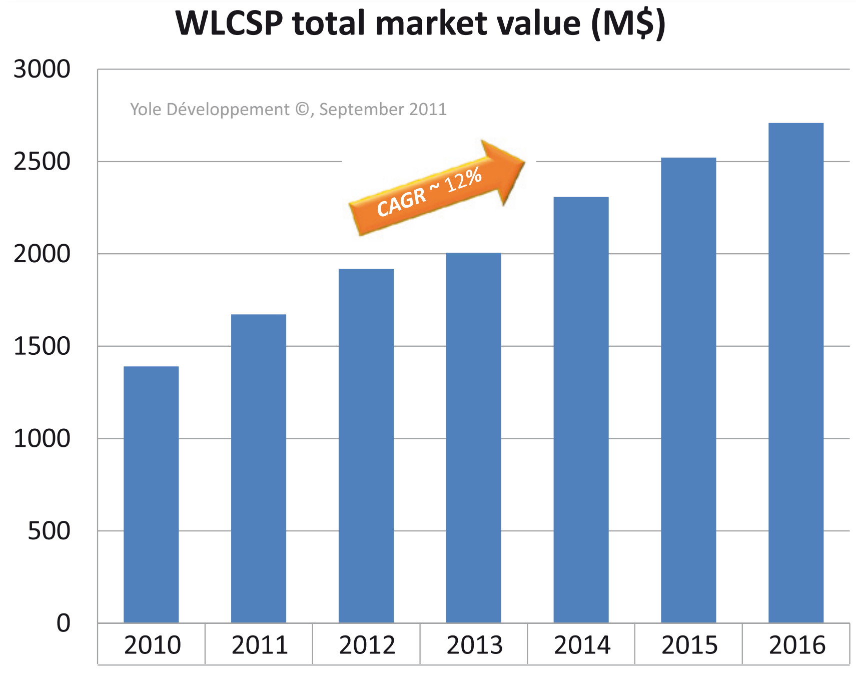
WLCSP Market & Industrial Trends

TECHNOLOGY & MARKET REPORT – NOVEMBER 2011

High value market remains an attractive diversification opportunity for semiconductor manufacturing players

GROWTH RATE IS HIGH, BUT THE MARKET SHOWS EARLY SIGNS OF MATURITY

Many "WLP" technologies are now cruising at a very high altitude. This is serious business: **over 23 billion units** packaged with 'fan-in' as we may call it are expected to sell and be mounted in smartphones, tablet PCs or other mobile devices in 2011. Size reduction and cost, remain the main drivers for adoption of this technology. If 'fan-in' WLCSP already reached high penetration rates in mobile applications for connectivity (Bluetooth+WLAN+FM combos, GPS) and analogue integrated circuits (DC/DC converters, LDO's, ESD/EMI protection devices), it is still growing fast for some other IC types as well as in MEMS and sensors.



REACHING 2.3 MILLION 300MM EQUIVALENT 'FAN-IN' WLCSP WAFERS IN 2011 FOR A TOTAL MARKET SIZE OF $1.7B

The average size of a 'fan-in' WLCSP device tended to increase over the past 2 years, with many "connectivity" devices reaching sizes of more than 30mm². **We estimate that in 2011, more than 2.3 million 300mm equivalent 'fan-in' WLCSP wafers will be processed** for the first time.
All steps compounded (wafer level, die level and test), **we estimate that the 2011 market value of 'fan-in' WLCSP is close to $ 1.7B.**

PRICES KEEP ON DECREASING, BUT THE MARKET GROWTH RATE IS EXPECTED TO STAY HIGH AT 12% OVER THE 2010-2016 TIME PERIOD

Although costs and prices are decreasing as the technology and its market mature, the market value growth rate for the 2010-2016 timeframe is still expected around 12%, 4 points higher than semiconductor packaging in general. However, this is lower than the 22% 2008-2013 growth rate we had computed for the same market 2 years ago. Costs kept on decreasing as the capacity shortage on 12-inch diameter wafers ended and process flows were standardized and simplified. While technologies have improved to the point that the maximum possible die size could be extended, it is not all clear skies for 'fan-in' WLCSP as the fallout of Nokia, WLCSP's historical biggest supporter, on the handsets market continues, and some **tier two handset manufacturers remain reluctant to adopt the technology.**

