



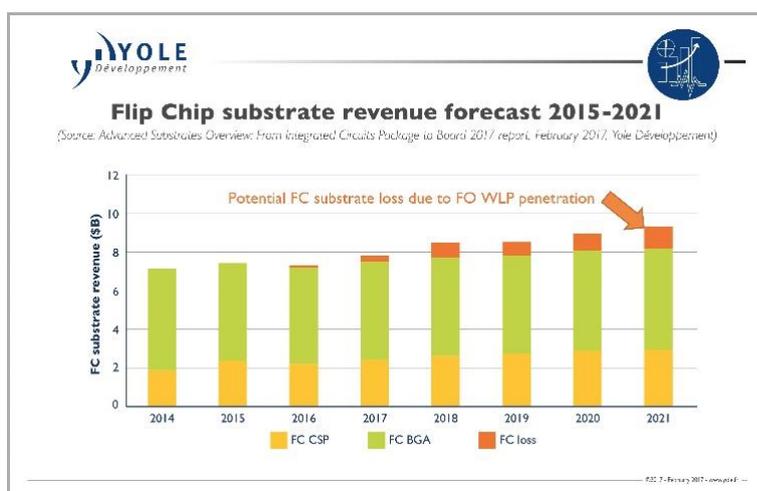
FOR IMMEDIATE RELEASE:

Advanced substrates: from FO¹ to PCB²

Advanced Substrates Overview: From IC Package to Board report
– Yole Développement – February 2017

LYON, France – April 13, 2017: As development of packaging technologies intensifies, in order to accommodate further front-end scaling trends and multi-die integration, advanced FO RDL³ and FC⁴ substrates represent the key interconnect components. The competition between FO and FC packages and the features of their interconnect components is resulting in an abundance of new package architectures that are crucial in enabling future products and markets. For this reason, the “More than Moore” market research and strategy consulting company [Yole Développement \(Yole\)](#) has established a stand-alone dedicated advanced substrate activity, focused on exploring the market, technologies and competition between thin film RDLs, and package substrates and its impact on PCBs. This activity is part of the Advanced Packaging & Semiconductor Manufacturing business unit and starts with the release of a dedicated report titled [Advanced Substrates Overview: From IC Package to Board](#).

How and where does FO compete with FC substrates? Why will further PCB scaling impact the FC substrate manufacturing and supply chain? Yole’s Advanced Packaging & Semiconductor Manufacturing team offers you today a comprehensive overview of the latest technology and market trends.



Advanced substrate solutions are fueling tomorrow’s market.

The FO WLP platform is the advanced packaging platform with the highest growth, boasting revenue CAGRs⁵ of 49% from 2015 to 2021. The FO platform is forecasted to exceed US\$2.5 billion in packaging services revenue by 2021.

In parallel FC packaging platform holds 85% of the advanced packaging

¹ FO: Fan-Out

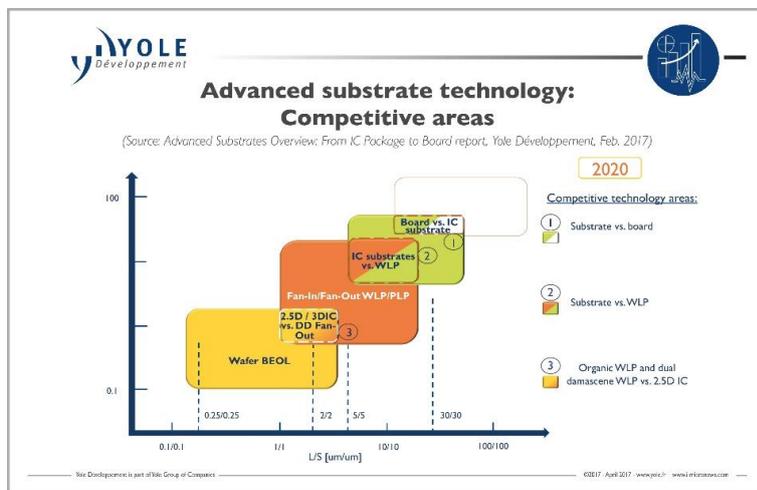
² PCB : Printed Circuit Board

³ RDL : Redistribution Layers

⁴ FC : Flip Chip

⁵ CAGR : Compound Annual Growth Rate

market, but regardless of its solid 5% CAGR, it is losing market share to FO WLP resulting in a drop to 76% by 2021. The fast-rising FO WLP platform is ambitiously developing higher density solutions while at the same time facing more competition from advanced FC and hybrid FC solutions. Though the FC substrate market exhibited a dip in 2016 due to further adoption of FO lead by TSMC InFO, it is expected to bounce back with mild growth at a 1.6% revenue CAGR. This can be split into a 3.6% FC CSP⁶ CAGR and a stagnating 0.6% FC BGA⁷ CAGR. Overall, FC substrate revenue is expected to exceed US\$8 billion by 2021.



