DRAM & NAND Service – Memory Research 2019
REPORT OBJECTIVES

- The Memory Research Services (NAND & DRAM) provide both a high-level perspective on the current memory market dynamics while also providing very detailed analysis on all aspects of the memory markets.

- The Market Monitors are in-depth, Excel-based reports covering all things related to the DRAM or NAND market: pricing, supply/demand, supplier and technology analysis

- The accompanying slides provide a convenient and effective way to visualize the data and make sense of what is happening in the market

- The Monthly Pricing Monitors provide a monthly snapshot of market pricing across a variety of products, including components and packaged solutions spanning multiple densities and technologies
COMPANIES CITED IN THE REPORT

DRAM Monitor
Micron, Nanya, Powerchip, Samsung, SK Hynix, Winbond, and more...

NAND Monitor
Samsung, Toshiba, Western Digital, Micron, SK Hynix, Intel, YMTC, and more...
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DRAM Monthly Pricing Monitor

Monthly Price Evolution from 2018 - 2020 for:

- Mobile DRAM ($/unit)
  - LPDDR2 8Gb
  - LPDDR2 16Gb
  - LPDDR3 8Gb
  - LPDDR3 12Gb
  - LPDDR3 16Gb
  - LPDDR3 24Gb
  - LPDDR4 16Gb
  - LPDDR4 32Gb
  - LPDDR4 48Gb

- Server DRAM ($/unit)
  - DDR3 2GB R-DIMM
  - DDR3 4GB R-DIMM
  - DDR3 8GB R-DIMM
  - DDR3 16GB R-DIMM
  - DDR4 8GB R-DIMM
  - DDR4 16GB R-DIMM
  - DDR4 32GB R-DIMM
  - DDR4 64GB R-DIMM

- PC DRAM
  - DDR3 1GB DIMM
  - DDR3 2GB DIMM
  - DDR3 4GB DIMM

Components

- SDR 16Mb
- SDR 64Mb
- DDR 256Mb
- DDR 512Mb
- DDR2 512Mb
- DDR2 1Gb
- DDR3 1Gb
- DDR3 2Gb
- DDR3 4Gb
- DDR4 4Gb
- DDR4 8Gb
- DDR4 16Gb
- DDR4 32Gb

Other shipments A complete Excel file with the analysis’ numerical data is included with the PPT presentation

*New in 2019
### NAND Quarterly Market Monitor

**NAND market overview**
- Market dynamics
- Revenue – Historical and forecast
- Shipments
- Blended pricing
- Market shares – Revenue and bit shipments
- Supplier ASPs
- Sufficiency
- Near-term shipment and pricing outlook
- Capex
- PCM forecast

**NAND demand**
- Emerging demand drivers
- Segment bit demand and share
- Mobile
- SSD – PC (client) and Datacenter (enterprise)
- Automotive

**NAND supply**
- Wafer production by supplier, process, and technology
- Bit production by process, technology, and density
- GB per wafer, by supplier
- SLC bit production and bit market share

**NAND supplier profile**
- New cleanroom updates
- Samsung
- Toshiba
- Western Digital
- Micron
- SK Hynix
- Intel
- YMTC
- Others

A complete Excel file with the analysis’ numerical data is included with the PPT presentation

### NAND Monthly Pricing Monitor

Monthly Price Evolution from 2018 - 2020 for:

- **QLC NAND ($/unit)**
  - 1Tb (128GB)

- **TLC NAND ($/unit)**
  - 128Gb (16GB)
  - 256Gb (32GB)
  - 512Gb (64GB)

- **MLC NAND ($/unit)**
  - 16Gb (2GB)
  - 32Gb (4GB)
  - 64Gb (8GB)
  - 128Gb (16GB)
  - 256Gb (32GB)

- **SLC NAND ($/unit)**
  - 1Gb
  - 2Gb
  - 4Gb
  - 8Gb (1GB)

