

LIDAR for Automotive

Patent Landscape Analysis

April 2018

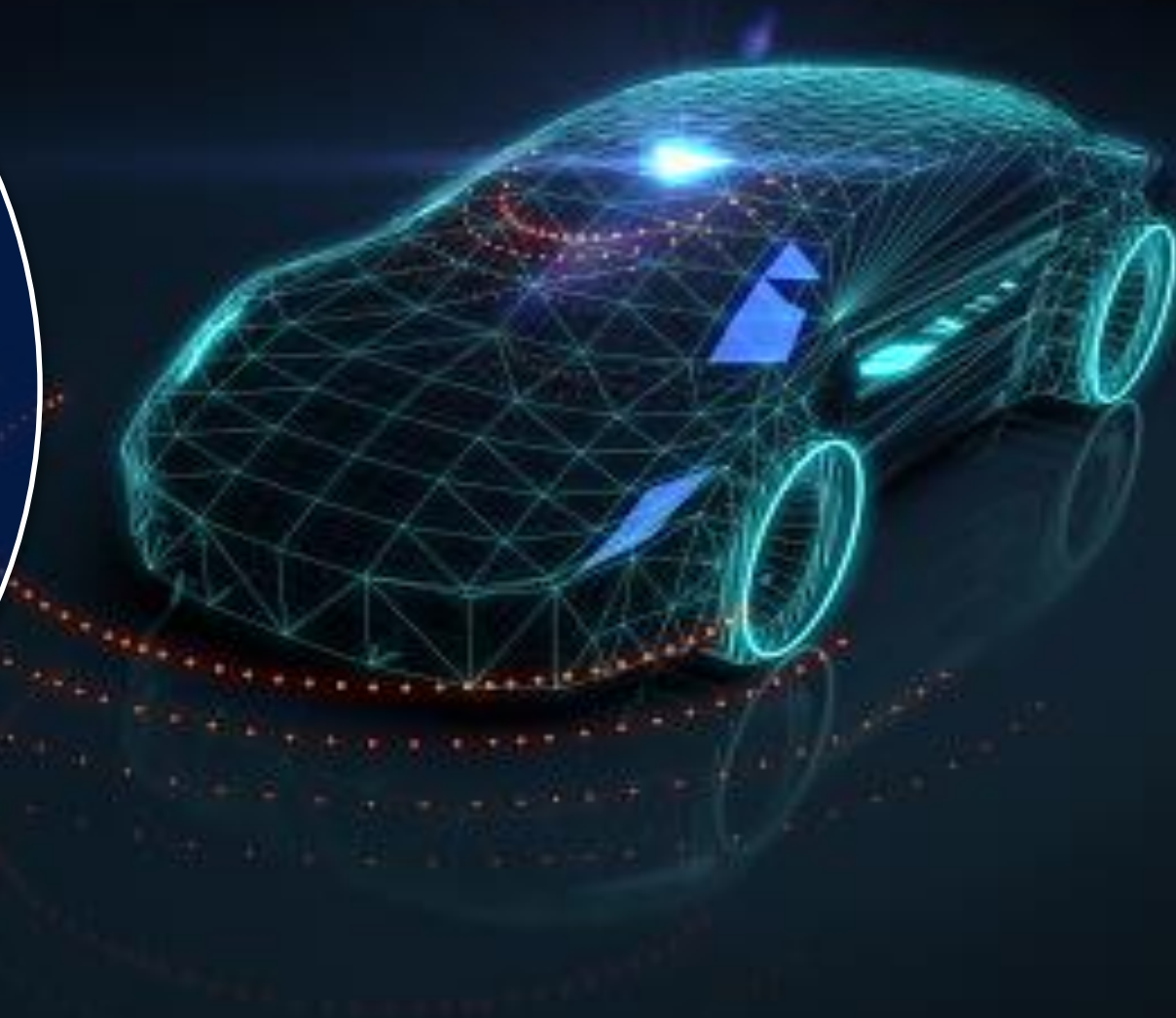


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Key feature of the report		Main assignees		Portfolio overview	
Objectives of the report		IP leadership		Detailed analysis of their patents	
		Blocking potential		Main IP players	
		Reinforcement potential		Companies overview	
		IP strength index		Most valued patent families	
				Recent IP strategy and patent families analysis	
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Search equations		Detectors: APD and SPAD		KNOWMADE PRESENTATION	229
Mergers and Acquisitions		Scanning: MEMS mirrors, Flash LIDAR			
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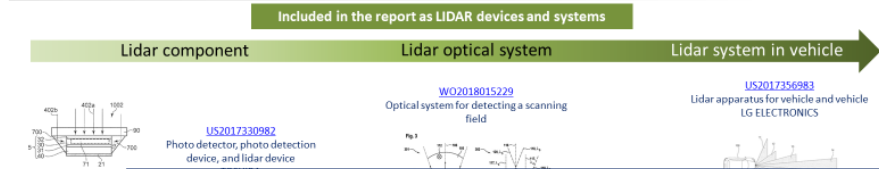
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Scope of the report

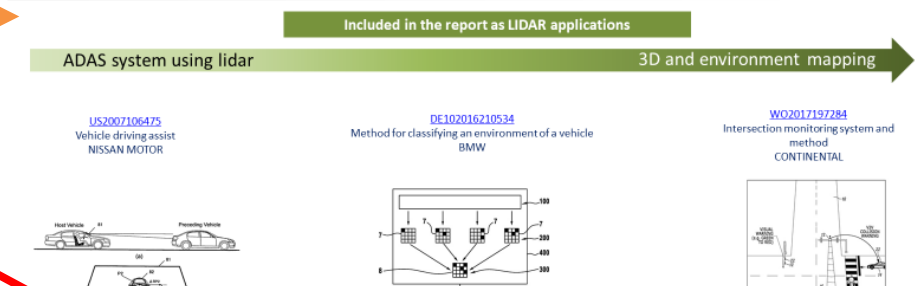
- This report provides a detailed picture of the patent landscape for **LIDAR dedicated to automotive applications**.
- This report covers **patents published worldwide up to September 2017**. We have selected and analyzed more than **12,990+ patents and patent applications** grouped in more than **6,480+ patent families** relevant to the scope of this report.

