Građa računala

Basic computer parts

von Neumann computer

- Program is stored in binary format in memory unit – so that stored execution results can be used for something later in the program (*Stored Program Concept*)
- This concept states that instructions are stored in memory along with the data in CPU-readable format, and the computer itself can manipulate with that data as instructions and data depend on other parameters (for example, control states)
- Instructions executed in serial fashion (sequentially), strictly following the control flow written in memory

Why do we care?

- All computer work like this
- This is the default application execution model
- If we didn’t have this concept, all instructions would have to be manually executed – impractical, useless and impossible to use in real life

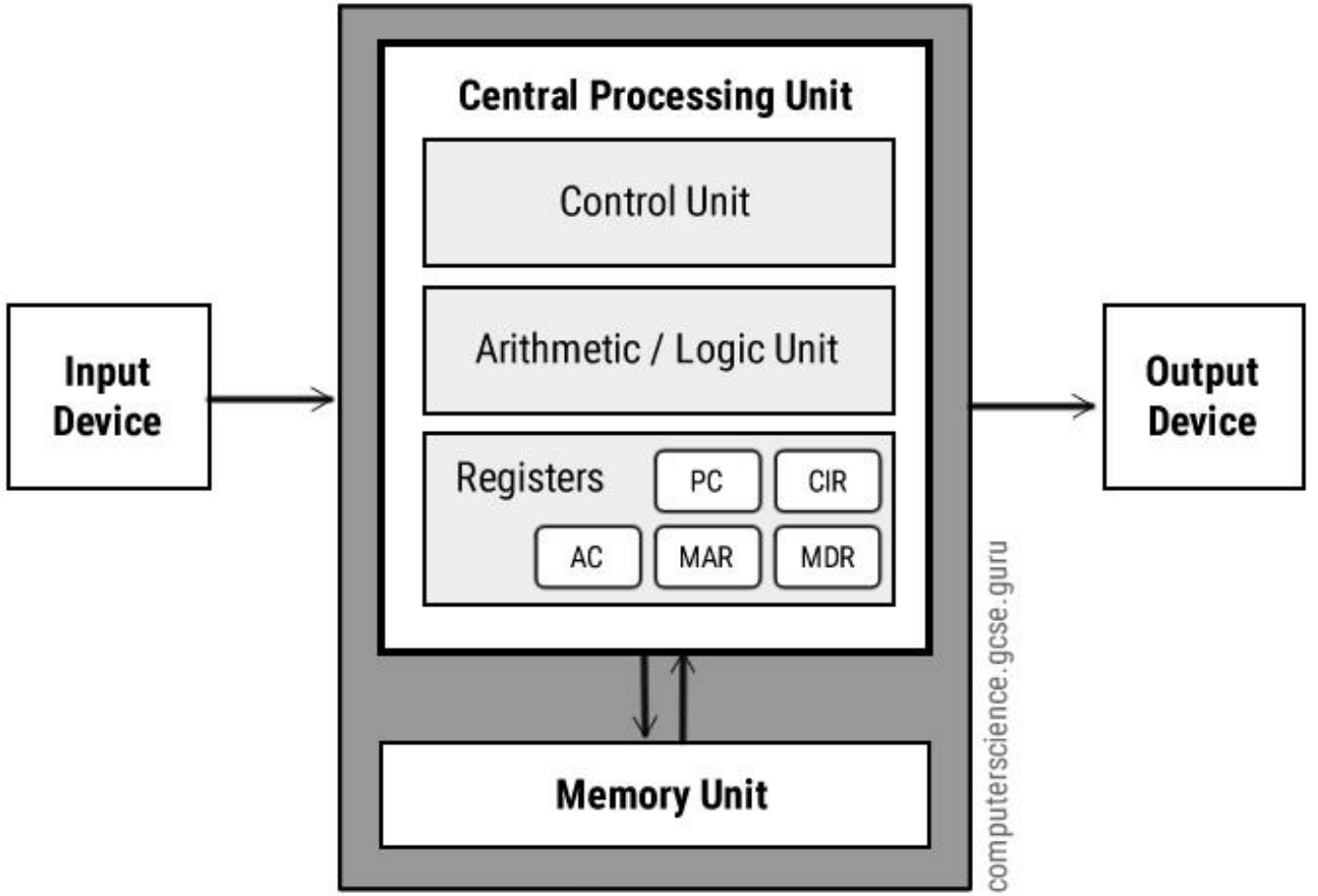
von Neumann architecture

- To facilitate this execution method, we need von Neumann concept, that has the “usual” building blocks:
  - ALU
  - Memory
  - Input/output
  - Control unit
- ALU needs to have a register called accumulator
- PC needs to have a register/counter called PC (Program Conter) – it’s there to help with the next instruction in the app execution
- These registers are usually implemented as memory components in the CPU that help with app flow execution being done in correct way

So, to recap – computer functional units

- ALU
- CU
- Memory
- U/I

Von Neumann model



Basics of IBM PC compatible computer

- It uses a CPU compatible with x86 architecture
- Built to be compatible with ISA specification
- It uses one of the busses compatible with ISA or PCI bus, which includes expansion slots that later started using VLB, PCI and PCI Express)
- It uses IBM compatible BIOS
- It’s capable of executing apps compatible with operating systems like MS-DOS, MS Windows (at least originally, later Linux and others)

