

# Memory markets poised for major changes as COVID-19 weighs on demand<sup>1</sup>

## OUTLINES:

- In the long term, NAND and DRAM market revenues are expected to grow up to US\$82 billion and US\$95 billion respectively, by 2025. Yole Développement (Yole) announces a 11% CAGR<sup>2</sup> for the NAND market and 7% for the DRAM one, between 2019 and 2025.
- Market status per technology:  
NAND and DRAM account together for the main part of the overall stand-alone memory market, with 96% market shares in 2019.  
Other memory technologies represent only about 4% of memory business. 3D XPoint is poised to grow in datacenter applications.
- China is entering the NAND business with aggressive plans, whereas China DRAM developments continue to advance.
- COVID-19 outbreak:  
The DRAM revenues will be growing modestly, about 5% in 2020.  
From the NAND side, market figures are much better with about 35% of revenue growth. 2020 DRAM ASP<sup>3</sup> is directly impacted, announce Yole in its memory report and Q2 2020 memory monitor, around -9% from 2019, although growing on a quarterly basis starting from Q1 2020.  
NAND ASP started growing earlier in Q4 2019. On a yearly basis, the NAND ASP will grow 6% in 2020.

*“Despite the COVID-19 outbreak, which negatively impacted the smartphone and automotive industries, but spurred demand for server and PC memory for stay-at-home activities, 2020 is expected to be a year of recovery,” asserts **Simone Bertolazzi, PhD, Technology &***

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<sup>1</sup> Extracted from:

- [Status of the Memory Industry 2020 report](#), Yole Développement, 2020
- [YMTC 3D NAND Flash Memory report](#), System Plus Consulting, 2020
- [NAND Quarterly Market Monitor](#), Yole Développement, 2020
- [DRAM Quarterly Market Monitor](#), Yole Développement, 2020
- [3D NAND Memory Comparison 2019 report](#), System Plus Consulting, 2019

<sup>2</sup> CAGR: Compound Annual Growth Rate

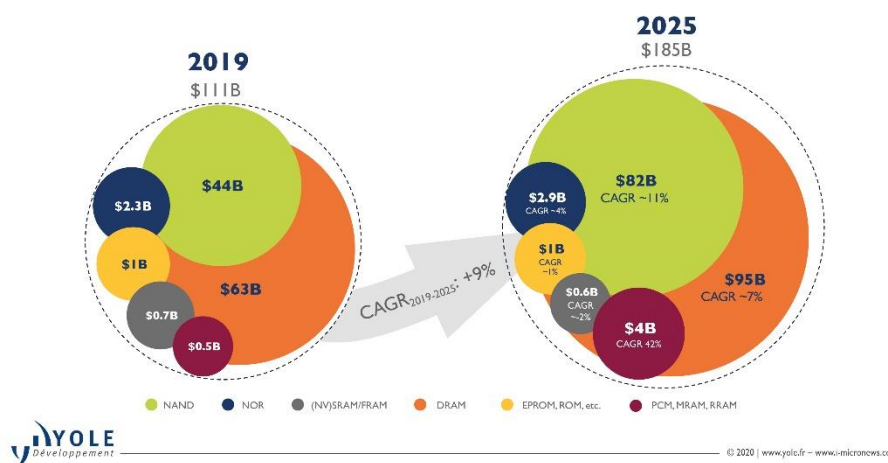
<sup>3</sup> ASP: Average Selling Price

**Market analyst, Semiconductor, Memory & Computing, at Yole Développement (Yole).** “At Yole, we see the beginning of a new era of prosperity for the memory industry.”

Driven by important megatrends such as mobility, cloud computing, AI<sup>4</sup> and the IoT<sup>5</sup>, the stand-alone memory market has experienced extraordinary growth over the past decade. However, this exciting growth period ended in Q4-2018 when both the NAND and DRAM markets started experiencing oversupply caused by weak demand. This included lower-than-expected smartphone sales and a slowdown in datacenter demand. Inventory levels increased for memory suppliers and their OEM<sup>6</sup> customers, with ASP (\$/Gb) declining by more than 49% in 2019. Meanwhile, combined DRAM and NAND revenue reached ~\$106B, down 34% from 2018. In 2019, significant DRAM and NAND capex cuts initiated a market recovery that began in late-2019, and which has continued in 2020.

