product to any other online service (including bulletin boards or the Internet);

- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

7. TERMINATION

7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

8. MISCELLANEOUS

All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

9. GOVERNING LAW AND JURISDICTION

9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Grasse, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.

KNOWMADE

Patent and Technology Intelligence

KNOWMADE PURPOSE

Turning **patent** and **scientific data** into **actionable insights** to support **decision-making in R&D, innovation, investment, and intellectual property.**

Competitive landscape | Technology trends | Opportunities / Risks | R&D and IP strategy



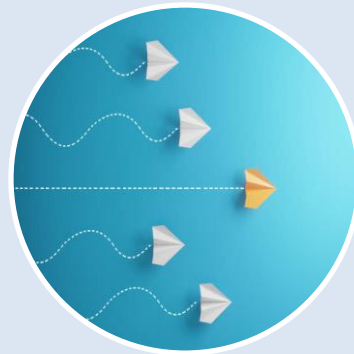
WHAT INFORMATION CAN YOU GET ?



INTELLECTUAL PROPERTY

*For IP teams,
patent attorneys*

- Risks and opportunities (FTO, litigations, licensing)
- Key patents
- Link between patents and products



TECHNOLOGY

*For R&D teams,
engineers, scientists*

- R&D activities
- Technological roadmap
- Position on the supply chain



MARKET

*For executives,
business developers*

- Identify competitors
- Compare IP with market position
- Evaluate the level of investment
- Future products & target markets

KNOWMADE OFFER

CUSTOM SERVICES

(Tailor-made analysis)

To meet your needs and budget/lead time constraints

- Specific and dedicated report.
- Prior-art search, literature review, patent landscape, freedom-to-operate, patent valuation, IP due diligence, technology scouting, monitoring service, etc.

Format

- PDF file with analyses.
- Excel file with data.
- Access to the analyst.

REPORTS

(multi-client product)

To understand the competitive landscape and explore the emerging ecosystems and new technologies

- Stand alone report
- Patent landscape.
- Overview on IP dynamics, trends and players.
- Competitor, technology and strategy analysis.
- Benchmark of patent portfolios.
- Key IP players & key patents.

Format

- PDF file with analyses.
- Excel file with patent data.

MONITORS

(multi-client product)

To track the latest R&D developments and IP activities, and to be sensitive to weak signals

- Annual subscription
- Patent monitoring service.
- Quarterly updated patent data and technology trends.
- Current R&D and IP activities.
- Early detect weak signals, opportunities and risks.
- Open discussion with analyst.

Format

- PDF file with analyses.
- Excel file with patent data.
- Direct access to the analyst.

INSIGHTS

(free article & webinar)

To get unique information about industry and technology

- Analyst point of view about industry news (product release, M&A, start-up, fund-raising, etc.) from a patent perspective.

Format

- KnowMade website

MAIN FIELDS OF EXPERTISE

SEMICONDUCTORS

- Materials & Substrates
- Power electronics
- RF & Wireless datacom
- MEMS, Sensing & Imaging
- Photonics, Lighting & Display
- Memory
- Packaging

ENERGY

- Batteries
- Fuel-cells
- Solar PV
- Power management

HEALTHCARE

- New therapeutic tools
- Medical diagnostics
- Medical devices and imaging
- Drug discovery and delivery

AGRI-FOOD

- Food processing & formulation
- Vegan food
- Next-gen packaging
- Microbiology







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