From Technologies to Markets

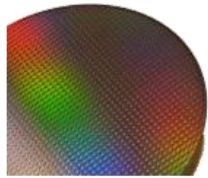2D and 3D Imaging markets overview and wafer level optics opportunities

EPIC Event at Suss MicroOptics

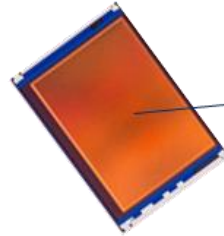Neuchâtel, Switzerland
November 7, 2019

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Développement

© 2019

WAFER LEVEL OPTICS

Optics

AF & OIS

Module Assy

courtesy of Sony

Sensor array

Illuminator

courtesy of PMDTech

courtesy of Apple

Wafers &
raw material

Sub-components
Sensor, optics
& illumination

Camera
Modules

Systems

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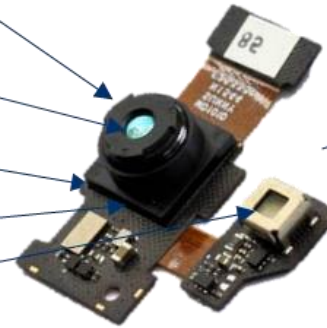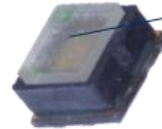
CIS MARKET REVENUE

Revenue Quarterly CIS - mobile vs. all other markets (in $M)

Legend: —— Total all markets —— Mobile — — All other markets exept Mobile
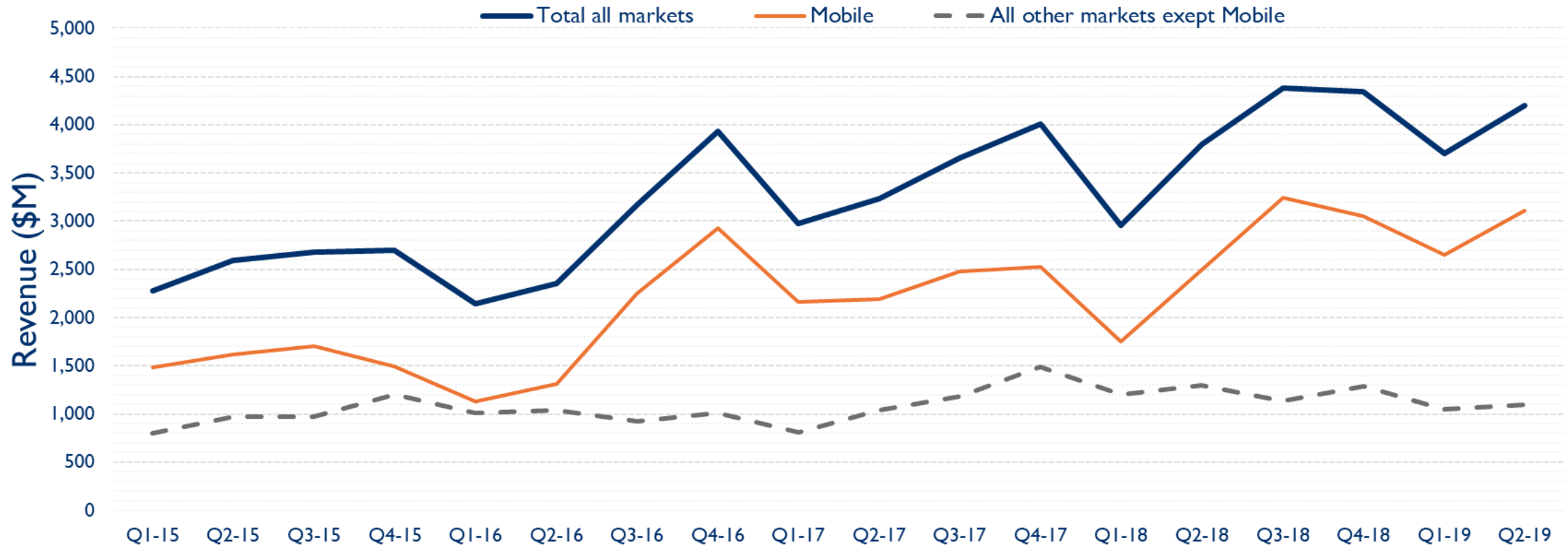
- CIS market is dominated by mobile which represent 68% of revenues
- No effect perceived of the smartphone market saturation…yet
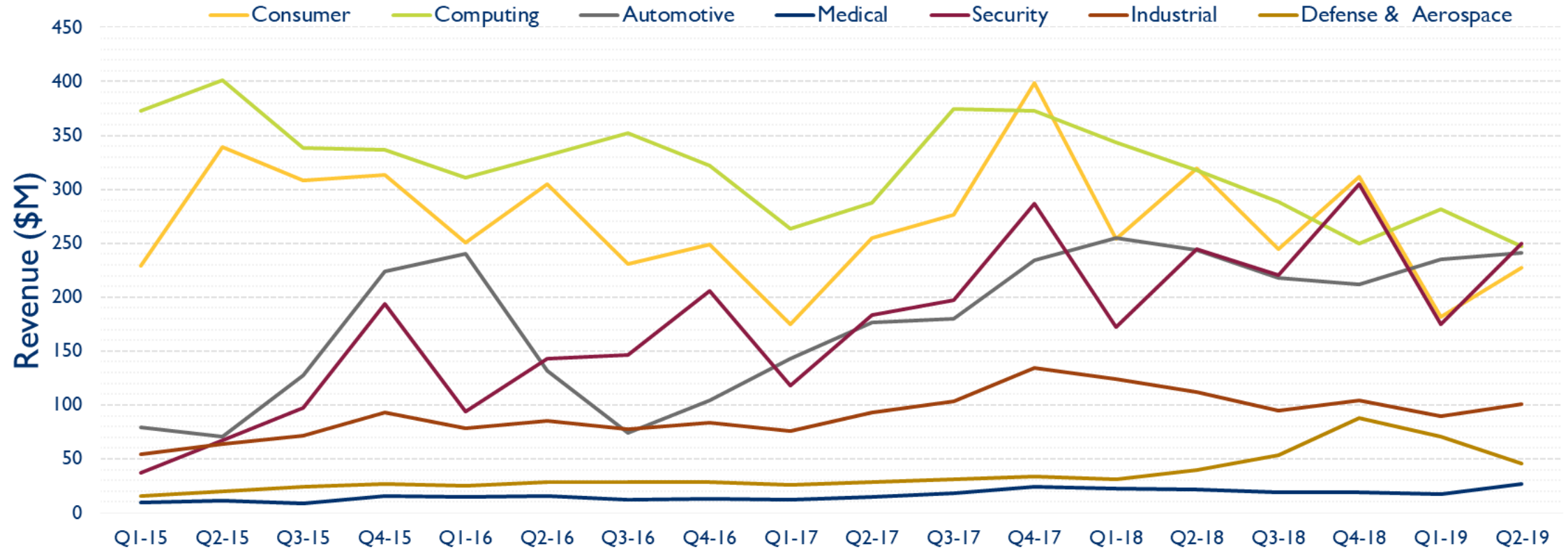- Proliferation of cameras per phone is the key new factor for growth.