**2019 – 2025 stand-alone memory market revenue forecast with breakdown by technologies**

(Source: Status of the Memory Industry 2020 report, Yole Développement, 2020)



In this context, Yole and its partner System Plus Consulting investigate disruptive memory technologies and related markets to point out the latest innovations and underline the business opportunities.

In this regard, both companies combine their technology and market expertise and propose deep added value collection of reports and monitors:

- A market and technology report, titled Status of the Memory Industry 2020 co-authored by the Yole’s Memory team.

This 2020 edition gives a comprehensive overview of the stand-alone memory market, including NAND, DRAM, NOR, 3D XPoint, (NV)SRAM, and more as well as detailed technical roadmaps, an overview of the memory activities all around the world, the competitive landscape and strategies of the leading memory companies.

<sup>4</sup> AI : Artificial Intelligence

<sup>5</sup> IoT : Internet of Things

<sup>6</sup> OEM : Original Equipment Manufacturer

This report gives a breakdown of the memory market from a system point of view, detailing present and future memory needs for servers, smartphones, personal computers, enterprise/client SSDs, and vehicles.

Taking into account the COVID-19 outbreak, Yole's analysts reveal a complete review of the industry and future trends.

- The structural, process & cost analyses from System Plus Consulting: [3D NAND Memory Comparison 2019](#) and [YMTC 3D NAND Flash Memory](#).

This latest report is based on a complete teardown analysis of the 3D NAND Memory developed by the leading memory company, Yangtze Memory Technologies Co. This study details the fabrication steps of YMTC's latest 64-layer NAND dies. The physical analysis included in this report, reveals the Xtacking architecture adopted by YMTC.

*“Featuring a comparison of YMTC's 64-layer NAND with the other 64-layer NAND memories from main NAND manufacturers like Samsung, Kioxia and Micron, this study helps to compare the YMTC cell features and highlights the similarities and differences from other 64-layer NAND”*, explains **Belinda Dube, Semiconductor Memories and Integrated Circuits analyst at System Plus Consulting**.

- Finally, quarterly market monitors released by Yole since 2018, [NAND Quarterly Market Monitor](#) and [DRAM Quarterly Market Monitor](#). Yole's memory monitors are published every beginning of March (Q1), June (Q2), September (Q3) and December (Q4). Aim of the Yole's Memory team is to give a closer look at the main markets and players.

What are the economic and technological challenges? What are the key market drivers? Who are the suppliers to watch? What are the innovative technologies, they are working on?

With a special focus on YMTC, what are the key technical choices for its 64-layer NAND?

What is the added value of this solution?

What are the impacts of COVID-19 outbreak on the memory industry in both short and long terms?

Yole and System Plus Consulting present today their vision of the memory industry.

As analyzed by Yole's team in its 2020 report, [Status of the Memory Industry](#), NAND and DRAM are ubiquitous technologies, together accounting for 96% of the overall stand-alone memory market. Thus, they determine the overall status and dynamics of the stand-alone memory industry.

However, besides NAND and DRAM, there exists a broad spectrum of technologies that fit the requirements of different end-systems and markets. NOR flash is the third-largest market with around US\$2.3 billion in 2019, fueled by numerous applications including industry and security, such as surveillance cameras, consumer, and automotive electronics, as well as telecom infrastructure, like 5G base stations for example. Despite some seasonality and cyclicity, NOR revenue is expected to grow at a 4% CAGR between 2019 and 2025.

