FOR IMMEDIATE RELEASE:

Memory business: applications are driving the long-term growth
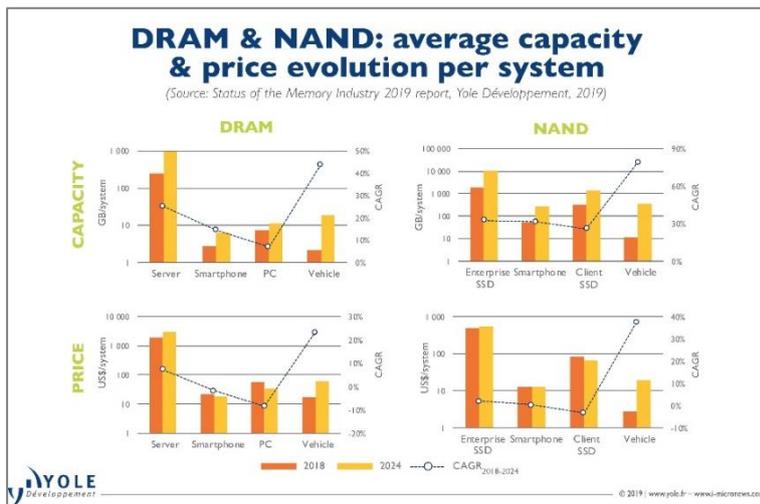
Extracted from:
- Status of the Memory Industry report, Yole Développement, 2019
- NAND Service – Memory Research & DRAM Service – Memory Research, Yole Développement, Q1, 2019
- Leading-edge 3D NAND Memory Comparison – System Plus Consulting, 2018

LYON, France – June 18, 2019: Despite some cyclicality and seasonality, the stand-alone memory market has experienced extraordinary growth over the past decade. This has been driven by important megatrends, such as mobility, cloud computing, AI[1], and IoT[2].

"NAND and DRAM account together for around 97% of the overall stand-alone memory market", announces **Simone Bertolazzi, Market & Technology Analyst, Memory at [Yole Développement (Yole).](#)**
"Their revenues hit a record high of around US$160 billion in 2018, registering an impressive CAGR[3] of 32% between 2016 and 2018."
Yole Group of Companies including Yole, [System Plus Consulting](#) and [Knowmade](#) is daily working with the leading memory players to collect valuable market and technology data. Memory analysts collaborate with them to understand their vision of the industry and evaluate the market growth and technological evolution on an ongoing basis. Yole Group's knowledge is now proposed through a wide collection of reports and monitor services.

DRAM & NAND: average capacity & price evolution per system
(Source: Status of the Memory Industry 2019 report, Yole Développement, 2019)

Memory market & technology reports provide an overview of the industry, with a detailed analysis of the technology challenges, devices' trends and a deep understanding of the supply chain with an accurate players mapping. [Status of the Memory Industry](#) report is the latest memory study published by Yole. This study proposes a comprehensive overview of the memory industry with a detailed description of the technologies and devices and competitive landscape.
Under this new report, Yole's analysts reveal today their vision of each market segment and related applications to highlight the impact of the

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[1] AI : Artificial Intelligence
[2] IoT: Internet of Things
[3] CAGR: Compound Annual Growth Rate

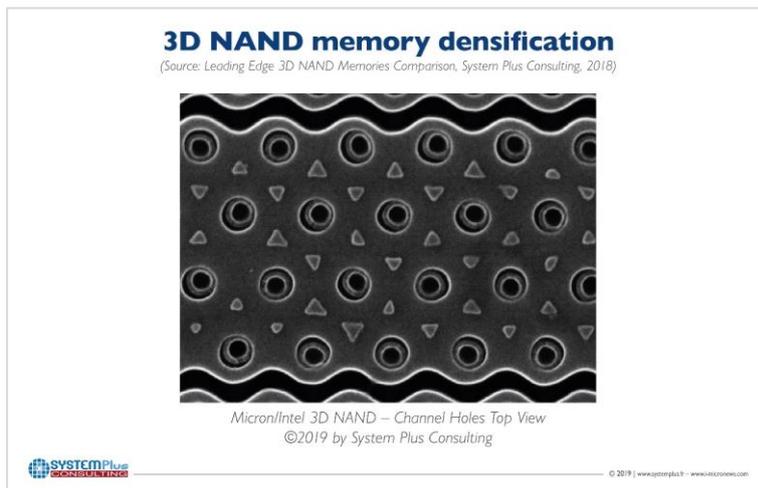megatrends and market drivers. This report also includes a large section focused on forecasts and roadmaps.

