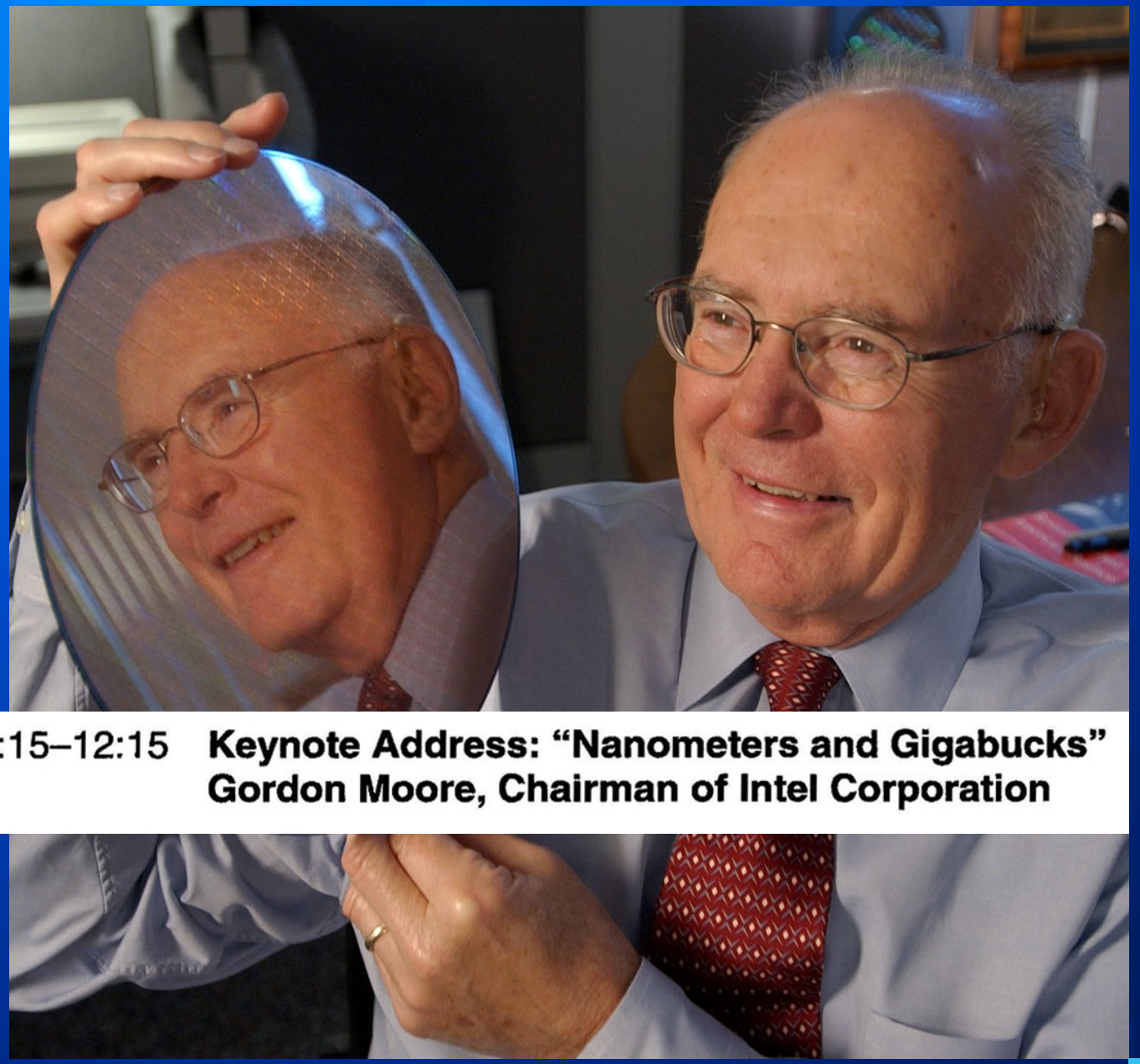

intel
Semiconductors
Run the World
Hot Chips 2022
Pat Gelsinger, Intel CEO

HOT CHIPS

Final Program

Monday, August 14, 1995—Memorial Auditorium

9:00–9:15	**Welcome and Opening Remarks** Nam Ling, General Chair Hasan S. AlKhatib and Norman P. Jouppi, Program Co-Chairs	
9:15–10:45	**Session 1: Embedded Processors** Session Chair: Robert Garner, Sun Microsystems	page
1.1	**The First Superscalar 29K™ Family Member** B. McMinn, Advanced Micro Devices	1
1.2	**The Architecture of the NS486 Integrated Processor** M. D. Nemirovsky, National Semiconductor	11
1.3	**The MiniRISC™ CW4010: A Superscalar MIPS Processor ASIC Core,** P. Cobb, J. Cesana, LSI Logic	19
10:45–11:15	Break	
11:15–12:15	**Keynote Address: "Nanometers and Gigabucks"** **Gordon Moore, Chairman of Intel Corporation**	
12:15–1:45	Lunch	
1:45–3:15	**Session 2: x86 Processors** Session Chair: Mark Horowitz, Stanford University	
2.1	**Optimizing the P6 Pipeline,** D. Papworth, Intel Corporation	31
2.2	**AMD–K5™ Microprocessor** D. Christie, Advanced Micro Devices	41
2.3	**Building a Better Beast: Native vs. RISC-like vs. VLIW Methods of Implementing x86 Microprocessors** T. Garibay, Cyrix	49
3:15–3:45	Break	
3:45–5:15	**Session 3: RISC–1** Session Chair: Winfried W. Wilcke, HaL Computer Systems	
3.1	**Performance Evaluation of the Superscalar Speculative Execution HaL SPARC64 Processor** A. Essen, S. Goldstein, HaL Computer Systems	59
