AMD Raphael(7000 series)

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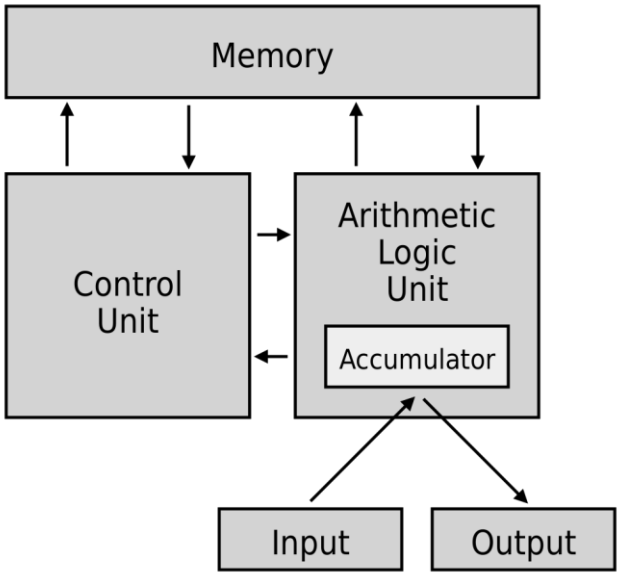
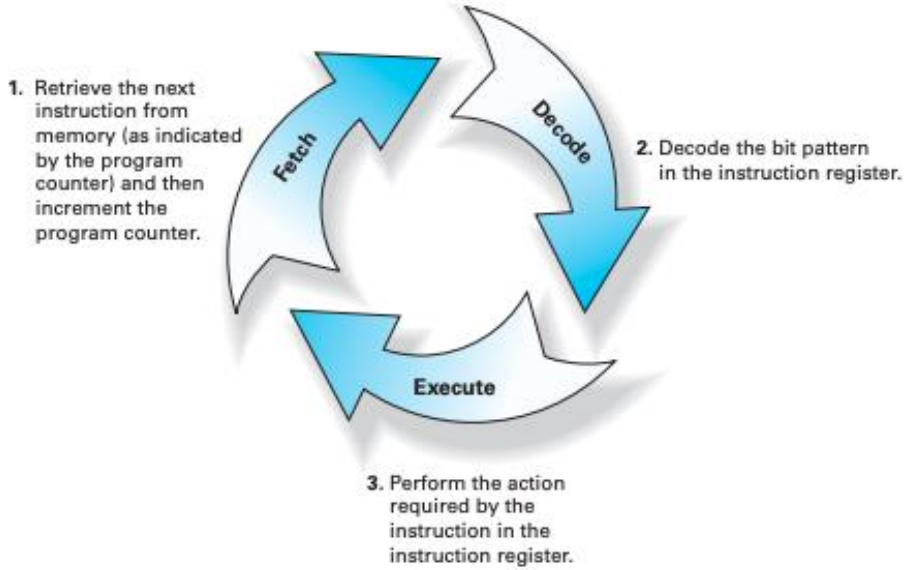
Outline

- General uses
- Product timeline
- System description
- Technology analysis
- Industry analysis
- Applications
- Future
- reference