Example	Lidar devices and systems	Lidar applications	Excluded
Generic patents describing lidar devices without describing any specific applications	X		
Patents describing electrical or optical compound especially dedicated to lidar systems	X		
Patents describing lidar driving systems	X		
Patents describing method for driver assisted system		X	
Patents claiming the use of LIDAR, RADAR and other sensors in anti-collision or other ADAS systems		X	
Patent describing non-embedded lidar for vehicle traffic surveillance			X
Patents describing lidar system for airborne, weather, laser guidance, industrial, robotic or surveillance applications			X
Generic patents describing laser, optical components, detectors, etc. and non-directly related to lidar applications			X

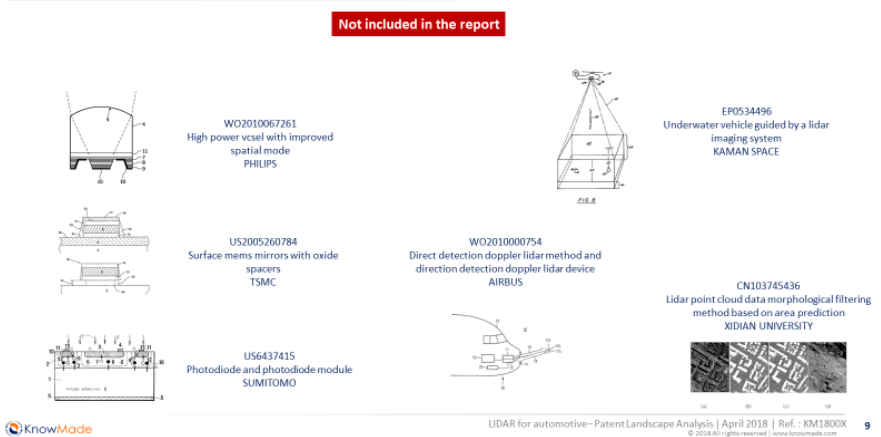
Scope of the report: examples of patents



Scope of the report: examples of patents



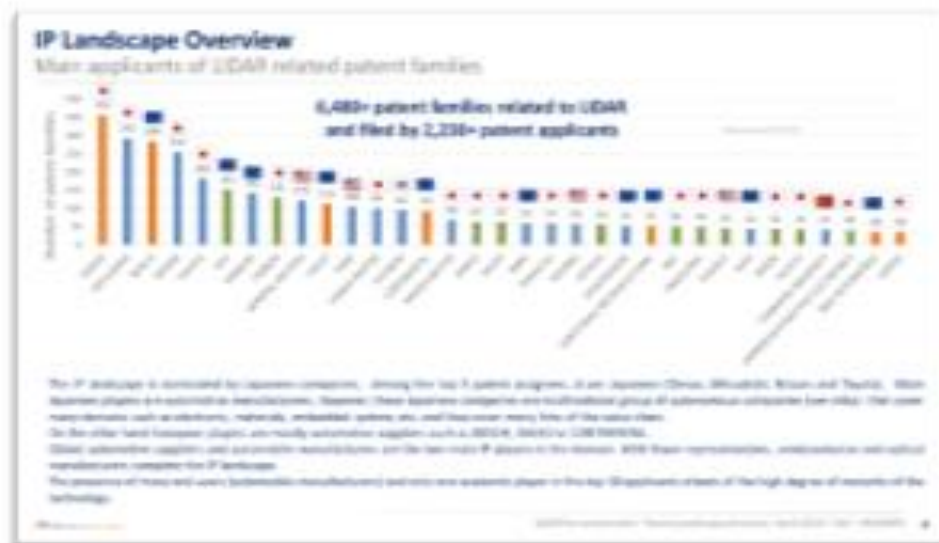
Scope of the report: examples of patents



Understanding of the main trend

Who, When and Where?

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Understanding the IP position of main assignee

IP dynamic and status of each assignee

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IP Landscape Overview

Current legal status of LIDAR patents held by main applicants

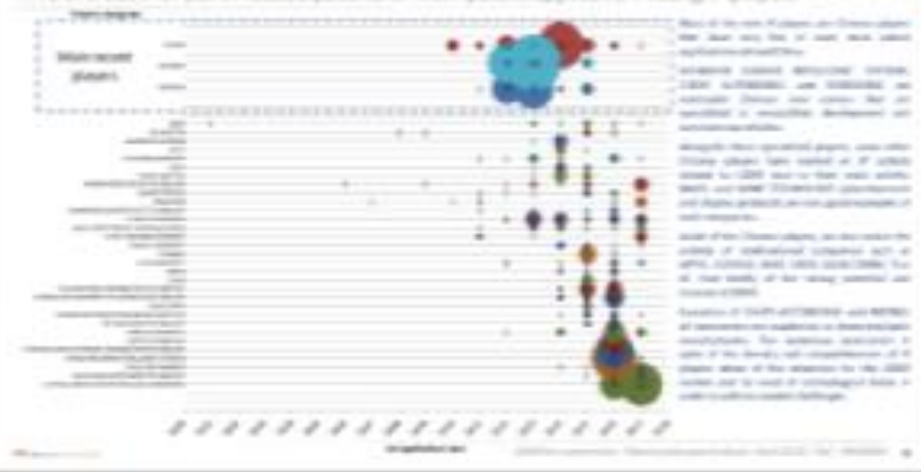


- More than 10% of all patents (Pending and granted) in the IP landscape related to lidar appear to be very recent filings. Furthermore, despite being an old technology, first patent filed in 1980 only 1% of the patent landscape, showing the strong patenting activity of the last 20 years.
- WIPAC is by far the most prolific player with 800 patent publications related to lidar. Furthermore, it also has the highest number of pending and granted applications which strengthen its position as leader of the IP landscape.
- IBM, Intel and LUMENIS appear as very active players which is noticeable by their high number of pending patent applications. To a lesser extent, NVIDIA, CORNING and WITTENBERG also exhibit a high ratio of pending patent applications which is due to their strong IP activity related to lidar.
- WITTENBERG and NVIDIA have a high number of filed patents and a low number of pending ones. These two main players were however players to the 80s and 90s but have progressively reduced their IP activity related to lidar for protection. However, WITTENBERG has now put more effort on the development of broader effect lidar (not included in this report) for autonomous cars (Google).