Today's advanced substrates in volume are FC substrates, 2.5D/3D TSV⁸ assemblies, and thin-film RDLs (FO WLP) below a L/S resolution of 15/15 µm and with transition below L/S < 10/10 µm. These interconnects are traditionally linked to higher-end logic (CPUs⁹/GPUs¹⁰, DSPs¹¹, etc.) driven by ICs¹² in the latest technology nodes in the computing, networking, mobile, and high-end consumer market segments (gaming, HD¹³/Smart TV). However, due to

additional form factor and low power demands, WLP and advanced FC substrates are also widespread in majority of smartphone functions: application processors, baseband, transceivers, filters, amplifiers, WiFi modules, drivers, codecs, power management, etc.

Future higher-end products will require package substrates with L/S < 10/10 µm and boards with L/S < 30/30 µm. These demands have given rise to three distinct competition areas:

- Board vs. FC substrate
- FC substrate vs. FO WLP
- FO WLP vs. 2.5D/3D packaging

The competitive areas of boards, substrates, and thin-film RDLs are directly linked to the underlying technologies used. Board

⁶ CSP: Chip Scale Packaging

⁷ BGA: Ball Grid Array

⁸ TSV : Through Silicon Via

⁹ CPU : Central Processing Unit

¹⁰ GPU : Graphics Processing Unit

¹¹ DSP : Digital Signal Processing

¹² IC : Integrated Circuit

¹³ HD : High Definition

manufacturers are representatives of the subtractive process, which is hard to scale beyond L/S 30/30 um. Meanwhile, substrate manufacturers have experience with SAP¹⁴ and mSAP processes that can lead to larger substrates and potentially “substrate-like PCBs”, but at higher cost. On the other side, when competing with FO WLP, FC substrates have a cost advantage but FO WLP scales faster.

Yole’s report compares the main processes and technologies used, discusses the limitations, advantages, and opportunities for each process, and provides roadmaps for thin-film RDLs (FO WLP) and FC substrates.

Furthermore, under this new report, Yole’s team proposes a common terminology for diverse substrate architectures and provides an advanced substrate segmentation, followed by in-depth analysis of advanced substrate drivers, markets and dynamics, the three competition areas, current and future FO and FC architectures, supply chain, player positioning, business model shifts, and advanced substrate market forecasts during the 2015 – 2021 period.

What type of FO and FC substrate solutions are in development? Which markets and applications will require advanced RDL and substrates below L/S 10/10 um? How does this also affect boards? What are the limitations and advantages of FO RDL, FC substrates and board technology, which players are taking charge of which solution, and how is the supply chain changing?...

A detailed description of this technology & market report is available on i-micronews.com, [advanced packaging report section](#).

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¹⁴ SAP : Semi-Additive Process



About [Advanced Substrates Overview: From IC Package to Board](#) report

How can advanced substrates and boards bridge the gap created by front-end scaling?

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“More than Moore” market research and strategy consulting company. Andrej holds a master’s degree in Electrical Engineering with specialization in Industrial Electronics from the University of Zagreb, Croatia, and a PhD in Mechanical Engineering from KU Leuven, Belgium. He started at ON Semiconductor, performing reliability tests, failure analysis, and characterization of power electronics and packages. He then worked for several years as an R&D engineer at IMEC Belgium on the development of 3D IC technology, focused on electrical and thermo-mechanical issues of 3D stacking and packaging. During this time he also worked at GLOBALFOUNDRIES as an external researcher. Andrej regularly presents at international conferences and has authored or co-authored >20 papers and one patent.

▪ Companies cited in the report:

3CEMS, 3 M, 3Win Group, A MD, Amkor, Amphenol, Aoshikang, Apple, AOI AT&S, ASE, Avago, Benchmark, Boardtek, Career, CCTC, Celestica, Chin Poon, ChipBond, ChipMOS, CMK, Compeq, Cosmotech, Daeduck, Deca Technologies, Dynamic, Eastern, Ellington, Ericsson, Facebook, Fast Print, Flex, Flexium, Founder, Foxconn, Fujikura, Fujitsu, Gold Circuit, Google, HannStar Board, HiSilicon, Hitachi Chemical, Huatian, Huawei, Ibsiden, Ichia, Inari Berhad, Infineon, Intel, Isu Petasys, Jabil, JCET, Juniper Networks, KCE Electronics, Kingboard, Kinsus, Kinwong, KYEC, Kyocera, Kyoden, Lenovo and many more...

About Yole Développement – www.yole.fr

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole Développement group has expanded to include more than 50 collaborators worldwide covering MEMS, Compound Semiconductors, LED, Displays, Image Sensors, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” company Yole, along with its partners System Plus Consulting, Blumorpho and KnowMade, support 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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