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Développement

CIS MARKET REVENUE

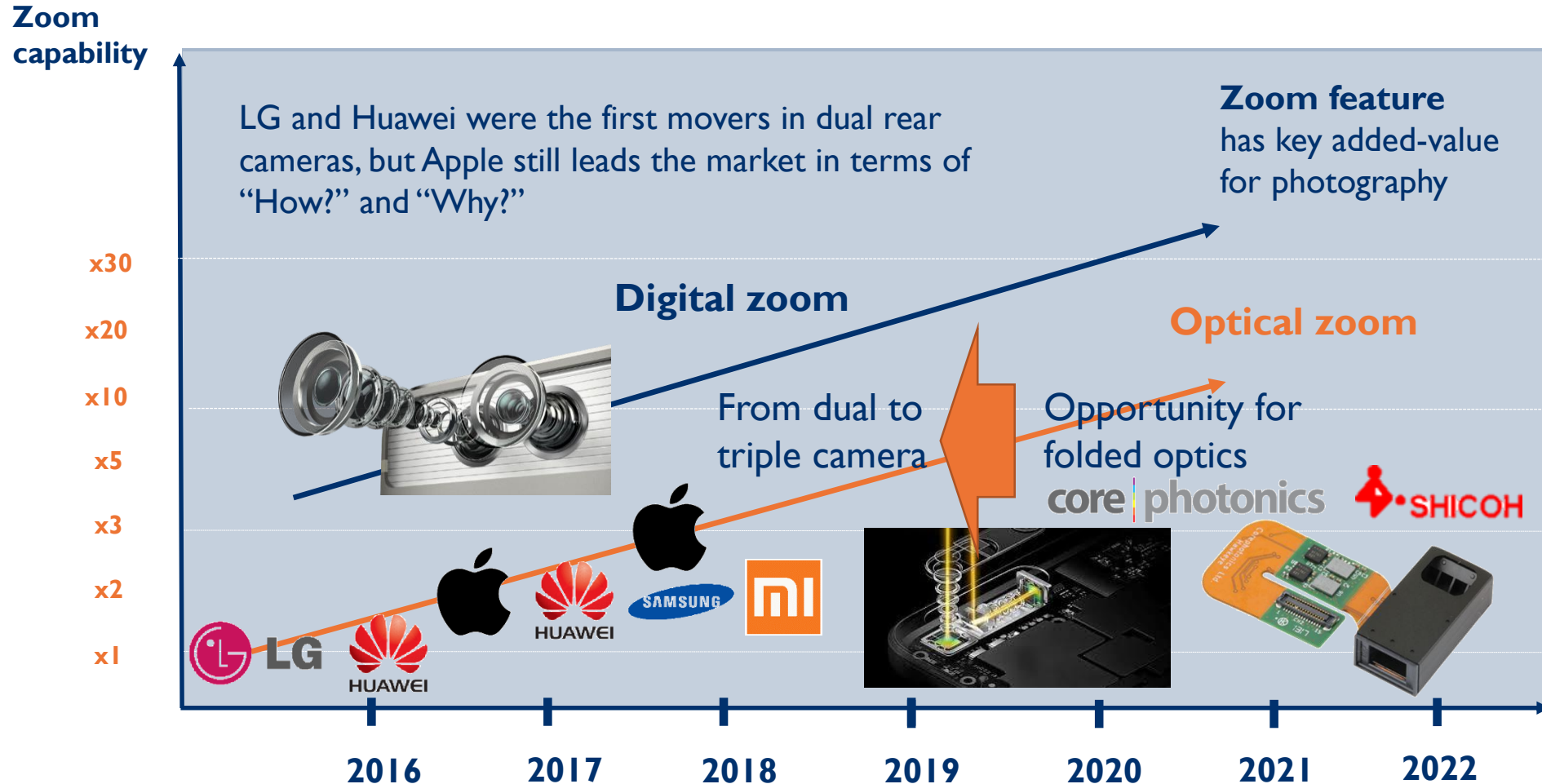**Revenue Quarterly CIS - all other markets (in $M)**

- *Automotive and Security markets now on par with Consumer and Computing which are on a multi year sliding slope*
- *Automotive and Security plateaued in the trailing last 4 quarters but should point north again along CN and US market recovery*
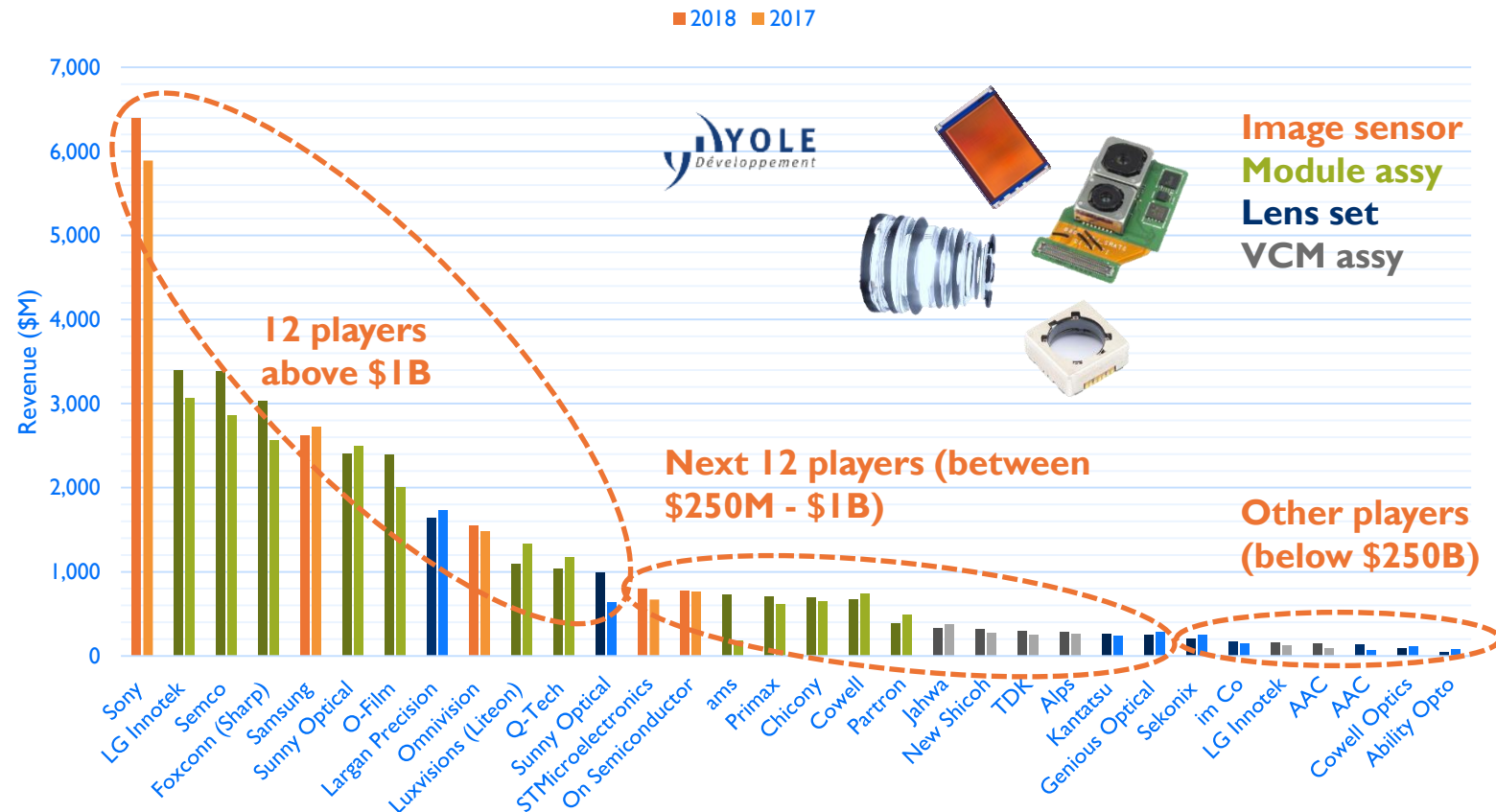
MOBILE TECHNOLOGY TREND

Zoom technology

Apple is starting a new race towards optical zoom capability

Zoom capability

LG and Huawei were the first movers in dual rear cameras, but Apple still leads the market in terms of "How?" and "Why?"

Zoom feature has key added-value for photography

Digital zoom

Optical zoom

From dual to triple camera

Opportunity for folded optics

core|photonics

SHICOH

- x30
- x20
- x10
- x5
- x3
- x2
- x1

2016 2017 2018 2019 2020 2021 2022

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CAMERA MODULE INDUSTRY - ECOSYSTEM

2018 "state of the industry"

The CCM ecosystem features 12 companies with revenue exceeding $1B

Camera module industry - main players

Image sensor
Module assy
Lens set
VCM assy

12 players above $1B

Next 12 players (between $250M - $1B)

Other players (below $250B)

Optical Elements

Optical elements can be classified as passive or active: Changing with time or not.

Passive elements

Lens

Lenses are used to shape light beams.

Mirror

Mirrors are used to shape or deflect light beams.

Filter

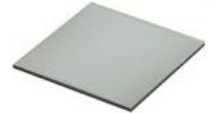Filters are used to select wavelength.

Window

Windows are used to protect optical elements and let the light through.

Diffuser

Diffusers are used to homogenize the light emitted from a punctual source.

Holographic elements

Holographic elements are used to convey light into waveguides for augmented reality.

Diffraction grating

Diffraction gratings are used to create regular light patterns from punctual sources.
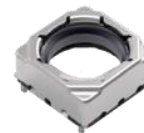
Diffractive elements

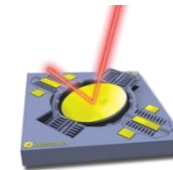Diffractive elements are used to convey light into waveguides for augmented reality.

Active elements

AF & OIS

Autofocus and Optical Image Stabilization is used in photography.

Beam scanner

Beam scanners are used to scan light with time.

Spatial Light Modulator

Spatial light modulators modulate light with respect to space and time.

