

DATA CENTER

(2022 Revenue: \$6.043 Billion)



<p>Server Central Processing Units (CPUs)</p>	<p>Field Programmable Gate Arrays (FPGA) & Adaptive System-on-Chip (SoC) Data Center Products</p> <p>FPGA</p> <p>Adaptive SoCs</p> <p>Accelerator Cards</p>	<p>Data Processing Units (DPUs)</p>	<p>Data Center Graphics Processing Units (GPUs)</p> <p>Addressing the growing demand for compute-accelerated data center workloads, including AI training and supercomputing applications where the GPU's compute capabilities provide additional performance)</p>
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CLIENT

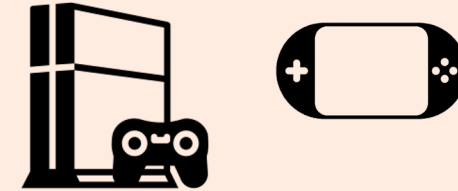
(2022 Revenue: \$6.201 Billion)



<p>Desktop CPUs</p>	<p>Notebook CPUs</p>	<p>Commercial CPUs</p> <p>AMD Pro</p> <p>AMD Pro Mobile</p>	<p>Various Chip Sets That Support the AMD Ryzen and Threadripper Platforms</p>
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GAMING

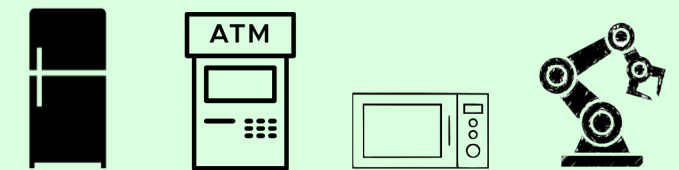
(2022 Revenue: \$6.805 Billion)



<p>Semi-Custom Products</p> <p>Semi-Custom SoC Products for Game Consoles</p>	<p>Discrete Desktop and Notebook GPUs</p> <p>AMD RADEON (GPU processors that support application programming interfaces and high refresh rate displays, software, and graphics cards)</p> <p>AMD FidelityFX (Open-source image quality software toolkit)</p>	<p>Professional GPUs (For Integration in Mobile and Desktop Workstations)</p>
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EMBEDDED

(2022 Revenue: \$4.552 Billion)



<p>Embedded CPUs, APUs, and GPUs</p>	<p>FPGAs and Adaptive SoCs</p> <p>FPGA Families</p> <p>7 Series and Older series</p> <p>Adaptive SoC Products</p>	<p>Development Boards, Kits and Configuration Products for FPGA and Adaptive SoC Products</p> <p>Hardware, Development Tools, IP, and Reference Designs</p>	<p>Legacy Product Families</p>
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AMD Ecosystem

Advanced Micro Devices, Inc.

2485 Augustine Drive
Santa Clara, California 95054
Phone: (408) 749-4000; Website: <https://www.amd.com>

Outside Relationships

Regulators	Capital	Suppliers	Customers
General Business Regulation Public Debt Holders	Bond Financing		
Environment U.S. Environmental Protection Agency (EPA)	Foreign Currency Forward Contracts		
U.S. Environmental Protection Agency (EPA) (regulation of, and permits for, discharges, leaks, emissions, disposals, storage of particular matter, hazardous waste, and toxic substances in the water, air and soil; superfund cleanup requirement for contamination)	Working Capital Financing		
Commercial Banks (Lead Bank: Wells Fargo Bank)			
Other Banks: Bank of America, JP Morgan Chase Bank, Credit Suisse, Goldman Sachs Bank, Morgan Stanley Bank, MFG Bank, Bank of China, Citibank, Bank of New York Mellon, Standard Chartered Bank			
U.S. Department of Labor (DOL) (DOL regulation of work practices, wage and overtime requirements; Equal Opportunity Employment Commission; enforcement of anti-discrimination laws in hiring, workplace practices, and safety; Occupational Safety and Health Administration; workplace health and safety, and serious injury reporting)	Business Regulation		
OSHA			
U.S. Patent and Trademark Office (USPTO); U.S. Copyright Office (USCO) (patent, trademark, service mark, copyright registration)	Supplies of (1) Assembly, Test, Marking and Packaging Services (\$1.7B of Supplies from Asia Pacific Region in 2022), (2) Memory, (3) Foundry Services for Waters/Chipsets and Integrated Circuits, and (4) Intellectual Property (via Third-Party Licenses)		
Restricted Transactions U.S. Department of the Treasury (FinCEN "know your customer" data collection requirements; anti-money laundering regulation; OFAC restricted party transactions; regulation; and Treasury economic sanctions)			
OFAC			
U.S. Internal Revenue Service (IRS) (Regulation of Corporate Income, Withholding and Payroll Taxes)			
Antitrust and Fair Trade U.S. Department of Justice (DOJ) and Federal Trade Commission (FTC) (DOJ/FTC enforcement of antitrust and fair-trade laws, and business combination/merger reviews and clearance; FTC regulation regarding data privacy, and DOJ foreign corrupt practices law enforcement)			
Imports U.S. Department of Homeland Security / Customs and Border Protection (CBP) (regulation of imports of finished goods, raw materials and supplies, and information handling; export licenses)			
Exports U.S. Dept of Commerce Bureau of Industry and Administration (regulation of exports of finished goods, raw materials and supplies, and information handling; export licenses)			

Advanced Micro Devices, Inc. (a Delaware corporation)

Debt Structure

Debt (\$2.467 Billion @ 09/30/2023) Corporate Credit Ratings: A2 (Moody's), A- (S&P)