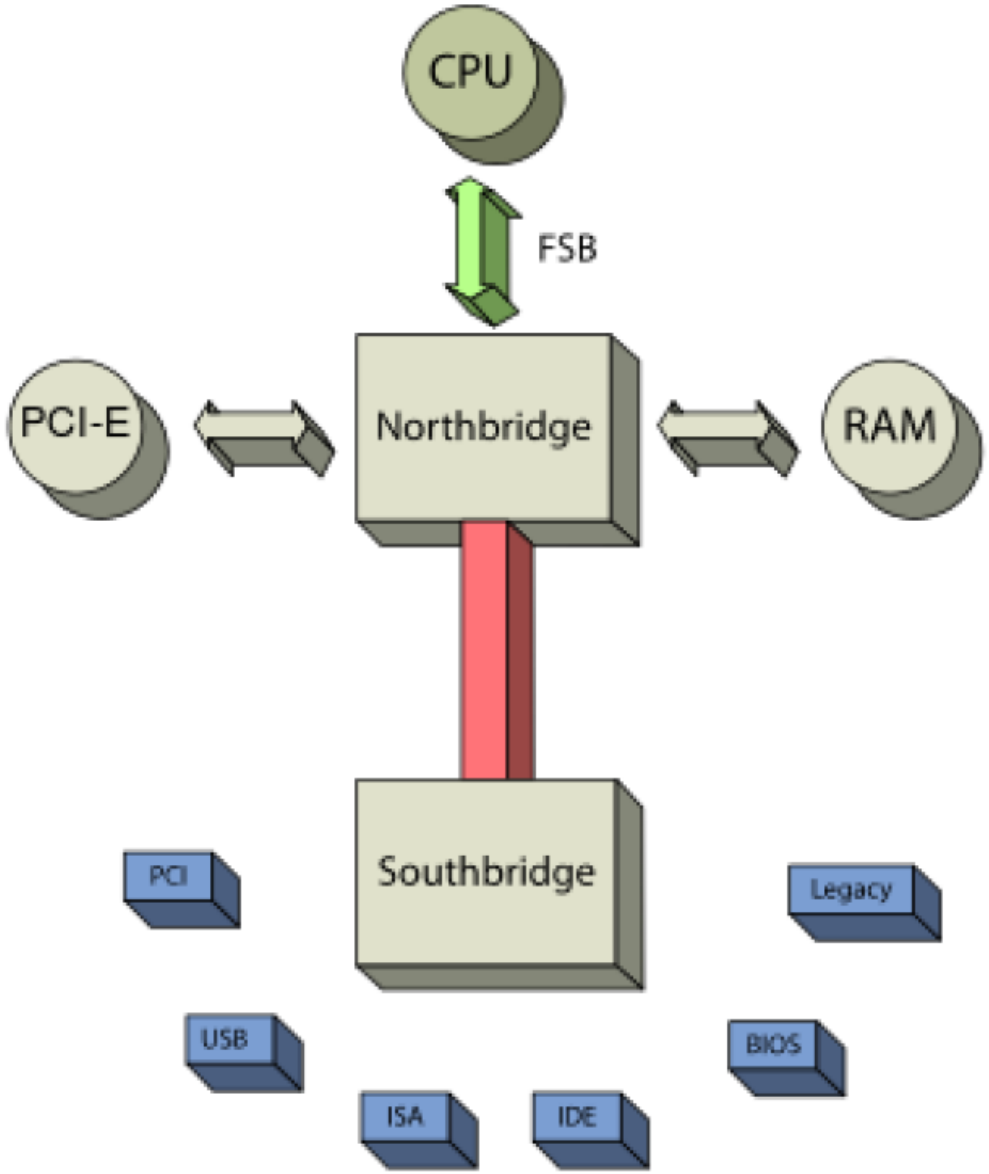
Computer subsystems

- Case and PSU
- Motherboard
- CPU
- Memory
- Storage subsystem
- Video, Audio subsystem
- Network subsystem
- Input/output devices
- Others

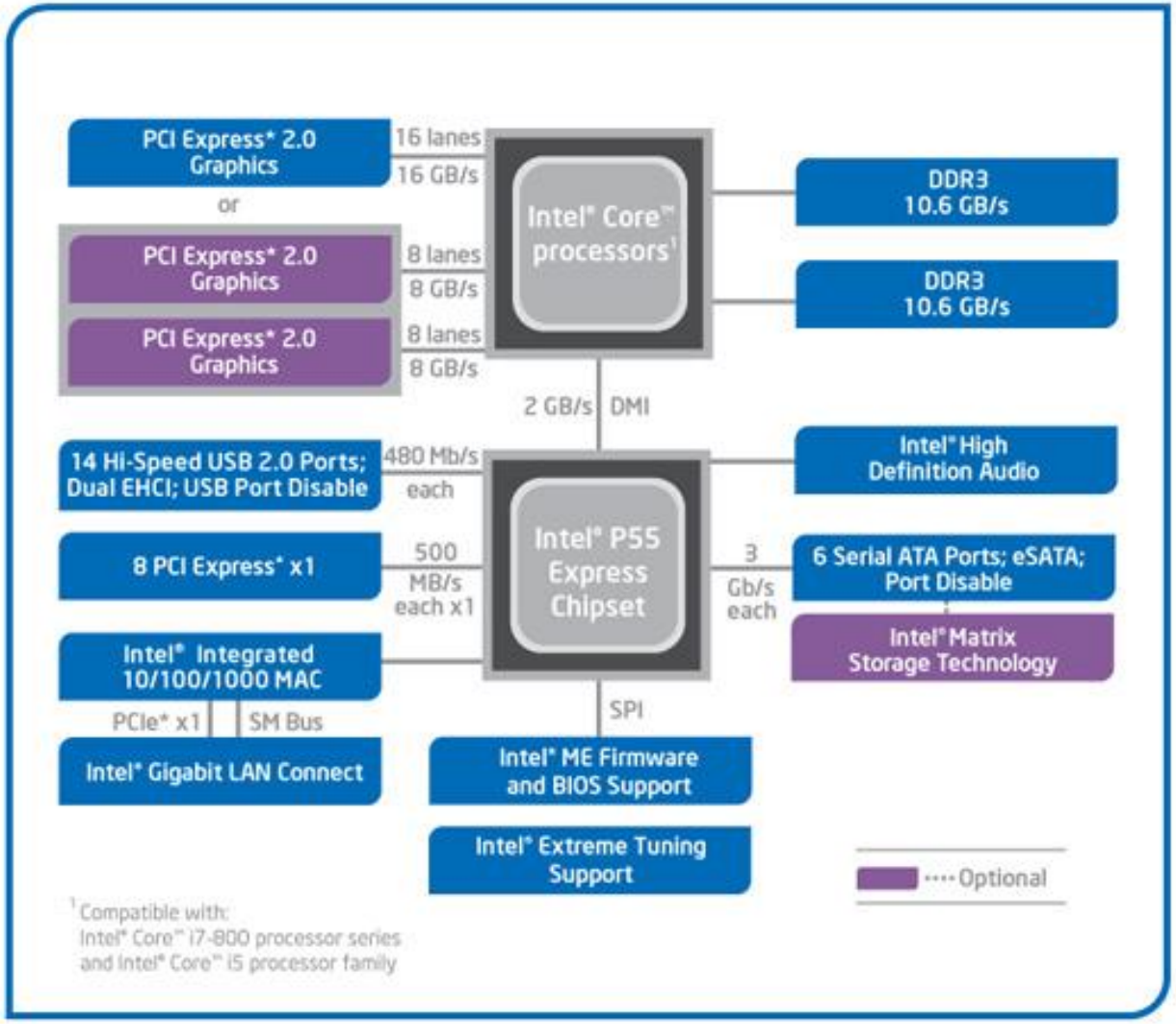
Chipset

- This is a circuit that enables connectivity between various busses in personal computers
- Chipsets of yester-year consisted of two main chips:
  - NorthBridge (fast busses like memory, GPU)
  - SouthBridge (slow busses)

