## Samsung 3D TSV stacked DDR4 DRAM: the first analyzed memory product with via-middle TSV

Samsung 3D TSV stacked DDR4 DRAM report from System Plus Consulting, a sister company of Yole Développement

LYON, France – July 31, 2015 – System Plus Consulting, sister company of Yole Développement (Yole), released this month its new reverse costing report, Samsung 3D TSV stacked DDR4 DRAM. In August 2014 Samsung announced the mass production of the first analyzed 3D TSV technology based DDR4 modules for enterprise servers. According to Samsung, this new module, because of its high density and high performance will play a key role in supporting the enterprise servers' development and cloud-based applications, as well as further diversification of data center solutions.

Reverse costing analysis from System Plus Consulting includes a physical analysis at the module, package, DRAM die and cross-section level, the dedicated manufacturing process flow (TSV & bumping manufacturing step – Flip-chip & stacking process – package assembly unit) and a detailed cost analysis per process step.
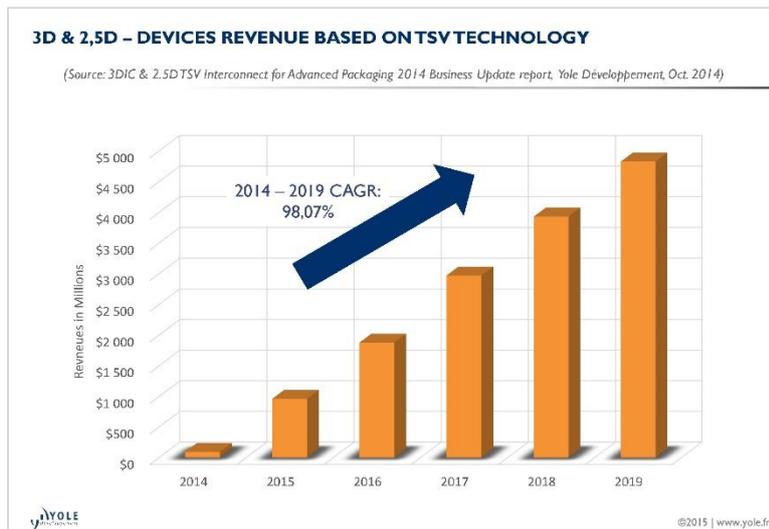
According to Yole, 3D TSV technology is expected to reach $4.8B billion in revenues by 2019, mainly driven by 3D stacked DRAM and followed by 3D Logic/Memory and Wide I/O (Source: 3DIC & 2.5D TSV Interconnect for Advanced Packaging 2014 Business Update, October 2014). With 40% share in the DRAM market, Samsung is by far the number 1 player. By introducing 3D TSV stacking in their latest 64Gb DDR4, Samsung allows this technology to enter in the main stream.

Samsung portfolio of DDR4-based modules using 20nm-class process technology includes registered dual in line memory modules (RDIMMs) and load-reduced DIMMs (LRDIMMs). These memory modules are available with initial speeds up to 2400 Mbps, increasing
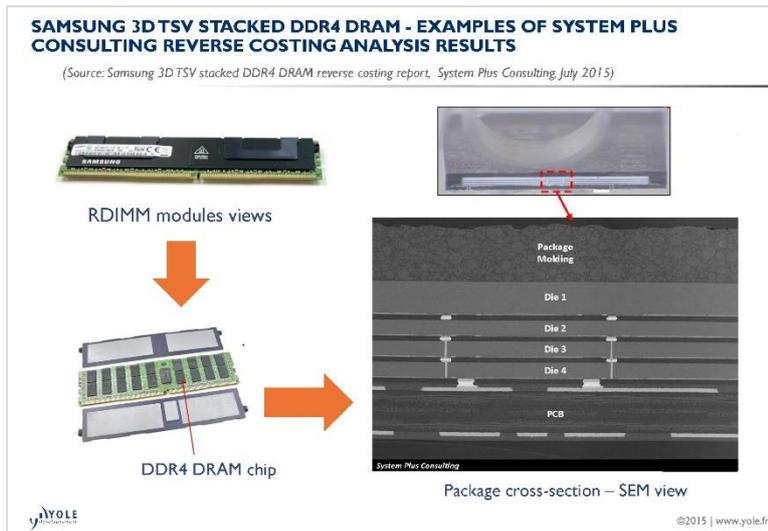
to the Joint Electron Devices Engineering Council (JEDEC)-defined 3200 Mbps.

