

Surging Advancements in Pure-play Foundries

*Omdia's view on Samsung Foundry's
Efforts and Progress*



Samsung Foundry

Executive summary

We attended the Samsung Foundry Forum (SFF) and Samsung Advanced Foundry Ecosystem (SAFE™) Forum 2024 in Silicon Valley. In this well-organized annual event, Samsung communicates its technology roadmaps and strategic directions to the wider Samsung Foundry community. This year's forum was particularly noteworthy as SFF discussed its roadmap of an All-In-One Heterogeneous Integration Technology (HIT) platform targeting custom AI chips.

Semiconductors play a seminal role in enabling AI, which has become a defining challenge for technology firms. The reason is clear: AI promises to drive productivity gains unprecedented in human history. In time, AI will permeate all industries, economies, and aspects of our lives. We are only at the beginning of the AI revolution, and there is no question that the technology is at an inflection point with significant growth ahead.



Samsung Foundry is uniquely qualified to provide an AI solution

As a top-ranking foundry service provider and leader in memory ICs, Samsung is exceptionally well-positioned to deliver cutting-edge solutions for custom AI implementations. Samsung Foundry brings together all the essential components for a highly integrated solution, including two generations of Gate-All-Around (GAA) on 3nm, leading-edge 2nm process, 2.5D and 3D stacked dies, including HBM, and co-packaged optics (CPO). Additionally, to offer complete solutions, Samsung has capabilities in silicon bridge (Si-bridge), integrated voltage regulator (IVR), and integrated stack capacitor (ISC) blocks.

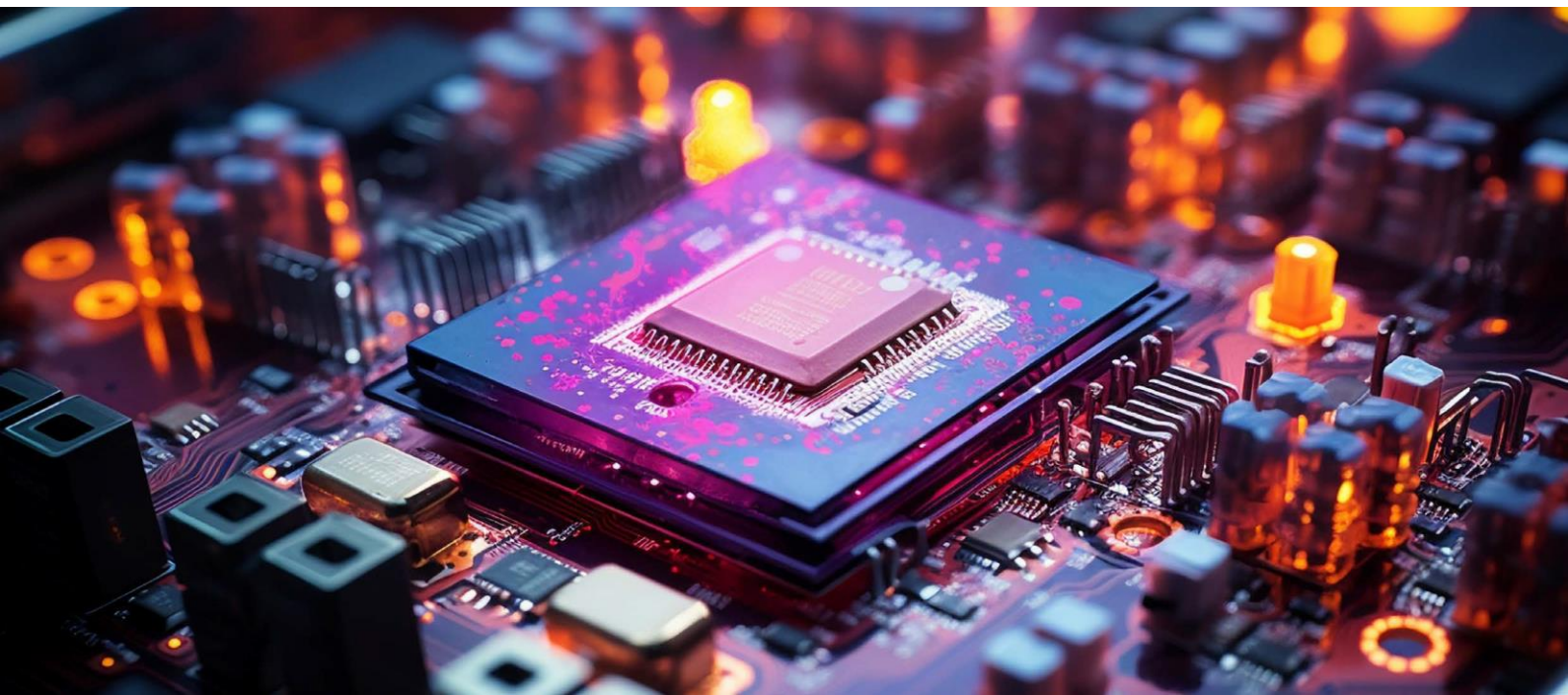
All these components are brought together through Samsung Foundry's advanced HIT in advanced chiplet packages. This comprehensive suite of technologies and capabilities uniquely positions Samsung to meet the demands of the rapidly evolving AI landscape.