3.2	**SPARC64™+: HAL's Second Generation 64-bit SPARC Processor** G. W. Shen, HaL Computer Systems	75
3.3	**Memory Performance Features of the 64-bit PA-8000** B. Naas, Hewlett-Packard	87
5:15–7:00	Monday Evening Buffet Dinner	
7:00–9:00	**Evening Panel Session: What is the Role of Competing Architectures in an x86 World Order?** Moderator: John Wharton, Consultant/Analyst, Applications Research. Panel members: Keith Diefendorff, Senior Member Technical Staff, Motorola; David Ditzel, President and CEO, Transmeta Corporation; John Novitsky, Director, CPU Products Group, Micro-Module Systems; Nick Tredennick, CEO, TechNerds International; Pete Wilson, Director, Microsystems Architecture, Groupe Bull	



11:15–12:15 **Keynote Address: "Nanometers and Gigabucks"**
Gordon Moore, Chairman of Intel Corporation

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CHIPS for America Act

"Since semiconductors are such key components, the fragile supply chain for semiconductors puts virtually every sector of the economy at risk of disruption."

- Department of Commerce's E.O. 14017 industrial base review

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Tech Superpowers

= Ubiquitous

(Compute × Connect × Infrastructure × Artificial Intelligence)

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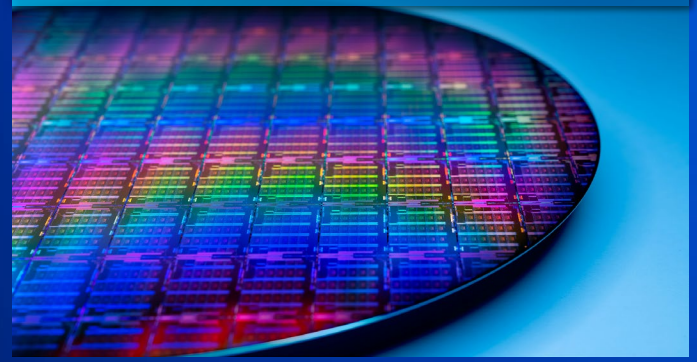
Wafer Foundry

