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Intel's Software Advantage, Decoded

Intel has unique assets and a strong, open ecosystem that gives Intel a competitive edge and an ability to disrupt.

Executive summary:

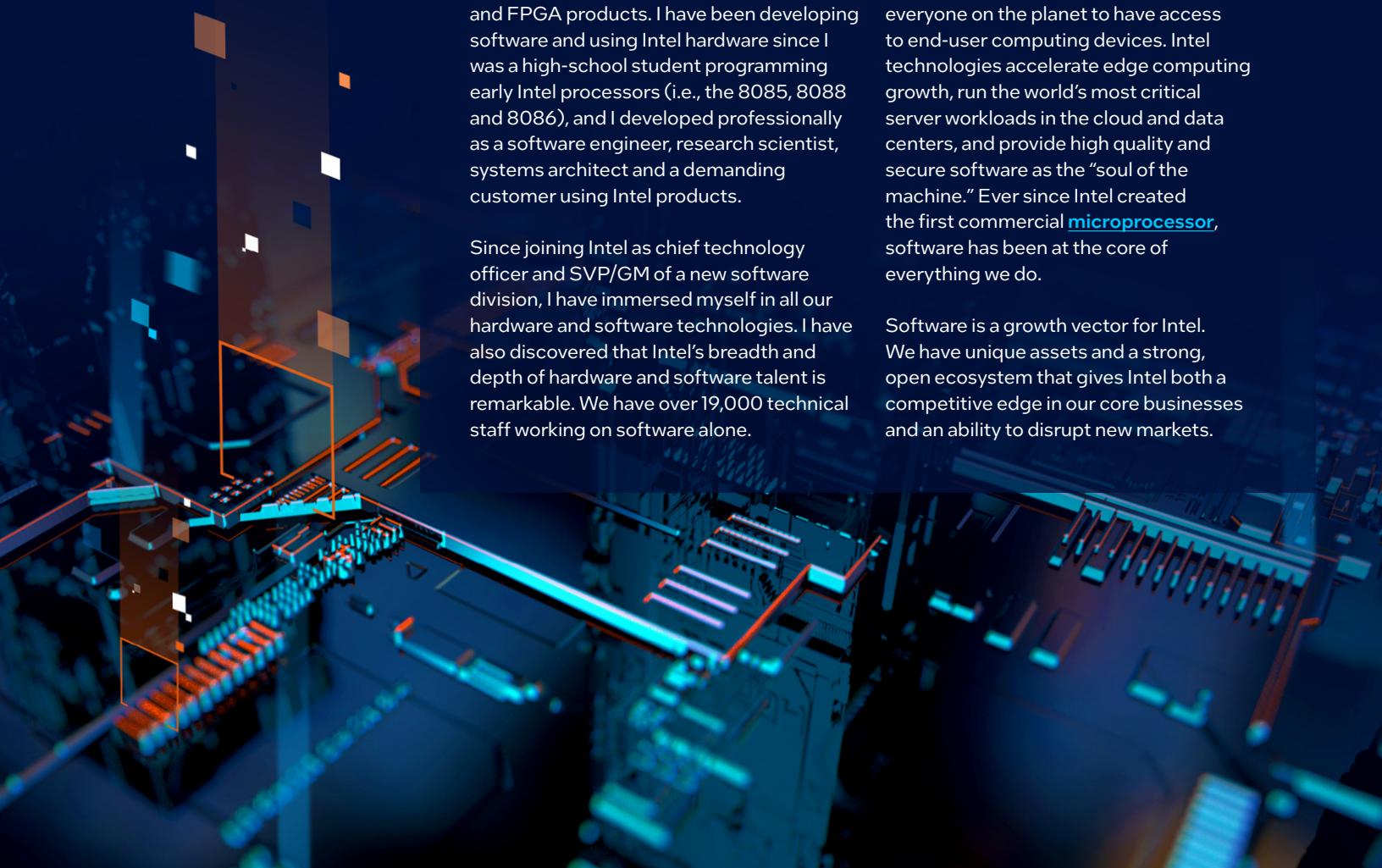
- Software is driving competitive advantage to Intel core businesses spanning client, edge, cloud and data center.
- Intel's strategy is to foster an open ecosystem that ensures trust, choice and interoperability for our industry.
- Intel is investing in growth opportunities enabled by software, including disruptive end-to-end AI and security platforms, services and APIs.