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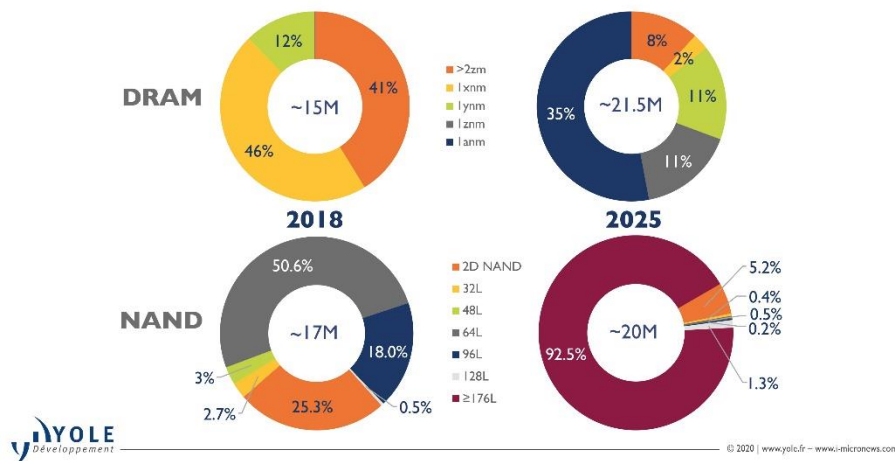
<sup>7</sup> YMTC: Yangtze Memory Technologies Co.

Other technologies, such as volatile and NV<sup>8</sup> SRAM, FRAM<sup>9</sup>, and EEPROM<sup>10</sup> represent “niche” markets that are rather static and collectively account for just about 1.5% of the stand-alone memory market.

On the other hand, emerging NVM<sup>11</sup> technologies, like MRAM, PCM, and RRAM, are taking off in the SCM<sup>12</sup> market. Their combined revenue is expected to reach around US\$4 billion by 2025, with a 40% CAGR between 2019 and 2020. In this area, PCM<sup>13</sup> will maintain its leadership until 2025 thanks to the involvement of Intel, which leads the persistent memory business with its Optane™ non-volatile memory modules.

### DRAM & NAND process mix evolution in 300mm wafer units production

(Source: Status of the Memory Industry 2020 report, Yole Développement, 2020)



According to **Walt Coon, VP of NAND and Memory Research, part of the Semiconductor, Memory & Computing division at Yole** “Market concentration has accelerated dramatically in the last decade and is now remarkably high. Three dominant NAND and DRAM players, Samsung, Micron, and SK Hynix, and two pure NAND players, Kioxia and Western Digital, together hold about 90% of the stand-alone memory market”. All these data are deeply analyzed in the [NAND Quarterly Market Monitor – Q2 2020](#).

In 2019, all major NAND manufacturers were developing the new 1xxL generation and ramping-up production of 92/96L 3D NAND. However, to mitigate the oversupply situation, most manufacturers chose to slow their ramping of 92/96L, and many products launched in 2019 were still based on 64L 3D NAND. In this regard, its [3D NAND Memory Comparison 2019 report](#), System Plus Consulting gives a complete technology and cost analysis of 3D NAND memories from Kioxia/Western Digital, Samsung, SK Hynix and Micron.

<sup>8</sup> NV : Non-volatile

<sup>9</sup> FRAM : Ferroelectric RAM

<sup>10</sup> EEPROM : Electrically Erasable Programmable Read-only Memory

<sup>11</sup> NVM : Non-volatile Memory

<sup>12</sup> SCM : Storage-class Memory

<sup>13</sup> PCM : Phase Change Memory

**Belinda Dube from System Plus Consulting** comments: *“In order to accelerate bit growth and reduce NAND cost, all the four top manufacturers have added more word lines to their process. Meanwhile, new competition from YMTC will affect the NAND memory market”*.

In addition, in its [DRAM Quarterly Market Monitor - Q2 2020](#), Yole affirms, in the DRAM business, market equilibrium was sought via significant capital expenditure cuts in 2019. Between 25% and 30%, according to **Mike Howard, VP of DRAM and Memory Research, part of the Semiconductor, Memory & Computing division at Yole**. *“And as late as Q3-19, plans existed at suppliers to reduce capital expenditure by as much again in 2020. Both Micron and Samsung are expected to introduce products based on 1z technology by 2020; SK hynix will follow. The most advanced DRAM node by 2025 is expected to be 1 beta”*, he adds.

Meanwhile, Chinese players are starting to threaten the market’s equilibrium and could trigger profound changes in the memory business.

In the NAND business, YMTC is the leading memory maker in China. The company is currently shipping 64L NAND domestically in low volumes, including SSDs, with 128L production in development and shipments expected in 2021. YMTC’s 2020 ramp-up has been in part hampered by COVID-19, with delays in equipment deliveries/installations at its Wuhan manufacturing site.