Commercial Paper Program: Available: \$3.0B Outstanding: \$0	2027 Revolving Credit Facility: Available: \$3.0B Outstanding: \$0	Notes Assumed from Xilinx Acquisition	2024 Senior Notes: \$750M @ 2.95%	2030 Senior Notes: \$750M @ 2.375%	2032 Senior Notes: \$500M @ 3.924%	2052 Senior Notes: \$500M @ 4.393%
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Equity Structure

Equity

Share Repurchase Program Authorized: \$12.0 Billion Expiration: None Balance: \$5.8 Billion	Common Stock Authorized: 2.250 billion shares Issued: 1.645 billion shares Outstanding: 1.615 billion shares Record Holders: 5,014
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Governance

Board of Directors

Dr. Lisa T. Su	Joseph A. Householder (A, N)	Committees: Audit and Finance (A), Compensation and Leadership Resources (C), Innovation and Technology (I), Nominating and Corporate Governance (N)
Nora M. Denzel (I, N)	John Marren (A)	
Mark Durcan (C, I)	Jon A. Olson (A)	
Mike P. Gregoire (C, N)	Abhi Talwalkar (C, I)	
	Elizabeth Vanderslice (C, N)	

Management Team

Chair and CEO: Dr. Lisa T. Su	EVP, CFO and Treasurer: Jean Hu	SVP, Global Operations: Keivan Keshvari
President, AMD: Victor Peng	EVP and GM, Data Center Solutions: Forrest Horrod	SVP and Chief Human Resources Officer: Robert Gama
EVP, Strategic Partnerships, President EMEA: Darren Grasby	EVP and Chief Technology Officer, Technology and Engineering: Mark Papermaster	SVP, General Counsel and Corporate Secretary: Harry Wolin
EVP, Chief Commercial Officer: Phil Guido	SVP, Marketing, Communications, and HR: Ruth Cotter	SVP and Chief Strategy Officer, Corporate Development: Mathew Hein

Corporate Matters

Marketing, HR, and Investor Relations Transaction Integration Planning Office HR Policy and Planning Global Marketing Team Brand Awareness and Management Advertising Investor Relations Client Business Unit	Operations Supply Chain Strategy and Operations Capacity Planning Major Category Procurement Global Technology Business Operations New Product Introduction Engineering End-to-end Manufacturing
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Operations

Data Center (2022 Net Revenue: \$6.043 Billion)	Client (2022 Net Revenue: \$6.201 Billion)	Gaming (2022 Net Revenue: \$6.805 Billion)	Embedded (2022 Net Revenue: \$4.552 Billion)
Server Microprocessors (Central Processing Units / CPUs) AMD EPYC™ Series Processors (including recently launched 4th Gen AMD EPYC Processors and AMD EPYC 8004 Series CPUs)	Desktop CPUs AMD Ryzen Mobile Processors (AMD Ryzen Pro 7000 Series processors family powered by AMD's "Zen 4" core architecture has up to 8 high performance processing cores and delivers across-the-board leadership performance for gamers and content creators)	Semi-Custom Products AMD Semi-Custom Products (tailored, co-developed, high-performance, customer-specific solutions based on AMD CPU, GPU and multi-media technologies)	Embedded CPUs, APUs and GPUs AMD Embedded EPYC CPUs AMD Embedded Ryzen V-Series APUs, CPUs and SoCs AMD Embedded Radeon GPUs AMD Embedded Ryzen R-Series APUs, CPUs and SoCs
Field Programmable Gate Arrays (FPGAs) and Adaptive System-on-Chip (SoCs) Data Center Products Virtex™ and Kintex™ FPGA Products Versal™ Adaptive SoC Products AMD Zynq MPSoC Zynq™	Notebook CPUs AMD Athlon Mobile Processors (AMD Athlon™ 7000 Series Desktop Processors with Radeon™ Graphics; designed to deliver responsive, reliable computing with great battery life)	Discrete Desktop and Notebook GPUs AMD Radeon™ Series Discrete GPU Processor for Desktop and Notebook PCs AMD Radeon Software (expands remote gaming functionality and enables new features and customization capabilities) AMD Radeon RX 7000M and 7000S Series Mobile Graphics Processors (for high-performance graphics on gaming notebooks) AMD FidelityFX™ (open-source image quality software toolkit for developers)	FPGAs and Adaptive SoCs FPGA families (includes UltraScale+™ (based on 16 nm technology), UltraScale™ (20 nm), and 7 Series (28 nm)) Adaptive SoC products (includes the Zynq SoC and UltraScale+ Multi-Processing System on a Chip (MPSoCs), as well as the industry's first RfSoC architecture with integrated radio frequency (RF) data converters) The Versal Portfolio (consists of software-programmable Adaptive SoCs)
Data Processing Units (DPUs) P4 Programmable DPU (designed to help offload data center infrastructure services from the CPU; the DPU focuses on moving data within the data center, while a CPU and GPU are focused on compute, the DPU is in many ways optimized for data movement)	Commercial CPUs Enterprise-Class Desktop and Notebook PC Solutions Mobile Desktop AMD Athlon PRO 7040 Series with AI built in AMD Athlon PRO 3000 Series AMD Threadripper PRO	Professional GPUs AMD Radeon PRO Family of Professional Graphics Products (includes multi-view graphics cards and GPUs designed for integration in mobile and desktop workstations) Radeon PRO W6800X series GPUs for the Mac Pro (to power a variety of professional applications and workloads) AMD Radeon PRO W7000 Series Professional Graphics with AMD RDNA 3 architecture	Development Boards, Kits and Configuration Products Development Kits for all their FPGA and Adaptive SoC Products (includes hardware, development tools, IP and reference designs that are designed to streamline and accelerate the development of domain-specific and market-specific applications)
Data Center Graphics Processing Units (GPUs) AMD Instinct™ Family of GPU Products (specifically designed to address the growing demand for compute-accelerated data center workloads; the AMD Instinct™ MI300 accelerators will usher in a new era of computing capabilities ideal for large language models (LLM))	Chipslets (for Desktop PCs) AMD Chipslets for Desktops (designed to support cutting-edge platform technologies for home entertainment, gaming and business productivity) Socket sWRX90 Platform for Ryzen Threadripper PRO Processors Socket sTR5X50 Platform for 3rd Gen AMD Ryzen Threadripper Processors Socket TR4 X399 Platform for 1st and 2nd Gen Ryzen Threadripper Processors	AMD Instinct™ Family of GPU Products AMD Infinity Hub AMD Instinct MI200 series accelerators AMD Instinct MI300X series accelerators	Legacy Product Families Prior Generation High-End Virtex FPGA Families (includes Virtex-6, Virtex-5, Virtex-4, Virtex-II Pro, Virtex-II and the original Virtex family) Prior Generation Low End Spartan™ FPGA Families (includes Spartan-6, Spartan-3, the Spartan-3E and Spartan-3A, Spartan-1E, Spartan-1L, Spartan-XL and the original Spartan family) Prior Generations of Complex Programmable Logic Devices (CPLDs) (includes the CoolRunner™ and XC9500 product families)

