Press Release
January 22th, 2020
LYON, France

FCBGA packaging reaches new heights to US$12 billion by 2025

Advanced Packaging Quarterly Market Monitor - Q4, 2020

MARKET DYNAMICS:

- Market forecasts:
  FCBGA[1] package revenue is expected to reach US$12 billion US USD by 2025 from $10 billion in 2020, driven by AI[2], datacenter and HPC[3] momentum.
  FCBGA packages are expected to reach 3% CAGR[4] over the next five years (in revenue).
  FCBGA revenue is expected to surpass US$10 billion by 2025.
  The majority of wafer demand stemming comes from 3D stacked devices with total wafer growth CAGR at 8.5% compare to 2020. It includes FCBGA, Fan-out, WLCSP[4], and 3D stacked packages.
  The 3D stacked IC[5] targets for 24.8% CAGR over the next five years with HBM[6] accounting for 48% growth, 3D accounting for 27% and 3D NAND for 82%.
- Supply chain:
  TSMC remains the leader with 69% market share in 2019 for fan out packages.
  WLCSP packages get a strong foothold in smart phone eco-system.
  ASE, JCET, Amkor, and SPIL lead the WLCSP wafer market.

FCBGA PACKAGING REACHES NEW HEIGHTS TO $12B BY 2025 DRIVEN BY AI, DATACENTER AND HPC MOMENTUM

FCBGA package revenue is expected to reach US$12 billion US USD by 2025 from $10 billion in 2020. This unprecedented growth is due to increased demand in automotive, high performance computing, laptops and client computing segment and increased need for graphics in consumer and server applications.

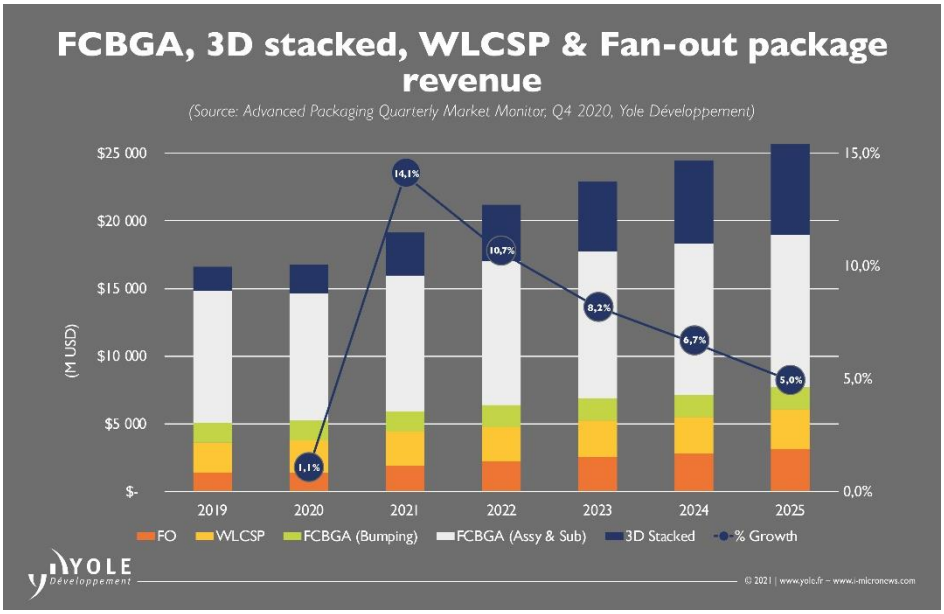
According to **Vaibhav Trivedi, Senior Technology & Market analyst, Semiconductor & Software division at Yole Développement (Yole):** *"FCBGA packages traditionally been used in workstation, laptop, and desktop applications as CPU[7]s and server CPUs. These markets have traditionally been dominated by giants such as Intel and AMD. With slow-down of Moore's law in*

[1] FCBGA: Flip Chip Ball Grid Array
[2] AI: Artificial Intelligence
[3] HPC: High Performance Computing
[4] WLCSP: Wafer Level Chip Scale Package
[5] IC: Integrated Circuit
[6] HBM: Human-Body Model
[7] CPU: Central Processing Unit

recent years, how to assemble, package and integrate various functionality blocks in the SoC[8] has become increasingly challenging. High Density FCBGA substrate continues to evolve and get more denser with finer line & space as more routing and multiple chips are being heterogeneously integrated on to the substrate".