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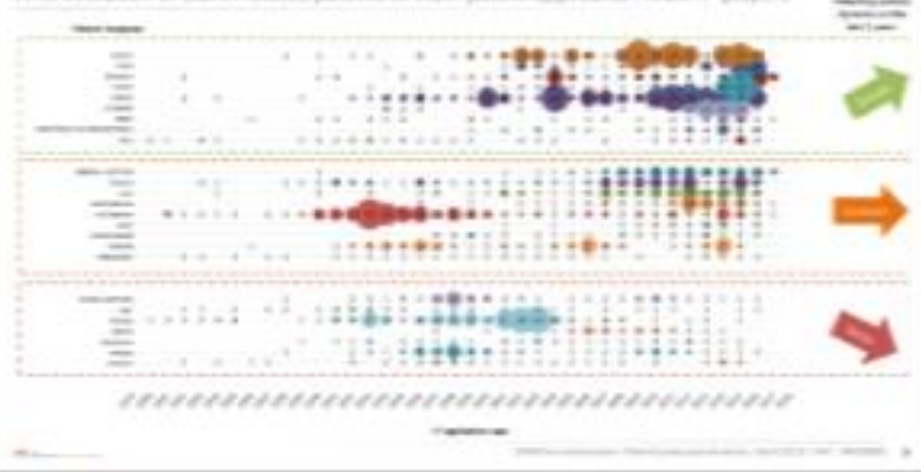
IP Landscape Overview

Time evolution of LIDAR related patents of main patent applicants - Young IP players



IP Landscape Overview

Time evolution of LIDAR related patents of main patent applicants - Main IP players



Analysis by segment

Segment overview and main IP players identification

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Lidar systems and components segment

Segmentation methodology

The selected scope can be divided into two segments regarding the position of the patented technology in the value chain. As a first step, it has been segmented between patents related to applications using lidar (mainly lidar systems and lidar sensors) and patents related to lidar itself (lidar components and lidar sensors).

Value chain: from components to systems and applications



Lidar systems and components segment

Main IP players position on the value chain

The selected scope can be divided into two segments regarding the position of the patented technology in the value chain. As a first step, it has been segmented between patents related to applications using lidar (mainly lidar systems and lidar sensors) and patents related to lidar itself (lidar components and lidar sensors).

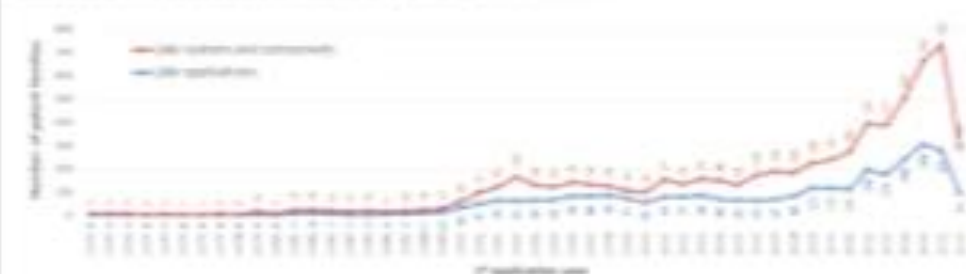
In the automotive market, lidar is used for autonomous driving. The automotive market is divided into two segments: lidar systems and lidar components. The automotive market is divided into two segments: lidar systems and lidar components.

Regarding the systems market, lidar is used for autonomous driving. The automotive market is divided into two segments: lidar systems and lidar components. The automotive market is divided into two segments: lidar systems and lidar components.

	Lidar systems and components	Lidar applications
Automotive market	Automotive market (lidar systems and lidar components)	Automotive market (lidar systems and lidar components)
Automotive market	Automotive market (lidar systems and lidar components)	Automotive market (lidar systems and lidar components)
Automotive market	Automotive market (lidar systems and lidar components)	Automotive market (lidar systems and lidar components)
Automotive market	Automotive market (lidar systems and lidar components)	Automotive market (lidar systems and lidar components)

Lidar systems and components segment

Time evolution of patent publications per segments

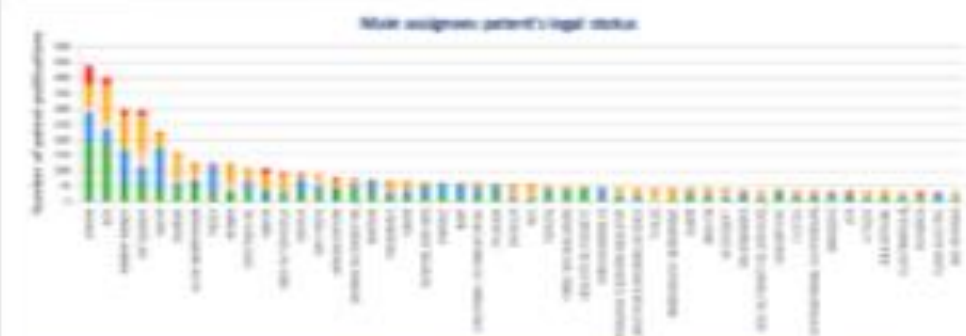


Both segments have a similar time evolution of patent publications with a first increase of IP activity in the 80's and a second around 2010. However, we notice a small delay of the starting activity related to lidar systems and components between 2010 and 2015 which results with a progressive change in the IP players related to lidar systems and components.

Since 2010 and the IP activity regarding the lidar systems and components segment shows a higher growth rate which is related to the entrance of new players that come from electronics, semiconductor and IT field and contribute to the development of lidar for automotive applications.