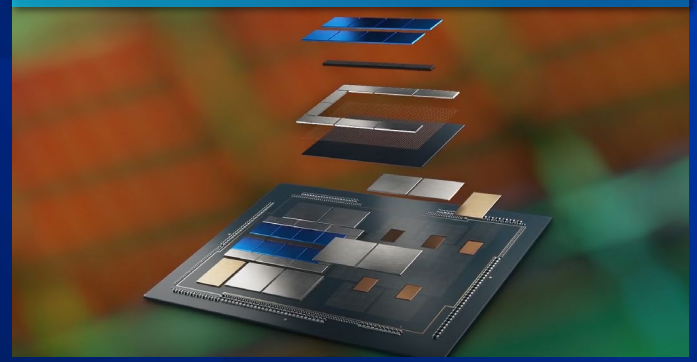
Systems Foundry

Wafers



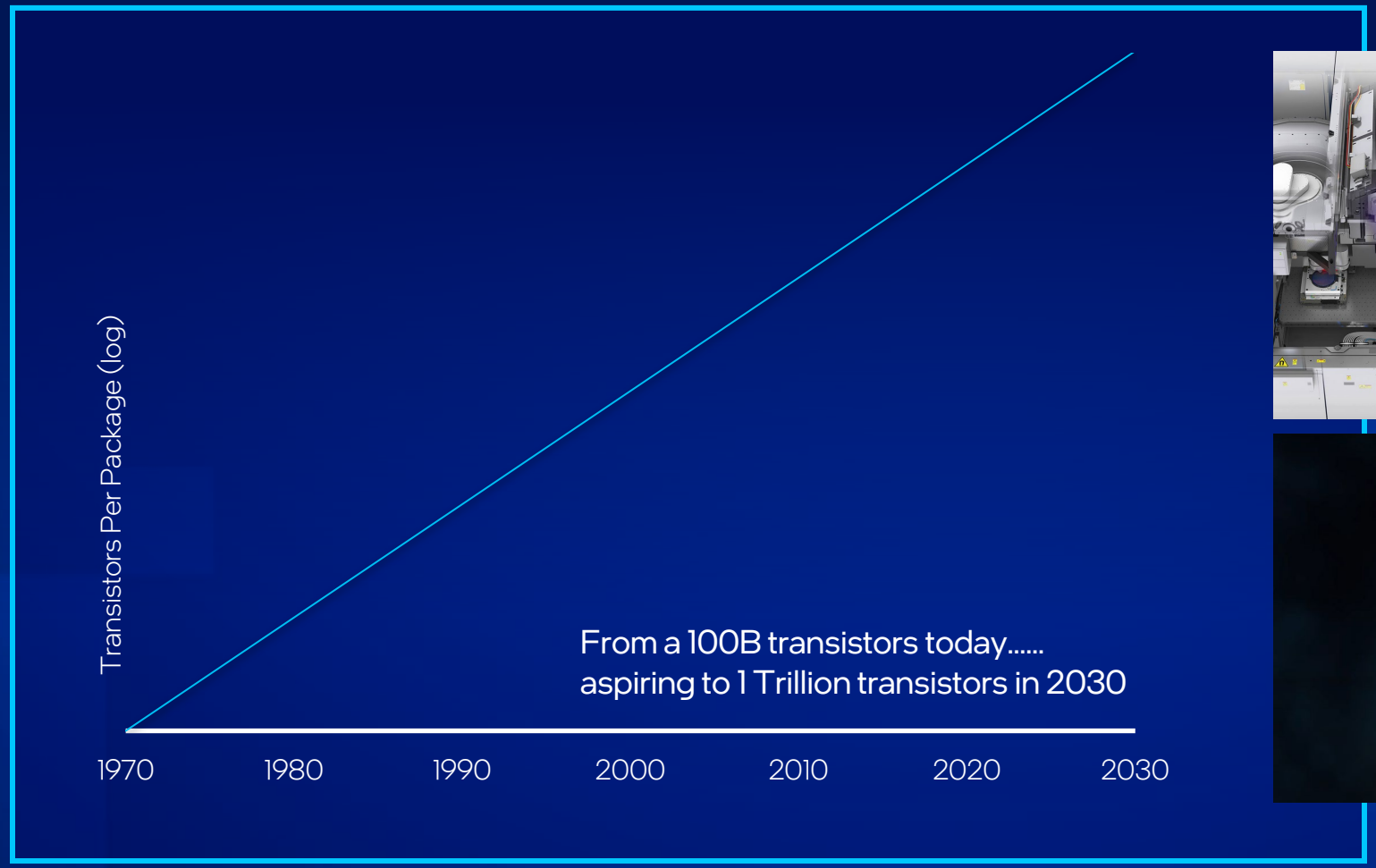
Packaging

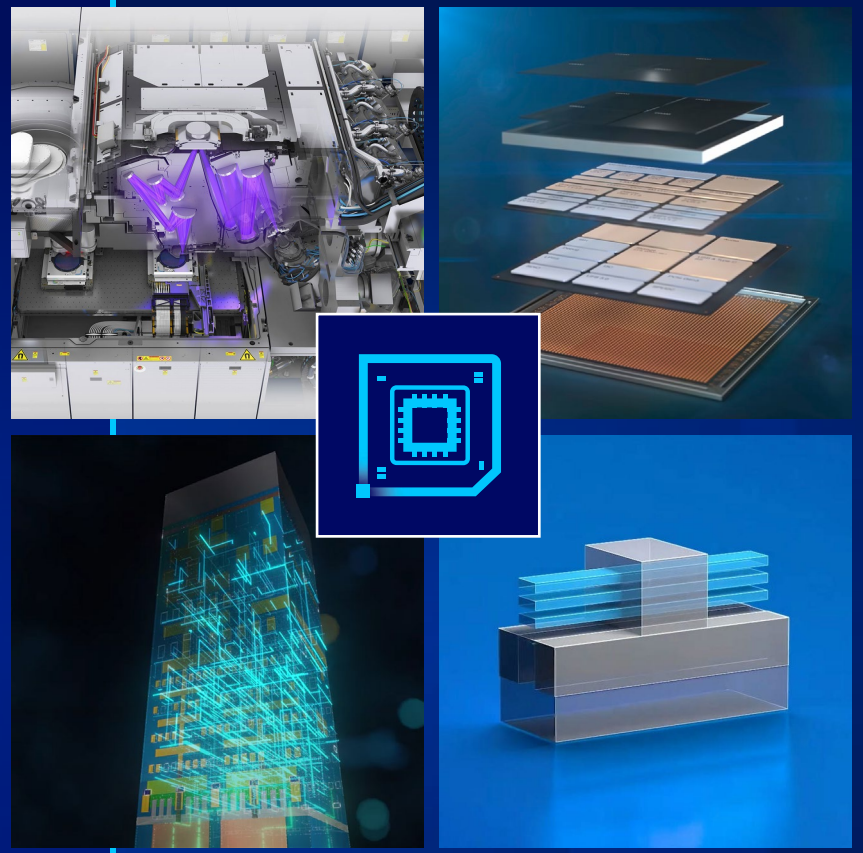
Chiplets



Software

Moore's Law Alive and Well





Future projections based on products still in design. Future transistor counts are projections and are inherently uncertain

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We will not rest until the periodic table is exhausted

1 H Hydrogen 1.008																	2 He Helium 4.002602
3 Li Lithium 6.94	4 Be Beryllium 9.0121831											5 B Boron 10.81	6 C Carbon	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998403163	10 Ne Neon 20.1797
11 Na Sodium 22.98976928	12 Mg Magnesium 24.305											13 Al Aluminium 26.9815385	14 Si Silicon 28.085	P Phosphorus 30.973761998	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955908	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938044	26 Fe Iron 55.845	27 Co Cobalt 58.933194	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.630	33 As Arsenic 74.921595	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90584	40 Zr Zirconium 91.224	41 Nb Niobium 92.90637	42 Mo Molybdenum 95.95	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293
55 Cs Caesium 132.90545196	56 Ba Barium 137.327	57 - 71 Lanthanoids	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.592	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 - 103 Actinoids	104 Rf Rutherfordium (267)	105 Db Dubnium (268)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (269)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (289)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)

57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90766	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93033	68 Er Erbium 167.259	69 Tm Thulium 168.93422	70 Yb Ytterbium 173.045	71 Lu Lutetium 174.9668
89 Ac Actinium (227)	90 Th Thorium 232.0377	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (266)

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Moore's Predicted "Day of Reckoning"