MOBILE TECHNOLOGY TREND

Free-form lenses

Free-form lens is the logical next step to address some current issues:

- Illumination optics
- Zoom optics
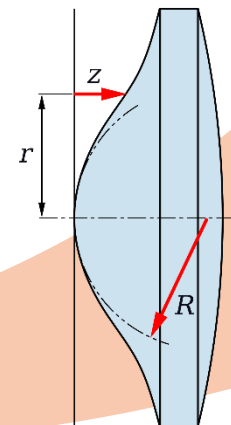- Periscope optics
- 180° panoramic optics

Lens manufacturing methods are evolving too, offering the optical designer more degrees of freedom

DynaOptics

IMMERVISION

Anteryon

Freeform lens

courtesy of Anteryon

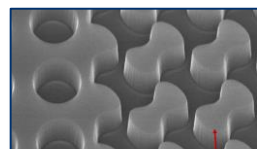**Aspherical lens**

Spherical lens

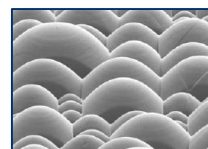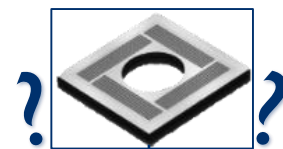# OPTICAL MICROTECHNOLOGIES - TECHNOLOGY ROADMAP

Smartphone
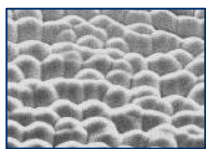
Diffuser for 3D sensing (ToF)

Diffractive gratings for 3D sensing (SL)

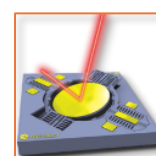Random MLA for 3D sensing (ToF)

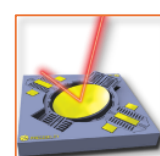MEMS or Liquid Crystals challenge in autofocus?
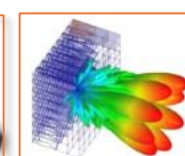
Automotive
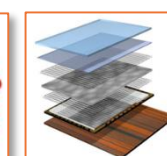
DMD for Headlamps

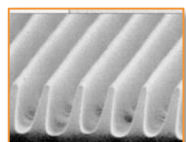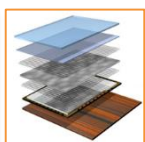MEMS Scanner for LiDAR

MEMS Scanner for Headlamps

OPA for LiDAR

LCOS for LiDAR

AR HMD

Diffractive Optical Elements

LCOS
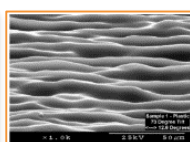
HOE on glass

DMD
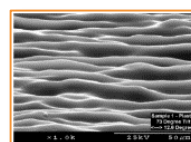
HOE on plastic

Micro LED display
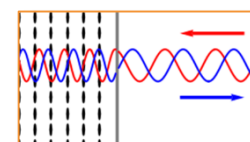
Phase modulated LCOS (Holography)
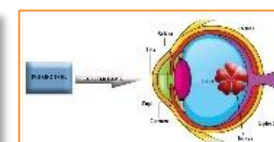
Retinal projection display

2016   2017   2018   2021   2025

WLO MARKET SEGMENTATION

Known **WLO** application
Potential **WLO** application
Key application

Market	Application	Fresnel Lens	Lens	Diffuser	DOE	MLA	AF	OIS
Industrial	Barcode reader						Camera AF	
	Power laser				Illuminator	Light combiner		
Medical	Dermatology					Dot illuminator		
	Endoscopy		Camera lens					
Automotive	DMS & lidar			Illuminator		Light combiner		
Consumer	Smart watch	Pulse Oxymeter	Camera lens				Camera AF	
	Other 3D & AR/VR		3D dot illuminator Multi-pt. ranger?	3D flood illuminator	3D dot illuminator	3D dot illuminator	Retina projector AF	
Mobile	Smartphones	Flash lens	3D dot illuminator	3D flood illuminator	3D dot illuminator	3D dot illuminator	Front camera AF	Rear camera OIS

WLO ECOSYSTEM MAPPING

Known **WLO** application
Potential **WLO** application
Key application
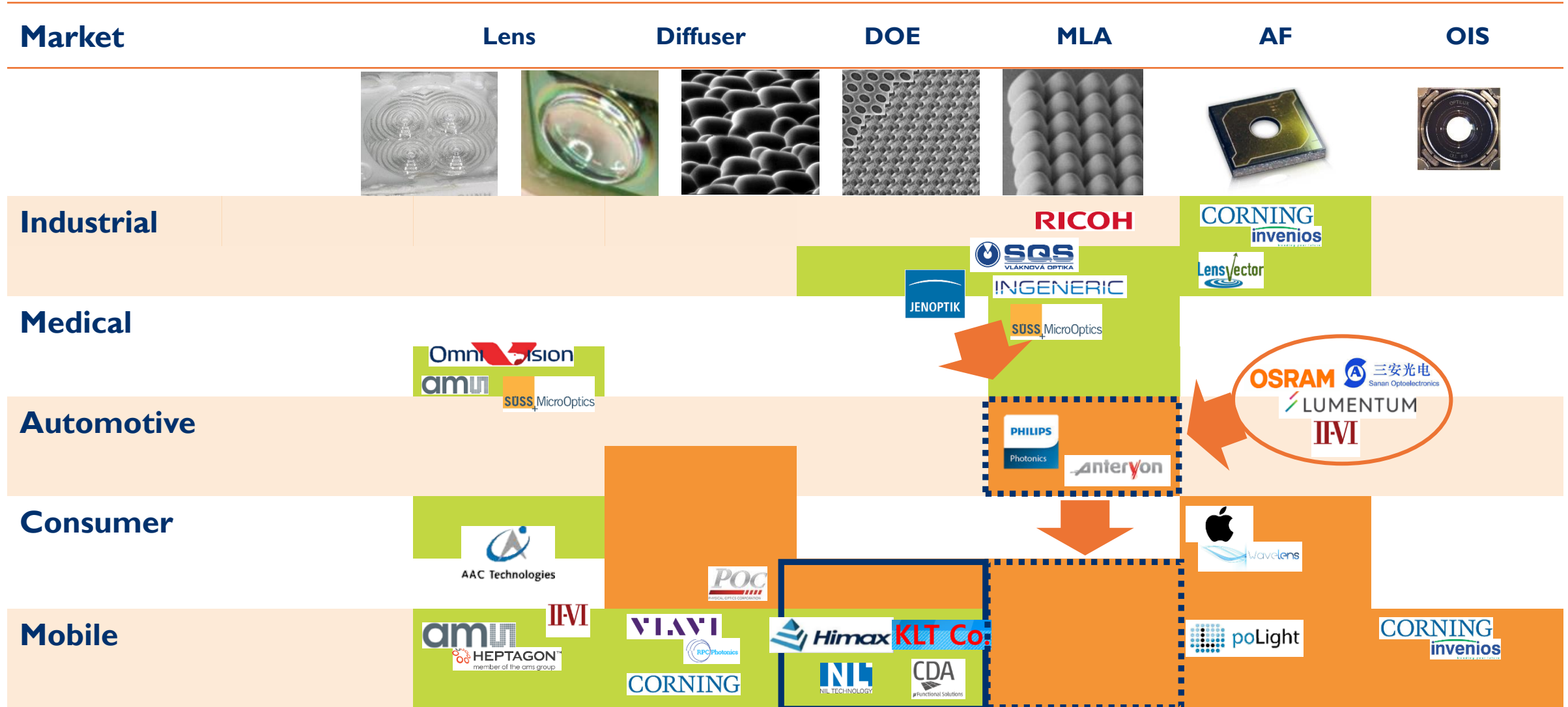
WAFER-LEVEL CAMERA MODULE PLAYERS

- ➢ WLO is a key technology for 3D sensing
- ➢ Multiple acquisitions are a direct consequence

➢ Recent acquisitions

WAFER-LEVEL OPTICS - SUPPLY CHAINS

WAFER-LEVEL OPTICS - REVENUE FORECAST

by applications *(in $M)*

The 3D-sensing illuminator serving mobile and consumer is dominant

2012 - 2024 WLO - revenue forecast (in $M)

■ Mobile ■ Consumer ■ Automotive ■ Medical ■ Industrial

Yole Développement © January 2019

55% CAGR

OPTICAL ELEMENT FORECAST BY APPLICATION

2018-2024 Forecast

Legend:
- Mobile phones lens elements
- Mobile phones AF & OIS
- DMD and LCOS for AR HMD
- DOE and HOE for AR HMD
- Diffusers and diffractive elements for 3D sensing in smartphones
- Automotive optical elements, including DMD for headlamps, MEMS scanners for LiDAR, LiDAR lens elements, headlamp lenses, reflectors and MLAs.

The applications which will have the most impact on optical element technologies are AR HMD and 3D sensing in smart-phones.

2018
- $2.1B
- $254M
- $2.3B
- $24M
- $3.6M
- $3M
- Total $4.7B

These three segments are only partially impacted by micro technologies.