Lidar systems and components analysis

Main IP players portfolio legal status



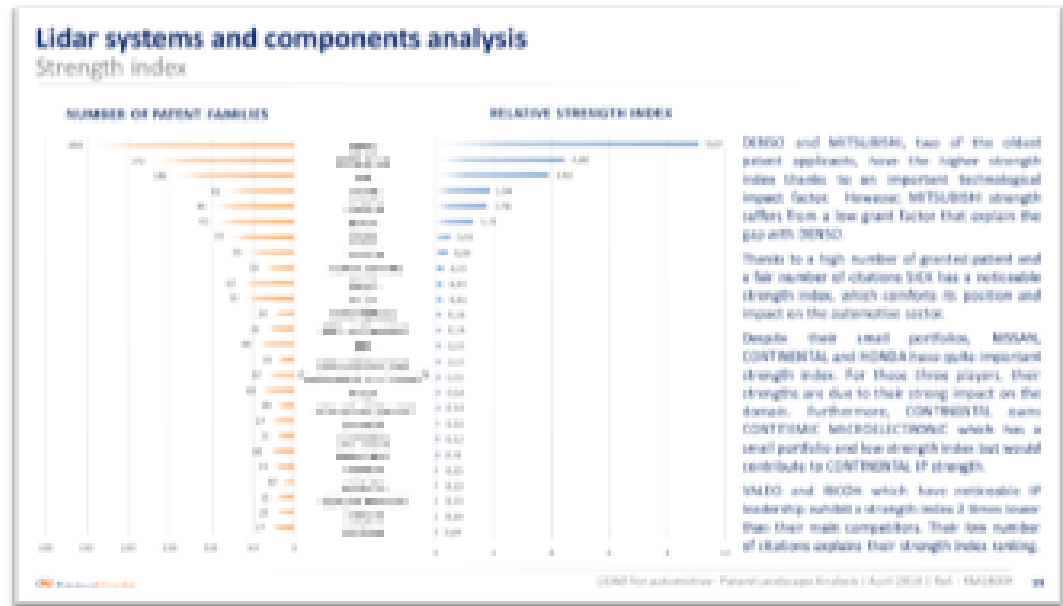
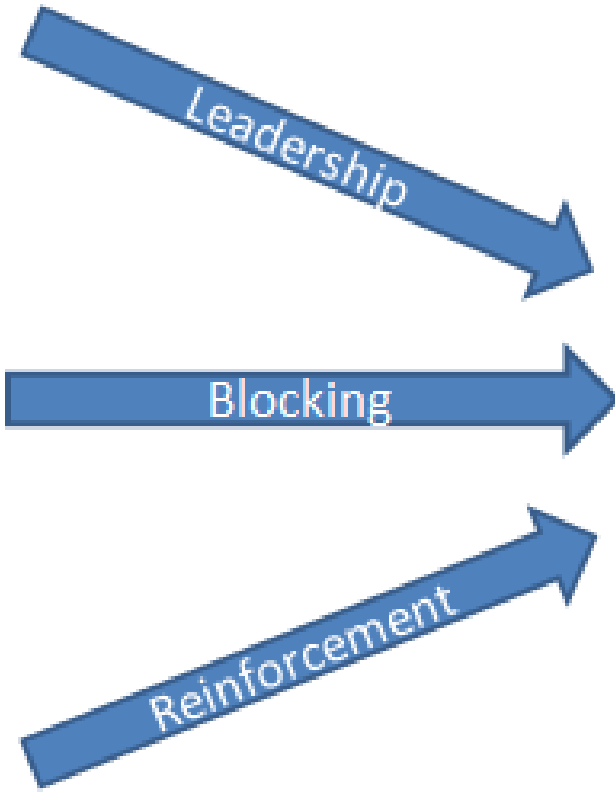
Lidar systems and components segment is dominated by the automotive suppliers and sensor supplier players. However, we notice a small delay of the starting activity related to lidar systems and components between 2010 and 2015 which results with a progressive change in the IP players related to lidar systems and components.

Since 2010 and the IP activity regarding the lidar systems and components segment shows a higher growth rate which is related to the entrance of new players that come from electronics, semiconductor and IT field and contribute to the development of lidar for automotive applications.

Comparison of IP players

Who has the strongest portfolio related to the segment and why?

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Key technologies

Overview of each promising IP segments and illustration of main solutions

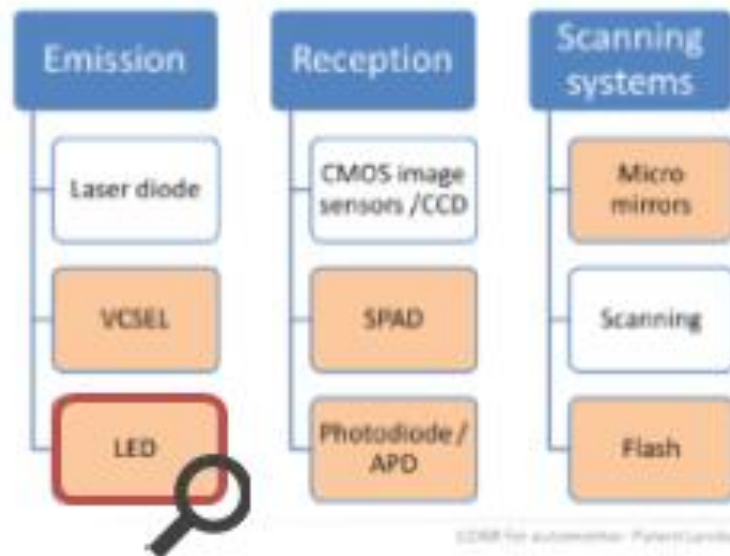
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Key technologies

Sub-segmentation methodology

To identify and analyze the main technological key patents, we have chosen to sub-segment the lidar systems and components by key technological bricks. The segmentation includes patents related to:

- laser/light emission with a focus on laser diode and VCSEL technologies
- reflected light sensors including single photon avalanche diode (SPAD), CMOS image sensors (CCD camera, etc.) and photodetectors
- Scanning mechanisms with a focus on micro mirrors / MEMS solutions and disk scanning solution (rotating mirror)



N.B.: Due to our search strategy and patent scope, patents related to components (lenses, photodiodes, etc.) that are not specifically related to lidar are not included.