MBO with NB/SB



MBO without NB/SB

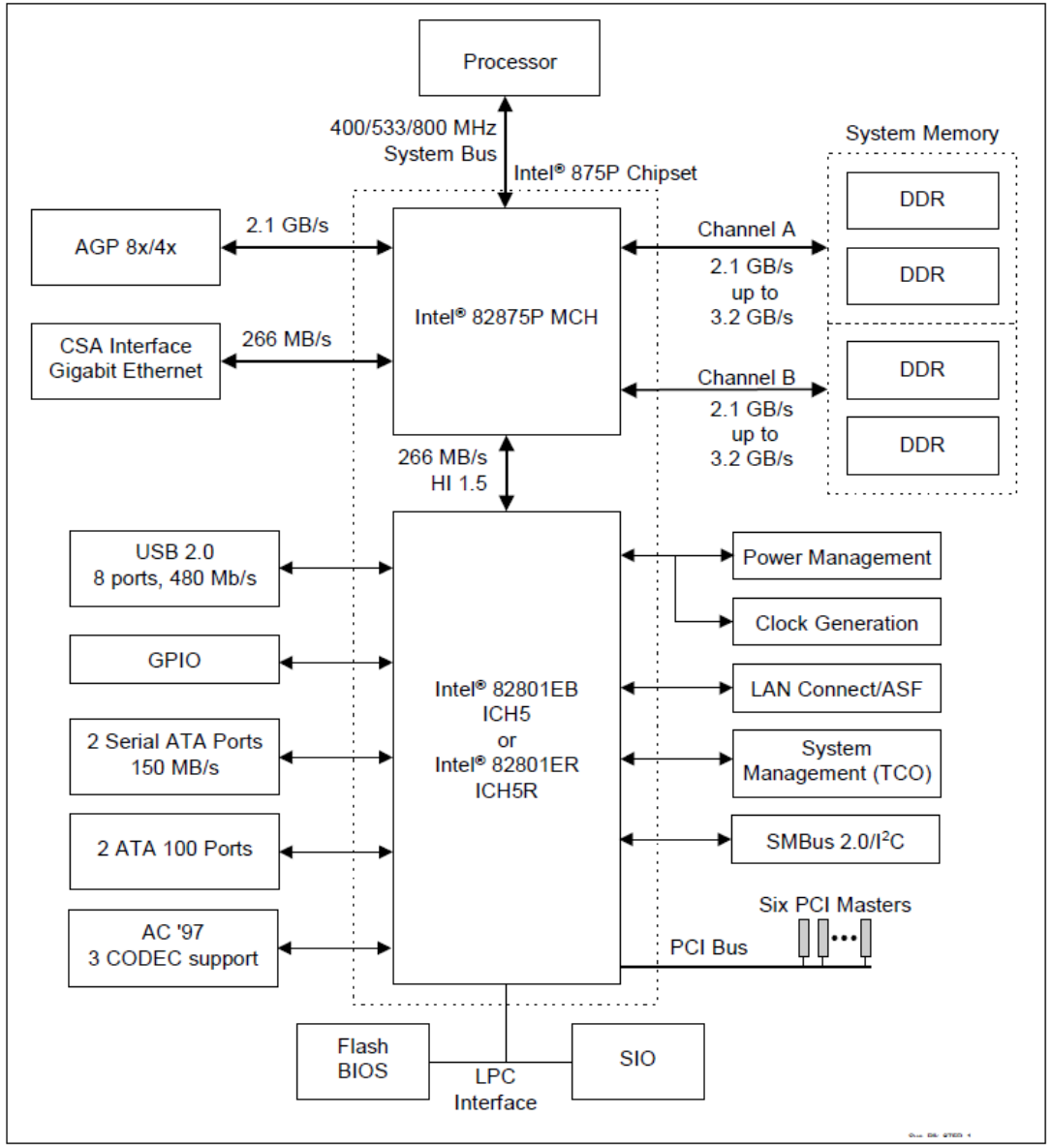


Intel® P55 Express Chipset Platform Block Diagram

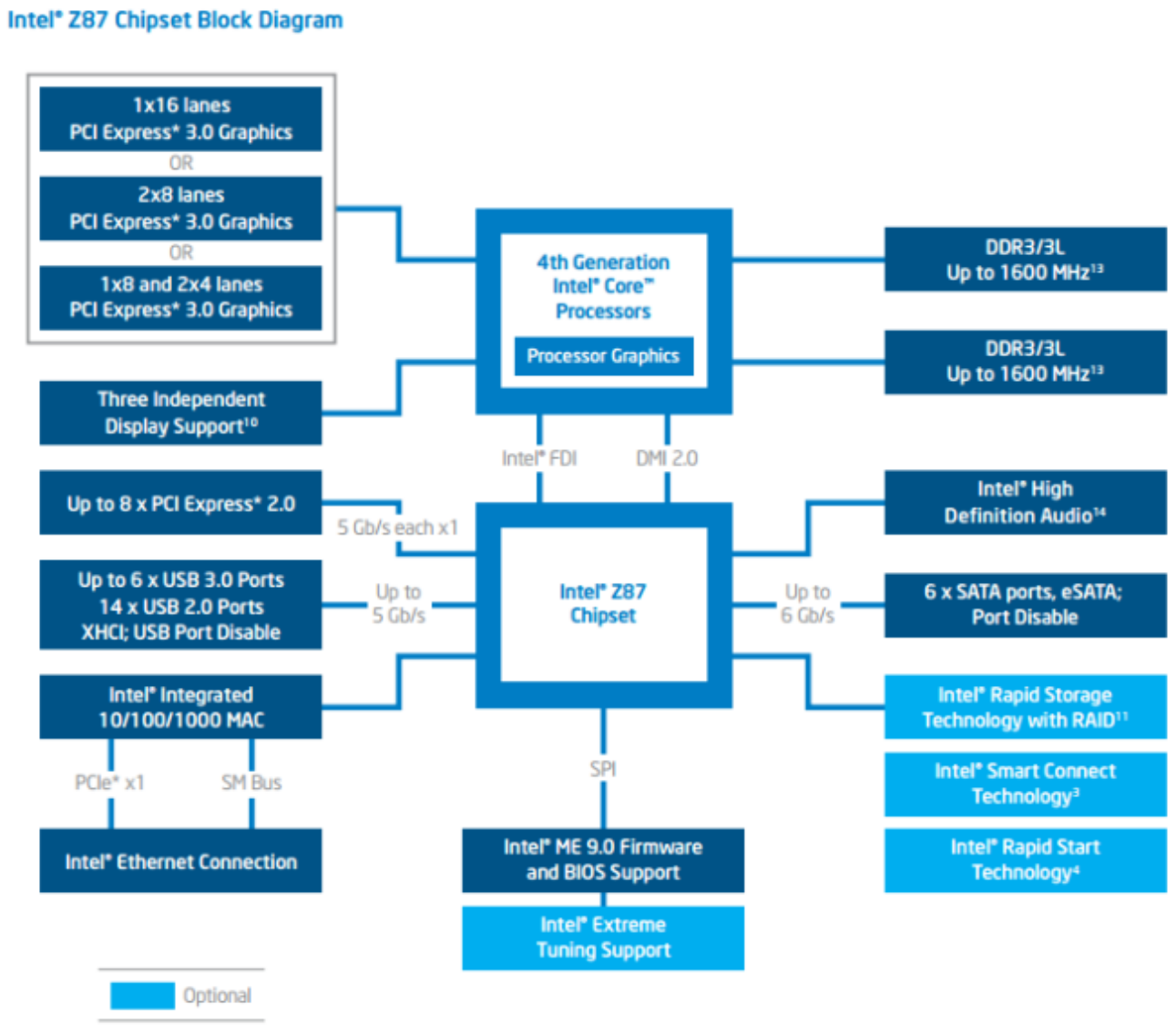
Comparison of the last NB/SB chipset vs first DMI based chipset