This registered dual Inline memory module (RDIMM) includes 36 DDR4 DRAM chips (ref. K4AAG045WD), each of which consists of four 4Gb DDR4 DRAM dies (Ref. K4A4G085WD). The chips are manufactured using Samsung's 20nm process technology and 3D TSV via-middle package technology.

As a result, the new 64Gb TSV module performs twice as fast as a 64Gb module that uses wire bonding packaging, while consuming approximately half the power.

SAMSUNG 3D TSV STACKED DDR4 DRAM - EXAMPLES OF SYSTEM PLUS CONSULTING REVERSE COSTING ANALYSIS RESULTS

(Source: Samsung 3D TSV stacked DDR4 DRAM reverse costing report, System Plus Consulting, July 2015)

RDIMM modules views

DDR4 DRAM chip

Package cross-section – SEM view

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"On the process side, Samsung used a temporary bonding approach using adhesive glue material and copper via-filled using bottom up filling", details **Romain Fraux, Project Manager, MEMS Devices, IC's and Advanced Packaging at System Plus Consulting**. And he adds: *"At System Plus Consulting, we paid particular attention in identifying all technical choices made by Samsung on process and equipment (wafer bonding, DRIE via etching, via filling, bumping, underfill…)."*

System Plus Consulting has published more than 100 reverse costing reports on advanced packaging, MEMS and more… Detailed descriptions and related samples are available on i-micronews, reports section.

"Reverse Costing is the process of disassembling a device to identify manufacturing technology and calculate cost", explains **Michel Allain, CEO of System Plus Consulting**. Since 1993 the company has analyzed hundreds of integrated circuits, modules, electronic boards and systems for the benefit of large corporations in the semiconductor, automotive and telecom, consumer and energy sectors.

Based on its technical expertise and its knowledge of the semiconductor industry, the engineering and consulting company has developed a dedicated reverse costing methodology conducted within three phases:

- Teardown analysis: Under this phase, package is analyzed and measured. Dies are extracted in order to get overall data such as dimensions, main blocks, pad number and pin out, die

marking. Then System Plus Consulting's team is working on all manufacturing process steps in order to provide detailed description and analysis.

- Costing analysis: this phase includes a detailed analysis of the manufacturing environment and the cost simulation of the process steps.
- Selling price analysis: this phase is based on the supply chain analysis as well as the analysis of the selling price.

A detailed description of Samsung 3D TSV stacked DDR4 DRAM's reverse costing analysis is available on i-micronews website, advanced packaging report section.

About Samsung 3D TSV Stacked DDR4 DRAM report:

Samsung 3D TSV stacked DDR4 DRAM: the first analysed memory product with via-middle TSV!

A complete teardown with:

Detailed Photos - Precise Measurements - Material Analysis - Manufacturing Process Flow - Supply Chain Evaluation - Manufacturing Cost Analysis - Selling Price Estimation

Full reverse costing report: EUR 3,290 – 2015 Edition

About 3DIC & 2.5D TSV Interconnect for Advanced Packaging 2014 Business Update report:

3D TSV is in MEMS, CMOS Image Sensors and High-End Applications. When will it be used for mainstream consumer applications?

Rates: Euros 5,990.00 (Full report - Multi user license). For special offers and the price in dollars, please contact David Jourdan (Phone: +33 472 83 01 90).

About System Plus Consulting

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems, and has developed a complete range of services and costing tools to provide in-depth production cost studies and to estimate the objective selling price of a product.

COSTING SERVICES

- On demand Reverse Costing studies are performed on ICs, ASICs, MEMs, Power Devices, ECUs, electronic boards and full electronic systems.
- Catalogue of available reports includes cost analyses on MEMS, LEDs, modules and electronic systems.

All these analyses are performed using in-house developed, proprietary costing tools and their technological databases.

COSTING TOOLS

«Purchaser» tools

- IC Price+ to estimate the cost of any integrated circuit
- PCB Price+ for printed circuit boards
- Power Price+ for any power component or module
- SYS.Cost+ for electronic boards and systems

Cost Simulation Tools, process flow based

- MEMS CoSim+
- PowerCoSim+
- LED CoSim+
- 3D Package CoSim+

About Yole Développement

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, Image Sensors, Optoelectronics, Microfluidics & Medical, Photovoltaics, Advanced Packaging, Manufacturing, Nanomaterials and Power Electronics. The group supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.

CONSULTING

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• Reverse engineering & costing services

• Strategy consulting

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• Component reverse engineering & costing analysis

• Patent investigation

• Patent analysis

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• Mergers & Acquisitions

• Due diligence

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