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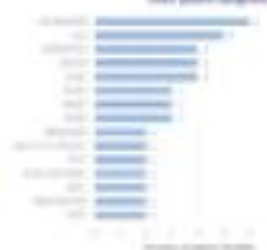
Key technologies

Emission segment- LED

Free availability of patent applications



Most patent assigners

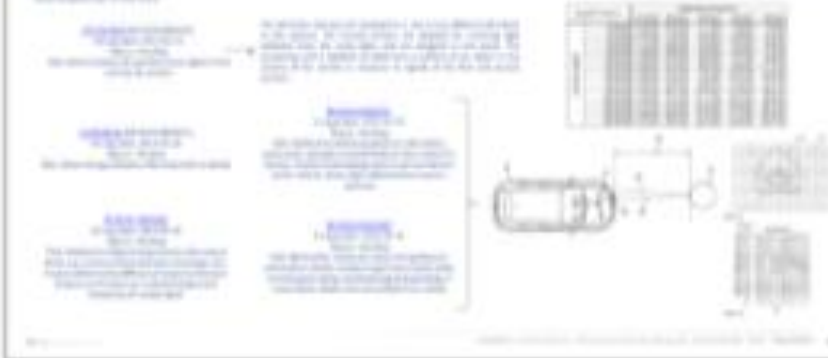


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Key technologies

LIDAR opportunities - Integrating Lidar in localization

A 2017 study by the industry has identified that the most significant opportunities for integrating Lidar in localization are in the areas of autonomous driving, autonomous construction, and autonomous agriculture.



Understanding of newcomers patented technologies and IP strategy



Main IP players portfolio analysis

Identification of main IP players position and current IP strategies

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Patent database

Excel file containing all the patents analyzed in this report with technology segmen



This Excel database allows multi-criteria searches and includes patent publication number, hyperlinks to the original documents, priority date, title, abstract, patent assignees, legal status and technical segment for each patent families.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	LiDAR for automotive – Patent List (April 2018)																			
2																				
3																				
4																				
5	Patent unique family ID (FP)	Publication number	Title	Abstract	Earliest application #	Earliest publication #	Expected expiry date	Current assignee	Inventors	Legal status (Pending, Granted, Revoked)	Original document	Lidar device	Lidar application	LED	VCSEL	Micro Mirror	Solid state	APD	SPAD	
6	79235784	EP3301480 WO2018065429	System and method	The invention	2016-10-03	2018-04-04	2036-10-03	XENOMATIX	VANDYCK DIRK VANDEN BOSSCHE	EP3301480 PENDING	Open	X					X			
7	79235780	EP3301479 WO2018065426	Method for	The invention	2016-10-03	2018-04-04	2036-10-03	XENOMATIX	VANDYCK DIRK PAESENRIK	EP3301479 PENDING	Open	X					X			
8	79235779	EP3301477 WO2018065428	System for	The invention	2016-10-03	2018-04-04	2036-10-03	XENOMATIX	PAESENRIK VANDYCK DIRK	EP3301477 PENDING	Open	X					X			
9	79235778	EP3301478 WO2018065427	System for	The invention	2016-10-03	2018-04-04	2036-10-03	XENOMATIX	VANDYCK DIRK VANDEN BOSSCHE	EP3301478 PENDING	Open	X					X			
10	79225929	BR112016005690 BR112016005690	POSITIONING	(BR112016005690)	2013-09-20	2016-04-12	2033-09-20	CATERPILLAR	Smith David William Brauckman Peter John	PENDING	Open	X								
11	79224025	IL165859 US2010191418	Vehicle mounted	(US8600656)	2003-08-05	2006-01-15	2023-08-05	ELBIT SYSTEMS		GRANTED	Open		X							
12	79147198	US8600656 US8600656	Lidarsystem with	(US8600656)	2008-06-18	2010-07-29	2029-08-17	LEDDARTECH	MIMEAULT YVAN CANTINDANIEL	GRANTED	Open		X							
13	78535249	DE102016213509 DE102016213509	Lidar with	(DE102016213509)	2016-07-22	2018-01-25	2036-07-22	ZF	FRIEDRICHSHAFEN HEINLE ANNA	PENDING	Open	X					X			
14	78535196	DE102016213446 WO2018015229	Optical system for	(WO2018015229)	2016-07-22	2018-01-25	(WO2018015229)	ROBERT BOSCH	STOPPEL KLAUS BOGATSCHER	PENDING	Open	X					X			
15	78535182	DE102016213427 DE102016213427	Lidar with after	(DE102016213427)	2016-07-22	2018-01-25	2036-07-22	ZF	FRIEDRICHSHAFEN HEINLE ANNA	PENDING	Open	X					X			
16	78535120	DE102016213348 WO2018015172	Optical arrangement	(WO2018015172)	2016-07-21	2018-01-25	(WO2018015172)	ROBERT BOSCH	STOPPEL KLAUS KAESTNER FRANK	PENDING	Open	X								
17	78535112	DE102016213344 WO2018015082	Optical system for	(WO2018015082)	2016-07-21	2018-01-25	(WO2018015082)	ROBERT BOSCH	STOPPEL KLAUS KAESTNER FRANK	PENDING	Open	X								
18	78456792	US2018019268 US2018019268	Stacked-chip	(US2018019268)	2016-07-18	2018-01-18	2036-07-18	OMNIVISION	ZHANG BOWEI VENEZIA VINCENT	PENDING	Open	X						X	X	
19	78451707	US9869754 US9869754	Scan alternator for	(US9869754)	2017-03-22	2018-01-16	2037-03-22	TECHNOLOGIES	CAMPBELL SCOTT R CLEVE RODGER W	GRANTED	Open	X			X		X			
20	78298139	DE102016112478 EP3273268	Deflection mirror	(EP3273268)	2016-07-07	2018-01-11	(EP3273268)	VALEO SCHALTER & SENSOREN	NIES JUERGEN HORVATH PETER	PENDING	Open	X			X					
21	78291782	KR101814135 KR101814135	Lidar system	(KR101814135)	2017-08-23	2018-01-02	2037-08-23	MJB	KIM CHEOL YOUNG	GRANTED	Open	X								
22	78291773	KR101814129 KR101814129	Optical Assembly for	(KR101814129)	2017-08-23	2018-01-02	2037-08-23	MJB	KIM CHEOL YOUNG	GRANTED	Open	X								
23	78289192	AU2006203759 AU2006203759	Aircraft docking	(EP3259615)	2006-08-29	2006-09-14	2021-12-11	SAFEGATE	MILLGARD LARS	GRANTED	Open	X								
24	78240922	WO2016154321 CN107257921	Activated optical	(CN206804870U)	2016-02-19	2016-08-25	2026-02-19	APPLE	KALSCHOUR MICHAEL P	EP3259615 PENDING	Open	X			X					
25	78197428	CN206804870 CN107515388	Laser range finder	(CN107515388)	2017-06-22	2017-12-26	2027-06-22	ZHENG SHENG FANG	ZHENG SHENG FANG	GRANTED	Open	X								
26	78188090	CN107515388 CN107505608	Laser range finder	(CN107505608)	2017-06-22	2017-12-26	2027-06-22	BEIJING ENCRADAR	WANG HAO LIU XIAOKANG	PENDING	Open	X								
27	78167649	CN107505608 CN107505608	Front-end reading	(CN107505608)	2017-06-22	2017-12-22	2027-06-22	INDIAN UNIVERSITY	ZHU ZHANGMING ZHENG HAO	PENDING	Open	X						X		