In addition, memory analysts reveal the status of the memory business each quarter with the DRAM & NAND Quarterly Market Monitor services. These services provide an accurate outlook of the market, its current status, and near- and long-term outlooks.

Counting for more than one third of the whole semiconductor market today, the memory business is key for numerous companies, from substrate to devices, including modules and systems makers. What could happen in a near future? In a long-term? Yole Group of Companies is following issues and innovations to give you a better understanding of the industry evolution.

At the end of 2018, both NAND and DRAM markets started experiencing oversupply caused by unseasonably weak demand, including lower than- expected smartphone sales and a slowdown in datacenter demand:

"DRAM prices are projected to decline by around 40% this year and likely will not increase again until 2020", asserts **Mike Howard, VP of DRAM and Memory Research at Yole**.

"For NAND, hopes of a second-half 2019 market rebound are shrinking as the anticipated demand recovery continues to be elusive and supplier inventory levels remain elevated," adds **Walt Coon, VP of NAND and Memory Research at Yole.** See the Quarterly DRAM & NAND snapshot: From bad to worse in Q1 2019 published on i-micronews.com.

3D NAND memory densification
(Source: Leading Edge 3D NAND Memories Comparison, System Plus Consulting, 2018)

Micron/Intel 3D NAND – Channel Holes Top View
©2019 by System Plus Consulting

As part of the NAND business, 3D NAND technology is showing impressive developments… *"To answer to the impressive demand for higher storage capacity and reliability while lowering cost per bit, 3D NAND manufacturers implements innovative techniques,"* explains **Belinda Dube, Cost Analyst at System Plus Consulting**. "*They change the storage type, the memory cell design and stack more layers with each generation to increase bit density hence reducing the die sizes. The technological changes in the cell architecture and modification of the fundamental memory features add complexity to the manufacturing process. However these techniques do lower the cost per gigabyte."* System Plus Consulting is following the evolution of memory technologies with a collection of reverse engineering and costing reports. With the Leading-edge 3D NAND Memory Comparison 2018 the team presents a technological and economical comparison of the latest generation of 3D NAND solutions available

on the market from four different manufacturers. These are the 64-layer designs from Toshiba/SanDisk, Samsung and Intel/Micron and the 72-layer 3D NAND by SK Hynix.

In the long-term, NAND and DRAM revenues are forecast to grow with 4% and 1% CAGR respectively, between 2018 and 2024. This is thanks to ever-growing bit demand fueled by novel AI/IoT applications and systems, such as smart cities, connected homes and intelligent factories, smartphones and Echo-like personal assistants, virtual and augmented reality and autonomous vehicles. All these rely on a massive amount of data and on the networks that connect them all. Thus, the coming rollout of 5G wireless technology will be critical for their future market expansion.

Under the Status of the Memory Industry report, Yole's memory team carried out a systematic study of the evolution of memory requirements in various key systems, including servers, smartphones, PCs, enterprise/client SSDs[4], and vehicles. Servers and enterprise SSDs for datacenters are the most important bit-consuming systems for DRAM and NAND memory, respectively. On the other hand, automotive is the fastest growing segment. The amount of bits in cars is expected to grow by orders of magnitude due to increasing penetration of ADAS[5] for autonomous vehicles.

Notably, eNVM[6] started making inroads into the SCM[7] market with the introduction in 2017 of Intel's Optane PCM[8] products. As the new generations of Xeon server CPUs are conceived to be compatible with the new Optane persistent memory modules (NVDIMM), Intel might be able to gain significant business at the expense of Samsung and SK Hynix, who are now getting ready with their own PCM products.

A detailed description of memory services and reports is available on i-micronews.com, memory section.

To present key results and explain its vision of the memory industry evolution, the team of Yole Group of Companies attends a selection of key conferences and trade shows all year long. These events provide opportunities for the memory experts to share their vision of the industry and debate with leading players. Save the date right now with the next events:

- MRAM Developer Day on August 5, in Santa Clara, CA with a presentation by Simone Bertolazzi, PhD, Technology & Market Analyst from Yole Développement.
- Flash Memory Summit – August 6 to 9 in Santa Clara, CA. Make sure to visit our booth and meet our experts.