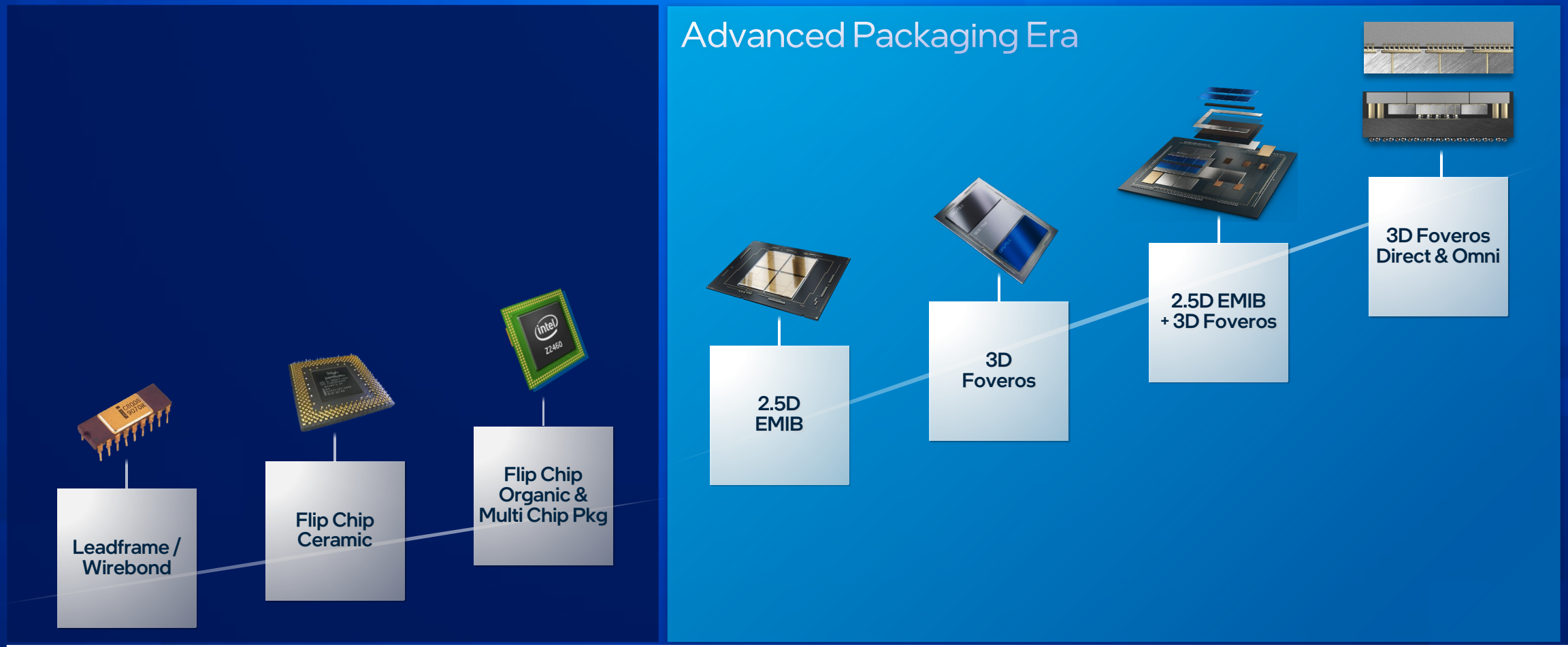
"It may prove to be more economical to build large systems out of smaller functions, which are separately packaged and interconnected[1]."

- Gordon E. Moore

Image: Intel®

1. "Cramming more components onto integrated circuits", Electronics, Volume 38, Number 8, April 19, 1965