AI Inference/Large Language Model Operators (each of Meta, OpenAI, and Microsoft has said it still uses AMD's latest Instinct MI300X AI chip, a sign that tech companies want alternatives to the expensive Nvidia graphics processors that have been essential for artificial intelligence)	Value Added Resellers (VARs) and Integrated Solution Vendors (ISVs)	Selected Chipset Computing Product Customers Dell Technologies, Acer, HP	Personal Computer OEMs Dell Technologies, Acer, HP	Desktop and Server Motherboard Manufacturers Intel, NVIDIA	Semi-Custom Products Customers Sony (AMD's gaming business unit was the biggest driver of the company's revenue last year, Sony became AMD's largest customer in Q2 2022, the PlayStation maker brought \$3.776 billion to AMD, or 16% of AMD's revenue, as PlayStation 5 outsold its competitors last year.) Microsoft (Xbox Series S, Xbox Series X Consoles) Valve (Valve and AMD teamed up to create the processor that runs Valve's Steam Deck handheld gaming PC.) Steam Deck
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GlobalFoundries Inc. (Waters at the 12 nm and 14 nm technology nodes)
GlobalFoundries was a part of AMD prior to its spinoff in 2009 and the divestment by AMD of its final 14% stake in the company in 2012). In 2014, IBM sold its microelectronics business to GlobalFoundries, which today operates 10 foundries. GlobalFoundries went public in 2021 and remains a top maker of the most advanced chips found in simpler components like a car's anti-lock brakes or head-up display. But it stopped making leading-edge chips in 2018. Now AMD outsources its less-sophisticated semiconductor fabrication work to GlobalFoundries, which is in contrast to Intel, which is an integrated device maker and currently expanding its own foundry capacity.

Taiwan Semiconductor Manufacturing Company Limited (TSMC)
(manufactures integrated circuits and wafers at 7 nanometer (nm) or smaller nodes. For its most advanced, leading-edge chips, AMD relies on TSMC)

Intel
(develops, markets and licenses high-performance, low-cost, energy-efficient central processing unit designs and related technology such as systems IP, graphics processing unit designs, physical IP, software, and tools; AMD at least has access to an Arm architectural license, which allows AMD to design custom ARM cores)

ARM
(In the 1980s, AMD was a secondary source of chips supply for Intel. However, after AMD and Intel parted ways, AMD reverse engineered Intel's chips to make its own products that were compatible with Intel's groundbreaking x86 software. Intel sued AMD and, as part of a settlement in 1995, gave AMD the right to continue designing x86 chips, making an Arm processor pricing more competitive for end customers. It is believed that some advanced features may require an x86 license from Intel.)

Outside Relationships

Customers	Suppliers	Capital	Regulators
			Securities Regulators U.S. Securities and Exchange Commission (Regulation of Offers and Sales of Securities, Material Event Disclosure and Financial Reporting Requirements, and Anti-Bribery Record-Keeping Requirements)
			Significant Shareholders Vanguard Group (8.75%) BlackRock Fund (7.60%) BlackRock State Street Corporation (4.01%) STATE STREET Fidelity Management and Research (2.57%) Fidelity JP Morgan Chase & Company (2.57%) JPMorgan Chase Institutional Ownership: 72.05%
			Key Professional Services Firms Ernst & Young (audit services) W2O (advertising services) Forbes Tate Partners (lobbying services) FTI CONSULTING Skadden, Arps, Slate, Meagher & Flom (legal services) Skadden Google Cloud (cloud computing, storage, and data analytics services) Aerospace and Defense Test and Measurement Industrial Automotive Broadcast Thin Clients (computers that serve as an access device on a network) DELL Technologies Communication Infrastructure Data Center (includes networking, security and storage) Emulation (3d software for simulation and emulation) Multimedia Medical Distributors and OEM Partners
			Securities and Exchange Listing Rules Equity Capital Common Stock Repurchases (AMD does not pay a dividend)
			Professional Services Sales and Licensing of AMD Intellectual Property Purchasers and Licensees of AMD Intellectual Property FPGA and Adaptive SoC Customer Markets

Key Company Data (as of 12/31/2022)

Business Overview: Headquartered in Santa Clara, California, AMD (Advanced Micro Devices) is a US multinational semiconductor firm that designs computer processors and related technologies for consumer and enterprise markets. While the company at first made its own processors, AMD spun-off control of its foundries in 2009 under the GlobalFoundries name and now outsources its semiconductor fabrication work to GlobalFoundries. The main products developed by AMD include microprocessors, embedded processors, graphics processors, motherboard chips, and field-programmable gate arrays (FPGAs) for personal computers, workstations, gaming devices, and embedded systems applications, servers, and data centers.