	AMD SB750	Intel ICH10R	Intel P55
Additional PCI Express	None	6 x1 PCIe 1.1	8 x 1 PCIe 2.0
USB	12 ports	12 ports	14 ports
SATA (300MB/s)	6 ports	6 ports	6 ports
PATA	2 channels	None	None
RAID*	RAID 0/1/5/10	RAID 0/1/5/10	RAID 0/1/5/10
HD Audio Interface	Yes	Yes	Yes
Ethernet	Not Integrated	Intel Gigabit LAN	Intel Gigabit LAN
Northbridge Interface	4 lane PCIe 1.1	DMI 10Gb/s each direction, full duplex	DMI 10Gb/s each direction, full duplex

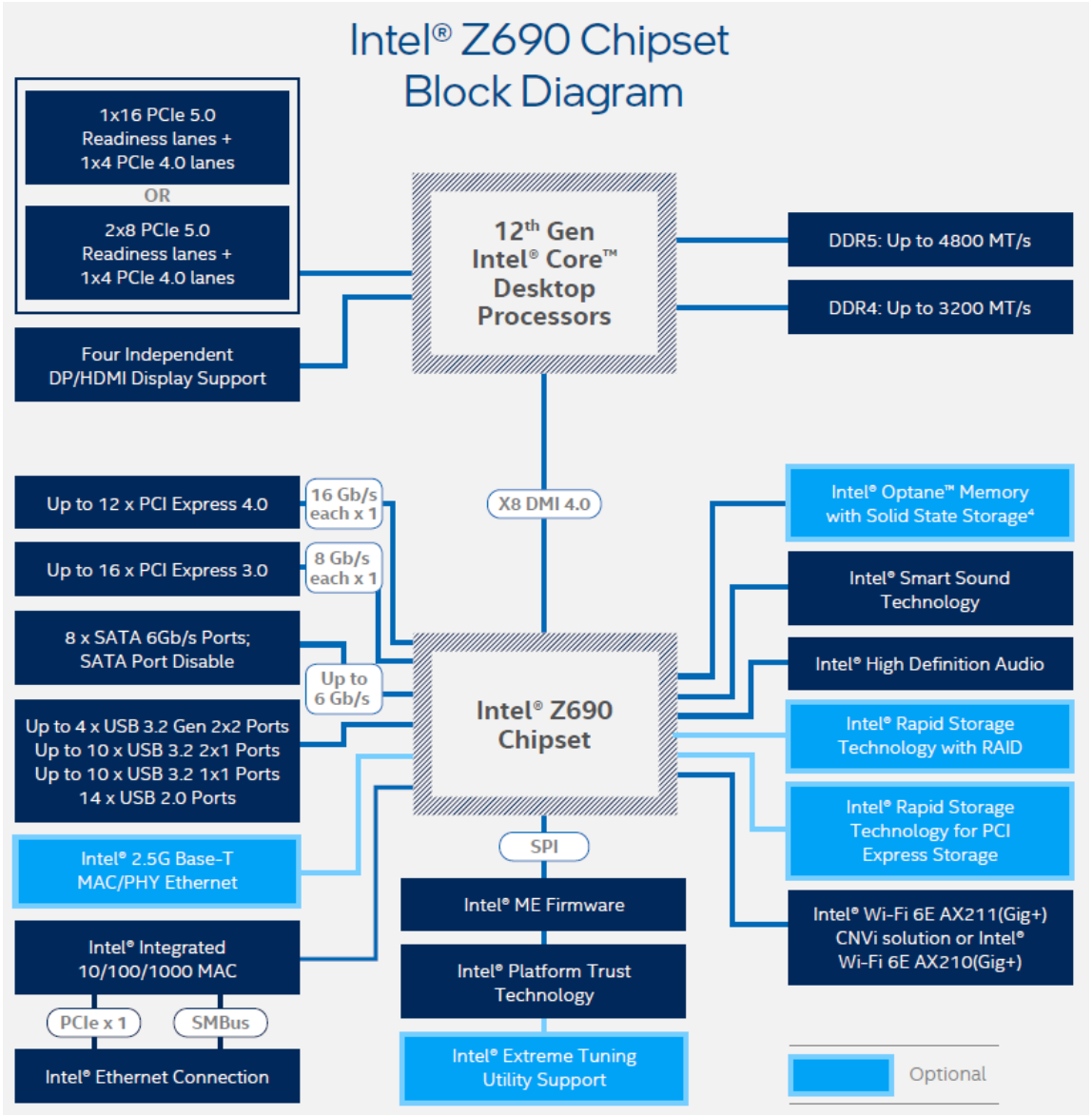
Intel 875 chipset, 2003.



Intel Z87 chipset, 2013.



Intel Z690 chipset, 2022.



