



FOR IMMEDIATE RELEASE:

Apple selected substrate-like PCBs for its latest iPhones. Who's next?

Extracted from: Status of advanced substrates: Embedded Dies & Interconnects, substrates like PCB trends report, Yole Développement – March 2018

LYON, France – March 12, 2018: The semiconductor industry's trends are affecting the semiconductor package and package-to-board interconnect level. Performance-driven applications like PCs and smartphones are giving way to functional applications that are plotting the semiconductor industry's future course. IoT¹, the automotive market, 5G connectivity, AR & VR², and AI³ are part of them. In this context, advanced semiconductor packaging is seen as a way to increase the value of a semiconductor product by adding functionality, maintaining/increasing performance, and lowering cost – and to this end, PCB⁴ is not just an interconnection anymore but also an integration solution...

The market research and strategy consulting company [Yole Développement \(Yole\)](#) pursues its investigations within the advanced substrates world and explore market and technologies of PCBs, IC⁵ substrates and embedded die in laminate. A new technology & market report, [Status of Advanced Substrate 2018: Embedded Dies & Interconnects, Substrates like PCB Trends](#) is now available and reveals the latest innovations and business challenges. It provides segmentation per types of substrates, by players and business models. It proposes a technology roadmap with competition zones and overlaps. In addition, this report assesses future developments with main players, supply chain description, market forecasts, drivers, emerging applications as well as a detailed financial analysis.

According to Yole's analysts, Apple's usage of SLP⁶ in the latest iPhone 8 and X will revolutionize the substrate and PCB markets. What is the status of such technologies? What will be the evolution of this market? How will evolve the supply chain, especially for substrate manufacturers? Yole invites you to discover the latest technology and market trends.

*“Advanced substrates must answer demands on both the scaling and functional roadmaps”, asserts **Emilie Jolivet, Technology & Market***

¹ IoT : Internet of Things

² AR & VR : Artificial Reality & Virtual Reality

³ AI : Artificial Intelligence

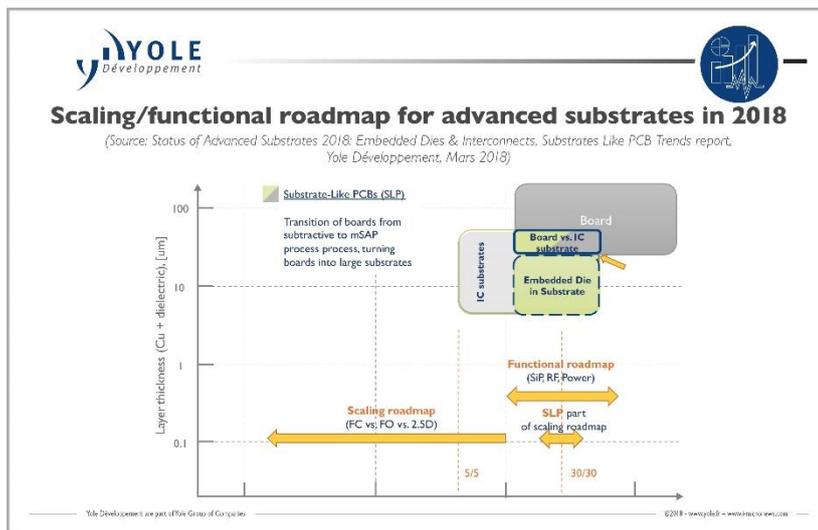
⁴ PCB : Printed Circuit Board

⁵ IC : Integrated Circuit

⁶ SLP : Substrate-Like PCBs

Analyst at Yole. On the scaling roadmap, three competition zones are active below the 30/30um line width/space:

- Board vs. package substrate: between L/S 30/30 um and L/S 20/20um: leading to SLP
- Package substrate vs. no substrate with FO⁷ platforms: around L/S 10/10um and sub-L/S 10/10 um: FC⁸ substrates, embedded die in PLP⁹ substrate, competing with fan-out WLP¹⁰/PLP.



- TSV¹¹ packaging vs. TSV-less packaging alternatives (between L/S 5/5 um and L/S 1/1 um, possibly lower): 2.5D (i.e. Si interposer) configurations vs. high-density FO.

The functional roadmap for advanced substrates is linked to devices that do not primarily require interconnect scaling but must satisfy particular demands such as high frequency, high reliability, higher power, etc. Such advanced packaging types include RF SiPs¹² for 5G mmWave and embedded die-in-substrate for higher reliability/power applications.