Share Data	Financial Highlights
NASDAQ Ticker Symbol: AMD	Statement of Earnings
Share Price: \$140.15 (12/19/2023)	Net Revenue: \$23.6B
Earnings Per Share (Trailing 12 Months): \$0.12	Cost of Sales: \$13.0B
2022 Annual Dividend: None	Gross Profit: \$10.6B (45% Margin)
Market Capitalization: \$226.4B (12/19/2023)	Operating Expenses: \$9.3B
Total Assets: \$67.6B	Operating Income: \$1.3B
Total Liabilities: \$12.7B	Net Income: \$1.3B
Equity: \$55.0B	Balance Sheet (@ 9/30/23)
Employees: 25,000	Cash Flow
Headquarters: Santa Clara, California	From Operations: \$3.65B
Manufacturing Locations: Austin, Texas; Dresden, Germany; Penang, Malaysia; Hsinchu, Taiwan; Bangalore, India; Shanghai, China	From Investing: \$1.1B
	Used in Financing: (\$197M)
	Financial Return
	Return on Equity: 0.38%

Key Developments

Xilinx Acquisition: In February 2022, AMD acquired Xilinx, Inc., a company that designs and develops programmable logic devices. AMD's product portfolio now includes FPGAs and Adaptive SoCs used in the data center and embedded markets.

Pensando Systems Acquisition: In May 2022, AMD acquired Pensando Systems, Inc., which provides With this acquisition, AMD now develops data processing units (DPUs) and next generation data center solutions.

Windows PCs: Qualcomm has long been understood to have an exclusive agreement to supply Arm processors to the Windows PC market. In October 2023, wire service Reuters reported (without confirmation) that AMD and NVIDIA are readying Arm processors for Windows PCs when Qualcomm's agreement expires in 2024.

ARM IS THE FOUNDATION OF THE SEMICONDUCTOR INDUSTRY*

Software

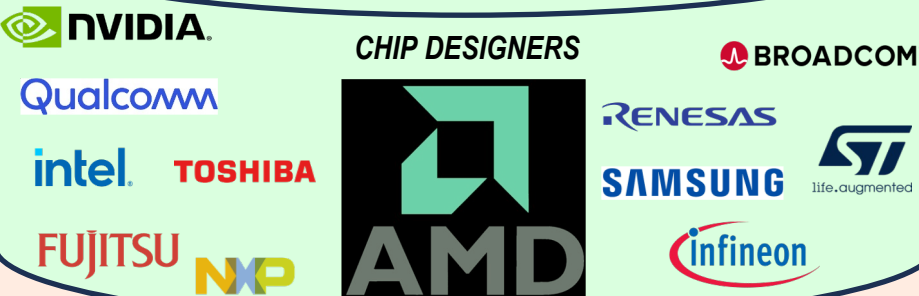
ORIGINAL EQUIPMENT MANUFACTURERS



SEMICONDUCTOR FOUNDRIES



CHIP DESIGNERS



PROCESSOR DESIGN, IP, SOFTWARE, AND TOOLS DEVELOPERS



*Source of Concept: Arm Holdings Preliminary Prospectus on SEC Form F-1, p.4.

EDA

Accelerator Cards: Accelerator cards, also known as hardware accelerator cards or coprocessor cards, are specialized hardware components designed to offload and accelerate specific tasks or workloads in a computer system. These cards are typically used to enhance the performance of a computer or server for specific types of computations, such as graphics processing, artificial intelligence, machine learning, cryptography, and more. Accelerator cards can significantly speed up these tasks by taking on the processing load, leaving the CPU free to handle other types of applications.

AI: Refers to "artificial intelligence," which is the simulation of the human brain by machines or computer systems to enable problem solving. Specific applications of AI include expert systems, natural language processing, speech recognition, and machine vision.

AMD: Refers to Advanced Micro Devices, Inc., a Delaware corporation. Headquartered in Santa Clara, California, AMD is a U.S. multinational semiconductor firm that designs computer processors and related technologies for consumer and enterprise markets. While the company at first made its own processors, AMD spun-off its foundries name and now outsources its semiconductor fabrication work to GlobalFoundries and TSMC. The main products developed by AMD include microprocessors, embedded processors, graphics processors, motherboard chipsets, and application-specific integrated circuits (ASICs).

APIs: Application Programming Interfaces, which is a software intermediary, connection or mechanism that enables two software applications or components to communicate with each other using a set of standardized protocols. APIs extract and share data within and across organizations.

APU: Refers to "accelerated processing unit," first created by AMD in 2011. An APU is a microprocessor that combines the central processing unit (CPU) with the graphics processing unit (GPU) on a single chip.

AR: Refers to "augmented reality," which is the integration of digital information with the user's environment in real time. Unlike VR, which creates a totally artificial environment, AR overlays a virtual environment with generated perceptual information overlaid on top of it.

Arm: Arm Holdings plc, a legal entity. The acronym "Arm" stands for "Advanced RISC Machine." Arm uses an architecture based on RISC that is different from one-standard x86 architecture building on the foundation of CISC.

ASIC: Refers to "application-specific integrated circuit," which is a chip on which the pattern of connections has been set up exclusively for a specific function. Any chip that is custom-made is an ASIC, designed for a specific purpose. ASICs are typically designed and used by a single company in a specific system. They are expensive, time-consuming, and resource-intensive to develop, but they offer extremely high performance coupled with low power consumption.

ASSP: Refers to "application-specific standard processors." In contrast to ASICs, ASSPs are general-purpose devices intended for use by multiple system design users.