Samsung Foundry's AI solution good for emerging companies

Samsung positions itself favorably in the trend toward custom SoCs/ICs in the AI explosion with its All-In-One HIT platform and transition path that future-proofs designs. Samsung's AI solutions remove potential roadblocks for emerging companies looking to develop custom ICs for optimal cost-performance trade-offs.

Groq is an example of the synergy between Samsung Foundry's solutions and AI startups. Groq's founder and CEO, Jonathan Ross, announced that the company plans to manufacture its next-generation language processing unit (LPU) chip for fast inference on Samsung's 4nm SF4X process.

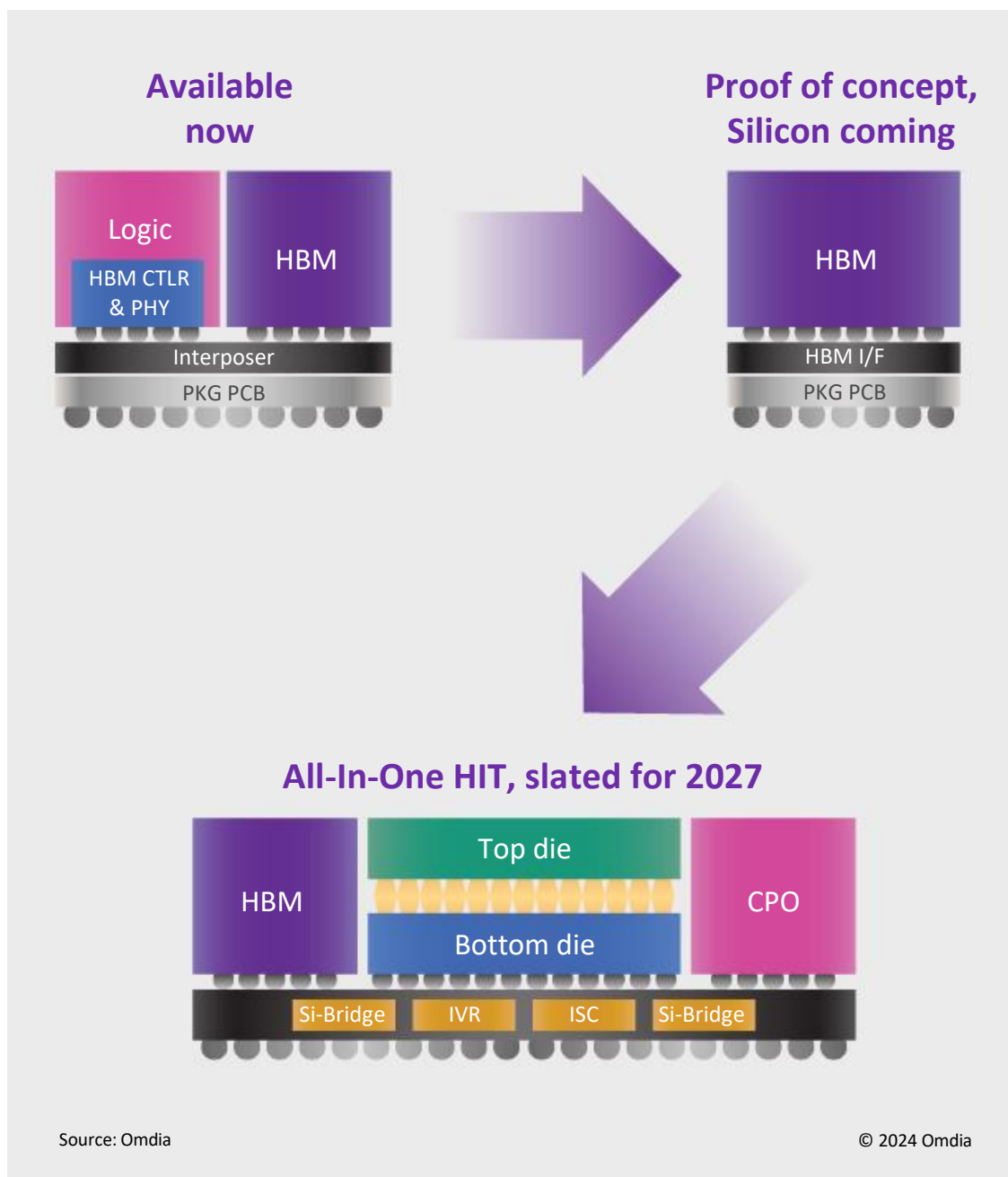
ARM's CEO, Rene Haas, also spoke at the forum, highlighting the company's decades-long relationship with Samsung and emphasized the importance of silicon for AI, particularly as new AI models, such as Meta's Large Language Model Meta AI (Llama), are developed.



Samsung's all-in-one heterogeneous integration solution for AI

Samsung aims to launch its full AI All-In-One Heterogeneous Integration Technology (HIT) platform for mass production by 2027 (see Figure 1). The HIT platform will feature integrated HBM, stacked 2.5D and 3D logic dies manufactured on advanced nodes, CPO, integrated silicon bridge, IVR, and ISC in Samsung's advanced chiplet package.

Figure 1: Samsung Foundry's solution for custom AI chips



High-Bandwidth Memory (HBM)

HBM is a crucial technology that enables high-performing, large-scale AI models. As a leader in memory technology, Samsung has a distinct advantage with its expert knowledge and intellectual property (IP). The company's HBMs can be seamlessly interconnected with logic using HIT in a chiplet package.

Stacked logic dies

At the center of Samsung Foundry's All-in-One AI platform are stacked logic dies. Samsung's conceptual illustration at the forum showed two dies—a top die and a bottom die (See Figure 1). Presently, the SF3 process and SF4 process are recommended for the top and bottom die. When the SF2 (circa 2025) process becomes available, it will be an option for the top die and the bottom die as well. These process advancements will improve the overall Performance-Power-Area (PPA) and offer better support for new and emerging applications.

Multi-Bridge Channel Field Effect Transistor (MBCFET™)

Samsung is in its second generation of Multi-Bridge Channel Field Effect Transistor (MBCFET™) technology—the company's branded version of GAA. Compared to Fin Field Effect Transistor (FinFET), MBCFET™ offers better current flow and lower leakage, resulting in improved performance and power efficiency.