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To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

4. LIABILITIES

4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller’s website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

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.



www.knowmade.com

contact@knowmade.fr

KnowMade S.A.R.L., 2405 route des Dolines, CS 10065, 06902 Sophia Antipolis, France

Technology Intelligence and IP Strategy consulting company

Compound Semiconductors | Power & RF/microwave Electronics | LED/OLED Lighting & Display | Photonics | Memories | Solid-state Sensors, Actuators and Microsystems | Manufacturing & Advanced packaging | Batteries & Energy management | Biotechnology | Pharmaceuticals | Medical Devices | Medical Imaging | Agri-Food & Environment.

Executive team



Dr. Nicolas Baron
CEO and co-founder of Knowmade.

He manages the development and strategic orientations of the company and personally leads the Electronics & Telecom department. He holds a PhD in physics from the University of Nice Sophia-Antipolis, and a Master degree in Intellectual Property Strategies and Innovation from the European Institute for Enterprise and Intellectual Property (IEEPI Strasbourg), France.



Dr. Brice Sagot
CTO and co-founder of Knowmade.

He manages the development of IP analysis tools and methodologies, and personally leads the Life Sciences & Healthcare department. He holds a PhD in molecular biology from the University of Nice Sophia-Antipolis, France.

Analyst team

7 full time analysts with PhD degree and in-depth knowledge in Intellectual Property and Scientific Information.

Founded in 2009

Headquartered in Sophia Antipolis FRANCE



Sophia Antipolis



JEI since 2013 (Innovative New Company)

CIR accreditation since 2012 (Research Tax Credit)

PARTNERS



+ expert network (Industrial & Academics)

WHAT WE DO

KNOWMADE OFFERS YOU THE CAPABILITY TO

- ✓ **Understand** your competitive environment
- ✓ **Follow** technology trends
- ✓ **Identify** patent/technology opportunities
- ✓ **Assess** patent/technology risks
- ✓ **Strategize** your IP and R&D
- ✓ **Monetize** your technologies and know-how
- ✓ **Defend** your business

KNOWMADE OPERATES IN THE FOLLOWING SECTORS

❖ Semiconductors

Compound semiconductors, Power & RF electronics, LED lighting & display, Photonics, Memories, Advanced packaging

❖ MEMS, Sensors & Actuators

Inertial sensor, Microphone & Microspeaker, RF switch, filter & resonator, Environmental sensor, Optical sensor & actuator, Microfluidics, Microfabrication technologies

❖ Batteries & Energy Management

Energy storage, Battery cell & pack, Power electronics, Renewable energies

❖ MedTech

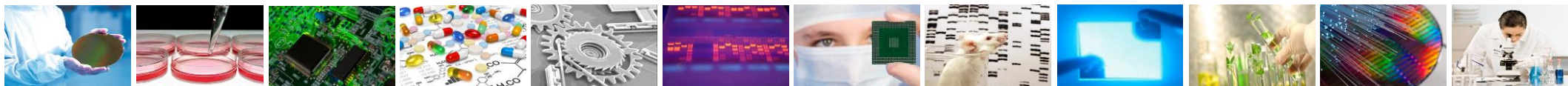
Biotech, Pharma, Medical devices, Medical imaging

Patents
Technologies
Prior art
Scientific findings
Opportunities
Partners
Competitors
Newcomers
M&A targets