- **eMMC NAND ($/unit)**
  - 16GB TLC
  - 32GB TLC
  - 64GB TLC
  - 128GB TLC

- **UFS ($/unit)**
  - 32GB TLC
  - 64GB TLC
  - 128GB TLC
  - 256GB TLC

- **eMCP ($/unit)**
  - 16GB+8Gb LP3
  - 16GB+16Gb LP3
  - 32GB+16Gb LP3
  - 32GB+24Gb LP4
  - 64GB+32Gb LP4
  - 64GB+48Gb LP4
  - 128GB+32Gb LP4
Walt Coon, VP of NAND and Memory Research

Walt Coon joins Yole Développement’s memory team as VP of NAND and Memory Research, part of the Semiconductor & Software division. Walt is leading the day-to-day production of both market updates, Market Monitors and Pricing Monitors, with a focus on the NAND market and semiconductor industries. In addition, he is deeply involved in the business development of these activities. Walt has significant experience within the memory & semiconductor industry. He spent 16 years at Micron Technology, managing the team responsible for competitor benchmarking, and industry supply, demand, and cost modeling. His team also supported both corporate strategy and Mergers & Acquisitions analysis. Previously, he spent time in Information Systems, developing engineering applications to support memory process and yield enhancement. Walt Coon earned a Master of Business Administration from Boise State University (Idaho, United-States) and a Bachelor of Science in Computer Science from the University of Utah (United-States). Contact: walt.coon@yole.fr

Mike Howard, VP of DRAM and Memory Research

Mike Howard is a member of the Memory team at Yole Développement, serving as VP of DRAM and Memory Research within the Semiconductor & Software division. He is a daily contributor to the business development of memory activities, with a special focus on the DRAM industry. Mike’s mission is to propose a comprehensive understanding of the memory and semiconductor markets, with a dedicated collection of market updates, Market Monitors, and Pricing Monitors. Over the course of his career Mike has developed broad DRAM memory expertise, including an effective combination of industrial and market research experience. Prior to his position at Yole as VP of DRAM and Memory Research, Mike worked at Micron Technology for more than a decade. During this time he held several key roles in Corporate Development, Marketing, and as a photolithography engineer in R&D. Mike earned a master’s of Business Administration from The Ohio State University (United States), along with a B.S. in Chemical Engineering and a B.A. in Finance from the University of Washington (Washington, United States). Contact: mike.howard@yole.fr
Report sample – DRAM
• DRAM revenue reached a new high in 2019 on strong pricing trends and modest shipment growth

• The emergence of significant Chinese DRAM production after 2022 will push revenue down as the market shifts into oversupply
Content growth in PCs has slowed dramatically over the last decade and is expected to continue to slow in the coming years.

PC demand is much less elastic today than it was a decade ago.
The DRAM market is no longer dominated by any single technology

- DDR4 bit share will fall to 10% by 2024
- DDR5 bit share will grow to 46% by 2024

% of DRAM shipments (bit basis)

- Legacy
- DDR4
- DDR5
- Mobile
- Graphics
# DRAM Monthly Pricing Monitor

**February 2019**

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<th>Server DRAM ($/unit)</th>
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<th>PC DRAM ($/unit)</th>
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<th>Components ($/unit)</th>
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Report sample – NAND
NAND revenue set another record in 2018, as annual bit growth approaching 40% offsets moderate year-over-year price declines.

2019 revenue is expected to decline, driven by weak pricing early in 2019 and slowing bit growth.

Revenue is expected to expand over time, as cost declines enable further penetration of NAND-based storage solutions into traditional HDD markets.

The NAND market is forecasted to decrease -18% to $48.7 billion in 2019.

NAND Revenues & Revenue Growth 2015-2024

- NAND revenue set another record in 2018, as annual bit growth approaching 40% offsets moderate year-over-year price declines.
- 2019 revenue is expected to decline, driven by weak pricing early in 2019 and slowing bit growth.
- Revenue is expected to expand over time, as cost declines enable further penetration of NAND-based storage solutions into traditional HDD markets.

© 2019 Yole Développement
• **Client SSDs dominate SSD unit shipments**
NAND WAFER PRODUCTION – BY PROCESS

- **3D NAND overtakes planar wafer output in Q4 2017**

  - Small amount of capacity to remain on planar long-term to support specialty applications

  - 3D to account for 76% of wafer output in 2019

  - Planar accounted for 39% of wafer output in 2018

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## NAND Monthly Pricing Monitor

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DRAM SERVICE – MEMORY RESEARCH

Market & Pricing Monitors - 2019

Despite increasing demand for DRAM, revenue and price are expected to decline in 2019.