Samsung Foundry introduced its MBCFET™ technology in 2022 with its SF3E process and made it available in 2024 with its SF3 process, which builds on the SF3E offering enhanced PPA. The company's future MBCFET™ roadmap through 2027 includes its SF2 family of processes. More generally, MBCFET™ is available on Samsung's 3nm and more advanced processes, while FinFET is available on Samsung's mature SF4 (4nm) and SF5 (5nm) processes.

As AI companies engage in hardware development, the benefits of MBCFET™ over FinFET will become increasingly critical, and Samsung Foundry's MBCFET™ technology should provide a sustained competitive advantage.



Advanced processes

4nm processes

While Samsung's SF3 process offers the highest available performance and density, the company's SF4 process is maturing as an advanced alternative. With SF4 available since 2021, Samsung released a variant, SF4P, in 2023. Samsung's SF4X, targeting high-performance computing (HPC), is slated for mass production in the second half of 2024. SF4A, optimized for automotive applications, is expected to reach mass production in 2025.

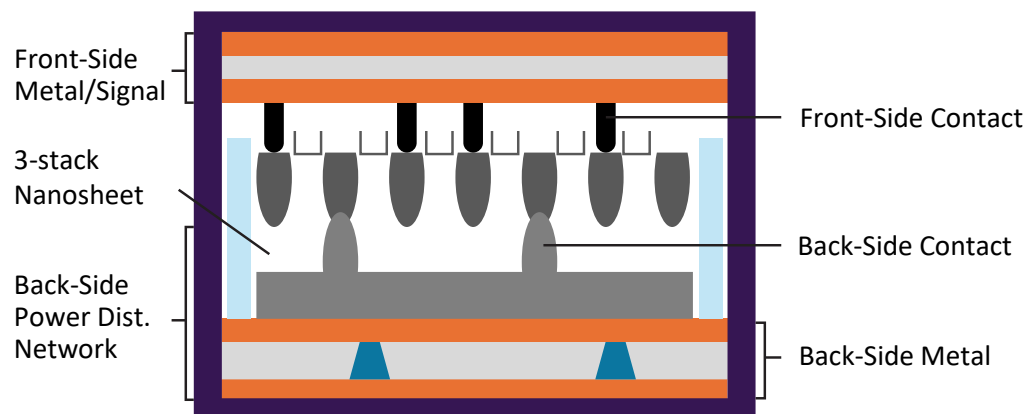
2nm processes

Samsung Foundry's 2nm process, SF2, is slated for mass production in 2025. SF2 is expected to be followed by SF2A (formulated for automotive applications) and SF2Z (for HPC and AI) in 2027.

Backside Power Delivery Network (BSPDN)

Samsung is developing BSPDN for integration into its SF2Z process, part of its latest 2nm technology roadmap. BSPDN allows power lines to be positioned on the back of the wafer, separated from the front-side circuitry, which effectively minimizes interference and enhances power efficiency. This method addresses key challenges such as voltage drop (IR drop), improves PPA, and ensures more stable and efficient power delivery. It is essential for producing the smaller, more powerful chips at the leading 2nm node for advanced HPC and AI solutions. Samsung's SF2Z process node, featuring this optimized BSPDN, is scheduled for mass production in 2027.

Figure 2. Samsung Backside Power Distribution Network



Source: Omdia

© 2024 Omdia

Other advanced processes

For automotive applications, Samsung is developing an 8nm process for manufacturing high-performance microcontroller units (MCUs). Processes for high-endurance embedded non-volatile memories (eNVMs) will extend down to 5nm. A 17nm Low Power Value (17LPV) process for CMOS image sensor image signal processor (CIS-ISP) and display drivers is under development.

For applications on 14nm requiring a cost-effective die shrink, Samsung Foundry is offering a transition to 8nm FinFET, which is a non-EUV process with PPA improvements over 14nm.

The current process for RF applications is 14nm. A transition to 8nm is in progress, and 5 nm is expected in the future.

