intel accelerated

Fact Sheet

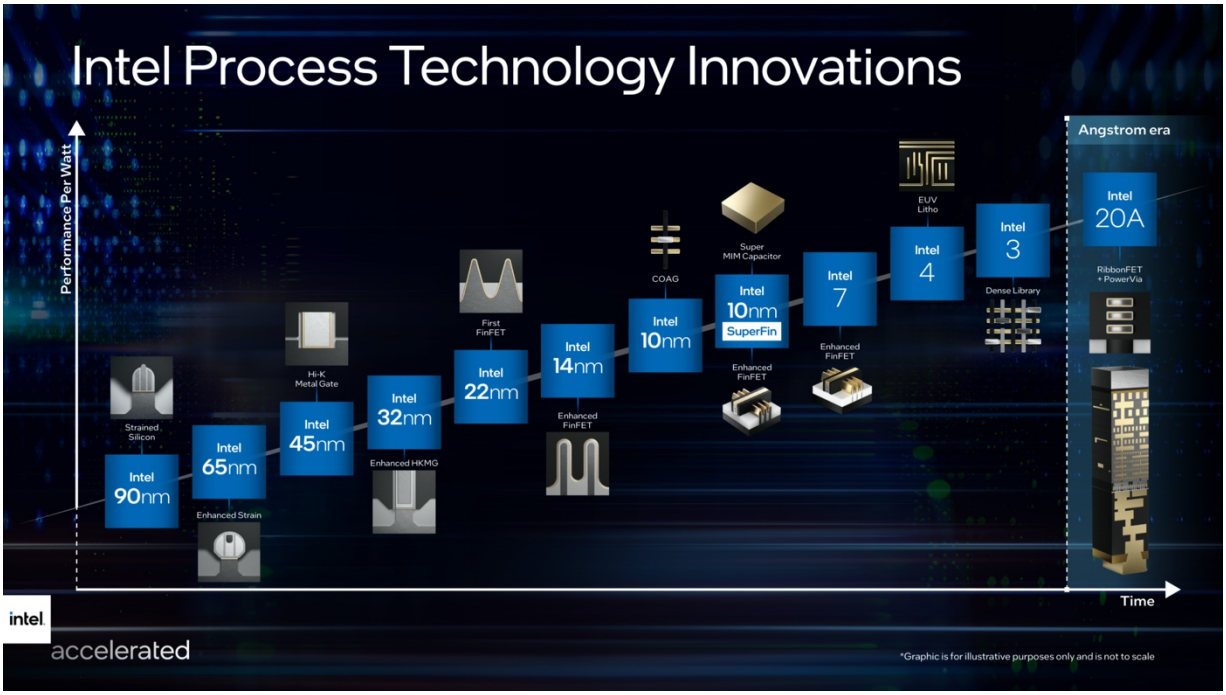
Accelerating Process Innovation

July 26, 2021 — Intel today unveiled one of the most detailed process technology roadmaps that the company has ever provided, showcasing breakthrough technologies that will power its products through 2025 and beyond. This fact sheet provides key details about the innovations underpinning this roadmap, as well as an explanation of the rationale behind the company's new approach to node naming.

The road ahead

Intel's roadmap is built on the foundation of an unmatched heritage of process technology innovation. By leveraging its world-class research and development pipeline, the company has introduced industry-first technologies that have profoundly impacted the semiconductor ecosystem, such as strained silicon, high-k metal gate and the 3D FinFET transistor.

Today, Intel continues this tradition with a roadmap that relies on new levels of innovation – including not only deep transistor-level enhancements, but also innovations all the way up the stack to the interconnect and standard cell level. The company has moved to an accelerated pace of innovation to enable an annual cadence of process improvements.



Innovations inside

Below are details about Intel's process technology roadmap, the innovations enabling each node and the company's new node names:

Intel 7 *(previously 10nm Enhanced SuperFin)*

Delivering an approximately 10% to 15% performance-per-watt[1] increase over Intel 10nm SuperFin through FinFET transistor optimizations, including increased strain, more low-resistance materials, novel high-density patterning techniques, streamlined structures and better routing with a higher metal stack. Intel 7 will be featured in products such as Alder Lake for client in 2021 and Sapphire Rapids for the data center, which is expected to be in production in the first quarter of 2022.

Intel 4 *(previously Intel 7nm)*

Providing an approximately 20% performance-per-watt[1] increase over Intel 7, Intel 4 is the first Intel FinFET node to fully embrace extreme ultraviolet lithography (EUV), which involves a highly complex optical system of lenses and mirrors that focuses a 13.5nm wavelength of light to print incredibly small features on silicon. This offers a vast improvement over prior technology that used light at a wavelength of 193nm. Intel 4 will be ready for production in the second half of 2022 for products shipping in 2023, including Meteor Lake for client and Granite Rapids for the data center.

Intel 3

Continuing to reap the benefits of FinFET, Intel 3 is expected to deliver around an 18% performance-per-watt[1] increase over Intel 4. This is a higher level of transistor performance improvement than typically derived from a standard full node. Intel 3 implements a denser, higher performance library; increased intrinsic drive current; an optimized interconnect metal stack with reduced via resistance; and increased use of EUV compared with Intel 4. Intel 3 will be ready to begin manufacturing products in the second half of 2023.