WHAT ABOUT THE DRAM SERVICE - MEMORY RESEARCH?

A full package:
The DRAM Quarterly Market Monitor and the Monthly Pricing Monitor include the following deliverables:

• Excel database with all historical and forecast data
• PDF slide deck with graphs and comments/analysis covering expected evolutions
• Direct access to a Yole Développement analyst for one year, providing an opportunity for on-demand Q&A and discussions regarding trends, analyses, forecasts, and breaking news

Frequency:
Receive every quarter the updated Market Monitor documents and every month the updated Pricing Monitor documents

Options:
• Memory Research are available for DRAM, NAND and both

MEMORY IS NOW THE PRIMARY MARKET SEGMENT FOR SEMICONDUCTOR PRODUCTS

The hyper-growth of the memory market in 2017 - 2018 has positioned both DRAM and NAND memory as leading devices within the semiconductor market. With the memory markets significantly impacting the semiconductor industry in terms of profits, capex, and sales, Yole Développement is publishing two monitors covering the fast-moving DRAM and NAND markets. Beginning in 2018, Yole Développement began publishing world-class research, data, and insights covering the memory markets in quarterly installments that analyze the evolution of the DRAM and NAND markets in terms of revenue, shipments, capex, and near-term price evolution, as well as demand per market segment, DRAM and NAND technology evolution, and detailed profiles of main suppliers. Yole Développement will also provide DRAM and NAND monthly pricing monitors to track the price evolution of key components and packaged solutions.

MEGATRENDS ARE PUSHING MORE DRAM INTO PRODUCTS

The long-term megatrends boosting the entire semiconductor industry have a very positive impact on the memory market, especially DRAM. Mobile phone in general and the 5G revolution in particular, along with hyperscale data center, Artificial Intelligence (AI) and machine learning, and autonomous driving are all pushing DRAM adoption, with a CAGR of more than 20% for bit demand over the next five years.

The DRAM market is constantly evolving and changing. The recent market volatility is clear evidence of this. New Chinese suppliers threaten to eventually disrupt the market and the memory markets in quarterl installments that analyze the evolution of the DRAM and NAND markets in terms of revenue, shipments, capex, and near-term price evolution, as well as demand per market segment, DRAM and NAND technology evolution, and detailed profiles of main suppliers. Yole Développement will also provide DRAM and NAND monthly pricing monitors to track the price evolution of key components and packaged solutions.

The DRAM market's future promises to be as dynamic as its past. Yole Développement's quarterly and monthly monitors will answer the pressing questions facing the industry, including:

• Will the three primary DRAM suppliers - Samsung, SK Hynix, and Micron - continue to manage supply and drive industry revenue to even higher levels!

(Yole Développement, March 2019)
WHAT DO THE UPCOMING QUARTERS HOLD?

2019 looks to be a very different year from 2018, with prices falling sharply and demand growing at an anemic 15% year over year. Clearly the DRAM market remains cyclical and dynamic.

2018 revenue reached an all-time high, surpassing $100B for the first time ever. Revenue is projected to drop more than 25% in 2019 due to weaker demand and excess supply (partly driven by excessive amounts of inventory built up in 2018).

Bit growth is expected to remain around 15% - 20% over the long-term: lower than historical bit growth because of tech difficulties linked to shrinking lithography. As a direct impact, bit growth is becoming more expensive and more processing steps are needed with each migration node because of multi-patterning, and therefore more cleanroom space per wafer-out.

Yole Développement provides its opinions and answers all of these questions on a quarterly basis with its DRAM Quarterly Market Monitor and DRAM Monthly Pricing Monitor.

COMPANIES CITED IN THE REPORT (non exhaustive list)
Micron, Nanya, Powerchip, Samsung, SK Hynix, Winbond, and more...