Capacity plans

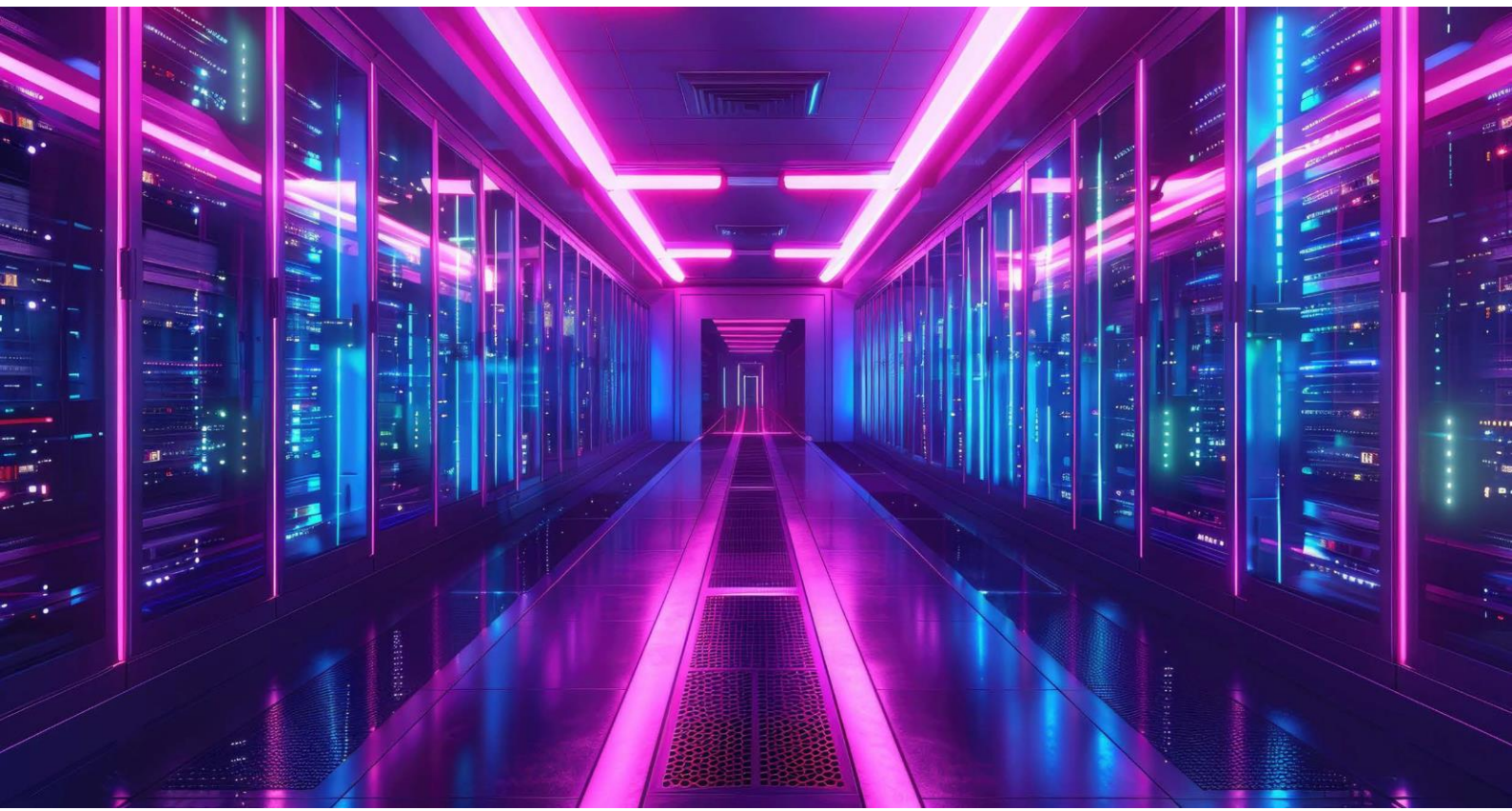
Samsung Foundry continues its expansion plan, including the new site in Taylor, Texas in the US, which is currently under construction. Samsung Foundry's pace of expansion underscores its position as a tier-one foundry service provider, and its plan to expand in the US demonstrates its commitment to the US market.