Total $8.8B CAGR 11%

2024e
- $521M CAGR 13%
- $2.5B CAGR 2%
- $4.4B CAGR 11%
- $1.3B CAGR 93%
- $120M CAGR 80%
- $35M CAGR 51%
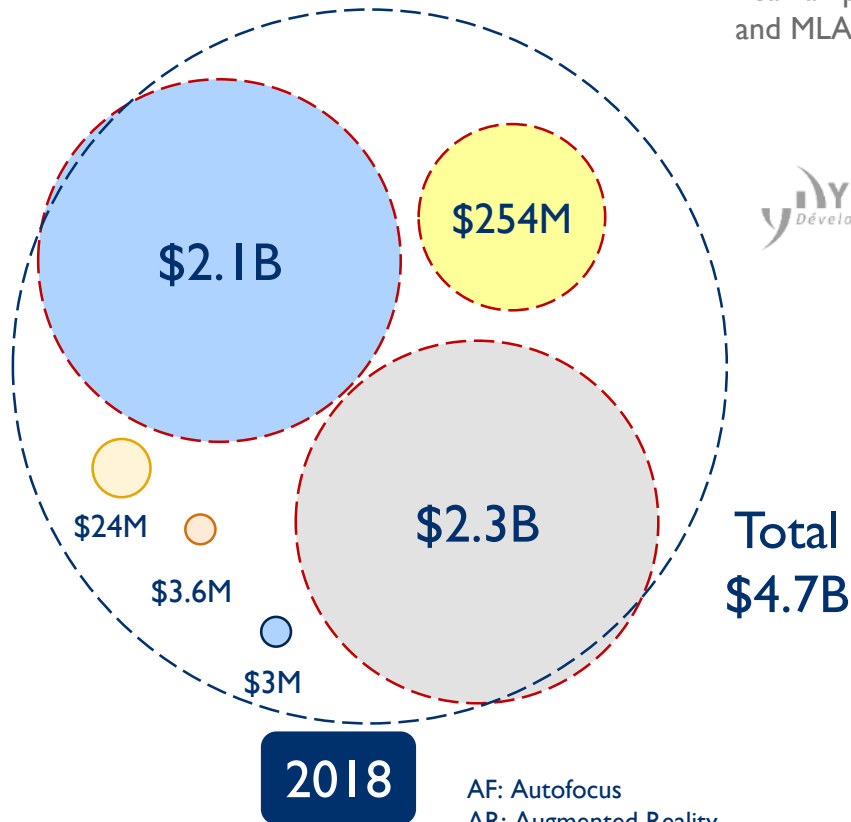
AF: Autofocus
AR: Augmented Reality
DMD: Digital Micromirror Device
DOE: Diffractive Optical Element
HMD: Head Mounted Display
HOE: Holographic Optical Element
MLA: Micro Lens Array
OIS: Optical Image Stabilization
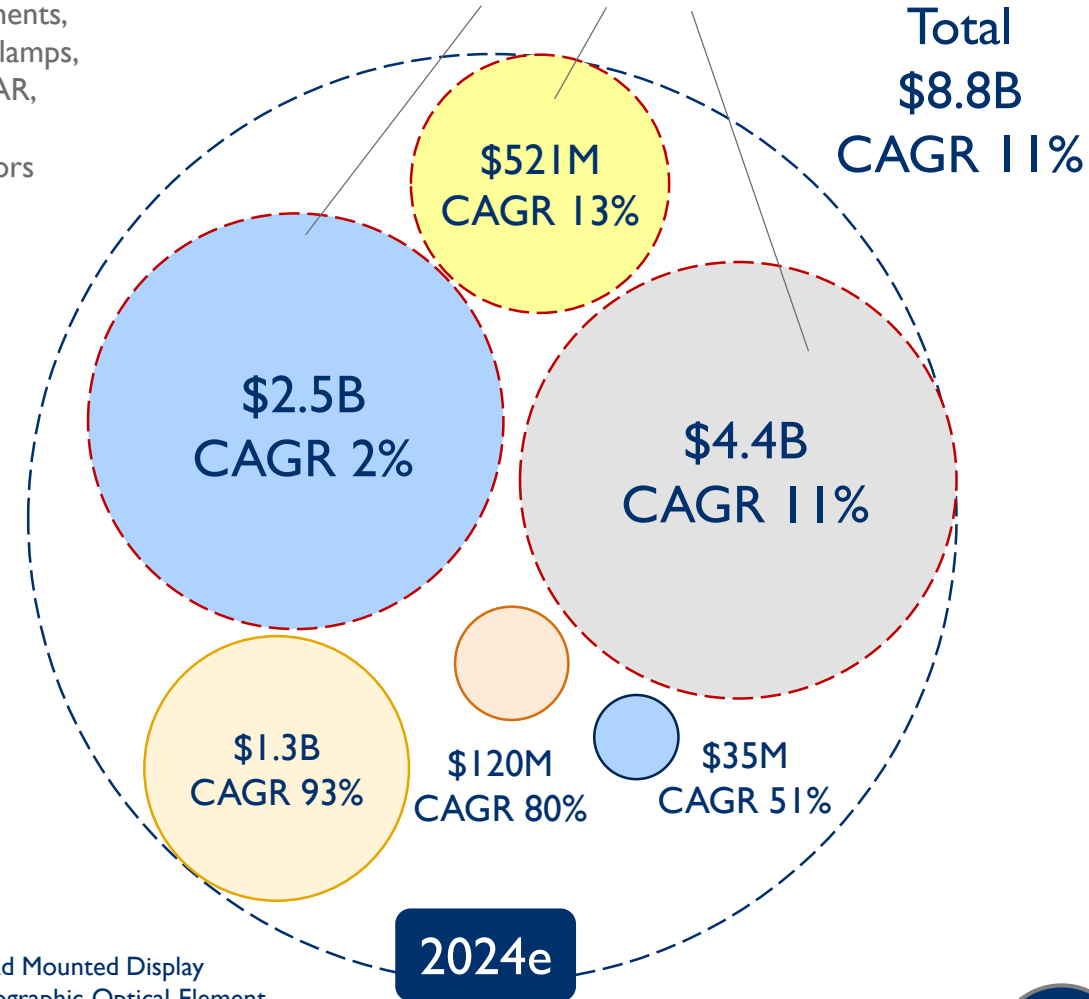
3D-SENSING SUPPLY CHAIN COMPLEXITY - IPHONE X

The TrueDepth camera adds new devices alongside the front-facing camera

NIR receiver camera

RGB camera

« Dot » projector

« flood » illuminator

New components
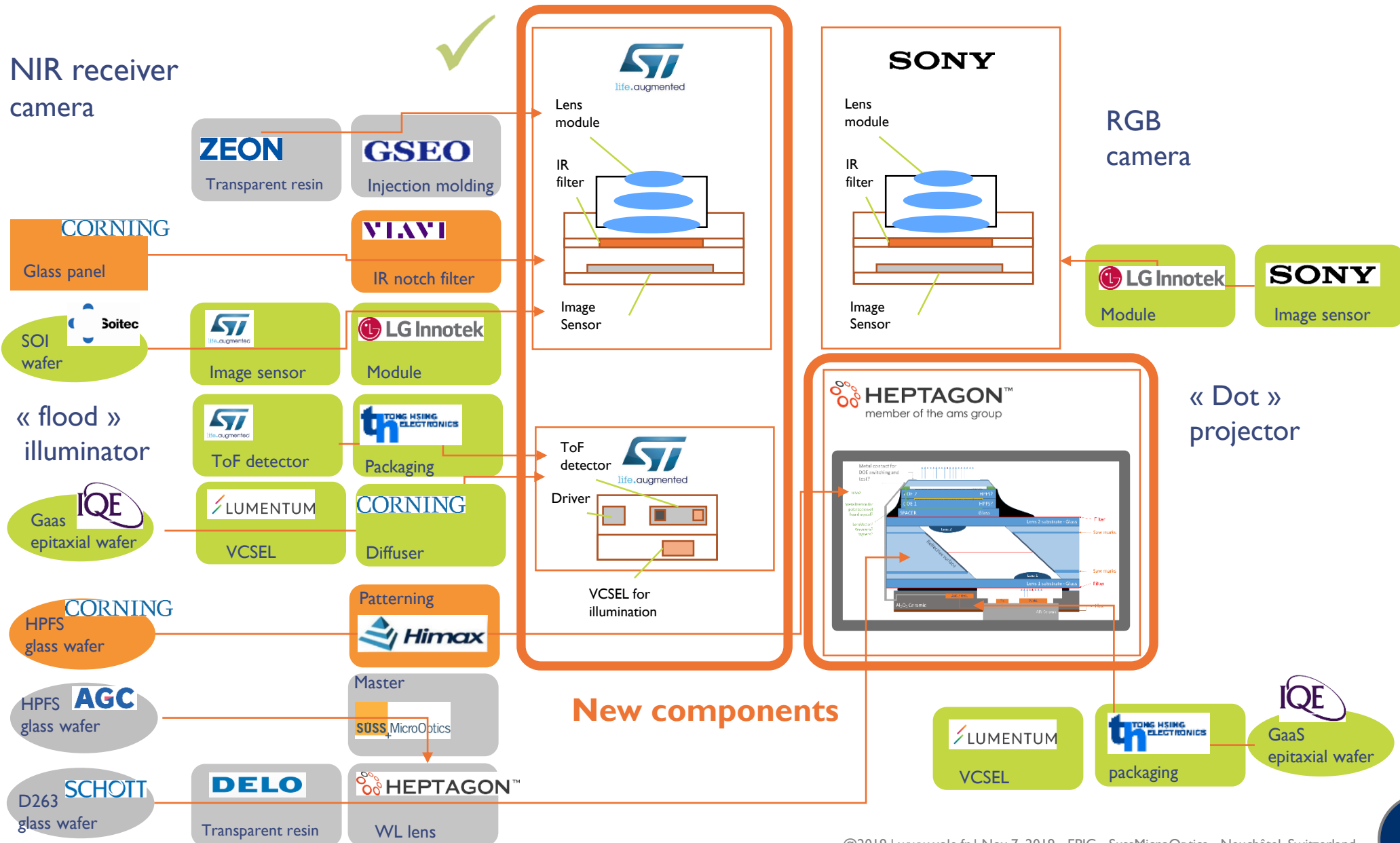
Folded optical path - WLO (2/2)

Folded path is panel-based

DOE is wafer-based

All the parts are pasted together.