Pentium 4

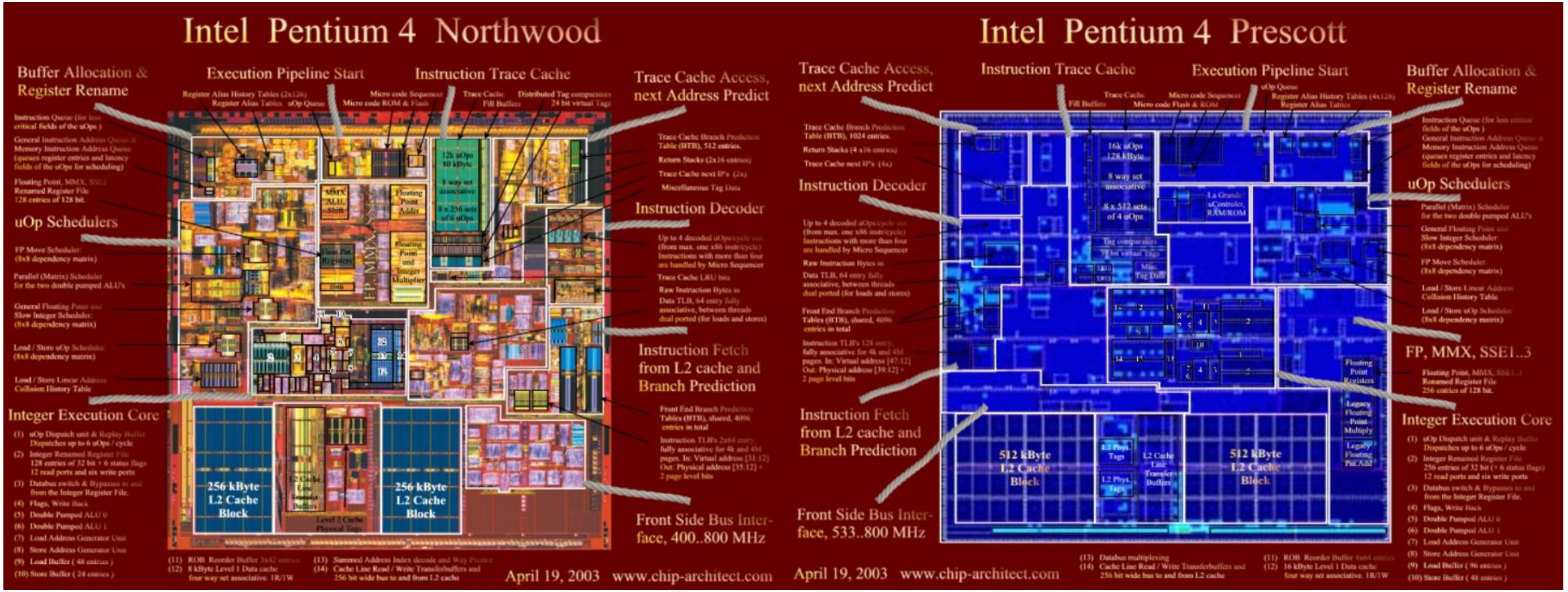
	Willamette	Northwood	Prescott
transistors	42M	55M	125M
process	180 nm	130 nm	90 nm
Die size	217 mm^2	145 mm^2	112 mm^2
Peak power	~70 Watt	~50 Watt	~100 Watt
Freq	≤ 2.0 GHz	≤ 3.4 GHz	2.8 – 3.8 GHz
Bus	400 MHz	400/533/800 MHz	533/800 MHz
L1 cache	8KB 4-way	8KB 4-way	16KB 8-way
L2 cache	256KB	512KB	1MB
HT	No	Yes	yes
Architecture	MMX, SSE, SSE2	MMX, SSE, SSE2	MMX, SSE, SSE2, SSE3

Intel CPUs

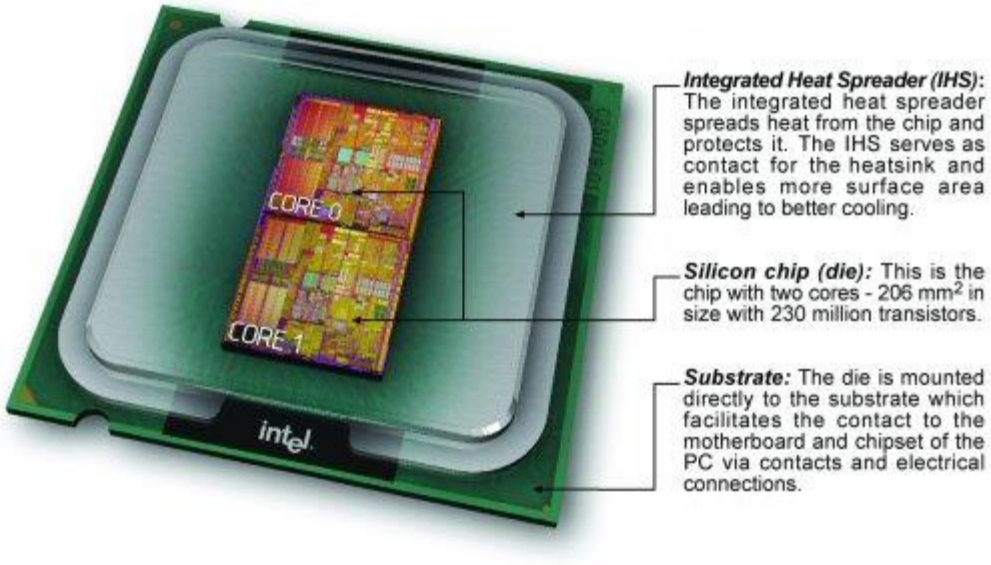
x86 PROCESSORS (from Intel)

Bits	Family	Clock Speed (approx.)	Bus Size (bits)	Max RAM	Storage Range	OS
64	Xeon	4.3GHz	64	3TB	500GB-10TB	Windows: 10, 8, 7 XP, 2000 NT, 98 95, 3.x Linux Mac OS X SCO Unix Solaris
	Core i9	3.3GHz		128GB		
	Core i3, i5, i7	3.3GHz		64GB		
	Core 2 Duo	2.6GHz				
	Pentium 4	3.8GHz				
	Pentium D	3.4GHz				
32	Core Duo	2.2GHz		4GB	500MB-60GB	DOS DR DOS OS/2 Misc DOS Multiuser
	Pentium 4	2.8GHz				
	Xeon	3.2GHz				
	Celeron	2.4GHz				
	Pentium III	1.2GHz				
	Pentium II	450MHz				
	Pentium Pro	233MHz		64GB		
	Pentium	200MHz		4GB		
	486DX	100MHz	32		200 - 500MB	
	486SX	40MHz				
	386DX	40MHz			60 - 200MB	
	386SX	33MHz				
	386SL	25MHz				
16	286	12MHz	16	16MB	20-80MB	DOS DR DOS Win 3.x OS/2 1.x
	8086	10MHz		1MB	10-20MB	DOS DR DOS
	8088	5MHz	8			