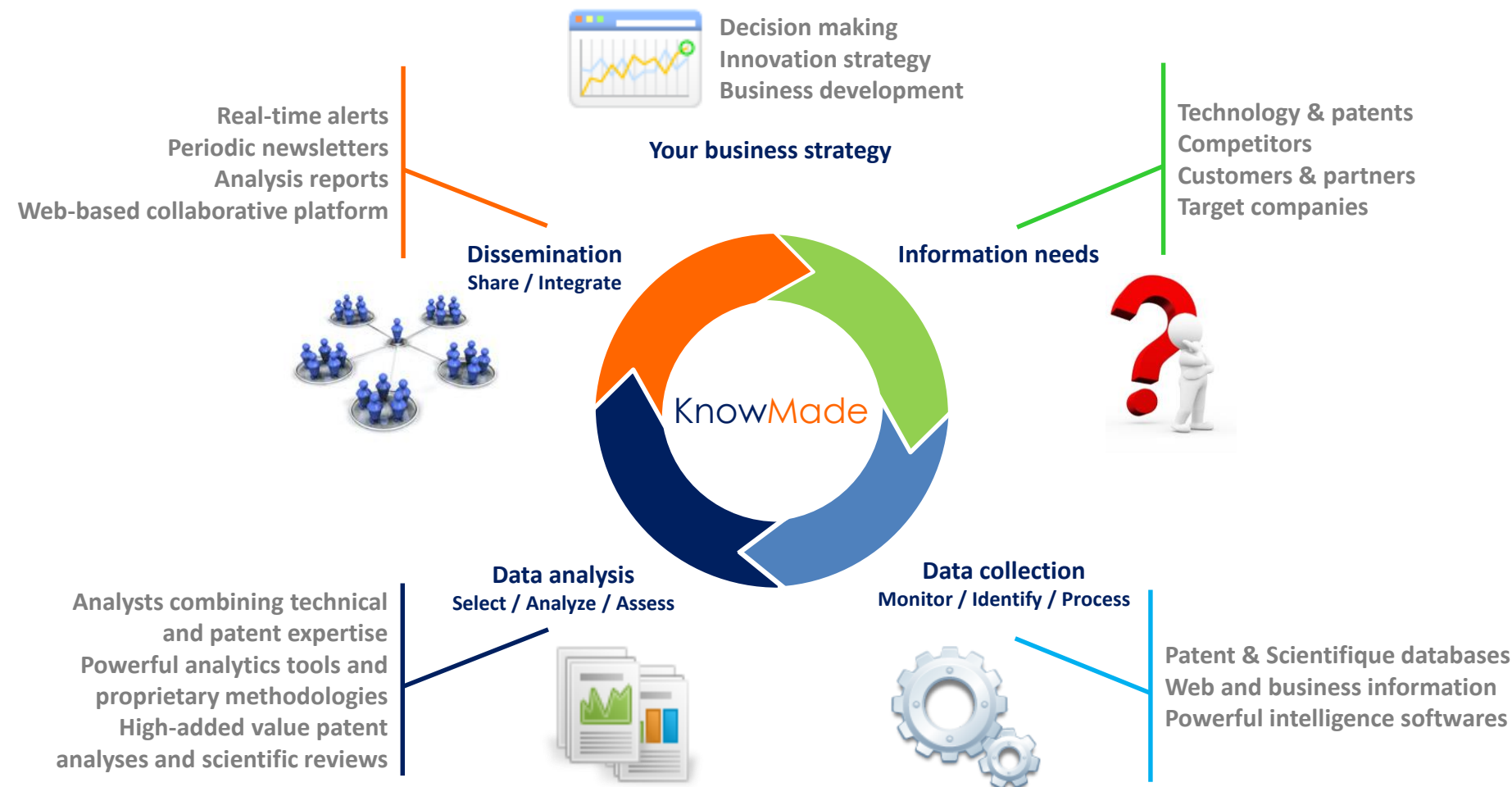
Patent landscape analysis
Scientific review
IP portfolio assessment
Patent valuation
Freedom-to-operate analysis
Litigation & licensing support
Patents linked to products
Technology scouting
Technology trends
Competitive IP landscape
Market trends
Reverse engineering

Make strategic decisions
Sustain competitive advantages
Speed R&D and enhance innovation process
Align R&D and IP with key business objectives
Strengthen IP portfolio and acquire technologies
Anticipate risks and defend core businesses
Explore new opportunities and monetize IP



INTELLIGENCE CYCLE

Tracking key technologies and competitors' R&D activities in order to anticipate changes, early detect business opportunities, mitigate risks, and make strategic decisions



CLIENT BENEFITS

Understand

your competitive environment from technology and patent perspective

- Identify risks & opportunities
- Understand technology & market from a patent perspective
- Discover new markets & technology direction
- Understand the competitive landscape
- Know where your competition is headed
- Identify your current and future competitors
- Understand your competitors' strategic direction and future product offerings
- Determine your competitors' strengths and weaknesses
- Identify strategic partnerships
- Identify untapped areas and opportunities to direct R&D and patenting activity

Strategize

your R&D and IP portfolio

- Speed your R&D and enhance your innovation process
- Sustain competitive advantages
- Protect your core technologies from competitors
- Anticipate the risks
- Assess your IP portfolio and competitive positions
- Realize the full value of your IP portfolio
- Explore new opportunities
- Strengthen your IP position
- Align your R&D and IP portfolio with key business objectives
- Leverage your IP portfolio to make strategic business decisions
- Identify new revenue opportunities
- Mitigate litigation risks

Build

an effective R&D and IP portfolio

- Strengthen your IP portfolio
- Acquire technologies and know-how
- Optimize your patent prosecution budget
- Improve your patent application process

Defend

your business

- Protect key markets and products by leveraging your IP to address competitive threats
- Defend your position in licensing negotiations or patent litigation

Monetize

your IP portfolio

- Turn your IP portfolio into valuable asset
- Assert your patent rights
- Develop successful patent sales or licensing program
- Improve your position in licensing negotiations or patent litigation

CUSTOM STUDY & CONSULTING

Tailor-made analysis to meet your needs and budgetary constraints

Prior art search

Evaluate the patentability of your invention in the course of a patent filing.

Invalidate competitor's patents in the course of patent litigation or in anticipation of one.

Make third-party observations concerning the patentability of competitor's inventions.

Patent landscape analysis

Understand the competitive environment and the technology trends from a patent perspective.

Identify key players, their IP strategy and their key patents.

Know IP collaborations, licensing agreements and litigation history.

Freedom-to-operate analysis

Assess the risks to infringe third-party patents.

Ensure that your products/processes can be safely manufactured, sold and used in specific countries without infringing patents held by others.

Litigation and licensing support

Evidence of infringement/non-infringement for offensive/defensive support.

Defend your position in licensing negotiation or patent litigation.



Patent assessment

Identify most valuable patents prior to patent acquisition/sales, licensing agreement, capital fundraising process, M&A or IP due diligence.

Estimate the financial value of your patent portfolio.

IP due diligence

Assess the patent portfolio of a company and reveal the SWOT matrix prior to patent acquisition/sale, licensing agreement or M&A.

Scientific literature analysis

Pinpoint key research findings and new emerging research fields, key laboratories and scientific experts, industrial/academic research collaborations, and identify prospective R&D partners.

Technology scouting

Identify, qualify and get access to external innovation.

IP & Technology watch service

Follow IP/technology trends, keep a watch on your competitors and identify new entrants, anticipate the changes, early detect business opportunities and mitigate the risks.