Samsung Advanced Foundry Ecosystem (SAFE™)

Samsung is strategically positioning itself at the forefront of technological advancements through partnerships and investments in disruptive technologies. Close collaborations with customers—for example, Siemens—enable Samsung to guide customers seamlessly from design to manufacturing, ensuring a comprehensive and efficient production process. Samsung's strategic investment in Celestial AI exemplifies its commitment to leading the evolution of AI architectures, enhancing its competitive edge in this rapidly developing field.

By becoming Groq's foundry partner, Samsung will manufacture for Groq on its advanced 4nm process, validating the process's maturity. This partnership underscores Samsung's credibility and leadership in the fast-growing application of AI inference technologies.

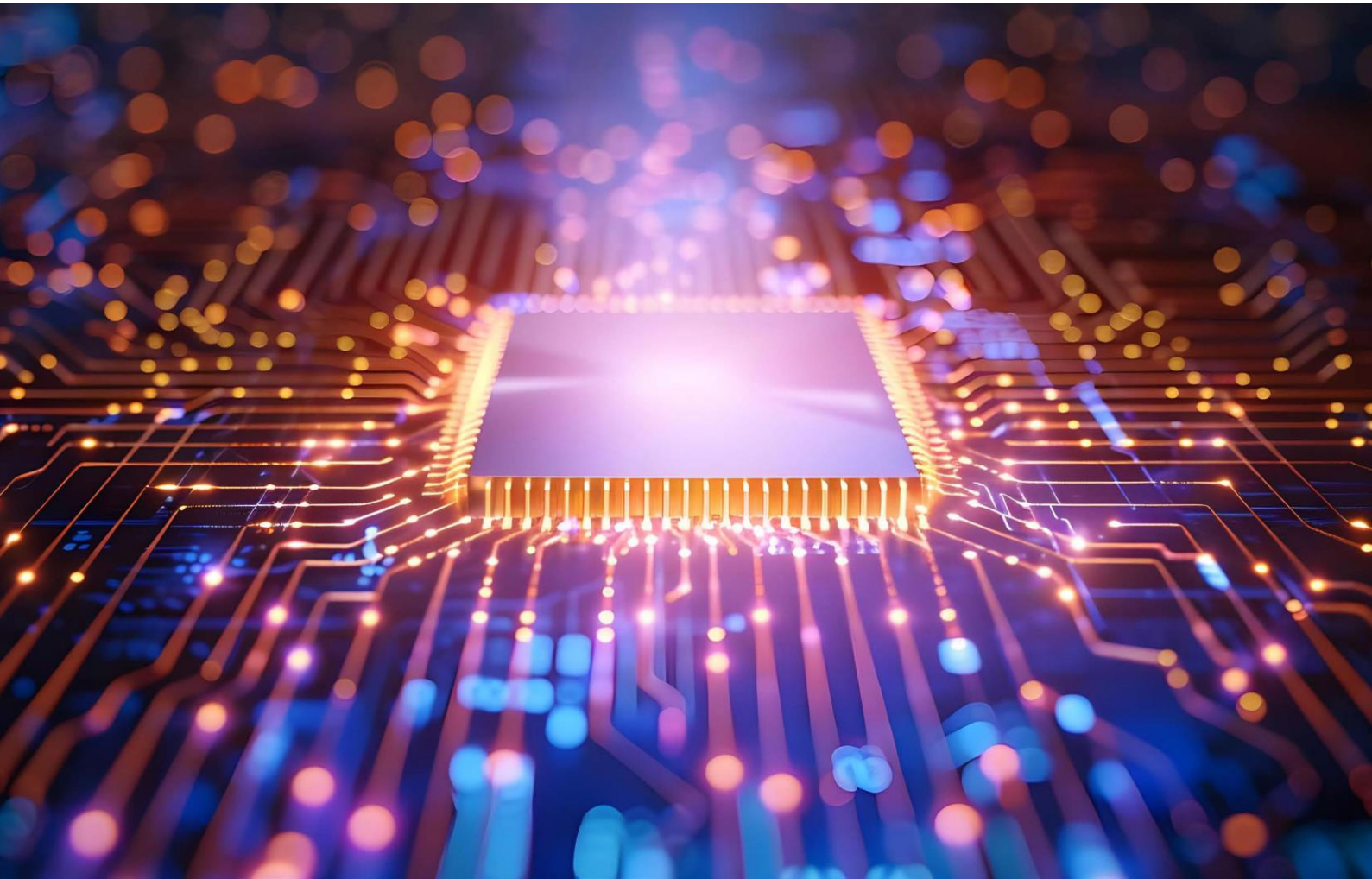
Samsung also stands out by offering custom memory solutions. This proposition is particularly attractive to large data center customers looking to optimize their systems' performance.