<sarcasm> Two heroes, first half of 2000s </sarcasm>



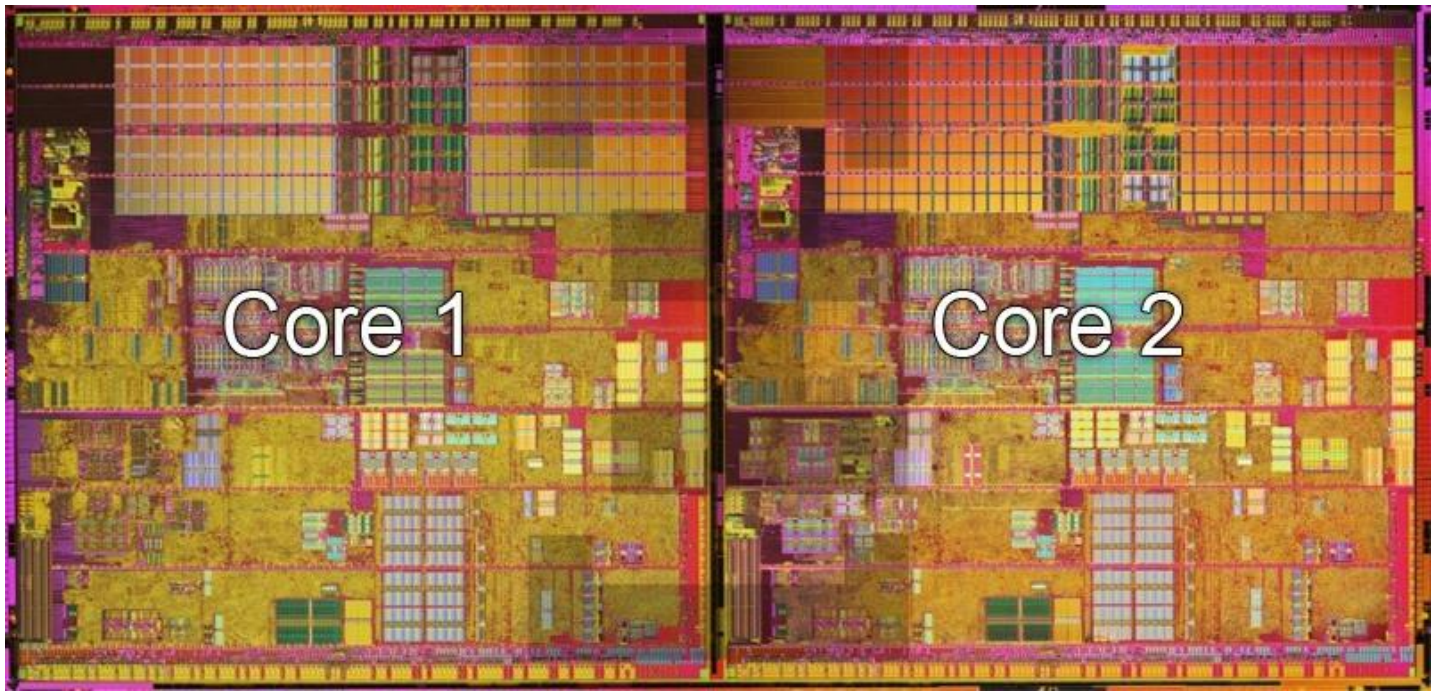
“Modern-day hero”, Pentium D (2005.)



Integrated Heat Spreader (IHS): The integrated heat spreader spreads heat from the chip and protects it. The IHS serves as contact for the heatsink and enables more surface area leading to better cooling.

Silicon chip (die): This is the chip with two cores - 206 mm^2 in size with 230 million transistors.

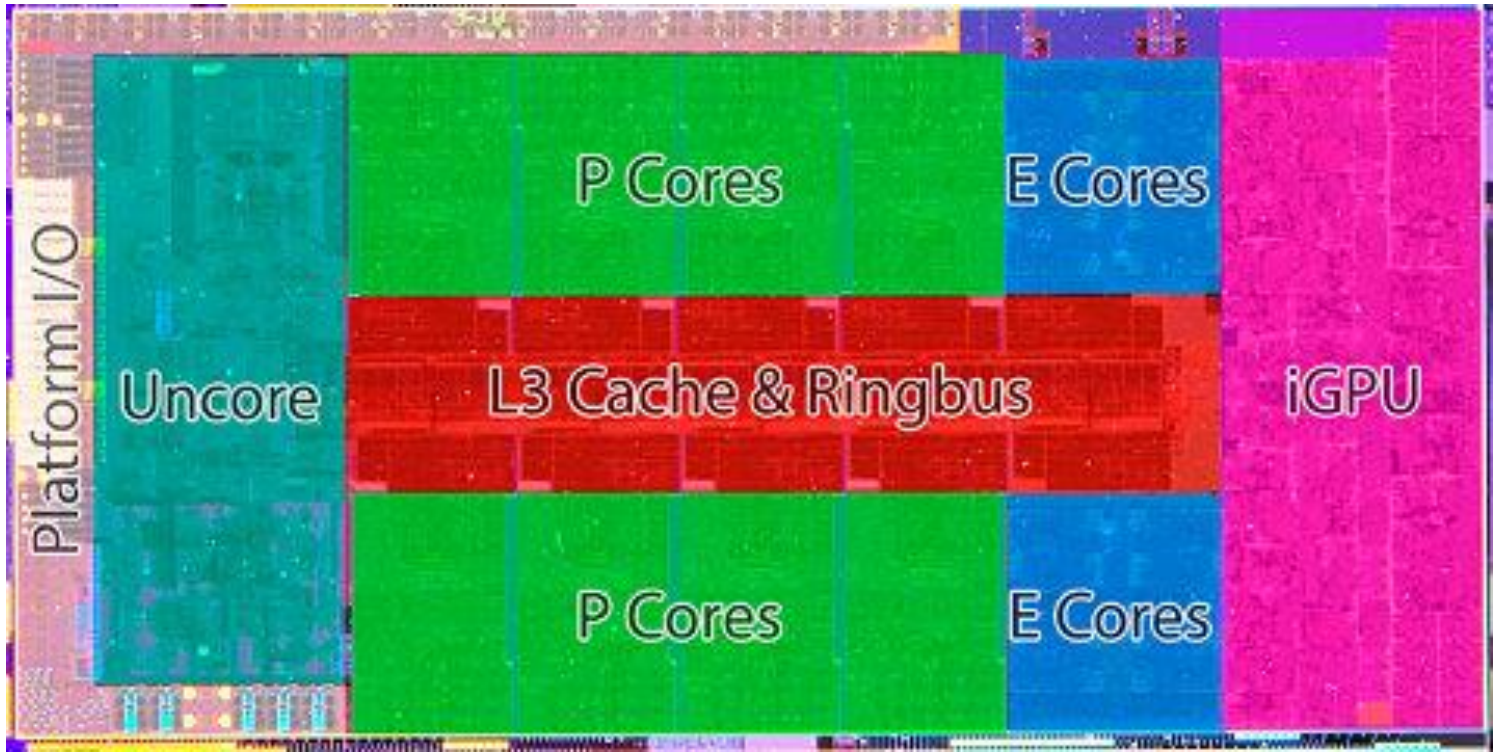
Substrate: The die is mounted directly to the substrate which facilitates the contact to the motherboard and chipset of the PC via contacts and electrical connections.