CISC: Refers to "complex instruction set computing," which is distinct from RISC. RISC-V and Arm processors are based on RISC concepts and computing architectures while x86 processors from Intel and AMD employ CISC designs. CISC processors seek to minimize the number of instructions per program at the expense of the number of computer clock cycles per instruction. CISC computing seeks to complete a task in as few lines of code as possible. CISC instruction sets are more complex than RISC, and they require more transistors to design a processor's ISA or architecture.

Cloud Native Environment: Refers to the concept of building and running applications to take advantage of distributed computing offered by the cloud delivery model. Cloud native apps are designed to be built to exploit the scale, elasticity, resiliency, and flexibility the cloud provides. In a cloud-enabled solution, a company's application is deployed in the public cloud but still requires a physical server that connects to the cloud.

CPU: Refers to "central processing unit," which is a chip that functions as the brains of computing devices. Also called the central processor, main processor or just processor, the CPU is made up of a set of electronic circuits that execute instructions comprising a computer program to perform basic arithmetic, logic, controlling, and I/O (input/output) operations specified in the program.

Compute: Compute means the processing of data.

Deep Learning: A subset of ML, deep learning is a computer science approach where neural networks (1) are trained to recognize patterns from massive amounts of data (in the form of images, sounds and text), often better than humans, and in turn (2) provide predictions in a production process. Deep learning is often used to make non-linear, complex decisions.

Developers Toolkit: A developer's toolkit includes a range of tools and resources that enable third party semiconductor developers to create, analyze, test, and refine their designs, ensuring that the final products meet the required specifications and perform reliably in their intended applications. The toolkit might include design software, development kits and platforms, testing and measurement equipment, programming, manufacturing and packaging services.

EDA: Refers to "electronic design automation," a category of software tools for designing electronic systems such as ICs and printed circuit boards. According to EDA leader Synopsys, the goal of EDA is to assist in the definition, planning, design, implementation, verification, and subsequent manufacturing of semiconductor devices, or chips.

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Edge: Refers to the "edge of a network." In a centralized network, client devices are connected to one server whose job is to process the information requested by the users and hand it back to them. While a centralized network is good enough to interact with simpler websites, companies have found that complex projects involving a great bank of customers work better with an edge server. Unlike a centralized network, because an edge server sits at the edge of a network, it improves latency, reduces loading times, and removes the load from the origin server. Instead of sending data to a central server, the data is processed at the edge.

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Global Foundries: Global Foundries, Inc., a Cayman Islands company, is the world's third largest semiconductor manufacturer and design company by revenue. Headquartered in Malta, New York, Global Foundries was created by the divestiture of the manufacturing arm of AMD. The company was privately owned by Mubadala Investment Company, the sovereign wealth fund of the United Arab Emirates, until an initial public offering in 2021. The company manufactures integrated circuits or wafers designed for markets such as smart mobile devices, automotive, aerospace and defense, consumer internet of things, and for data centers and communications infrastructure. It is the only fabrication company with operations in Singapore, the European Union, and the U.S. — one in each of these 300 mm wafer fabrication plants in Singapore and one in each of the 300 mm wafer fabrication plants in Malta, New York, and Vermont.

GPU: Refers to "graphics processing unit," a type of microprocessor, capable of rendering graphics display on an electronic device, such as a gaming console or vehicle infotainment system. GPUs also have application for video editing and content creation, machine and deep learning, and artificial intelligence.

HPC: Refers to "high performance computing," which is the ability to process data and perform complex calculations at high speeds. To put it into perspective, a laptop or desktop with a 3 GHz processor can perform 3 billion calculations per second. While that is much faster than any human can achieve, it pales in comparison to HPC solutions that can perform quadrillions of calculations per second.

IC: An "integrated circuit" (also referred to as a chip or microchip) is a set of electronic circuits on one small flat piece of semiconductor material, usually silicon. Large numbers of miniaturized transistors and other electronic components are integrated together on the chip. This results in circuits that are orders of magnitude smaller, faster, and less expensive than those constructed of discrete components, allowing a large transistor count. The IC's mass production capability, reliability, and building-block approach to integrated circuit design have ensured the rapid adoption of standardized ICs in place of designs using discrete transistors.

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Intel: Founded in 1968, Santa Clara, California-based Intel develops, manufactures, markets, and sells (1) platform products, such as central processing units and chipsets, and system-on-chip and multichip packages; and accelerators, boards and systems, connectivity products, and memory and storage products, (2) high-performance compute solutions for targeted verticals and embedded applications for retail, industrial, and healthcare markets; and solutions for assisted and autonomous driving comprising compute platforms, computer vision and machine learning-based sensing, mapping and localization, driving policy, and active sensors, and (3) workload-optimized platforms and related products for edge servers, AI servers, and service providers.

IoT: Refers to "Internet of Things," which describes physical objects that are embedded with sensors, processing ability, and other technology that connects and exchanges data with other devices over the Internet.

IP: Refers to the "intellectual property" of Arm, including (1) Arm architecture IP such as the company's RISC-based ISA, (2) physical IP, consisting of components used in the process of translating a design of complex SoC integrated circuits into a manufactured chip, (3) system IP consisting of components used in an SoC design (other than the GPU and CPU), such as interfaces to external components and on-dash chip interconnects that bridge functional components within the SoC, and (4) software IP, including updates, support, patches, and bug fixes.