In the [YMTC 3D NAND Flash Memory report](#), **Belinda Dube from System Plus Consulting** asserts: *“YMTC memory is expected to pick significant market shares in the NAND market revenue. The YMTC memory enters the NAND flash market as a solution to cater for higher I/O (In/Out) Speed because of the use of advanced CMOS that can be manufactured on a different wafer from the NAND Array wafer. This memory provides the combination of high speed and large density characteristics”*.

**For Simone Bertolazzi from Yole:** *“DRAM manufacturing is incredibly difficult, and it will likely take a while longer for China to achieve competitive parity with the industry at-large. CXMT<sup>14</sup>, China’s most advanced DRAM maker, is expected to ramp up production on the 1xnm node in 2020, about three years later than the industry’s leading players”*.

As analyzed in the [NAND Quarterly Market Monitor](#), for NAND, Yole expects that significant output, around 4%, from YMTC could reach the market in 2021, while it will take longer for DRAM. Meanwhile, stand-alone NOR flash will remain the sturdiest memory business in China thanks to a well-developed local supply-chain system and the activities of GigaDevice, a key local player.

Without doubts, the memory business is about to change. Yole and System Plus Consulting highlight lot of signs in their report that underline this status. Analysts are daily following the

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<sup>14</sup> CXMT : Changxin Memory Technologies

industry and key parameters and discussing with leading memory players to get a clear understanding of their strategy and their ability to innovate. The story will so not stop here.

All year long, System Plus Consulting and Yole Développement combine their expertise and deep understanding of the markets and disruptive technologies to publish numerous memory reports and monitors. In addition, experts realize various key presentations and organize key conferences. In this regard, don't miss the upcoming event, Flash Memory Summit – 2020 on October 20th in Santa Clara (California).



In parallel, they recommend to watch the DRAM & NAND Market Update: Headwinds Expected from COVID-19 – LIVE MARKET BRIEFING. A recorded version is available on i-Micronews.  
Stay tuned!

### Press contacts

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### About our analysts

**Simone Bertolazzi**, PhD is a Technology & Market analyst at Yole Développement (Yole) working with the Semiconductor, Memory & Computing division. He is member of the Yole's memory team and he contributes on a day-to-day basis to the analysis of nonvolatile memory technologies, their related materials and fabrication processes. Previously, Simone carried out experimental research in the field of nanoscience and nanotechnology, focusing on emerging semiconducting materials and their opto-electronic device applications. He (co-) authored several papers in high-impact scientific journals and was awarded the prestigious Marie Curie Intra-European Fellowship. Simone obtained a PhD in physics in 2015 from École Polytechnique Fédérale de Lausanne (Switzerland), where he developed novel flash memory cells based on heterostructures of two-dimensional materials and high- $\kappa$  dielectrics. Simone earned a double M. A. Sc. degree from Polytechnique de Montréal (Canada) and Politecnico di Milano (Italy), graduating cum laude.

**Walt Coon** joins Yole Développement's memory team as VP of NAND and Memory Research, part of the Semiconductor, Memory & Computing division. Based in the US, Walt is leading the day-to-day production of both market updates and Market 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).

**Mike Howard** is a member of the memory team at Yole Développement (Yole) as VP of DRAM and Memory Research. Mike's mission at Yole is to deliver a comprehensive understanding of the entire memory and semiconductor landscape (with special emphasis on DRAM) via market updates and Market Monitors. Mike is also deeply involved in the business development of all memory activities. Mike is based in the US. Mike has a deep understanding of the DRAM and memory markets with a valuable combination of industry and market research experience. For the decade prior to joining Yole, Mike was the Senior Director of DRAM and Memory Research at IHS. Before IHS, Mike worked at Micron Technology where he had roles in corporate development, marketing, and engineering. Mike earned a Master of Business Administration at The Ohio State University (United-States), a Bachelor of Science in Chemical Engineering and a Bachelor of Arts in Finance at the University of Washington (Washington, United-States).