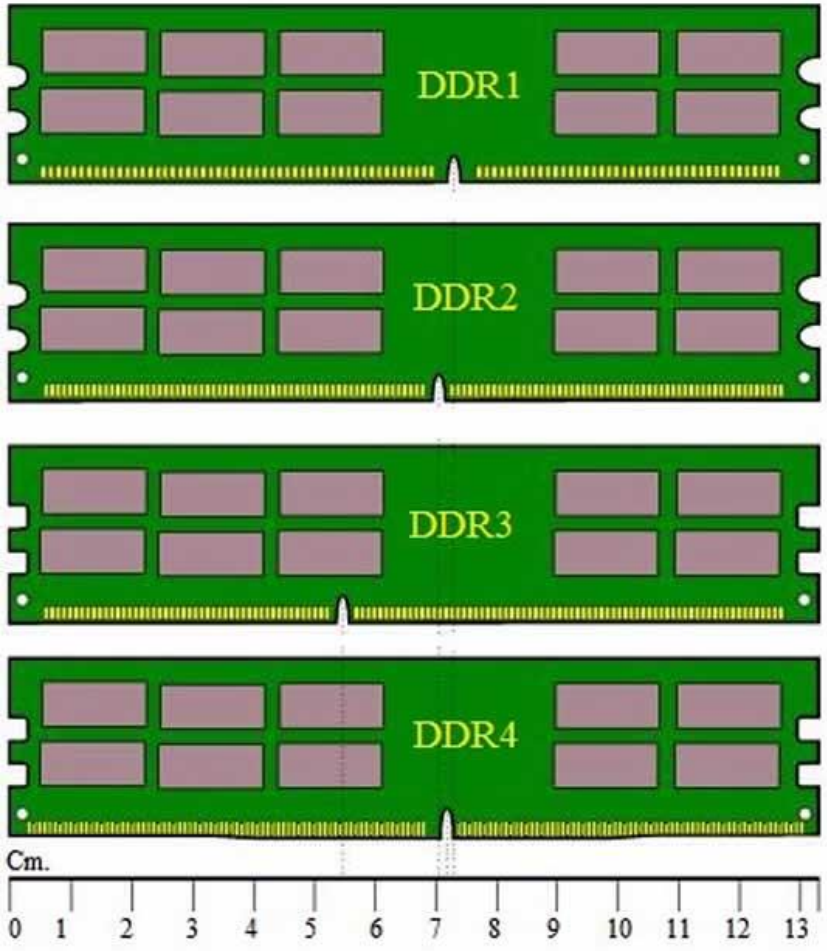
I9-12900k

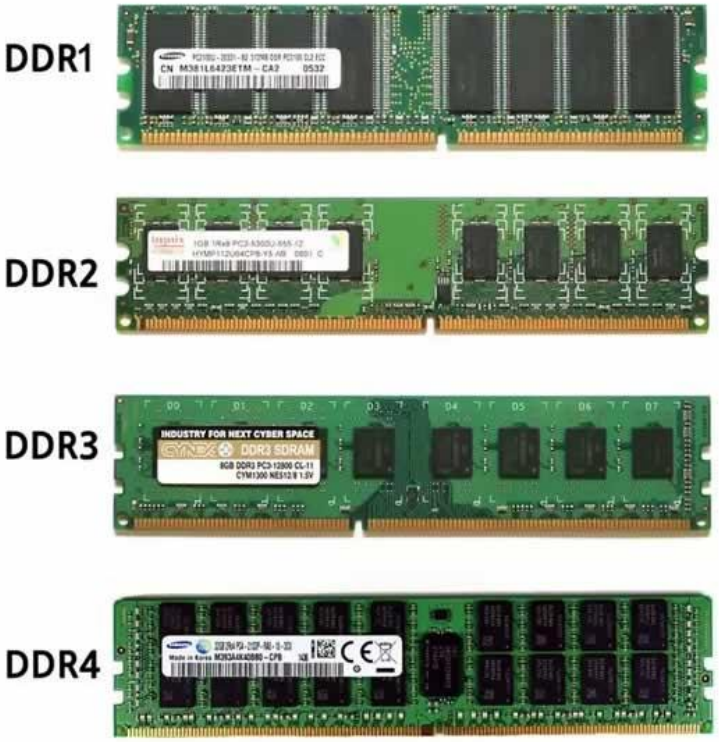

128-Bit DDR4-3200 / DDR5-4800 Physical Layer (PHY)
8x Lanes DMI4.0
16x PCIe Gen5 Lanes
4x PCIe4 Lanes
PCIe & DMI4.0 Control
Memory Control
System Agent
GNA3.0
Display Control Logic
5x Display PHY
FPU/ SIMD
Golden Cove CPU Core
1.25MiB L2$/MLC
3MiB L3$/LLC
2x Ring Agent
2MiB L2$/MLC
Gracemont CPU Core
Media Engine
16 EUs (128 Cores)
8x TMUs, L1/Tex$, SLM
GPU Front/Backend, GPU L3$, Other Logic
10nm ESF/Intel 7 Alder Lake die shot (~209mm²) from Intel via Andreas Schilling on Twitter:
https://twitter.com/aschilling/status/1453391035577495553
Die shot interpretation by Locuza, October 2021

