The demand for System-in-Package (SiP) has increased significantly in recent years, with SiP being adopted in a wide ranging of applications: from low-end (smaller package size and lower I/O count) to high-end (larger package size and higher I/O), and leveraging different packaging technologies.

Currently, the business model manufacturers choose to adopt is a make-or-break factor for SiP’s success. That is to say, the choice of business model is more crucial to SiP’s success than typical key factors such as materials, technology, and cost. SiP consists of multiple dies which can be packaged using existing technologies and infrastructure. However, if one die isn’t available due to delivery or quality problems, the whole SiP production process halts. Hence, SiP solutions will also require assembly and test capabilities. Therefore, a full turnkey SiP business model solution is ideally the best manufacturing option for the fabless or design house.

Unfortunately, in the current supply chain environment it is almost impossible for existing business models (foundry, OSAT, substrate maker, etc.) to establish a full turnkey without crossing over into a new business model to gain the required capabilities. Within the SiP context, new business model trends are starting to emerge. Yole Développement (Yole) believes both OSAT and foundry have the potential to progressively adopt a full turnkey. For example, foundries are attaining OSAT and substrate capabilities to gain control of testing and assembly capabilities in order to protect their interests if a yield issue arises towards the end of the supply chain.

Over the past few decades, OEMs, EMS, foundries, IDMs, and fabless have relied heavily on OSATs to lead or co-lead the development and up-scale of advanced packaging technologies. Based on a holistic analysis of the entire SiP supply chain, Yole believes OSAT and foundry business model evolution will be the empowering trends to strategically secure more SiP businesses. High-end OSATs can enable a full turnkey solution via good CapEx investment and M&A as a means of gaining substrate makers’ and EMS’ capabilities, attracting fabless at a lower cost and with co-design convenience. Meanwhile, foundries will manage M&A and CapEx trade-offs related to SiP requirements, in order to maximize their control over SiP quality and performance.

This report includes a detailed supply chain analysis of different advanced packaging platforms, SiP business model evolution, players’ strategy, commercialization trends, and more.

**System-in-Package supply chain: business model evolution**

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(Yole Développement, February 2020)

**FLIP-CHIP AND WIRE-BOND DOMINATE SYSTEM-IN-BUSINESS, BUT AMPLE OPPORTUNITIES EXIST FOR FAN-OUT AND EMBEDDED-DIE PACKAGING**

SiP has several advantages: form factor reduction, increased performance and functional integration with electromagnetic interference (EMI) isolation, design flexibilities compared to stand-alone packages/SoC, and lower cost. Presently, flip-chip and wire-bond technologies are being leveraged in high-end and low-end SiP applications, 2D/2.5D/3D heterogeneous SiP. Low-end SiPs are driven by form factor and performance for 5G and connectivity. High-end
SiPs are driven by cost reduction, hence the birth of chiplets by industry and the lack of large IC substrate supply in the market. With the latest surge in demand for higher-end at larger-sized package, manufacturers have commenced a new wave of unprecedented investment tailored for Flip-Chip / Wire-Bond System-in-Package (FC & WB SiP). Also, OSATs’ uniqueness allows for a smoother reposition in order to gain capabilities for full turnkey SiP solution in a FC & WB SiP ecosystem.

The FC & WB SiP market is valued at $12.2B (which accounts for more than 90% of SiP packaging revenue), and it is expected to reach $17.1B by 2025, growing at a 6% CAGR2019-2025. FC & WB SiP lead the way to create value for both low-end and high-end applications, and generate new opportunities in the supply chain.

Fan-out (FO) packaging has emerged as one of the main packaging options for SiP. However, SiP’s potential in FO is still fairly limited by yield-cost concern with multi-die processing. As a result, players that are currently exploring and manufacturing FO SiP products are already active fan-out players with strong know-how and production maturity. This market has been dominated by TSMC since 2017, with >90% market share in FO SiP for 2019. The key application for fan-out SiP will remain mobile & consumer. However, data centres, 5G, and autonomous vehicle trends will drive fan-out SiP adoption in the telecom, infrastructure, and automotive applications.

Embedded Die (ED) technology is moving from a single embedded die into multiple embedded dies. The complexity and size of IC substrate and board will increase, therefore the ASP (for some applications in certain markets) will appreciate. ED SiP growth (units) will be around 27% over the 2019 - 2025 forecast period, while ED SiP packaging revenue will exceed $315M by 2025, with automotive, telecom & infrastructure, and mobile accounting for majority of this revenue. Although ED SiP packaging revenue is very small, the growth rate is very strong.

This report focuses on SiP technology trends, roadmaps, market drivers, technical challenges, market status, etc., by different packaging platforms across various applications.

Various SiP factors, including the increasing adoption of SiP in mega-trend drive applications like 5G, connectivity, networking, servers and IoT; manufacturers’ evolving business models; growing cost concerns of advanced silicon technology nodes for SoC; and the strong advancement in packaging technologies are all expected to drive the SiP market’s growth. The SiP market attained a massive package revenue of $13.4B in 2019, and will grow at a 6% CAGR to achieve $18.8B in 2025. SiP’s biggest market is mobile & consumer, (CAGR ~5%), followed by telecom & infrastructure (CAGR 11%) and automotive (CAGR 11%). These figures are not surprising, since these markets spearheaded most of the new packages where footprint reduction and improved performance were key parameters. Within mobile & consumer, handset held the biggest portion of SiP in 2019. However, the fastest growing momentum comes from other end-devices with smaller market size. For the next five years,
wearables, Wi-Fi routers, and IoT will show significant growth in the SiP market space, with the main drivers being 5G and sensors. Although handsets (especially smartphones) are saturating the market, there are new opportunities to adopt SiP due to 5G demands. Within telecom & infrastructure, base stations and servers are both expecting double-digit CAGR growth, with base stations having a whopping 41% CAGR. This is primarily driven by 5G base stations needing more SiP integrated by Flip Chip Ball Grid Array. Also, servers include high-end SiPs like CPU, xPU (chiplets, si interposer, FO), and Field Programmable Gate Arrays.

For Automotive & Transportation, ADAS and infotainment are the main drivers. Although the camera is a very small portion, its growth is the highest with expected SiP platforms adopted for ADAS mono, stereo, and triple. Also, computing power is needed for Vision Processing Unit (VPU) and infotainment. The bulk of it is MEMS & sensors, which consists of applications like pressure, inertial measurement units (IMUs), optical MEMS, microbolometers, oscillators, and environmental sensors. For other markets like medical, industrial, and defense & aerospace, the SiP size is significantly smaller, although growth is reasonably strong in robotics and IoT-related applications.

This report includes Yole’s SiP market forecast (2018 - 2025) by units and revenue, and by different packaging platforms, across various applications - including the current manufacturer’s status and their market share.

COMPANIES CITED IN THE REPORT (non exhaustive list)

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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 120 collaborators worldwide covering MEMS and image sensors, Compound semiconductors, RF Electronics, Solid-state lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Power Electronics, Batteries & Energy Management and Memory.

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

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• Technology analysis
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• Reverse engineering & costing
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2.1 Products are sent by email to the Buyer:

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2.3 The mailing of the Product will occur only upon payment by the Buyer, according to article 3 of these Terms and Conditions.

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Bank code: 00170
Branch code: 00170
Account no: 0170 200 1545 87
BIC or SWIFT: CCFFRPFP
IBAN: FR76 3005 6001 7001 7020 0156 587
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3.3 Payment is due by the Buyer to the Seller within 30 days from the date of mailing, the Buyer receiving the Products from time to time. The effective price is deemed to be the one applicable at the time of the order.

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