Intel 20A

Ushering in the angstrom era with two breakthrough technologies, PowerVia and RibbonFET. PowerVia is Intel's unique, industry-first implementation of backside power delivery – eliminating the need for power routing on the front side of the wafer and providing optimized signal routing while reducing droop and lowering noise. RibbonFET, Intel's implementation of a gate-all-around transistor, is the company's first new transistor architecture since it pioneered FinFETs in 2011, delivering faster transistor switching speeds while achieving the same drive current as multiple fins in a smaller footprint. Intel 20A is expected to ramp in 2024.

[1] Based on internal estimates; results may vary.

What's in a name?

For decades, the process "node" name corresponded to the actual length of certain physical transistor features. While the industry departed from that practice many years ago, Intel has continued to use this historical pattern of assigning node names using decreasing numbers that evoke units of dimension, such as nanometers.

Today, the various naming and numbering schemes used across the industry no longer refer to any specific measurement and don't tell the full story of how to achieve the best balance of power efficiency and performance.

In disclosing its process roadmap, Intel is introducing a new naming structure based on key technical parameters including performance, power and area. The decrease from one node to the next generally reflects a holistic assessment of improvements across these critical metrics.[2] As the industry approaches what otherwise would have been the "1" node, the company is shifting naming to better evoke the next era of innovation. Specifically, after Intel 3 the next node will be called Intel 20A to evoke the transition to a new generation where engineers are crafting devices and materials at the atomic level – the angstrom era of semiconductors.

> "Moore's Law is alive and well. We have a clear path for the next decade of innovation to go to '1' and well beyond. I like to say that, until the periodic table is exhausted, Moore's Law isn't over and we will be relentless in our path to innovate with the magic of silicon."
>
> – Pat Gelsinger, Intel CEO

The refreshed naming lexicon will create a clear and meaningful framework to help the industry and customers have a more accurate view of process nodes across the industry to make better-informed decisions. This clarity is more important than ever with the launch of Intel Foundry Services.

[2] Intel's node numbers do not represent the actual dimension of any physical feature on a transistor or structure. They also do not pinpoint a specific level of improvement in performance, power or area, and the magnitude of a decrease from one node number to the next is not necessarily proportionate to the level of improvement in one or more metrics. Historically, new Intel node numbers were based solely on improvements in area/density; now, node numbers generally reflect a holistic assessment of improvement across metrics and can be based on improvement in one or more of performance, power, area, or other important factors, or a combination, and will not necessarily be based on area/density improvement alone.

About Intel
Intel (Nasdaq: INTC) is an industry leader, creating world-changing technology that enables global progress and enriches lives. Inspired by Moore's Law, we continuously work to advance the design and manufacturing of semiconductors to help address our customers' greatest challenges. By embedding intelligence in the cloud, network, edge and every kind of computing device, we unleash the potential of data to transform business and society for the better. To learn more about Intel's innovations, go to newsroom.intel.com and intel.com.

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All product and service plans, roadmaps, and performance figures are subject to change without notice.

Future node performance and other metrics, including power and density, are projections and are inherently uncertain and, in the case of other industry nodes, are derived from or estimated based on publicly available information.

This Fact Sheet contains forward-looking statements relating to Intel's future plans and expectations, including with respect to Intel's process technology roadmap and schedules; innovation cadence; future technology and products and the expected benefits and availability of such technology and products, including PowerVia and RibbonFET technologies, future process nodes, and other technologies and products; future use of EUV and other manufacturing tools; expectations regarding suppliers, partners, and customers; Intel's strategy; manufacturing plans; and plans and goals related to Intel's foundry business. Such statements involve a number of risks and uncertainties. Words such as "anticipates," "expects," "intends," "goals," "plans," "believes," "seeks," "estimates," "continues," "may," "will," "would," "should," "could," "strategy," "progress," "path," "accelerate," "path," "on-track," "roadmap," "pipeline," "cadence," and "deliver" and variations of such words and similar expressions are intended to identify forward-looking statements. Statements that refer to or are based on estimates, forecasts, projections, and uncertain events or assumptions also identify forward-looking statements. Such statements are based on management's current expectations and involve many risks and uncertainties that could cause actual results to differ materially from those expressed or implied in these forward-looking statements. Important factors that could cause actual results to differ materially from the company's expectations include, among others, Intel's failure to realize the anticipated benefits of its strategy and plans; changes in plans due to business, economic, or other factors; actions taken by competitors, including changes in competitor technology roadmaps; changes impacting our projections regarding our technology or competing technology; delays in development or implementation of our future manufacturing technologies or failures to realize the anticipated benefits of such technologies, including expected improvements in performance and other factors; delays or changes in the design or introduction of future products; changes in customer needs and technology trends; our ability to rapidly respond to technological developments; delays, changes in plans, or other disruptions involving manufacturing tool and other suppliers; and other factors set forth in Intel's reports filed or furnished with the Securities and Exchange Commission (SEC), including Intel's most recent reports on Form 10-K and Form 10-Q, available at Intel's investor relations website at www.intc.com and the SEC's website at www.sec.gov. Intel does not undertake, and expressly disclaims any duty, to update any statement made in this Fact Sheet, whether as a result of new information, new developments or otherwise, except to the extent that disclosure may be required by law.

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