STANDARD REPORTS

2018 reports collection

COMPOUND SEMICONDUCTORS

- **Status of the GaN IP** - Patent Activity 2017 + Patent Watch 2018*
- **RF GaN** - Patent Landscape 2018*
- **Power SiC** - Patent Landscape 2018*
- **Patent Trolls in the Semiconductor Market** - Litigation Risk and Potential Targets 2017
- **GaN Technology** - Top-100 IP Profiles 2016
- **GaN Devices for Power Electronics** - Patent Landscape 2015
- **GaN-on-Silicon Substrate** - Patent Landscape 2014
- **GaN Substrate** - Patent Landscape 2014
- **FD-SOI** - Patent Landscape 2014

POWER ELECTRONICS

- **Power SiC** - Patent Landscape 2018*
- **Wireless Power Charging** - Patent Landscape 2017
- **GaN Devices for Power Electronics** - Patent Landscape 2015

RF DEVICES & TECHNOLOGIES

- **RF GaN** - Patent Landscape 2018*
- **RF Front End Module** - Patent Landscape 2018
- **RF Acoustic Wave Filters** - Patent Landscape 2017

LED/OLED LIGHTING & DISPLAYS

- **MicroLED Display** – Patent Landscape 2018
- **Phosphors and QDs for LED Applications** - Patent Landscape 2015
- **Nanowire LED** - Patent Landscape 2014

MEMORY

- **3D Non-Volatile Memories** - Patent Landscape 2018
- **Patent Trolls in the Semiconductor Market** - Litigation Risk and Potential Targets 2017
- **TSV Stacked Memories** - Patent Landscape 2016
- **ReRAM and Memristor Technologies** – Patent Landscape 2015
- **Emerging Non-Volatile Memories (eNVM)** - Patent Landscape 2014

BATTERY AND ENERGY MANAGEMENT

- **Status of the Battery IP** - Patent Activity 2017 + Patent Watch 2018
- **Solid-state Batteries** - Patent Landscape 2018*
- **NMC Li-ion Batteries** - Patent Landscape 2017
- **Microbattery** - Patent Landscape 2016

IMAGING

- **iPhone X Dot Projector** - Patent-to-Product Mapping 2018*
- **LiDAR for Automotive** - Patent Landscape 2018
- **MicroLED Display** – Patent Landscape 2018
- **Consumer Physics SClO Molecular Sensor** - Patent-to-Product Mapping 2017
- **Biomedical Photoacoustic Imaging** - Patent Landscape 2015
- **Honeywell Microbolometer** - Patent Portfolio Analysis 2015
- **Capsule Endoscopy** - Patent Landscape 2014

* Coming soon

Complete list of reports on www.knowmade.com

STANDARD REPORTS

2018 reports collection

ADVANCED PACKAGING

- **Hybrid Bonding for 3D Stack** - Patent Landscape 2018*
- **3D Non-Volatile Memories** - Patent Landscape 2018
- **Fan-Out Wafer Level Packaging** - Patent Landscape 2016
- **TSV Stacked Memories** - Patent Landscape 2016

MEMS & SENSORS

- **MEMS Microphone** - Patent Landscape 2018*
- **LiDAR for Automotive** - Patent Landscape 2018
- **iPhone X Dot Projector** - Patent-to-Product Mapping 2018*
- **RF Acoustic Wave Filters** - Patent Landscape 2017
- **Pumps for Microfluidics** - Patent Landscape 2017
- **Knowles MEMS Microphones in Apple iPhone 7 Plus** - Patent-to-Product Mapping 2017
- **Microfluidic Technologies for Diagnostic Applications** - Patent Landscape 2017
- **Consumer Physics SCiO Molecular Sensor** - Patent-to-Product Mapping 2017
- **Miniaturized Gas Sensors** - Patent Landscape 2016
- **MEMS Microphone** - Patent Infringement Risk Analysis 2015
- **Capacitive Fingerprint Sensors** - Patent Landscape 2015
- **Capacitive Fingerprint Sensors** - Patent Infringement Risk Analysis 2015
- **Honeywell Microbolometer** - Patent Portfolio Analysis 2015
- **9-Axis MEMS IMU** - Patent Infringement Risk Analysis 2014
- **Emerging MEMS** - Patent Landscape 2014

MEDTECH

- **Organ on a Chip** - Patent Landscape 2018*
- **CTC Isolation** - Patent Landscape 2018*
- **Microfluidic IC Cooling** - Patent Landscape 2018*
- **OCT Medical Imaging** - Patent Landscape 2018
- **Fluidigm** - Patent Portfolio Analysis 2017
- **Pumps for Microfluidics** - Patent Landscape 2017
- **Microfluidic Technologies for Diagnostic Applications** - Patent Landscape 2017
- **3D Cell Culture Technologies** - Patent Landscape 2016
- **Miniaturized Gas Sensors** - Patent Landscape 2016
- **Non-Invasive Glucose Monitoring** - Patent Landscape 2015
- **Biomedical Photoacoustic Imaging** - Patent Landscape 2015
- **Capsule Endoscopy** - Patent Landscape 2014

** Coming soon*

Complete list of reports on www.knowmade.com

TRAINING & WORKSHOP

Benefit from face-to-face meeting with our experts

Training

Knowmade provides guidance to companies and research laboratories seeking to gain an understanding of the issues linked with competitive intelligence, set up an internal intelligence process or improve their existing processes.

- ✓ Patent information for R&D, strategy and marketing
- ✓ Patent Intelligence: Tapping the economic potential of patent information
- ✓ Technology Intelligence and Innovation
- ✓ Setting up a strategic intelligence unit
- ✓ Intelligence process optimization



Workshop

Objective

One day face-to-face presentation of our data and analysis with Q&A session on specific questions of your choice (direct interaction with our experts at your site)

- Have the ability to ask questions or for specific analysis before the workshop
- Access to Knowmade ongoing analyses
- Direct contact with Knowmade analysts
- Open Q&A session with the key persons of your company

Content

- ✓ Presentation of updated Knowmade analyses
- ✓ Presentation of the analysis done for your company
- ✓ Executive synthesis
- ✓ Q&A session and open discussion





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