ISAs: Refers to "instruction set architecture," which specifies how software running on a CPU will behave. At the heart of every processor's functioning lies its ISA, which is often thought of as the blueprint that (1) outlines the set of instructions a processor can understand and execute and (2) shapes the capabilities and performance of a processor. The choice of ISA influences how software is developed, and it has a lasting impact on a processor's efficiency, compatibility, and flexibility. ISAs can be broadly categorized into two types: open and closed. Closed ISAs, like Arm's, are proprietary and tightly controlled by their owner (e.g., Arm Holdings plc), offering established reliability and compatibility but limiting customization. On the other hand, open ISAs, exemplified by RISC-V, are community-driven and can be used for a variety of purposes and are found in everything from cell phones to cars to spacecraft. Unlike the microprocessor, which is designed to run software applications and gives better performance, integrated circuits are ideal for smaller applications that don't require as much computing power. Integrated circuits allow devices to be smaller and more lightweight. However, an integrated circuit cannot function independently because it doesn't have any program instructions or other information stored inside itself. In general, there are three types: (1) commodity integrated circuits, which are simple chips produced in large quantities and used for a specific purpose, called application-specific integrated chip (ASIC); (2) custom integrated circuits, which are designed for a specific application, such as automotive, aerospace, and industrial sectors.

ISP: Refers to an "image signal processor" used to process images from sensors in digital cameras and other devices. It is often included in a SoC.

LLM: Refers to large language models. LLMs are advanced artificial intelligence systems designed to understand, generate, and interact with human language in a way that mimics human-like comprehension and responses. These models are trained on vast amounts of text data, enabling them to perform a wide range of language-related tasks, such as translation, summarization, answering questions, and creative writing. They work by analyzing the context and structure of language, learning patterns and nuances, and using this knowledge to generate coherent and contextually relevant text. Large language models, like OpenAI's GPT (Generative Pre-trained Transformer) series, represent the cutting-edge of natural language processing technology and are continuously evolving to become more sophisticated and versatile in their language capabilities.

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Machine Learning: Also known as "ML," machine learning is a subset of AI. ML is a computer science approach used in data science that leverages algorithms and data to learn how to make predictions or determinations. In other words, ML is an application of AI where machines/computer programs are given access to data and then use algorithms to find patterns in data (i.e., learn from the data). ML applications are often used to make simple, linear correlations, and can run on a CPU instead of a GPU that excels at running many smaller tasks at once.

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Middleware: Refers to software that different applications use to communicate with each other. Middleware acts as a bridge between diverse technologies, tools, and databases so the user can integrate them seamlessly into a system.

Mobile Processors: A mobile processor is a microprocessor designed for mobile devices such as laptops and cellphones. They are the brains of the device. Mobile processors tend to be less powerful than PC processors due to their lower TDP and power consumption. PC processors are optimized for high-performance, while mobile processors are optimized for low power consumption and long battery life. Mobile processors are typically cheaper than PC processors which are one of the reasons why some PC processors in terms of performance, but these are usually the exception and not the rule.

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Semiconductor Foundries: Also known as fabs, foundries are the facilities in which semiconductor chips or devices are manufactured. These highly complex and expensive facilities are either owned and operated by large, vertically integrated semiconductor companies (e.g., Infineon, Samsung, Intel, and Renesas) or operated as independent, "pure-play" manufacturing service providers (e.g., TSMC or Global Foundries). This latter category has become a dominant force in the industry.

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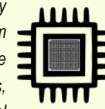
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WHAT SEMICONDUCTORS DO

Overview: Semiconductors are an essential component of modern life! They are tiny electronic circuits made up of materials that partially conduct electricity. A broad portfolio of semiconductors are essential components of electronic devices and enable these devices to perform their functions. As such, semiconductors are considered the brains for millions of electronic devices and electrical systems located inside space vehicles, TVs, radios, video game consoles, car computers and electrical systems, smartphones, personal computers, supercomputers, advanced medical diagnostic equipment, appliances, military weapons systems, renewable energy systems, industrial equipment, data center servers, and telecommunications networks.



Composition and Function: A semiconductor is a material that allows current to flow more than an insulator but less than a pure conductor. Memory chips, microprocessors, and integrated chips are some examples of semiconductors. Semiconductors are made by imprinting a network of electronic components onto a semiconductor wafer. These devices are designed to perform various functions such as processing, amplifying and selectively filtering signals, controlling electronic system functions and processing, and transmitting and storing data.

Products and Devices That Incorporate Semiconductors

GENERAL APPLICATIONS		SPECIFIC CASES		
<p>Vehicles (See Specific Cases)</p> <p>Space Vehicles</p> <p>Railcars</p> <p>Robotic Welding Machine</p> <p>Video Game Consoles</p> <p>Medical Diagnostic Equipment</p> <p>Data Center Servers</p> <p>Embedded Systems (Small Computers that Form Part of a Larger Machine; They Control the Device and Allow User Interaction)</p> <p>GPS Systems</p> <p>Smart Watches</p> <p>Engine Management Systems</p> <p>Central Heating Systems</p>	<p>IT Devices (see Specific Cases)</p> <p>Factory Automation Systems</p> <p>Appliances</p> <p>Smart Phones</p> <p>Supercomputers</p> <p>Oil, Gas and NGL Pipelines</p> <p>Military Weapons Systems</p> <p>Thermoelectric Applications (Including Lighting and LED Displays)</p> <p>Radios</p> <p>Telecommunications Networks</p> <p>Networking Equipment</p> <p>Solar Cells and Other Renewable Energy Systems</p>	<p>Vehicles</p> <p>The typical modern car is loaded with over 1,400 semiconductors to control safety, powertrain, electrical, comfort, infotainment, and connectivity systems. For this reason, vehicles are often referred to as "computers on wheels."</p> <p>Comfort</p> <p>Window/Mirror Controls</p> <p>Vibration Control</p> <p>Seat Controls</p> <p>Climate Controls</p> <p>Noise Suppression</p> <p>Adaptive Cruise Control</p>	<p>Infotainment</p> <p>Audio/Video</p> <p>Driver Display</p> <p>Navigation</p> <p>Powertrain</p> <p>Engine Control</p> <p>Fuel-Injection System</p> <p>Hybrid-Electric Control</p> <p>Transmission Control</p> <p>Electric Power Steering</p>	<p>Safety</p> <p>Airbag Controls</p> <p>Collision Avoidance</p> <p>Parking-Assist</p> <p>Power Locks</p> <p>Braking-Assist</p> <p>Tire-Pressure-Monitoring</p> <p>Traction-Control System</p> <p>Electrical</p> <p>Starter</p> <p>Lighter</p> <p>Vehicle-Diagnostics</p>
		<p>IT Devices</p> <p>Most people associate semiconductors with information technology devices, such as personal computers (desktop and laptop computers), mobile devices (smart phones and tablets), and servers in data centers.</p> <p>Personal Computers</p> <p>In 2021, 342 million PCs were shipped around the world. It was expected that 310 million PCs were to be shipped in 2022. However, PC shipments only reached 286.2 million units in 2022, a 16.2% decrease from the previous year. Most PCs include only one chip.</p> <p>Mobile Devices</p> <p>There are 6.7 billion smartphone subscriptions globally (85% of the world population). By 2028, the rise in the number of smartphone subscriptions is projected to grow to 7.7 billion. Current generations of smartphones come in a range of multi-range of processors, such as Dual-Core (2), Quad-Core (4), and Octa-Core (8), with the Octa-Core processor (used by Apple in iPhone 13 and 14) being the most powerful.</p> <p>Servers</p> <p>Servers today feature one or two x86 chips, or maybe an Arm processor. In 5 or 10 years they will feature many more. The typical data center with 850 Megawatts of capacity</p> <p>6,314,256 Low-Powered 1U Servers</p> <p>1,768,000 Mid-Powered 1U Servers</p> <p>803,608 High-Powered 1U Servers</p>		