I9-12900k, drugi čin

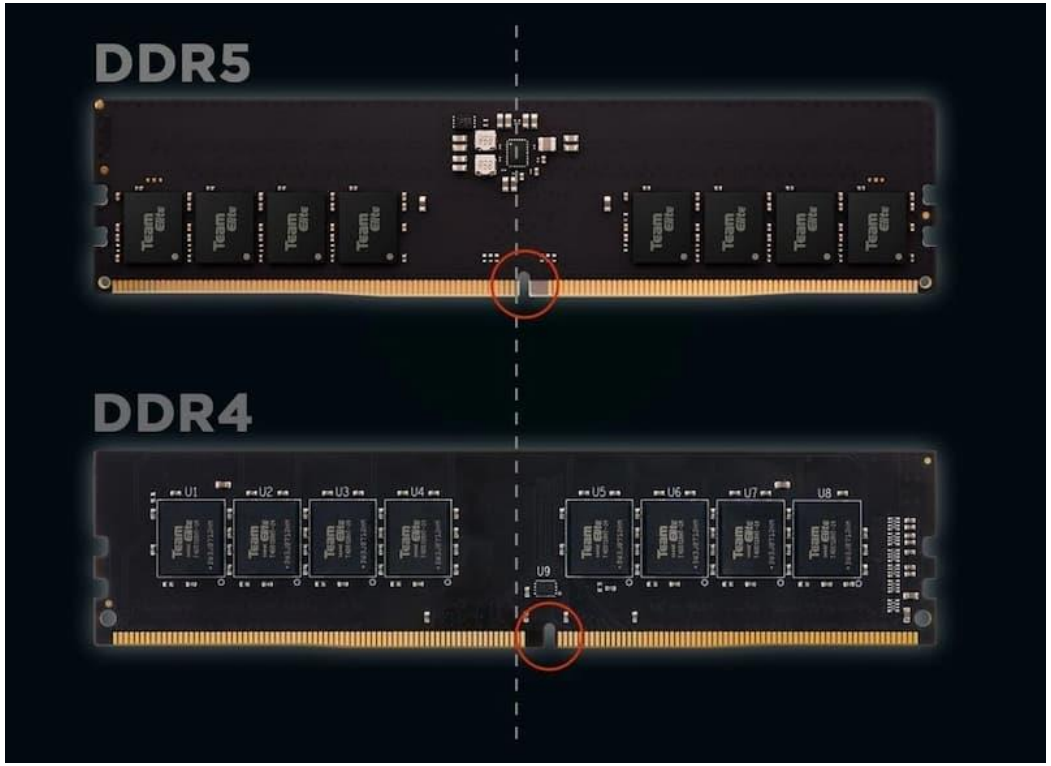


Memorija - DDR1, DDR2, DDR3, DDR4





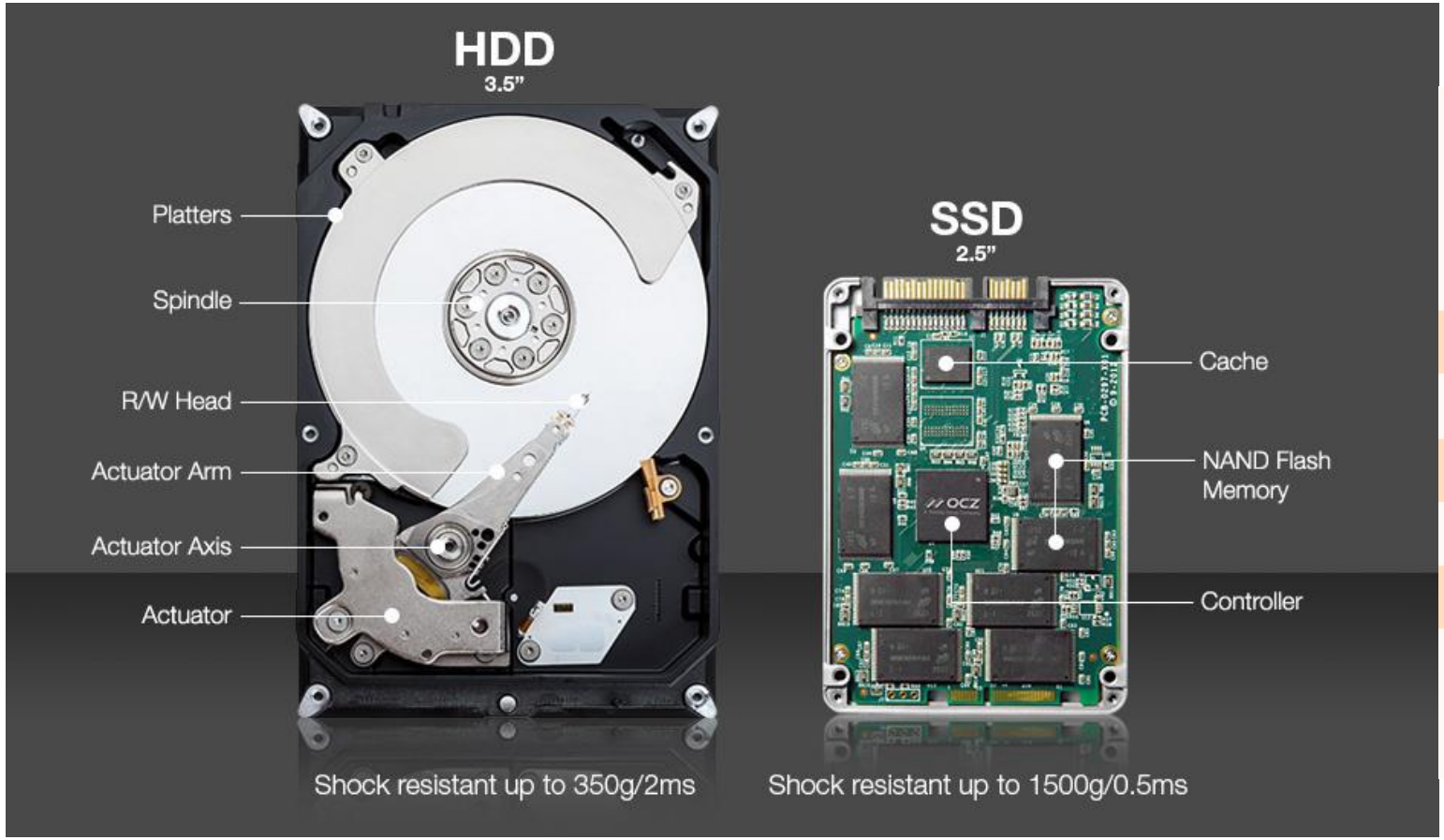
DDR4 vs DDR5



DDR5 SPECIFICATIONS

ITEMS	DDR4	DDR5
Frequency	1600~3200Mbps	3200~8400Mbps
Density	2Gb, 4Gb, 8Gb, 16Gb	8Gb, 16Gb, 24Gb, 32Gb, 64Gb
On die ECC	No	Yes
Bank	16banks	32banks
VDD/VDDQ	1.2V	1.1V
VPP	2.5V	1.8V
BL	8	16
DFE	No	Yes
Same bank refresh	No	Yes

Storage



SSD vs HDD

SSD		HDD
faster	✓ ✗	slower
shorter lifespan	✗ ✓	longer lifespan
more expensive	✗ ✓	cheaper
non-mechanical (flash)	✓ ✗	mechanical (moving parts)
shock-resistant	✓ ✗	fragile
best for storing operating systems, gaming apps, and frequently used files		best for storing extra data, such as movies, photos, and documents

Hvala na pažnji!