FCBGA packaging can be broken down in key ingredients such as wafer bumping using CuP[9], packaging that includes die singulation, chip attach, underfill, and mounting a thermal solution as many SoCs have high TDP[10] requiring integrated heat spreader and thermal interface material.

For more information, discover Vaibhav Trivedi's article: Rise of FCBGA packages amid coronavirus pandemic on i-Micronews.



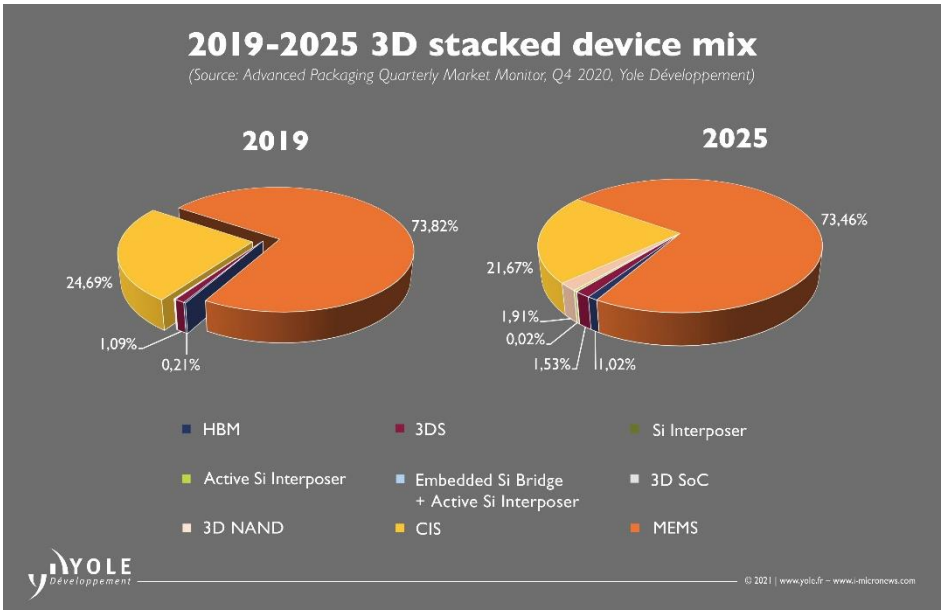
WAFER LEVEL PACKAGING PLATFORMS SERVE MOBILE & CONSUMER MARKETS

WLCSP/Fan-In packages have found its place in many smartphone devices due to its lowest cost and scalability features. WLCSP can be found in PMIC[11]s, PMU[12]s, Audio Codecs, RF[13] transceivers, switches, antenna tuners, CMOS Image Sensors and number of other applications suited for consumer market such as for smartphone and wearable device application. WLCSP remains an attractive option given its reasonable reliability, process maturity, and lowest cost. OSATs remain top leaders in manufacturing WLCSP as it has become a commodity market.

Yole's analysts follow closely the advanced packaging industry. In this regard, they release the OSAT ranking every year.

[8] SoC : System on a Chip
[9] CuP : Cu Pillar
[10] TDP : Thermal Design Power
[11] PMIC : Power Management Integrated Circuits
[12] PMU : Power Management Unit
[13] RF : Radio Frequency

In 2020, **Vaibhav Trivedi** and **Favier Shoo, Technology and Market Analyst, Package, Analyst & Substrate at Yole** wrote "the Future of OSATS" article for Chip Scale Review. Discover it on i-Micronews.