Bottom Lenses Substrate **Light Guide** **Top Lenses Substrate** **DOE** (diffractive optical element)
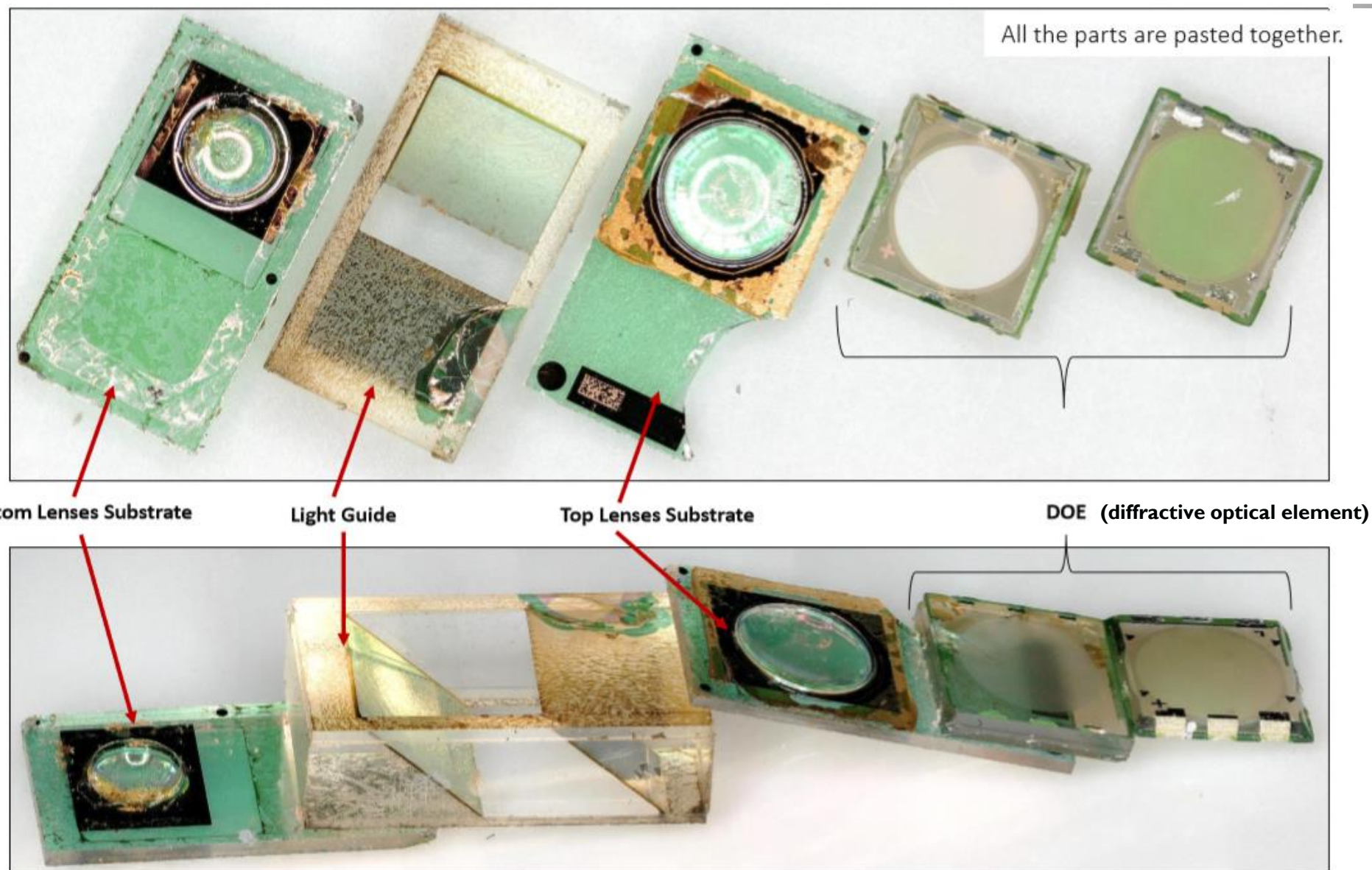
2012 – 2024 **CCM** revenue forecast ($B)

(Source: Status of the Camera Module Industry 2019 - Focus on Wafer Level Optics, Yole Développement, February 2019)

LINKED REPORTS

Pierre Cambou: cambou@yole.fr

Alexis Debray: debray@yole.fr

Pierre Cambou: cambou@yole.fr
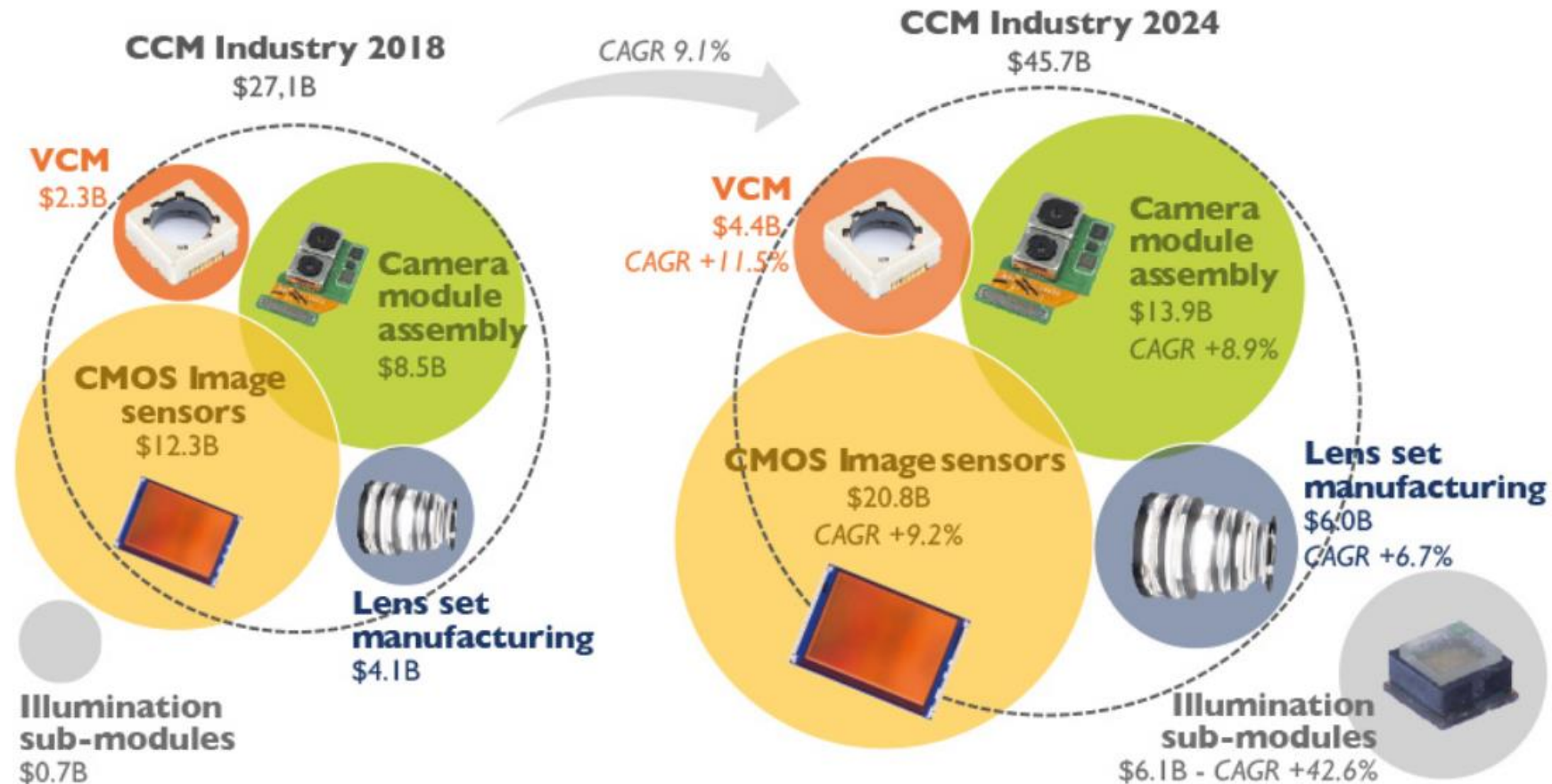
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From Technologies to Market

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YOLE DEVELOPPEMENT – FIELDS OF EXPERTISE

Photonics & Sensing

› Photonics
› Lighting
› Imaging
› Sensing & Actuating
› Display

- Photonics, BioPhotonics & Optoelectronics
- 2D/3D/NIR/FIR Imaging
- Solid-State Lighting
- MEMS, Microfluidics, Sensors & Actuators
- BioMEMS & Medical Microsystems
- Inkjet and accurate dispensing
- Display