In conclusion

Samsung Foundry holds a unique position among pure-play foundries owing to its dominance in memory ICs and its portfolio of leading-edge process nodes, extending down to 2nm. The company's FinFET technology for nodes of 4nm and larger and its advanced GAA technology for nodes of 3nm and smaller demonstrate its technological capabilities. Furthermore, Samsung Foundry's extensive offers in advanced packaging and the enhanced SAFE™ provide a comprehensive product manufacturing platform for its customers. These capabilities—memory, advanced processes, and advanced packaging—give Samsung Foundry a sustainable competitive advantage.

Through the strategic initiatives highlighted, Samsung continues to solidify its position as an industry leader, driving innovation and growth in the semiconductor landscape.



Get in touch

www.ondia.com | askananalyst@ondia.com

Omdia Consulting

Omdia is a market-leading data, research, and consulting business focused on helping digital service providers, technology companies, and enterprise decision-makers thrive in the connected digital economy. Through our global base of analysts, we offer expert analysis and strategic insight across the IT, telecoms, and media industries.

We create business advantages for our customers by providing actionable insight to support business planning, product development, and go-to-market initiatives.

Our unique combination of authoritative data, market analysis, and vertical industry expertise is designed to empower decision-making, helping our clients profit from new technologies and capitalize on evolving business models.

Omdia is part of Informa Tech, a B2B information services business serving the technology, media, and telecoms sector. The Informa group is listed on the London Stock Exchange.

We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Omdia's consulting team may be able to help your company identify future trends and opportunities.

Copyright notice and disclaimer

The Omdia research, data and information referenced herein (the "Omdia Materials") are the copyrighted property of Informa Tech and its subsidiaries or affiliates (together "Informa Tech") or its third party data providers and represent data, research, opinions, or viewpoints published by Informa Tech, and are not representations of fact.

The Omdia Materials reflect information and opinions from the original publication date and not from the date of this document. The information and opinions expressed in the Omdia Materials are subject to change without notice and Informa Tech does not have any duty or responsibility to update the Omdia Materials or this publication as a result.

Omdia Materials are delivered on an "as-is" and "as-available" basis. No representation or warranty, express or implied, is made as to the fairness, accuracy, completeness, or correctness of the information, opinions, and conclusions contained in Omdia Materials.

To the maximum extent permitted by law, Informa Tech and its affiliates, officers, directors, employees, agents, and third party data providers disclaim any liability (including, without limitation, any liability arising from fault or negligence) as to the accuracy or completeness or use of the Omdia Materials. Informa Tech will not, under any circumstance whatsoever, be liable for any trading, investment, commercial, or other decisions based on or made in reliance of the Omdia Materials.