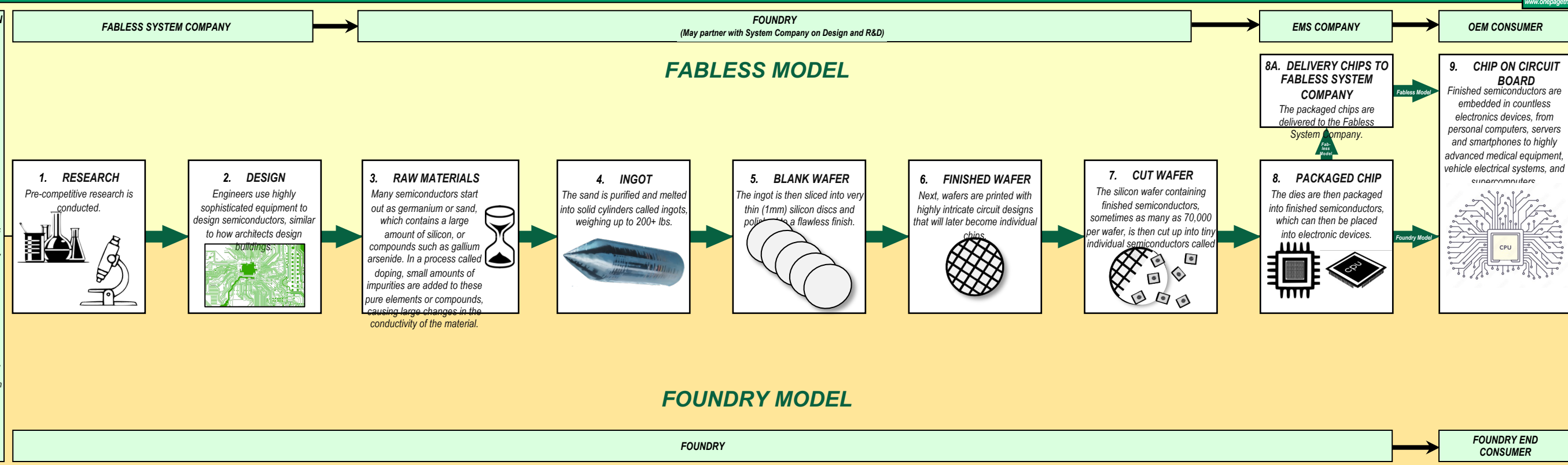
SEMICONDUCTOR ECOSYSTEM

INDUSTRY PARTICIPANTS
Key semiconductor players include:

- DESIGN ARCHITECTS**
(Design architects research and develop instruction set architectures for processors as well as physical and system IP, which they license to system companies for customization and manufacturing of chips).
arm
- SYSTEM COMPANIES**
(Semiconductor companies whose research and integrated circuit designs set the stage for chip production).
AMD, Qualcomm, BROADCOM
- FABS OR FOUNDRIES**
(Pure-play foundries and integrated circuit manufacturers perform front-end wafer manufacturing operations. Foundry operators may be System Companies or a third-party contract manufacturers (if the System Company operates on a "fabless" basis).
Infineon, intel
- ELECTRONICS MANUFACTURING SERVICES EMS**
(Companies provide integrated circuit assembly, packaging, testing, and repair services to the System Company. These companies are also capable of designing and manufacturing semiconductors.)
Amkor Technology, FOXCONN, ASE GROUP
- OEM CONSUMERS**
(OEM consumers are the original equipment manufacturers of electronic devices (or the makers of electronic components and assemblies of such devices) into which semiconductors will be incorporated.)
Dell, Verizon, AWS, Ford, RTX

PRODUCTION PROCESS

According to the Semiconductor Industry Association, the semiconductor production process consists of nine steps—research, design, raw materials procurement, ingot production, blank wafer production, finished wafer production, finished wafer cutting, finished wafer packaging, and embedding finished wafers in circuit boards.