Semiconductor Manufacturing & Computing

› Advanced Packaging, Assembly & Substrates
› Semiconductor Manufacturing
› Memory
› Computing
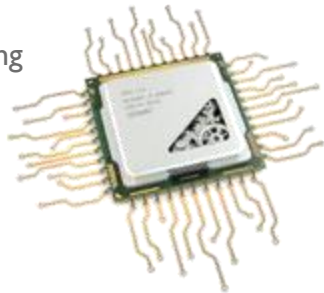
Power & Wireless

› RF Devices & Technologies
› Compound Semiconductors & Emerging Materials
› Power Electronics
› Batteries & Energy Management

4 PRODUCTS AND SERVICES

125+ reports per year   **160+ teardown per year**

6 monitors per quarter

○ **Syndicated reports**

- Market data & research, marketing analysis
- Technology analysis
- Market & technology reports
- Patent investigation and patent infringement risk analysis
- Teardowns & reverse costing analysis
- Cost simulation tool

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○ **Consulting and Analysis**

- Technology analysis
- Strategy consulting
- Reverse engineering & costing
- Patent analysis
- Design and characterization of innovative optical systems
- Financial services (due diligence, M&A with our partner)

www.yole.fr

○ **Monitors**

- Monthly and/or Quarterly update
- Excel database covering supply, demand, and technology
- Price, market, demand and production forecasts
- Supplier market shares

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PISEO photonics.innovation.services

Design and characterization of innovative optical systems

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light.innovation.lab.services
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WOODSIDE CAPITAL PARTNERS
WCP
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of our business

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Développement

ANALYSIS SERVICES - CONTENT COMPARISON

Our analysts provide market analysis, technology evaluation, and business plans along the entire supply chain

Integrators, end-users and software developers

Device manufacturers

Suppliers: material, equipment, OSAT, foundries…

Financial investors, R&D centers

SERVING MULTIPLE INDUSTRIAL FIELDS

We work across multiples industries to understand the impact of More-than-Moore technologies from device to system

Industrial and defense

Medical systems

Energy management

Automotive

Transportation makers

Mobile phone and consumer electronics

From A to Z...

REPORTS COLLECTION
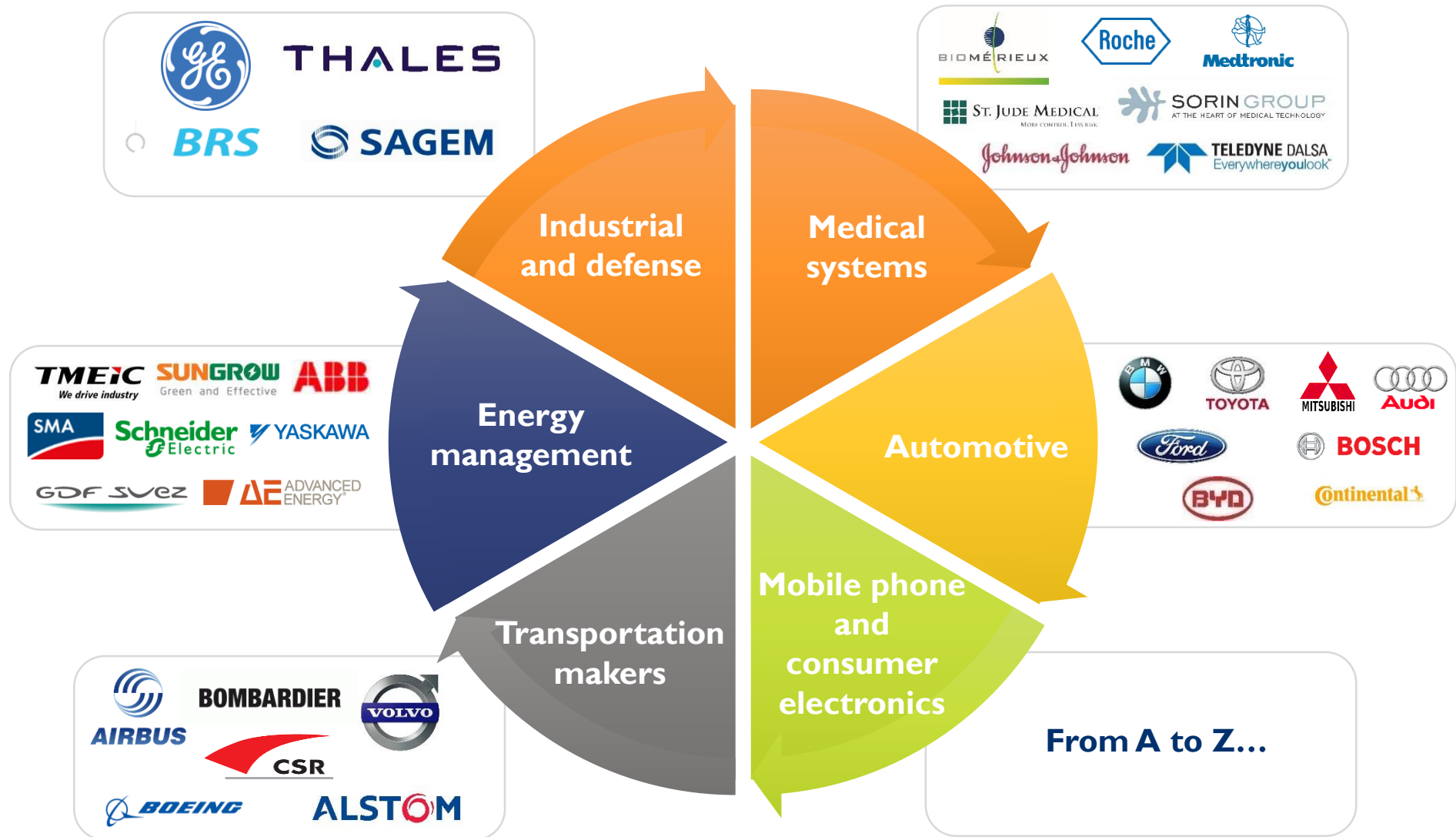
○ Over the course of more than 20 years, Yole Développement has grown to become a group of companies. Together with System Plus Consulting and KnowMade, we now provide marketing, technology and strategy consulting, media and corporate finance services, reverse costing, structure, process and cost analysis services and well as intellectual property (IP) and patent analysis. Together, our group of companies is collaborating ever closer and therefore will offer, in 2019, a collection of over 125 reports and 10 new monitors. Combining respective expertise and methodologies from the three companies, they cover:

- MEMS & Sensors
- RF devices & technologies
- Medical technologies
- Semiconductor Manufacturing
- Advanced packaging
- Memory
- Batteries and energy management

- Power electronics
- Compound semiconductors
- Solid state lighting
- Displays
- Software
- Imaging
- Photonics

○ If you are looking for:

- An analysis of your product market and technology
- A review of how your competitors are evolving
- An understanding of your manufacturing and production costs
- An understanding of your industry's technology roadmap and related IPs
- A clear view supply chain evolution

Our reports and monitors are for you!

www.i-Micronews.com

○ Our team of over 70 analysts, including PhD and MBA qualified industry veterans from Yole Développement, System Plus Consulting and KnowMade, collect information, identify trends, challenges, emerging markets, and competitive environments. They turn that information into results and give you a complete picture of your industry's landscape. In the past 20 years, we have worked on more than 2,000 projects, interacting with technology professionals and high-level opinion makers from the main players of their industries and realized more than 5,000 interviews per year.

WHAT TO EXPECT IN 2019?

In 2019 we will extend our offering with a new 'monitor' product which provides more updates on your industry during the year. The Yole Group of Companies is also building on and expanding its investigations of the memory industry. Moreover, in parallel, the Yole Group reaffirms its commitment to a new collection of reports mixing software and hardware and is increasing its involvement in displays, radio-frequency (RF) technology, advanced substrates, batteries and compound semiconductors. Discover our 2019 program right now, and ensure you get a true vision of the industry. Stay tuned!

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

Market – Technology – Strategy – by Yole Développement

Yole Développement (Yole) offers market reports including quantitative market forecasts, technology trends, company strategy evaluation and indepth application analyses. Yole will publish more than 55 reports in 2019, with our partner PISEO contributing to some of the lighting reports.

Reverse Costing® – Structure, Process and Cost Analysis – by System Plus Consulting

The Reverse Costing® report developed by System Plus Consulting provides full teardowns, including detailed photos, precise measurements, material analyses, manufacturing process flows, supply chain evaluations, manufacturing cost analyses and selling price estimations. The reports listed below are comparisons of several analyzed components from System Plus Consulting. More reports are however available, and over 60 reports will be released in 2019. The complete list is available at www.systemplus.fr.

Patent Reports – by KnowMade

More than describing the status of the IP situation, these analyses provide a missing link between patented technologies and market, technological and business trends. They offer an understanding of the competitive landscape and technology developments from a patent perspective. They include key insights into key IP players, key patents and future technology trends. For 2019 KnowMade will release over 15 reports.