Before I joined Intel last year, I thought of it as a semiconductor chip company with a broad portfolio of client, server, networking and FPGA products. I have been developing software and using Intel hardware since I was a high-school student programming early Intel processors (i.e., the 8085, 8088 and 8086), and I developed professionally as a software engineer, research scientist, systems architect and a demanding customer using Intel products.

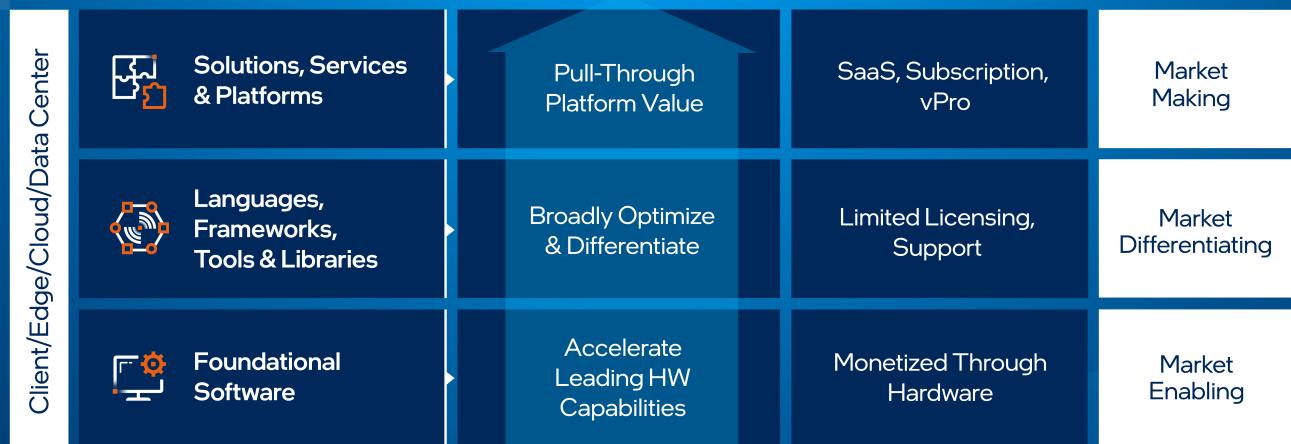
Since joining Intel as chief technology officer and SVP/GM of a new software division, I have immersed myself in all our hardware and software technologies. I have also discovered that Intel's breadth and depth of hardware and software talent is remarkable. We have over 19,000 technical staff working on software alone.

At Intel our goal is to catalyze our customers and partners to adopt our latest technologies and enable everyone on the planet to have access to end-user computing devices. Intel technologies accelerate edge computing growth, run the world's most critical server workloads in the cloud and data centers, and provide high quality and secure software as the "soul of the machine." Ever since Intel created the first commercial [microprocessor](#), software has been at the core of everything we do.

Software is a growth vector for Intel. We have unique assets and a strong, open ecosystem that gives Intel both a competitive edge in our core businesses and an ability to disrupt new markets.



Software Value Realization



Holistic, developer-first approach delivers value across all layers of the stack

The graphic above categorizes the depth and breadth of software that Intel develops, supports and contributes to the open source ecosystem across several layers of software capabilities. The chart shows how software value is realized at each layer of the stack, which in turn delivers value for developers and for Intel.

At Intel we believe that a successful software strategy depends on a broad and deep portfolio of investments that puts the needs of developers — at every level of the stack — first. And that is exactly what we are focused on at Intel:

- The **foundational software** layer of the stack exposes Intel's industry-leading platform technologies, features and rich capabilities that enable our hardware accelerators, from the cloud to end-points. This provides developers with a steady stream of innovation, performance and security.
- We invest in **languages, frameworks, tools and libraries** to deliver optimization and differentiation across open software ecosystems — from cloud to client and edge, and across multiple XPU architectures (CPU, GPU, FPGA, VPU,

IPU, etc.). The priorities for developers here are performance, code portability and efficiency.

