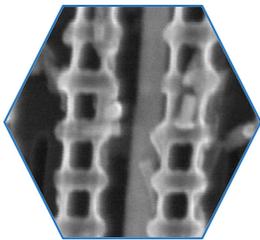
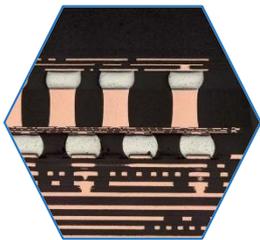
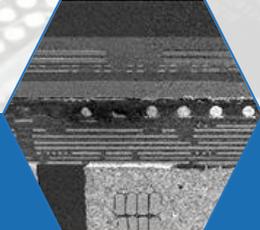




Apple's A14 Bionic System-on-Chip

Analysis of Apple's A14 SoC in the iPhone 12 and iPad Air 4th, including TSMC's first 5nm processor with updated inFO packaging.



Apple's A14 Bionic arrived on the scene in 2020 right as the smartphone processor industry was building up to a revenue of \$29.7b for the year. Apple's SoCs have consistently been at the leading edge of performance and process technology, and the A14 is no exception.

This full reverse costing study was conducted to provide insight on the technology data, manufacturing cost, and selling price of the Apple A14 Bionic System-on-Chip (SoC).

Apple has always developed its own processors for commercial products. Among its entire processor series, the A series has contributed most to Apple's net sales. This is because Apple's iPhone is powered by an A series chip. Moreover, the A series is also applied in many other hot products such as the iPad, iPod, and Apple TV. Today the newest generation, A14 Bionic, is potently supporting the iPhone 12 Pro and iPad Air 4th.

The A14 Bionic is a 64-bit ARM-based SoC with 6-CPU in a big.LITTLE configuration, 4-GPU plus a new 16-core Neural Engine. According to Apple's statement, the A14 is the fastest smartphone chip ever, and 40% faster than the previous generation. The chip has 11.8 billion transistors and was fabricated by TSMC on 5nm process. This manufacturing process is also applied on Apple's M1.

The A14 SoC side contains SRAM cache in the die and integrates external LPDDR4X DRAM with packaging. To integrate the DRAM die, Apple performed standard PoP technology which includes copper pillar, redistribution layers, and silicon high-

density capacitor integration.

In order to reveal every detail of the A14 Bionic, this report features multiple analyses. These include front-end construction analysis to reveal the most interesting features of the TSMC 5nm process, and back-end construction analysis for the packaging structure. This report also provides a detailed study of the SoC die analyses and its cross-sections. Furthermore, along with a complete construction analysis using SEM cross-sections, material analyses, and delayering, we offer a high-resolution TEM cross-section of TSMC's 5nm from the Apple M1. CT-scan (3D X-ray) is also furnished to reveal the layout structure of the package. Lastly, this report includes a complete cost analysis and a selling price estimation of the component without the main PCB substrate.

Title: Apple's A14 Bionic System-on-Chip

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COMPLETE TEARDOWN WITH:

- Detailed photos
- Precise measurements
- Front-end structural analysis with TEM
- Back-end structural analysis with CT-scan
- Materials analysis
- Manufacturing process flow
- Supply-chain evaluation
- Manufacturing cost analysis

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AUTHORS



Ying-Wu Liu serves as a Technology & Cost Analyst at System Plus Consulting. Ying-Wu's core expertise is Integrated Circuits technologies. Ying holds a master's degree in Theoretical Physics from the National Tsing Hua University (Taiwan), and a master in Integration, Security and Trust in Embedded systems from the Grenoble INP, ESISAR (France).



Véronique Le Troadec has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

RELATED ANALYSES



Apple's A15 Bionic System-on-Chip

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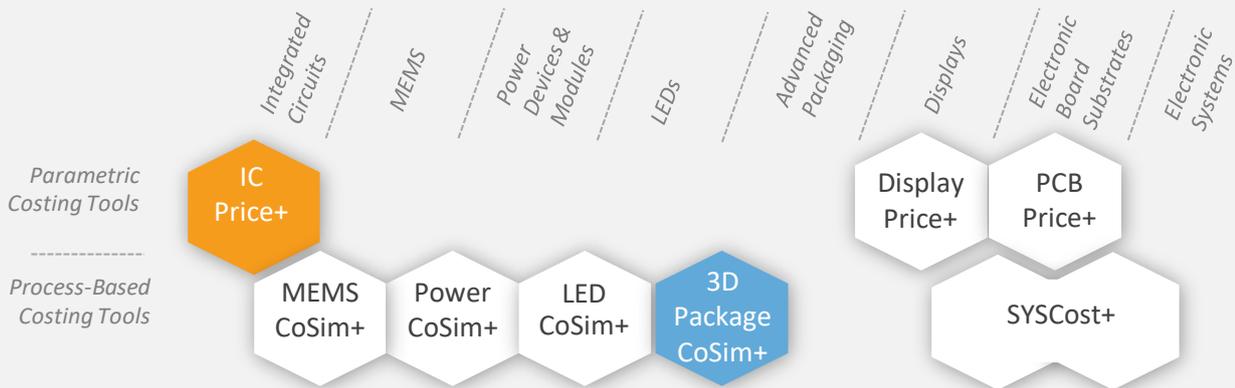
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Our analysis is performed with our costing tools 3D Packaging CoSim+ and IC Price+.

System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

3D Packaging CoSim+

Cost simulation tool to evaluate the cost of any Packaging process: Wafer-level packaging, TSV, 3D integration...

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The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, DSP, memories, smartpower...

ABOUT SYSTEM PLUS CONSULTING

WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



CONTACTS

Headquarters

22, bd Benoni Goullin
Nantes Biotech
44200 Nantes
France
+33 2 40 18 09 16
sales@systemplus.fr

Europe Sales Office

Lizzie LEVENEZ
Frankfurt am Main
Germany
+49 151 23 54 41 82
lizzie.levenez@yole.fr

America Sales Office

Hal LEVY
Western USA & Canada
+1 408 334 0554
hal.levy@yole.fr

Chris YOUUMAN
Eastern USA & Canada
+1 919-607-9839
chris.youuman@yole.fr

Asia Sales Office

Takashi ONOZAWA
Japan & Rest of Asia
+81 80 4371 4887
onozawa@yole.fr

Mavis WANG
Greater China
TW +886 979 336 809
CN +8613661566824
wang@yole.fr

Peter OK
Korea
+82 10 4089 0233
peter.ok@yole.fr

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