Intel Package Technology

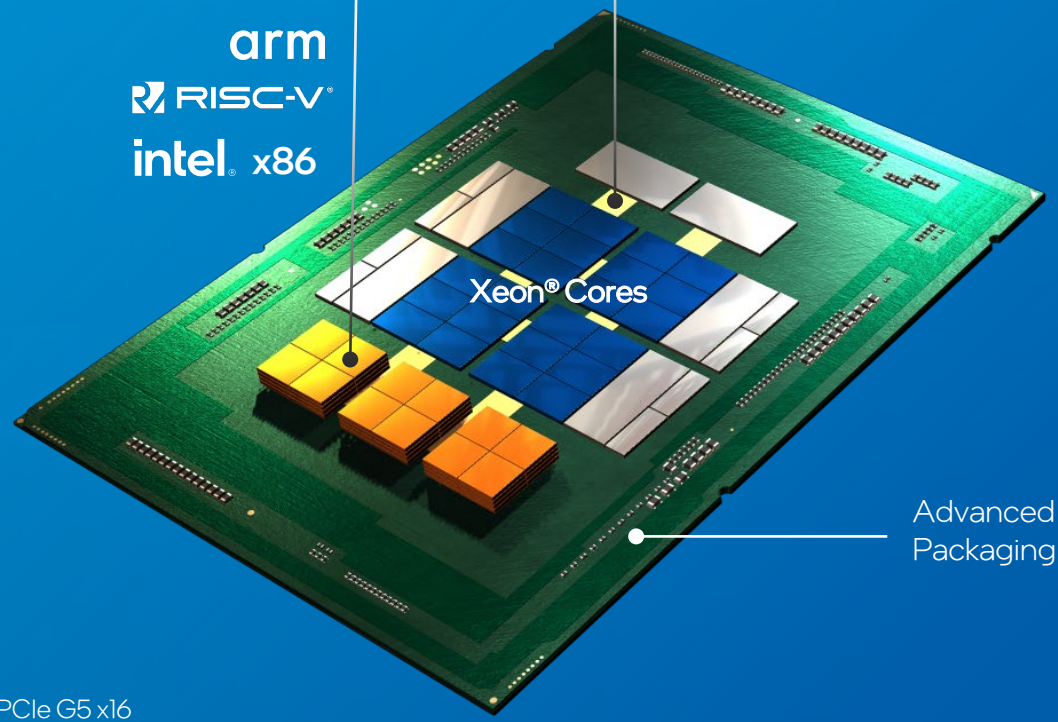


Package main function: provide power and signaling from motherboard to die

Added Package value: high density interconnects that enable larger die complexes from multiple process nodes

*Graphic is for illustrative purposes only and is not to scale

Open Chiplet: Platform on a Package



*relative to PCIe G5 x16

UCIe
Universal Chiplet
Interconnect Express

White Paper: Universal Chiplet Interconnect Express (UCIe)®: Building an open chiplet ecosystem, Dr. Debendra Das Sharma, Intel Senior Fellow and Chief Architect, I/O Technologies and Standards Promoter Member of UCIe

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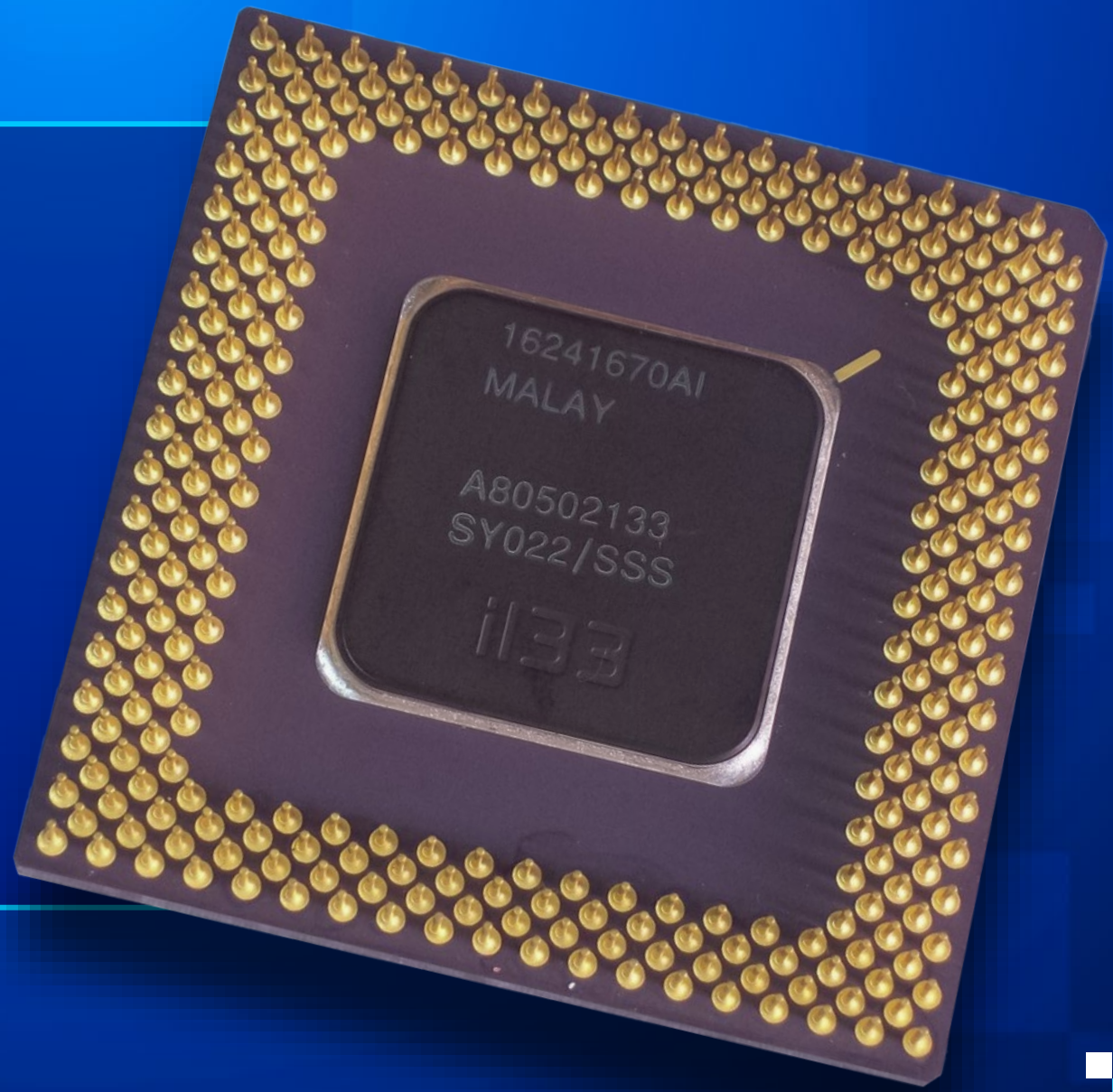
pentium®
PROCESSOR