As VP of Yole Finance at Yole Développement (Yole), **Ivan Donaldson** manages the company's financial advisory service, collaborating with supply chain clients on strategic reviews, M&A, and portfolio optimization projects. In addition, Ivan is responsible for managing the firm's consulting service for the global financial segment including institutional investors, research firms, private equity funds, venture capital funds, and investment bankers. Prior to Yole, as VP of Corporate Strategy at Micron Technology, Ivan's responsibilities included corporate strategic planning, M&A and business development, and generating strategic intelligence. In addition, he represented the company externally with key counterparties, business partners, and government officials. He was also previously the head of Micron Technology's Investor Relations team, representing the company with investors worldwide. Ivan earned a Bachelor of Business Administration degree in Finance from Boise State University.

**Emilie Jolivet** is Director of the Semiconductor, Memory & Computing Division at Yole Développement, part of Yole Group of Companies, where her specific interests cover package & assembly, semiconductor manufacturing, memory and software & computing fields. Based on her valuable experience in the semiconductor industry, Emilie manages the expansion of the technical and market expertise of the Semiconductor and Software Team. The team interacts daily with leading companies allowing semiconductor & software analysts to collect a large amount of data and integrate their understanding of the evolution of the market with technology breakthroughs. In addition, Emilie's mission focusses on the management of business relationships with

semiconductor leaders and the development of market research and strategy consulting activities inside the Yole group. Emilie Jolivet holds a Master's degree in Applied Physics specializing in Microelectronics from INSA (Toulouse, France). After an internship in failure analysis at Freescale (France), she was an R&D engineer for seven years in the photovoltaic business where she co-authored several scientific articles. Enriched by this experience, she graduated with an MBA from IAE Lyon and then joined EV Group (Austria) as a business development manager in 3D & Advanced Packaging before joining Yole Développement in 2016

**Santosh Kumar** is currently working as Principal Analyst and Director Packaging, Assembly & Substrates for Yole Développement's activities in Korea. Based in Seoul, Santosh is involved in the market, technology and strategic analyses of the microelectronic assembly and packaging technologies. His main interest areas are advanced IC packaging technology including equipment & materials. He is the author of several reports on fan-out / fan-in WLP, flip chip, and 3D/2.5D packaging. Santosh Kumar received the Bachelor's and Master's Degree in Engineering from the Indian Institute of Technology (IIT), Roorkee and University of Seoul respectively. He has published more than 40 papers in peer reviewed journals and has obtained 2 patents. He has presented and given talks at numerous conferences and technical symposiums related to advanced microelectronics packaging.

**Belinda Dube** is working for System Plus Consulting as Analyst in Semiconductor Memories and Integrated Circuits. She holds a Masters degree in Nano Science and Nanotechnologies from Ecole Central Lyon and INSA Lyon.

**Véronique Le Troadec** has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

### About the reports

#### **Status of the Memory Industry 2020**

*The entrance of Chinese players and the rise of new technical solutions are poised to trigger profound changes in the memory business. – Performed by Yole Développement*

#### **Companies cited:**

4DS, AdataAlliance Memory, AP Memory, Apple, Canon, Centon, CXMT, Cisco, Dell, ESMT, Facebook, Ferroelectric Memory Company, Fujitsu, Fusion IO, GigaDevice, GlobalFoundries, Google, Hitachi, HLMC, Honeywell, HP, Huawei, IBM, Infineon, Intel, ISSI, Kingston, KLA Tencor, Lapis, Lenovo, Longsys, Liteon, Lyontek, Macronix, Marvell, Mediatek, Nikon, NEC, ON Semiconductors, Panasonic, Powertech, Qualcomm, Samsung, Semtech, Silicon Motion, SK Materials, Smart Modular Technologies, SMIC, Sony, Memory, STMicroelectronics, Texas Instruments, Toshiba, Transcend, TSMC, UMC, UnilC Semiconductors, Unimos Microelectronics, Viking, Violin Memory, X-Fab, XMC, YMTC, new Chinese emerging NVM players, and many more...

#### **YMTC 3D NAND Flash Memory**

*Technology and cost analysis of YMTC's 64-layer 3D NAND with hybrid bonding – Performed by System Plus Consulting*

### Related reports:

- [NAND Quarterly Market Monitor](#)
- [DRAM Quarterly Market Monitor](#)
- [3D NAND Memory Comparison 2019](#)
- [Emerging Non-Volatile Memory 2020](#)

### About System Plus Consulting

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... [More](#)

### About Yole Développement





## Press Release

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... [More](#)

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