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[4] SSD: Solid State Drives
[5] ADAS : Advanced Driver Assistance Systems
[6] eNVM : emerging Non-Volatile Memory
[7] SCM : Storage-Class Memory
[8] PCM : Phase-Change Memory

During this event, Yole Group is organizing a dedicated breakfast to highlight the latest results coming from reports and monitors. Full program will be available soon. For any questions, please contact Camille Veyrier. More info. on i-micronews.com, events section.

ABOUT THE MEMORY ACTIVITIES:

Yole Développement and its partners have launched a global Memory Service to deliver world class research, data, and insight to ensure our clients are well-versed in all aspects of this dynamic industry ecosystem.

- ▪ **New monitor services - DRAM & NAND focus**

  Market monitor:

  An Excel and PowerPoint based quarterly report that includes both historical and forecast data covering pricing forecast - Detailed supply/demand analysis - Supplier shipments, revenue, and market shares - Detailed analysis of key demand segments including smartphones, compute, data center, automotive and Solid State Drive (SSD) analysis - Memory technology.

  Pricing monitor:

  A monthly snapshot of market pricing across a variety of products, including components and packaged solutions spanning multiple densities and technologies

  A detailed description is available on i-micronews.com: DRAM - NAND

- ▪ **Reports**

  Status of the Memory Industry

  A 360° analysis of the memory industry and its competitive landscape. – Performed by Yole Développement

  Leading-edge 3D NAND Memory Comparison 2018

  A deep technology analysis and cost comparison report on cutting edge 3D NAND memory chips from Toshiba/SanDisk, Samsung, SK Hynix and Intel/Micron – Performed by System Plus Consulting

  Emerging Non Volatile Memory

  After more than 15 years in development, PCM has finally taken off in stand-alone applications.

  STT-MRAM will lead the embedded memory race. – Performed by Yole Développement

  3D Non-Volatile Memory

  The 3D Non-Volatile Memory field is changing fast. How the Chinese players can find a place in a crowded space? – Performed by Knowmade

  AMD Radeon Vega Frontier Edition

  New GPU is AMD's first with Samsung 8-Hi second generation high bandwidth memory and the latest 2.5D chip-on-wafer packaging from SPIL – Performed by System Plus Consulting

  Memory Packaging Market and Technology

  Wire bond is still the dominant interconnect for memory packaging, but flip-chip is making inroads into mainstream memory packaging – Performed by Yole Développement

ABOUT YOLE GROUP OF COMPANIES

Specializing in patent analysis and scientific information, **Knowmade** provides technology intelligence and IP strategy consulting services. The company supports R&D organizations, industrial companies, and investors in their business development by offering them a deep understanding of their IP environment and technology trends. Knowmade operates in the following industrial sectors: Compound Semiconductors, Power Electronics, RF & Microwave Technologies, LED/OLED Lighting & Display, Photonics, Memory, MEMS & Sensors, Manufacturing & Advanced Packaging, Batteries & Energy Management, Biotechnology, Pharmaceuticals, Medical Devices, Medical Imaging, and Agri-Food & Environment.

Knowmade's experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence, and freedom-to operate analysis. In parallel, the company offers litigation/licensing support, technology scouting, and IP/technology watch services. Knowmade's analysts combine their technical and patent expertise with powerful analytics tools and proprietary methodologies to deliver relevant patent analyses and scientific reviews. More information on www.knowmade.com and follow Knowmade on LinkedIn.

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems. Created more than 20 years ago, System Plus Consulting has developed a complete range of services, costing tools and reports to deliver in-depth production cost studies and estimate the objective selling price of a product.

System Plus Consulting engineers are experts in Integrated Circuits - Power Devices & Modules - MEMS & Sensors - Photonics – LED - Imaging – Display - Packaging - Electronic Boards & Systems. Through hundreds of analyses performed each year, System Plus Consulting offers deep added-value reports to help its customers understand their production processes and determine production costs. Based on System Plus Consulting's results, manufacturers are able to compare their production costs to those of competitors. System Plus Consulting is a sister company of Yole Développement. More info on www.systemplus.fr and on LinkedIn and Twitter.

Founded in 1998, **Yole Développement (Yole)** 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 & Sensors - Imaging - Medical Technologies - Compound Semiconductors - RF Electronics - Solid State Lighting - Displays - Photonics - Power Electronics - Batteries & Energy Management - Advanced Packaging - Semiconductor Manufacturing - Software & Computing - Memory and more...

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. . For more information, visit www.yole.fr and follow Yole on LinkedIn and Twitter.

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Yole Développement, System Plus Consulting, Knowmade, PISEO and Blumorpho are part of Yole Group of Companies. Yole Group of Companies - Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr).

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