- At the **solutions, services and platform layer of the stack**, it is critical that we pull through the full platform potential at the application and workload level. For this group of developers, a hardware vendor may not be the main driving force of their decisions, but choice of accelerator technology is a critical factor. Intel's broad portfolio of software across all layers of the stack provides customers and developers with a significant time-to-value advantage.

How do all of these enable developers? One great example is the software-defined network, where Intel's work has been foundational. From OpenNFV at the foundational layer of the stack through to the Intel® Smart Edge portfolio at the solutions and services layer, Intel's software work is enabling innovation, performance and new business models for partners while driving preference for Intel hardware for network deployments — leading to a large and growing new business for Intel.

This example illustrates why we invest in software at every layer of the stack to deliver value for developers, customers and partners. When we succeed, that value accrues back to Intel, bringing hero silicon features and performance to life in software,

setting our platforms apart when applications run best on Intel, and generating new business opportunities and growth.

At the heart of Intel software is our broad set of world-class tools, frameworks and libraries, and our compilers to platform solutions like Intel® Bridge Technology (which allows native Android apps to run on Windows 11 systems). Our software ensures no transistor is left behind.

Open ecosystem drives innovation with trust, choice and interoperability

We believe a successful software ecosystem needs to be open to thrive. And we believe in enabling choice for our partners and fostering trust in everything we do.

Being open is how we achieve choice and trust. Intel has a rich history in driving open platforms and industry-shaping standards like USB, Wi-Fi, Bluetooth and many more — and the software and APIs that enabled them.

We are pushing the innovation envelope with tools like oneAPI. Based on a cross-platform open programming model, oneAPI unleashes developers to achieve optimized performance across multiple platforms. Developers are looking for open alternatives, and Intel is delivering a competitive choice.



The growing opportunity at the convergence of security and AI

Solving the challenge of choice creates more flexibility and freedom for developers, but one of the biggest challenges in today's digital environment is security and the ever-expanding attack surface.

That is why we have one of the most comprehensive portfolios of security technology, covering authentication, threat detection, confidential computing and many others. All of these security capabilities are designed and supported with a secure development lifecycle and industry-leading incident response processes and practices.

The convergence of security and artificial intelligence is demonstrating the incredible promise of an open and collaborative environment. My favorite example is University of Pennsylvania, Perelman School of Medicine's [Federated Tumor Segmentation initiative](#), which uses a set of Intel hardware and [open software](#) technologies to improve the training of AI models to locate brain tumors. The solution employs federated learning and OpenFL, an open-source framework we developed to distribute the training of machine learning models, to gather data insights from dozens of international healthcare and research institutions without sharing patient data, keeping each dataset confidential and private. UPenn Medicine is using 3rd Gen Intel® Xeon® processors with Intel® Software Guard Extensions

to protect tumor segmentation models and the aggregation of data from the collaborators.

The result is an AI model that improves efforts to locate tumors by 17%.¹ When we talk about improving people's lives with our technology, you cannot find a better example than helping the medical field to save lives. Intel will never stop in its quest to unleash the potential of data and advanced machine learning technologies to enable progress.

Our software approach is to foster a strong open ecosystem enabling choice and trust. We have pivoted the company to a software-first mindset, we have restructured for success, and we are rebuilding our "Groveian" execution engine from top to bottom.

Looking ahead, I see tremendous opportunity. As the "technology superpowers" (ubiquitous compute, cloud-to-edge infrastructure, pervasive connectivity and AI) drive semiconductor demand and Intel software is embedded at every layer — from development to deployment — workloads and applications run on Intel.

With our combined strengths in silicon process technology, at-scale manufacturing, innovation in CPUs and XPPUs, software and security, we are unleashing a new era of innovation for Intel, our partners and the world.