Yole's analysts announce a clash of two worlds: *"The transition from the subtractive to the mSAP¹³ process and from PCB to substrate-like PCB is under way in high-end smartphones, driven by Apple and its iPhone 8/iPhone X,"* explains Emilie Jolivet from Yole. *"Other high-end smartphone suppliers such as Samsung and Huawei are expected to join in the near future."*

SLP is a term that attempts to describe the transition of a board into a product with package-substrate-like features. Standard HDI¹⁴ and non-HDI boards use variations of the subtractive manufacturing process, while package substrates such as FC/WB¹⁵ CSP¹⁶/BGA¹⁷ use mSAP or SAP. SLP is in fact a large substrate, manufactured in mSAP, in the size and function of a board. The benefits of an SLP compared to a standard or HDI board include higher line resolution, better electrical performance, and the potential for space and energy-saving

⁷ FO : Fan-Out

⁸ FC : Flip-Chip

⁹ PLP : Panel Level Package

¹⁰ WLP : Wafer Level Packaging

¹¹ TSV : Through Silicon Via

¹² SiP : System In Package

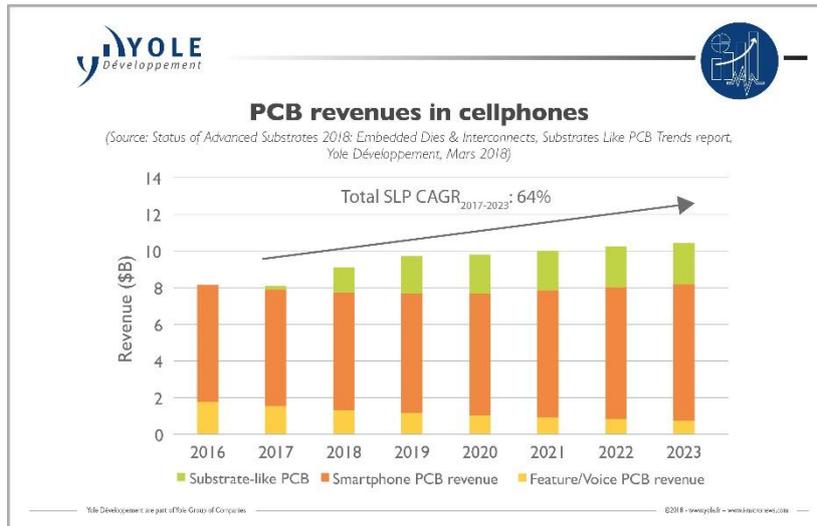
¹³ mSAP : modified Semi-Additive Process

¹⁴ HDI : High Density Interconnect

¹⁵ WB : Wire Bond

¹⁶ CSP : Chip Scale Packaging

¹⁷ BGA : Ball Grid Array



which are very important in a cramped, energy-limited smartphone environment.

SLP's entry opens a new market and disrupts the supply chain. The SLP market is estimated at US\$1.9 billion in 2016 and US\$2.24 billion by 2023, with a 64% CAGR between 2017 and 2023. SLP manufacturing will not just recover the PCB and substrate market, but also give it a significant boost. However,

from a technology-readiness point of view, although the mSAP process is mature for processing package substrate, considerable challenges still exist for manufacturing substrates in PCB-size.

To complete its market and technology approach, Yole's team makes a special focus on the financial activities in PCB/substrate manufacturing and other areas including revenue details, CAPEX, profit and players ranking. Therefore, with SLP's appearance in Apple's latest iPhones, PCB and substrate manufacturers have started producing SLP and investing in mSAP. "The 28 selected PCB/substrate manufacturers¹⁸ are all believed to have mSAP technology, and some of them can manufacture SLP," comments **Vivienne Hsu, Technology & Market Analyst and part of the advanced packaging team at Yole**. And she adds: "Driven by high-end smartphone demand, certain players appears to have high capital expenditures. Meanwhile, some large players show steady revenue in their PCB/substrate business."

Yole's financial analysis points out the importance of the Chinese players: more than one third of the top 100 PCB/Substrate manufacturers are from China, showing the highest growth with more than 18% from 2015 to 2016. Despite their numerical superiority in the top 100, Chinese companies drop to the third with respect to revenue... A detailed description of Status of Advanced Substrates report is available on i-micronews.com, [advanced packaging reports section](#).