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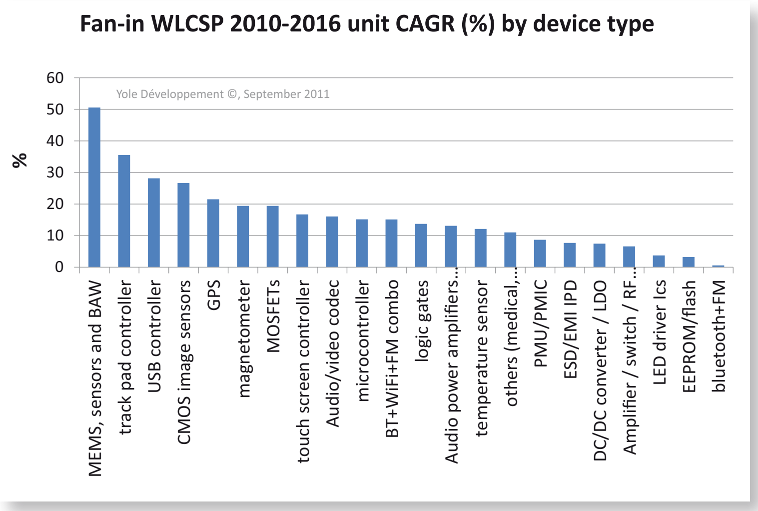
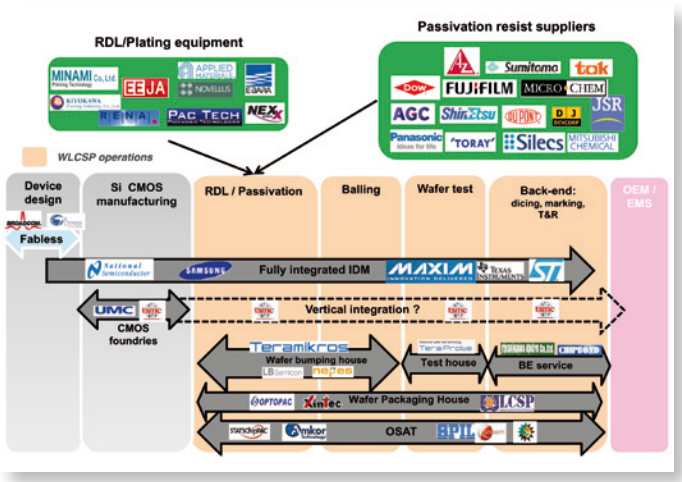
CHANGING PARADIGMS: FUTURE GROWTH WILL BE DRIVEN BY DIFFERENT DEVICES, BASED ON DIFFERENT TECHNOLOGIES

Looming over the horizon is the threat of the CMOS 28nm node technology with such a high IO density that some package with a "fan-out area" will be needed anyhow. Hopefully, A significant part of the 'fan-in' WLCSP market still relies on the analog ICs on the one hand, using older technologies, and on MEMS and sensors (particularly CMOS image sensors) on the other hand. This latter device type is expected to be a high potential growth application for fan-in WLCSP in the coming 5 years: we expect a tremendous growth of up to 25% for MEMS and sensors with WLCSP over the next 5 years. All in all, 'fan-in' WLCSP shows the first early signs of a maturing market with price pressure process standardization, but it still grows faster than the average semiconductor packaging market due to the fast growth rates of smartphones and tablet PCs in which WLCSP considerably helps save space and reduce costs.



HIGH MARGINS ARE ATTRACTING NEW PLAYER TYPES WITH DIVERSE BUSINESS MODELS



The supply chain is still primarily led by OSATs and IDMs, but the original "Wafer bumping houses" and "wafer packaging houses" take a significant share of the market too. All the major OSATs invested in 300mm WLCSP capacity over the past 2 years. TSMC recently announced their intention to step in this market too, possibly opening the way to other foundries.

In this WLCSP 2011 report, you will find detailed technical and market status and forecasts on WLCSP technologies and applications. Market forecasts and growth rates are provided based on device units and wafers for each market segment over the 2010-2016 timeframe. Market value forecasts in dollars are given over the same period of time. Based on our "bottom-up" analysis of the WLP fabs, the report displays the list and ranking of the WLCSP front-end (RDL, UBM and balling) players as of end of 2010, including the detailed respective wafer production capacities by player and wafer type.

Our "bottom-up meets top-down analysis" cross checks our forecasting models application by application, and player by player, delivering a high definition picture of the status of the 'fan-in' WLCSP market, with, for example, the level of loading of the major WLCSP fabs by application and by design company.

Numerous application examples are given, recent technical developments on materials, architectures and test are detailed, and industry-wide technology roadmaps are presented. In addition, the report provides for the analysis of the supply chain and a detailed cost analysis section with models and examples.

KEY FEATURES OF THE REPORT

- **Detailed account of all the application fields of WLCSP** (examples DC/DC converters and LDO's, connectivity 'WLAN+Bluetooth+FM' combos, GPS, audio codecs and amplifiers, MEMS, CMOS image sensors ...)
- **Market trends and figures** in Munits, M$, and wafer size equivalent with breakdown by application.
- **Wafer price ranges of WLCSP** contract assembly by wafer size and breakdown by main process step (wafer level, die level and test)
- Complete **technologies and material tool-box** analysis, covering 'fan-in' WLCSP as well as 3DWLCSP of MEMS devices and sensors.
- **Market Shares**

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WHO SHOULD BUY THIS REPORT

- **Integrated semiconductor Device Manufacturers and fabless semiconductor companies**
  - Get the list of the top WLCSP service providers.
  - Benchmark the competition and choose the right package for your future applications
- **Assembly and Test Service companies and wafer bumping houses**
  - Assess your technical and market position in the WLCSP service market.
  - Get the list of the main WLCSP users
  - Get acquainted with upcoming technologies and their potential
  - Plan ahead needed investments for capacity
- **Electronic module makers and Original Equipment Makers**
  - Evaluate the benefits of using these new technologies in your end system.
  - Monitor new WLCSP application trends and package developments
- **Equipment and Material manufacturers**
  - Identify new business opportunities and prospects
  - Understand the differentiated value of your products and technologies in this market
- **IC and MEMS Foundries**
  - Spot new opportunities and define diversification strategies

BIO

Jean-Marc Yannou joined Yole Developpement as technology and market expert in the fields of advanced packaging and Intergrate Passive Devices. He has 15-years of experience in the semiconductor industry. He worked for Texas Instruments and Philips (then NXP semiconductor) where he served as Innovation Manager for System-in-Package technologies.

BIO

Lionel Cadix joined Yole after the completion of several projects linked to the characterization and modeling of high density TSV and 3DIC chip stacking in collaboration with CEA-Leti and STMicroelectronics during his PhD. He is author of several publications and 8 patents in the field of 3D Integration.

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