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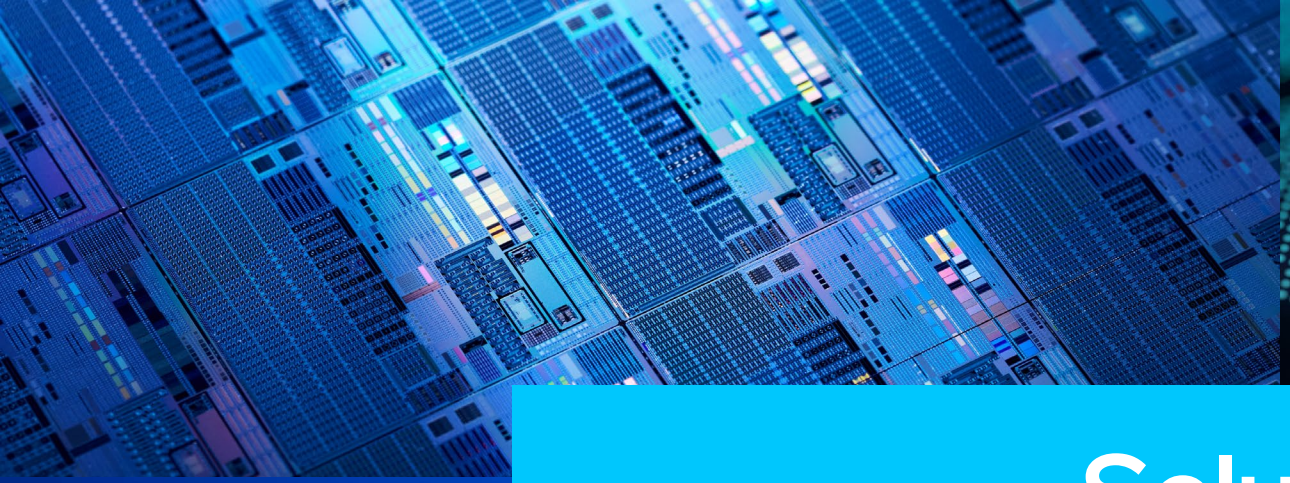

Solution

Silicon + Software & SaaS

"Software is the soul of the machine."

-Greg Lavender

Software Defined;
Silicon Enhanced

Client/Edge/Cloud/Data Center

Solutions, Services and Platforms

Languages, Frameworks, Tools, and Libraries

Foundational Software
(BIOS, OS, Simulation, Virtualization, and Services)

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Cloud
Transforms IT

Big Data
Transforms Business

Hot Chips 2012

In Summary

- Silicon design remains essential – HW/SW co- design is critical
- The action is in the edges (Mobile & Server)
- Cloud becomes the Software-Defined Datacenter
- Big Data opens up new opportunities for HW design

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IFS as an Open System Foundry

Secure Solution

System Software

x86
arm
RISC-V
oneAPI

Open SW Stack
- Operating System
- Virtualization
- BIOS
- Firmware
- Tools & Compilers