FO packaging began several years ago with limited applications, but it has now found a critical role and rightful place in the high-end packaging sector as a mature, reliable package technology. In fact, TSMC's InFO form-factors brought FO[14] technology to new heights in 2015 as Apple launched its A10 with InFO-PoP approach.

According to **Favier Shoo from Yole**: *"FO packages are primarily used in the mobile and consumer segments, with some proliferation in automotive radar. FO packaging is expected to gain wider adoption as 5G, AI, and autonomous driving take flight in the coming years - and revenue stemming from FO packaging is expected to reach US$2 billion - US$2.5 billion by 2025".*

Fan-Out panel packaging efforts are mainly being championed by PTI and Samsung electronics and this monitor also sheds light on panel level production using Fan-Out packaging technologies.

Yole's Advanced Packaging Monitor has been published every beginning of March (Q1), June (Q2), September (Q3) and December (Q4)... Aim of these services is to provide an in-depth coverage of rapidly changing market dynamics and main players' status and strategy.. This monitor subscription provides quarterly updates on unit shipments, wafer production, and revenue on near-term and long-term basis. It provides capacity, CapEx, and supply chain insights into emerging markets and growth rates in mature markets in addition to providing package level forecast:

- *Module I: Fan-Out Package Monitor – Wafer & Panel level (2019 Q4 released)*

[14] FO: Fan-Out

- *Module II: WLCSP / Fan-In Package Monitor (2020 Q1 released)*
- *Module III: 2.5D/3D Stacked Package (2020 Q3 released)*
- *Module IV: FCBGA Package (2020 Q4 released)* ***NEW***
- *Module V: FcCSP Package (2021 Q1)*

In addition, the market research and strategy consulting company Yole released the annual Advanced Packaging technology & market report: Status of the Advanced Packaging Industry 2020.
Yole's analysts will also be part of the Technology Unites Global Summit. ***Emilie Jolivet, Division Director, Semiconductor & Software at Yole Développement*** *will do a presentation about the Advanced Packaging Market, during the Advanced Packaging Forum on February 16, 2021 at 11:00AM.*
Stay tuned to i-Micronews to get further information about our Advanced Packaging, Semiconductor Manufacturing & Memory activities!

Press contacts

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About the packaging, assembly and substrate team at Yole Développement

Favier Shoo is a Technology and Market Analyst in the Semiconductor, Memory and Computing Division at Yole Développement, part of Yole Group of Companies. Based in Singapore, Favier is engaged in the development of technology & market reports as well as the production of custom consulting reports. During 7 years at Applied Materials as a Customer Application Technologist in the advanced packaging marketspace, Favier developed an in-depth understanding of the supply chain and core business values. As an acknowledged expert in this field, Favier has provided training and held numerous technical review sessions with industry players. In addition, he has obtained 2 patents. Prior to that, Favier worked at REC Solar as a Manufacturing Engineer to maximize production capacity. Favier holds a Bachelor's in Materials Engineering (Hons) and a Minor in Entrepreneurship from Nanyang Technological University (NTU) (Singapore). Favier was also the co-founder of a startup company where he formulated business goals, revenue models and marketing plans.

Vaibhav Trivedi is a Senior Technology & Market analyst at Yole Développement (Yole) working with the Semiconductor & Software division. Based in the US, he is a member of Yole's advanced packaging team and contributes to analysis of ever-changing advanced packaging technologies. Vaibhav has 17+ years of field experience in semiconductor processing and semiconductor supply chain, specifically on memory and thermal component sourcing and advanced packaging such as SiP and WLP. Vaibhav has held multiple technical and commercial lead roles at various semiconductor corporations prior to joining Yole. Vaibhav holds a Bachelor of Science in Chemical Engineering, and Master of Science of Material Science from University of Florida in addition to an MBA from Arizona State University.

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.

Emilie Jolivet is Director of the Semiconductor & Software 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.

About Yole Développement

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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