The markets targeted are :

 Mobile & Consumer

 Automotive & Transportation

 Medical

 Industrial

 Telecom & Infrastructure

 Defense & Aerospace

Linked reports are dealing with the same topic to provide a more detailed analysis.

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

MEMS & SENSORS

○ **MARKET AND TECHNOLOGY REPORT**
  - Status of the MEMS Industry 2019 - Update
  - Status of the Audio Industry 2019 - New
  - Uncooled Infrared Imagers and Detectors 2019 – Update
  - Consumer Biometrics: Technologies and Market Trends 2018
  - MEMS Pressure Sensor Market and Technologies 2018
  - Gas & Particle Sensors 2018

○ **STRUCTURE, PROCESS & COST REPORT**
  - MEMS & Sensors Comparison 2019
  - MEMS Pressure Sensor Comparison 2018
  - Particle Sensors Comparison 2019
  - Miniaturized Gas Sensors Comparison 2018

○ **PATENT REPORT**
  - MEMS Foundry Business Portfolio 2019 - New
  - Miniaturized Gas Sensors 2019 - New

PHOTONIC AND OPTOELECTRONICS

○ **MARKET AND TECHNOLOGY REPORT**
  - Photonic Integrated Circuit 2019 - New
  - LiDARs for Automotive and Industrial Applications 2019 - Update
  - Silicon Photonics 2018

○ **PATENT REPORT**
  - Silicon Photonics for Data Centers: Optical Transceiver 2019 - New
  - LiDAR for Automotive 2018

RF DEVICES AND TECHNOLOGIES

○ **MARKET AND TECHNOLOGY REPORT**
  - RF GaN Market: Applications, Players, Technology, and Substrates 2019 - Update
  - 5G's Impact on RF Front-End Module and Connectivity for Cell Phones 2019 - Update
  - Radar and V2X Market & Technology for Automotive 2019 - Update
  - Advanced RF Antenna Market & Technology 2019 - New
  - RF Standards and Technologies for Connected Objects 2018

○ **STRUCTURE, PROCESS & COST REPORT**
  - RF Front-End Module Comparison 2019 - Update
  - Automotive Radar RF Chipset Comparison 2018

○ **PATENT REPORT**
  - Antenna for 5G Wireless Communications 2019 - New
  - RF Front End Modules for Cellphones 2018
  - RF Filter for 5G Wireless Communications: Materials and Technologies 2019
  - RF GaN : Materials, Devices and Modules 2018

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18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

IMAGING

o **MARKET AND TECHNOLOGY REPORT**
- Status of the CIS Industry 2019: Technology and Foundry Business - Update
- Imaging for Automotive 2019 - Update
- Neuromorphic Technologies for Sensing 2019 - Update
- Status of the CCM and WLO Industry 2019 - Update
- Machine Vision for Industry and Automation 2018
- Sensors for Robotic Vehicles 2018

o **STRUCTURE, PROCESS & COST REPORT**
- Compact Camera Modules Comparison 2019
- CMOS Image Sensors Comparison 2019

o **PATENT REPORT**
- Facial & Gesture Recognition Technlogies in Mobile Devices 2019 - New
- Apple iPhone X Proximity Sensor & Flood Illuminator 2018

MEDICAL IMAGING AND BIOPHOTONICS

o **MARKET AND TECHNOLOGY REPORT**
- X-Ray Flat Panel Detectors for Military, Industrial and Medical Applications 2019 - New
- Microscopy Life Science Cameras: Market and Technology Analysis 2019
- Ultrasound technologies for Medical, Industrial and Consumer Applications 2018

o **PATENT REPORT**
- Optical Coherence Tomography Medical Imaging 2018

MICROFLUIDICS

o **MARKET AND TECHNOLOGY REPORT**
- Status of the Microfluidics Industry 2019 - Update
- Next Generation Sequencing & DNA Synthesis - Technology, Consumables Manufacturing and Market Trends 2019 - New
- Organ-on-a-Chip Market & Technology Landscape 2019 - Update
- Point-of-Need Testing Application of Microfluidic Technologies 2018
- Liquid Biopsy: from Isolation to Downstream Applications 2018
- Chinese Microfluidics Industry 2018

o **PATENT REPORT**
- Microfluidic Manufacturing Technologies 2019 – New

INKJET AND ACCURATE DISPENSING

o **MARKET AND TECHNOLOGY REPORT**
- Inkjet Printheads - Dispensing Technologies & Market Landscape 2019 - Update
- Emerging Printing Technologies for Microsystem Manufacturing 2019 - New
- Piezoelectric Materials from Bulk to Thin Film 2019 - New
- Inkjet Functional and Additive Manufacturing for Electronics 2018

o **STRUCTURE, PROCESS & COST REPORT**
- Piezoelectric Materials from Bulk to Thin Film Comparison 2019

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

BIOTECHNOLOGIES
○ **MARKET AND TECHNOLOGY REPORT**
- CRISPR-Cas9 Technology: From Lab to Industries 2018
○ **PATENT REPORT**
- Personalized Medicine 2019 – New

BIOMEMS & MEDICAL MICROSYSTEMS
○ **MARKET AND TECHNOLOGY REPORT**
- Medical Wearables: Market & Technology Analysis 2019 - New
- Neurotechnologies and Brain Computer Interface 2018
- BioMEMS & Non-Invasive Sensors: Microsystems for Life Sciences & Healthcare 2018
○ **PATENT REPORT**
- 3D Cell Printing 2019 - New
- Circulating Tumor Cells Isolation 2019 - New
- Nanopore Sequencing 2019 - New

SOFTWARE AND COMPUTING
○ **MARKET AND TECHNOLOGY REPORT**
- Hardware and Software for Artificial Intelligence (AI) in Automotive Applications 2019 - New
- Hardware and Software for Artificial Intelligence (AI) in Consumer Applications 2019 - Update
- From Image Processing to Deep Learning 2019 - Update
- xPU (Processing Units) for Cryptocurrency, Blockchain, HPC and Gaming 2019 – New

MEMORY
○ **MARKET AND TECHNOLOGY REPORT**
- Status of the Memory Business 2019 - New
- MRAM Technology and Business 2019 - New
- Emerging Non Volatile Memory 2018
○ **STRUCTURE, PROCESS & COST REPORT**
- Memory Comparison 2019
○ **PATENT REPORT**
- Magnetoresistive Random-Access Memory (MRAM) 2019 - New
- 3D Non-Volatile Memory 2018

ADVANCED PACKAGING
○ **MARKET AND TECHNOLOGY REPORT**
- Fan Out Packaging Technologies and Market Trends 2019 - Update
- 3D TSV Integration and Monolithic Business Update 2019 - Update
- Advanced RF SiP for Cellphones 2019 - Update
- Status of Advanced Packaging 2019 - Update
- Status of Advanced Substrates 2019 - Update
- Panel Level Packaging Trends 2019 - Update
- RF System-in-Package & Materials for 5G 2019 - New
- System in Package (SiP) Technology and Market Trends 2019 - New
- Trends in Automotive Packaging 2018
- Thin-Film Integrated Passive Devices 2018
○ **STRUCTURE, PROCESS & COST REPORT**
- Advanced RF SiP for Cellphones Comparison 2019

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SEMICONDUCTOR MANUFACTURING

○ **MARKET AND TECHNOLOGY REPORT**
- Nano Imprint Lithography 2019 - New
- Equipment and Materials for Fan Out Packaging 2019 - Update
- Equipment for More than Moore: Thin Film Deposition & Etching 2019 - New
- Wafer Starts for More Than Moore Applications 2018
- Polymeric Materials at Wafer-Level for Advanced Packaging 2018
- Bonding and Lithography Equipment Market for More than Moore Devices 2018

○ **STRUCTURE, PROCESS & COST REPORT**
- Wafer Bonding Comparison 2018

○ **PATENT REPORT**
- Hybrid Bonding for 3D Stack 2019 – New

SOLID STATE LIGHTING

○ **MARKET AND TECHNOLOGY REPORT**
- Status of the Solid State Light Source Industry 2019 - New
- Edge Emitting Lasers (EELS) 2019 - New
- Light Shaping Technologies 2019 - New
- Automotive Advanced Front Lighting Systems 2019 - New
- VCSELs - Technology, Industry and Market Trends 2019 - Update
- IR LEDs and Laser Diodes – Technology, Applications, and Industry Trends 2018
- Automotive Lighting 2018: Technology, Industry and Market Trends
- UV LEDs - Technology, Manufacturing and Application Trends 2018
- LiFi: Technology, Industry and Market Trends 2018

○ **STRUCTURE, PROCESS & COST REPORT**
- VCSEL Comparison 2019

○ **PATENT REPORT**
- VCSELs 2018

DISPLAY

○ **MARKET AND TECHNOLOGY REPORT**
- Next Generation 3D Display 2019 - New
- Next Generation Human Machine Interaction (HMI) in Displays 2019 - New
- Micro- and Mini-LED Displays 2019 - Update
- QD and Wide Color gamut (WCG) Display Technologies 2019 - Update
- Displays & Optical Vision Systems for VR, AR & MR 2018