Will China’s entrance in the DRAM market disrupt the current market balance?
Will DRAM manufacturing’s enormous technical challenges and the lack of access to DRAM intellectual property prove too difficult for China to overcome?
What demand segments will emerge to compensate for the diminishing PC and smartphone categories?
How much farther will the DRAM roadmap extend? Is there a future beyond 14nm?
How will AI and machine learning impact DRAM demand and the technology roadmap?
Will autonomous vehicles meaningfully impact the DRAM market? If so, when?
Will DRAM capital expenditures continue their recent trend upwards, or will capital intensity climb too high and threaten supplier stability?
Will DRAM wafer demand push the overall semiconductor market into drastic undersupply?
Will HBM2 emerge as the dominant DRAM graphics technology?
When will LPDDR5 and DDR5 become available, and will they ever dominate the market?
Have the recent DRAM price increases hurt demand, or is DRAM demand-elasticity dead?

Yole Développement provides its opinions and answers all of these questions on a quarterly basis with its DRAM Quarterly Market Monitor and DRAM Monthly Pricing Monitor.

DRAM Quarterly Market Monitor and DRAM Monthly Pricing Monitor - Content

The DRAM Quarterly Market Monitor and DRAM Monthly Pricing Monitor contain all of the data related to DRAM revenue per quarter, DRAM shipments, pricing per DRAM type, near and long-term revenue, market share per quarter, capex per company, and market demand/supply forecast, as well as a complete analysis and details of the demand side with a deep dive into data centers, mobile, automotive, graphics, and PC.

For the top seven players (Micron, Nanya, Powerchip, Samsung, SK Hynix, and Winbond), the DRAM Quarterly Market Monitor provides a detailed analysis of capex, shipments, wafer production per technology (process mix) and per fab, as well as the expected impact of DRAM technology changes.

The DRAM Quarterly Market Monitor and the Monthly Pricing Monitor include the following deliverables:

• Excel database with all historical and forecast data
• PDF slide deck with graphs and comments/analysis covering expected evolutions
• Direct access to a Yole Développement analyst for one year, providing an opportunity for on-demand Q&A and discussions regarding trends, analyses, forecasts, and breaking news.

YEARLY DRAM MARKET FORECAST

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> Samsung production
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> Shipments by density (historical and forecast)
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> Emerging memory
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> Micron shipments
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> Other shipments

A complete Excel file with the analysis’ numerical data is included with the PPT presentation

*New in 2019

DRAM Monthly Pricing Monitor (Excel file)

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PC DRAM
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> DDR3 4GB DIMM
> DDR3 8GB DIMM
> DDR4 4GB DIMM
> DDR4 8GB DIMM

Components
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> SDR 64Mb
> DDR 256Mb
> DDR 512Mb
> DDR2 512Mb
> DDR2 1Gb
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> DDR3 2Gb
> DDR3 4Gb
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*New in 2019

KEY FEATURES OF THE REPORT
Get the sample of the report on www.i-Micronews.com

- Market forecast through 2024 in Gb, US$, units, wafers, $/Gb
- Supplier market shares (Micron, Nanya, Powerchip, Samsung, SK Hynix, Winbond) from 2015 to present by revenue (US$), bit shipments (Gb), geography (US$), segment (US$), average selling price ($/Gb)
- Demand forecast through 2024 by category (PC, data center, mobile, consumer, Auto….) in units, revenue (US$), bit demand (Gb)
- Production forecast through 2020 by supplier for wafer production (wpm, by Fab), bit production (Gb, by Fab), process mix (% of wafers), average process node (nm, bit basis & wafer basis), average Gb per wafer

AUTHOR
Mike Howard is member of the memory team at Yole Développement (Yole) as VP of DRAM and Memory Research within the Semiconductor & Software division.
Mike is a daily contributor to the business development of memory activities with a special focus on the DRAM industry. Mike’s mission at Yole, is to propose a comprehensive understanding of the entire memory and semiconductor markets, with a dedicated collection of market updates, Market Monitors and Pricing Monitors. Mike developed a broad DRAM memory expertise with a relevant combination of industrial and market research experiences. Prior his position as Senior Director of DRAM and Memory Research for more than a decade, Mike served at Micron Technology. He had several roles in corporate development, marketing, and as photolithography engineer in R&D. Mike earned a Master of Business Administration at The Ohio State University (United-States), a Bachelor of Science in Chemical Engineering as well as a Bachelor of Arts in Finance at the University of Washington (Washington, United-States).
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(1) Our Terms and Conditions of Sale are available at www.yole.fr/Terms_and_Conditions_of_Sale.aspx
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Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-state lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