Within its "Advanced Substrate" activity, Yole aims to connect the landscapes of boards and IC substrates. Analysts identify and analyze all-day long competitive and overlapping technologies and propose detailed roadmaps. They analyze the market to get a comprehensive understanding of the supply chain and business model shifts and

¹⁸ Including top 20 manufacturers (by 2016 PCB/substrate activity revenue – in US\$ million) plus a selection of companies – Details are available in the report.

perform market forecasts and market shares. Through these activities, the company discloses market dynamics and disruptions, plus financial information. The analysis of the embedded die package challenge is also part of these activities and is well detailed in the new Advanced Substrates report, released this month.



Yole Group of Companies including Yole Développement, [System Plus Consulting](#) and [Knowmade](#), presents its latest results during a dedicated webcast, [Advanced Substrates – How to answer demands on scaling and functional roadmaps?](#) This live event takes place on March 28 at 5.00 PM CET and is sponsored by AT&S. Detailed agenda & registration on [i-micronews.com, webcasts section](#).



In addition, the Group proposes its annual Advanced Packaging & System Integration Technology Symposium taking place on June 20 & 21 in Wuxi, China. Full program and list of speakers will come soon on [NCAP & Yole Développement symposium](#).

Stay tuned with Yole's advanced packaging team, to discover future technology & market analyses and attend future presentations.



ABOUT THE REPORT:

STATUS OF ADVANCED SUBSTRATES 2018

Apple's usage of substrate-like PCBs in the latest iPhone 8 and X will revolutionize the substrate and PCB markets – Produced by Yole Développement

Companies cited in the report:

AMD, Amkor, Amphenol, AMS, Aoshikang, Apple, AOI, AT&S, ASE, Avago, Benchmark, Boardtek, Bosch, Career, Celestica, Chin Poon, ChipBond, ChipMOS, CMK, Compeq, Continental, Cosmotech, Cynotec, Daeduck, Daimler, Deca Technologies, Dyconex AG, Dynamic, Eastern, Elmos Semiconductor, Ericsson, Epoche and Esp, Flex, Flexium, Foxconn, Fujikura, Fujitsu, GaN Systems, General Electric, Gold Circuit, HannStar Board, Hella,...

[Full list](#)

Authors:

- **Emilie Jolivet** is a Technology & Market Analyst in the Advanced Packaging & Semicon. Manufacturing team at Yole Développement (Yole). After an internship at Freescale, she took the position of R&D engineer in photovoltaic business and coauthored several scientific articles. Prior Yole, Emilie joined EV Group as a business development manager. Emilie holds a Master's degree in Applied Physics specializing in Microelectronics from INSA Toulouse (France) and an MBA from IAE Lyon (France).
- **Dr. Andrej Ivankovic** was a member of the Advanced Packaging & Semicon. Manufacturing team at Yole Développement (Yole). Previously, Andrej served at IMEC with a position focused on 3D IC technology. He also worked in parallel at GLOBALFOUNDRIES. His first position takes place at ON Semiconductor to develop reliability tests, failure analysis, and characterization of power electronics and packages. Andrej holds a master's degree in Electrical Engineering from the University of Zagreb (Croatia), and a PhD in Mechanical Engineering from KU Leuven (Belgium).
- **Vivienne Hsu** is a Technology & Market Analyst at Yole Développement (Yole). As part of the Advanced Packaging & Semicon. Manufacturing team, Vivienne contributes to the development of these activities. She is engaged in the production of market research reports and customized services. Graduated from Phelma, Grenoble INP (France), she completed her Master's degree in Materials Science by carrying out a thesis at EDF.

This report includes global trends in patent application identified by Knowmade but does not include an in-depth analysis of any patents. Knowmade is part of Yole Group of Companies, including Yole Développement, System Plus Consulting, PISEO and Blumorpho. More information on www.knowmade.com as well as on [LinkedIn](#).

- **Dr. Nicolas Baron** is CEO and cofounder of Knowmade. He manages the development and strategic orientations of the company and personally leads the semiconductor department. Nicolas has more than 10 years-experience in semiconductor related patent & technology analysis. Previously Nicolas was research assistant at the French research laboratory CRHEA-CNRS where he worked on the development of a new generation of GaN-on-Silicon transistor for power and RF applications. Dr. Nicolas Baron holds a Ph-D in Physics from the University of Nice Sophia-Antipolis, and a Master of Intellectual Property Strategies and Innovation from the European Institute for Enterprise and Intellectual Property (IEEPI), Strasbourg, France.



ABOUT YOLE DEVELOPPEMENT

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. . For more information, visit www.yole.fr and follow Yole on [LinkedIn](#) and [Twitter](#).

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