○ **PATENT REPORT**
- MicroLED Displays : Intellectual Property Landscape 2018

Update : 2018 version still available

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POWER ELECTRONICS

○ **MARKET AND TECHNOLOGY REPORT**
- Power SiC: Materials, Devices and Applications 2019 - Update
- Power Electronics for EV/HEV and e-mobility: Market, Innovations and Trends 2019 - Update
- Status of the Power Electronics Industry 2019 - Update
- Discrete Power Packaging : Material Market and Technology Trends 2019 - New
- Status of the Power ICs Industry 2019 - Update
- Status of the Passive Components for the Power Electronics Industry 2019 - Update
- Status of the Inverter Industry 2019 - Update
- Status of the Power Module Packaging Industry 2019 - Update
- Wireless Charging Market Expectations and Technology Trends 2018
- Power GaN 2018: Epitaxy, Devices, Applications and Technology Trends

○ **STRUCTURE, PROCESS & COST REPORT**
- Automotive Power Module Packaging Comparison 2018
- GaN-on-Silicon Transistor Comparison 2019
- SiC Transistor Comparison 2019

○ **PATENT REPORT**
- Power SiC : Materials, Devices and Modules 2019 - New
- Power GaN : Materials, Devices and Modules 2019 – Update

BATTERY & ENERGY MANAGEMENT

○ **MARKET AND TECHNOLOGY REPORT**
- Status of the Rechargeable Li-ion Battery Industry 2019 - New
- Li-ion Battery Packs for Automotive and Stationary Storage Applications 2019 - Update

○ **PATENT REPORT**
- Battery Energy Density Increase: Materials and Emerging Technologies 2019 - New
- Solid-State Batteries 2019 - New
- Status of the Battery Patents 2018

COMPOUND SEMI.

○ **MARKET AND TECHNOLOGY REPORT**
- Emerging Compound Semiconductor Market & Technology Trends 2019 - New
- Status of the Compound Semiconductor Industry 2019 - New
- InP Materials, Devices and Applications 2019 - New
- GaAs Wafer and Epiwafer Market: RF, Photonics, LED and PV Applications 2018

○ **PATENT REPORT**
- GaN-on-Silicon Substrate: Materials, Devices and Applications 2019 - Update

Get the most updated overview of your market to monitor your strategy

Yole Développement, System Plus Consulting and KnowMade, all part of the Yole Group of Companies, are launching a collection of 10 monitors in 2019. The monitors aim to provide updated market, technology and patent data as well dedicated quarterly analyses of the evolution in your industry over the previous 12 months. Furthermore, you can benefit from direct access to the analyst for an on-demand Q&A and discussion session regarding trend analyses, forecasts and breaking news.

Topics covered will be compact camera modules (CCMs), advanced packaging, compound semiconductors, microfluidics, batteries, RF and memory.

MARKET MONITOR by Yole Développement

A FULL PACKAGE:
The monitors will provide the evolution of the market in units, wafer area and revenues. They will also offer insights into what is driving the business and a close look at what is happening will also be covered in it.

The following deliverables will be included in the monitors:
- An Excel database with all historical and forecast data
- A PDF slide deck with graphs and comments/analyses covering the expected evolutions

o **ADVANCED PACKAGING – NEW**
This monitor will provide the evolution of the advanced packaging platforms. It will cover Fan-Out Wafer Level Packaging (WLP), Fan-Out Panel Level Packaging (PLP), Wafer-Level Chip Scale Packaging (WLCSP), Flip Chip packaging platforms, and 2.5D and 3D Through Silicon Via (TSV) integration. *Frequency: Quarterly, starting from Q3 2019*

REVERSE TECHNOLOGY MONITOR by System Plus Consulting

o **SMARTPHONES – NEW**
To stay updated on the latest components, packaging and silicon chip choices of the smartphone makers, System Plus Consulting has created its first Smartphone Reverse Technology monitor. This year, get access to the packaging and silicon content database of at least 20 different flagship smartphones – more than five per quarter. Starting at the beginning of 2019, the monitor will include an Excel database report for each phone and a quarterly comparison.

o **COMPOUND SEMI. – NEW**
This monitor will describe how the compound semiconductor industry is evolving. It will offer a close look at GaAs, InP, SiC, GaN and other compounds of interest providing wafer volumes, revenues, application breakdowns and momentum. *Frequency: Quarterly, starting from Q3 2019*

o **CAMERA MODULE – NEW**
This monitor will provide the evolution of the imaging industry, with a close look at image sensor, camera module, lens and VCM. Volumes, revenues and momentum of companies like Sony, Samsung, Omnivision and OnSemi will thus be analysed. *Frequency: Quarterly, starting from Q3 2019*

o **MEMORY – UPDATE**
For the memory industry you can have access to a quaterly monitor, as well as an additional service, a monthly pricing. Both services can be bought seprately:
- DRAM Service: Including a quarterly monitor and monthly pricing.
- NAND Service: Including a quarterly monitor and monthly pricing.

Get the most updated overview of your market to monitor your strategy

PATENT MONITOR by KnowMade

A FULL PACKAGE:
Starting at the beginning of the year, the KnowMade monitors include the following deliverables:

- An Excel file including the monthly IP database of:
  - New patent applications
  - Newly granted patents
  - Expired or abandoned patents
  - Transfer of IP rights through re-assignment and licensing
  - Patent litigation and opposition

- Quarterly report including a PDF slide deck with the key facts & figures of the quarter: IP trends over the three last months, with a close look to key IP players and key patented technologies.

o **GaN for Power & RF Electronics**
Wafers and epiwafers, GaN-on-SiC, silicon, sapphire or diamond, semiconductor devices such as transistors, and diodes, devices and applications including converters, rectifiers, switches, amplifiers, filters, and Monolothic Microwave Integrated Circuits (MMICs), packaging, modules and systems.

o **GaN for Optoelectronics & Photonics**
Wafers and epiwafers, GaN-on-sapphire, SiC or silicon; semiconductor devices such as LEDs and lasers; and applications including lighting, display, visible communication, photonics, packaging, modules and systems.

o **Li-ion Batteries**
Anodes made of lithium metal, silicon, and lithium titanate (LTO); cathodes made of Lithium Iron Phosphate (LFP), Nickel-Manganese-Cobalt (NMC), Lithium Nickel Cobalt Aluminium Oxide (NCA), Lithium Nickel Metal Dioxide (LiNiMO2), Lithium Metal Phosphate (LiMPO4), and Lithium Metal Tetroxide (LiMO4); electrolytes including liquid, polymer/gel, and solid inorganics; ceramic and other separators; battery cells including thin film/microbattery, flexible, cylindrical and prismatic; and battery packs and systems.

o **Post Li-ion Batteries**
Battery technologies including redox-flow batteries, sodium-ion, lithiumsulfur, lithium-air, and magnesium-ion, and their supply chains, including electrodes, electrolytes, battery cells and battery packs/systems.

o **Solid-State Batteries**
Supply chain including electrodes, battery cells, battery packs/systems and electrolytes, including polymer, inorganic and inorganic/polymer, inorganic materials, including argyrodites, LIthium Super Ionic CONductor, (LISICONs), Thio-LISICONs, sulfide glasses, oxide glasses, perovskites, anti-perovskites and garnets.

o **RF Acoustic Wave Filters**
Including Surface Acoustic Wave (SAW), Temperature Compensated (TC)- SAW, Bulk Acoustic Wave- Free-standing Bulk Acoustic Resonator (BAWFBAR), BAW-Solidly-Mounted Resonator (BAW-SMR), and Packaging.

o **RF Power Amplifiers**
Including Low Noise Amplifiers, Doherty Amplifiers, Packaging, and Millimeter-Wave technology.

o **RF Front-End Modules**

o **Microfluidics**
From components to chips and systems, including all applications.

MICRONEWS MEDIA

○ **About Micronews Media**

To meet the growing demand for market, technological and business information, Micronews Media integrates several tools able to reach each individual contact within its network. We will ensure you benefit from this.

ONLINE

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Unique, cost-effective ways to reach global audiences. Online display advertising campaigns are great strategies for improving your product/brand visibility. They are also an efficient way to adapt with the demands of the times and to evolve an effective marketing plan and strategy.

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ONSITE

Events

Brand visibility, networking opportunities
Today's technology makes it easy for us to communicate regularly, quickly, and inexpensively – but when understanding each other is critical, there is no substitute for meeting in-person. Events are the best way to exchange ideas with your customers, partners, prospects while increasing your brand/product visibility.

Several key events planned for 2018 on different topics to attract 120 attendees on average

INPERSON

Webcasts

Targeted audience involvement equals clear, concise perception of your company's message.
Webcasts are a smart, innovative way of communicating to a wider targeted audience. Webcasts create very useful, dynamic reference material for attendees and also for absentees, thanks to the recording technology.

Gain new leads for your business from an average of 340 registrants per webcast

Contact: *Camille Veyrier (veyrier@yole.fr), Marketing & Communication Director*

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