CONSULTING AND ANALYSIS
• Market data & research, marketing analysis
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• Reverse engineering & costing
• Patent analysis
• Design and characterization of innovative optical systems
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• Cost simulation tool

More information on www.i-micronews.com/reports

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• Press Relations: Sandrine Leroy (leroy@yole.fr)

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From Technologies to Market
YOLE DEVELOPPEMENT – FIELDS OF EXPERTISE

Life Sciences & Healthcare
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- BioMEMS & Medical Microsystems
- Inkjet and accurate dispensing
- Solid-State Medical Imaging & BioPhotonics
- BioTechnologies

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

Semiconductor & Software
- Package, Assembly & Substrates
- Semiconductor Manufacturing
- Memory
- Software & Computing

Photonics, Sensing & Display
- Solid-State Lighting
- Display
- MEMS, Sensors & Actuators
- Imaging
- Photonics & Optoelectronics
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We work across multiples industries to understand the impact of More-than-Moore technologies from device to system.
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!

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.

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.
OUR 2019 REPORTS COLLECTION (1/5)

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**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**
  - 5G's Impact on RF Front-End Module and Connectivity for Cell Phones 2019 – Update
  - 5G Impact on Wireless Infrastructure 2019
  - Radar and Wireless for Automotive: Market and Technology Trends 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

Update : 2018 version still available

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IMAGING

○ 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
  • 3D Imaging & Sensing 2018
  • Machine Vision for Industry and Automation 2018
  • Sensors for Robotic Vehicles 2018
○ STRUCTURE, PROCESS & COST REPORT
  • Compact Camera Modules Comparison 2019
  • CMOS Image Sensors Comparison 2019
○ PATENT REPORT
  • Facial & Gesture Recognition Technologies in Mobile Devices 2019 - New
  • Apple iPhone X Proximity Sensor & Flood Illuminator 2018

MEDICAL IMAGING AND BIOPHOTONICS

○ MARKET AND TECHNOLOGY REPORT
  • X-Ray Detectors for Medical, Industrial and Security Applications 2019- New
  • Microscopy Life Science Cameras: Market and Technology Analysis 2019
  • Ultrasound technologies for Medical, Industrial and Consumer Applications 2018
○ PATENT REPORT
  • Optical Coherence Tomography Medical Imaging 2018

MICROFLUIDICS

○ 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
○ PATENT REPORT
  • Microfluidic Manufacturing Technologies 2019 – New

INKJET AND ACCURATE DISPENSING

○ 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
○ STRUCTURE, PROCESS & COST REPORT
  • Piezoelectric Materials from Bulk to Thin Film Comparison 2019
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**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**
  - Artificial Intelligence Computing For Automotive 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
  - 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
OUR 2019 REPORTS COLLECTION (4/5)
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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
- **STRUCTURE, PROCESS & COST REPORT**
  - Bonding and Lithography Equipment Market for More than Moore Devices 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
- **STRUCTURE, PROCESS & COST REPORT**
  - VCSELs - Technology, Industry and Market Trends 2019 - Update
- **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
  - Technologies And Markets for Next Generation Televisions
  - 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
OUR 2019 MONITORS COLLECTION (1/2)

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

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

COMPUND 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

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

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

REVERSE TECHNOLOGY MONITOR by System Plus Consulting

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.
OUR 2019 MONITORS COLLECTION (2/2)

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.

- 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 Monolithic Microwave Integrated Circuits (MMICs), packaging, modules and systems.

- 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.

- 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 (LiNiM02), 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.

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

- 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.

- 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.

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

- RF Front-End Modules

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

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- i-Micronews.com
- i-Micronews.jp.com
- FreeFullPDF.com

**ONSITE**

- Events

**IN PERSON**

- Webcasts

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**ONLINE**

- Benefit from the i-Micronews.com traffic generated by the 11,200+ monthly unique visitors, the 10,500+ weekly readers of @Micronews e-newsletter

**ONSITE**

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

**IN PERSON**

- 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.

**ONLINE**

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

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