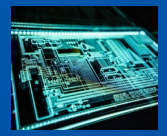
Intel® Simics®

System of Chips

System Partitioning

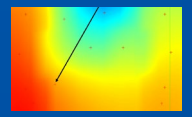
Intel® Chiplet Studio™ Suite

Accelerated Silicon Services



Architecture

Intel® Docea™



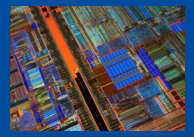
Thermals

Intel® Cofluent™

Performance

Security – Manageability - Test/Debug

Differentiated IP

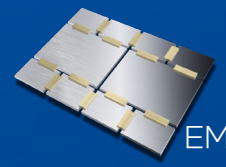


ASIC

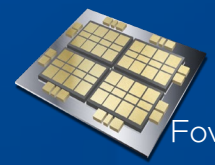
Validation

Package & Interconnect Optimization

UCIe
Universal Chiplet Interconnect Express



EMIB



Foveros

Silicon

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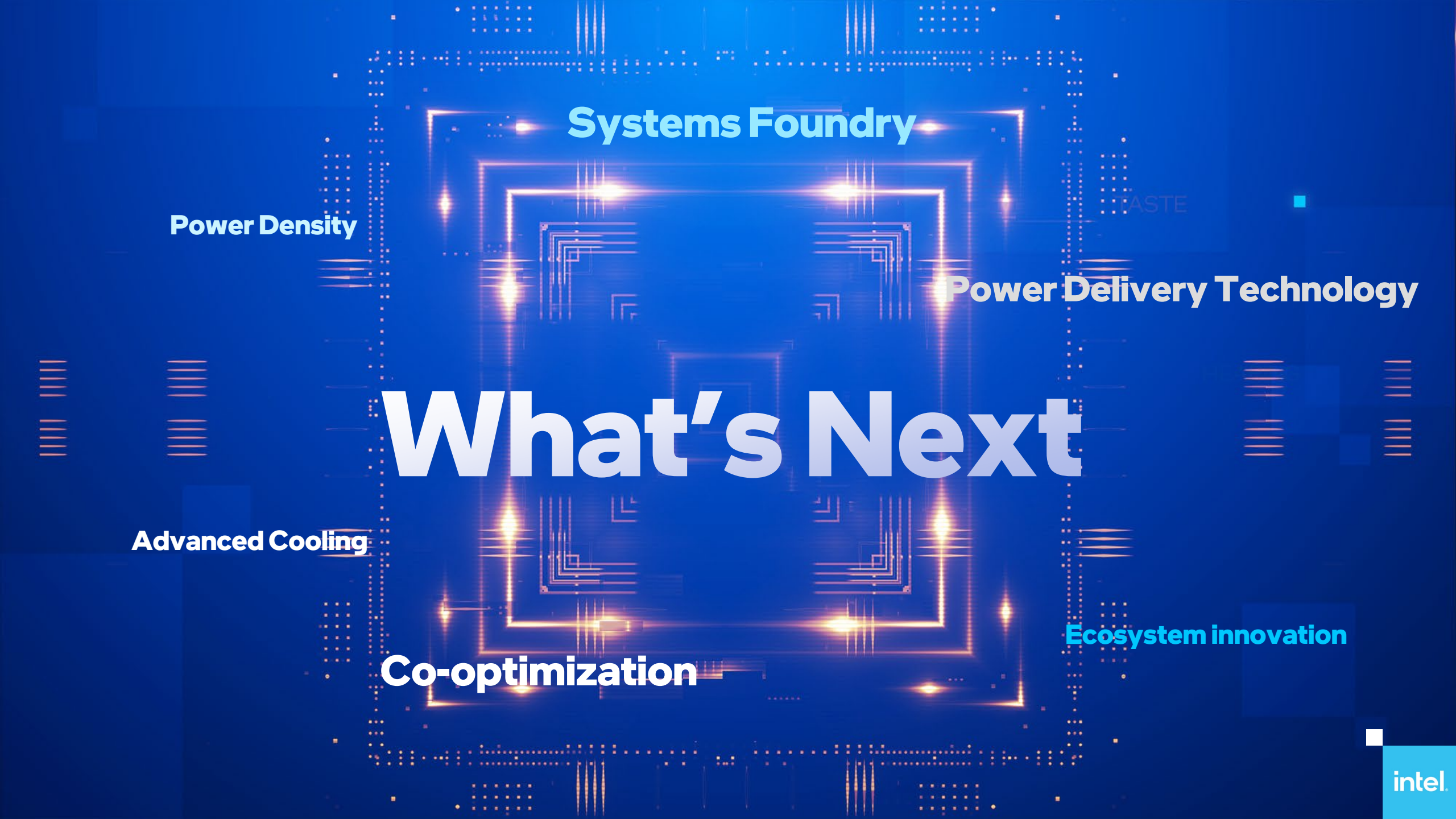
Systems Foundry
Power Density
Power Delivery Technology
What's Next
Advanced Cooling
Ecosystem innovation
Co-optimization
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Stewards of Moore's Law

In the Golden Age of Semiconductors


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