CHIPMAKERS

SYSTEM COMPANIES
The numerous chipmakers range from (1) household names with global reach to (2) smaller suppliers little known outside their specialized market niche. Semiconductor firms focus their operations around one of three models:

- FABLESS**
(Fabless companies focus only on chip design and then outsource their chip designs to foundries.)
Qualcomm, NVIDIA
- INTEGRATED DEVICE MANUFACTURERS (IDMs)**
(IDMs conduct both design and manufacturing activities.)
samsung, intel
- FOUNDRIES**
(Pure-play foundries are companies that focus primarily on manufacturing for third parties.)
GlobalFoundries

DESIGN ARCHITECTS | **FABLESS COMPANIES** | **INTEGRATED DEVICE MANUFACTURERS** | **PURE-PLAY FOUNDRIES**

arm, RISC-V, intel x86, Qualcomm, TOSHIBA, AMD, BROADCOM, MEDiatek, SONY, NVIDIA, NXP, Apple-Designed, TSMC-Produced, FUJITSU, intel, MICRON, SAMSUNG, TEXAS INSTRUMENTS, infineon, SK hynix, RENESAS, GlobalFoundries, tsmc, UMC

CHIP TYPES

KEY CHIP CATEGORIES
Semiconductors can be divided into three main categories:

- MEMORY CHIPS**
- PROCESSORS AND CONTROLLERS**
- INTEGRATED CIRCUITS**
(Including Neural Processing Units (NPU), Data Processing Units (DPU), Graphics Processing Units (GPU), and Systems on a Chip (SoC).)

MEMORY CHIPS
A memory chip is a semiconductor comprising numerous capacitors and transistors that can hold data (a) temporarily through random access memory (RAM) or (b) permanently through read only memory (ROM). Memory chips can be volatile (i.e., require power to maintain the stored information) or non-volatile (i.e., does not require a continuous power supply to retain the data or program stored in a computer).

CENTRAL PROCESSING UNITS (CPUs)
The CPU is a chip that functions as the brains of the personal computer (PC). Also called the central processor, main processor or just process, the CPU is made up of a set of electronic circuits that execute instructions comprising a computer program to perform basic arithmetic, logic, controlling and I/O (input/output) operations specified in computer program.

MICROPROCESSORS
Microprocessors are used in (and mounted on the mother-boards of) virtually all desktop and laptop computers. They are also found in other types of electronic equipment, such as cell phones, tablets, and cars. Microprocessors require extremely precise manufacturing to function properly, are power-hungry, and are better suited for more demanding tasks. They respond to user input, process instructions and perform the calculations and logic operations used to run software programs—i.e., play games, browse websites, edit photos, create documents, stream media, and perform mathematical calculations. The microprocessor contains all the components found in an integrated circuit—a CPU, input/output ports, and memory—but it also includes its own non-volatile storage for programs and data. This allows users to run software on computers without needing additional hardware devices.

MICROCONTROLLERS
In contrast to the microprocessor (which are used in applications where (a) the task is not pre-defined but depends on the user or (b) intensive processing is required), a microcontroller is used for a specific task. Based on input given by the user or a sensor, the microcontroller performs a light amount of processing and gives the result as an output. Examples include the washing machine and microwave oven, where the task is pre-defined—once the user sets the power and timing, the microwave gives the user cooked food; once the user sets the parameters, the washing machine gives the user clean clothes.

INTEGRATED CIRCUITS (ICs)
Integrated circuits are general-purpose devices that can be used for a variety of purposes and are found in everything from cell phones to cars to spacecraft. Unlike the microprocessor, which is designed to run software applications and gives better performance, integrated circuits are ideal for smaller applications that don't require as much computing power. Integrated circuits allow devices to be smaller and more lightweight. However, an integrated circuit cannot function independently because it doesn't have any program instructions or other information stored inside itself. In general, there are three types: (1) commodity integrated circuits (ICs), which are simple chips produced in large batches and used in single purpose appliances to perform repetitive processing routines (e.g., barcode scanners), (2) ICs made for a specific application—called application-specific integrated chips (ASICs)—and (3) all-in-one "system on a chip" (SoC) types of chips.

ACCELERATED PROCESSING UNITS (APUs)
Created by AMD in 2011, an accelerated processing unit (APU) is a microprocessor that combines the central processing unit (CPU) with the graphics processing unit (GPU) on a single computer chip.

GRAPHICS PROCESSING UNITS (GPUs)
A type of microprocessor, a graphics processing unit (GPU) is capable of rendering graphics display on an electronic device, such as a gaming console, personal computer or vehicle infotainment system. GPUs also have application for video editing and content creation, machine and deep learning, and artificial intelligence (AI).

NEURAL PROCESSING UNITS (NPUs)
A neural processing unit (NPU), such as the M2 chip used in latest versions of Apple's laptops and tablets, is a microprocessor that specializes in the acceleration of machine learning algorithms (10,000 times less time than a GPU), typically by operating on predictive models such as artificial neural networks (ANNs) or random forests (RFs). It is also known as neural processor.

DATA PROCESSING UNITS (DPUs)
DPUs are the new kids on the block. A DPU is a programmable processor designed to efficiently handle data-centric workloads such as data transfer, reduction, security, compression, analytics, and encryption, at scale in data centers. DPUs work with CPUs and GPUs to enhance the computing power and handling of increasingly complex modern data workloads. The DPU market has gained traction due to the rise in demand for AI, machine learning, and computing.

SYSTEMS ON A CHIP (SoCs)
A form of integrated circuit, the SoC is among the newest types of chip. All the electronic components needed for an entire system (e.g., CPU, Random Access Memory (or RAM), storage, I/O (input/output ports) are built into a single chip. SoCs break from the traditional approach to system architecture (e.g., with motherboards) where each component is discretely installed. This enables the creation of smaller and more efficient devices. For this reason, SoCs are driving innovation in the creation of netbooks, laptops, smartphones, Internet of Things (IoT) devices.