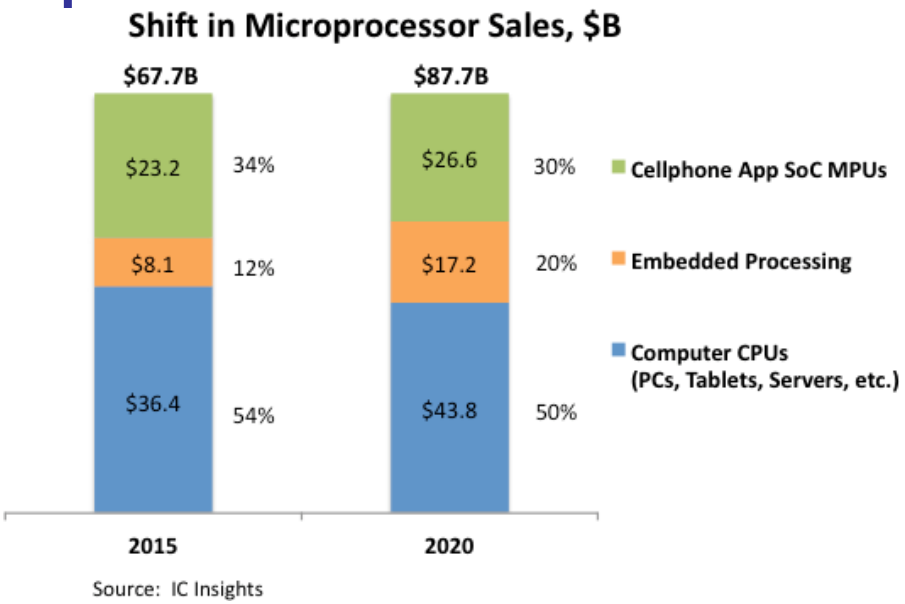
General uses

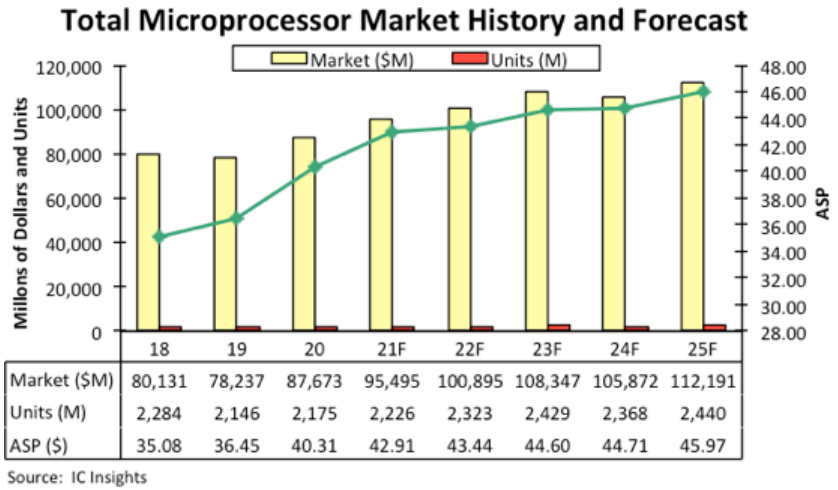
➢CPU function





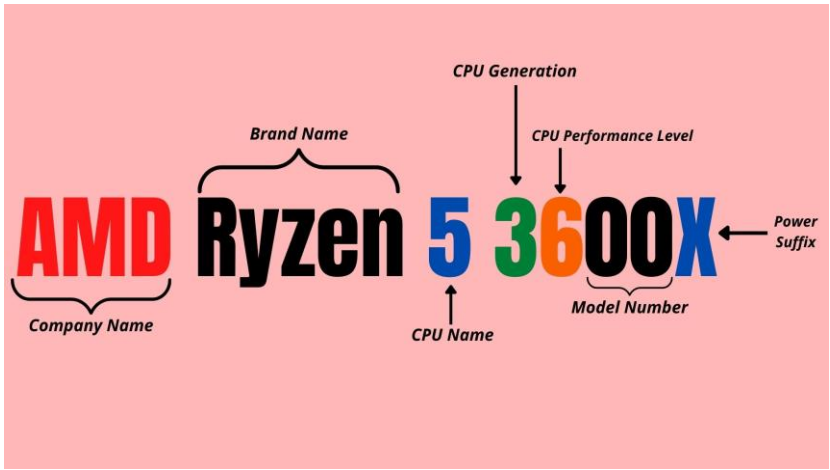
➢Market


Shift in Microprocessor Sales, $B
$67.7B
$87.7B
$23.2
34%
$8.1
12%
$36.4
54%
$26.6
30%
$17.2
20%
$43.8
50%
Cellphone App SoC MPUs
Embedded Processing
Computer CPUs
(PCs, Tablets, Servers, etc.)
2015
2020
Source: IC Insights


Total Microprocessor Market History and Forecast
Market ($M)
Units (M)
Millons of Dollars and Units
ASP
120,000
100,000
80,000
60,000
40,000
20,000
0
48.00
46.00
44.00
42.00
40.00
38.00
36.00
34.00
32.00
30.00
28.00
18 19 20 21F 22F 23F 24F 25F
Market ($M) 80,131 78,237 87,673 95,495 100,895 108,347 105,872 112,191
Units (M) 2,284 2,146 2,175 2,226 2,323 2,429 2,368 2,440
ASP ($) 35.08 36.45 40.31 42.91 43.44 44.60 44.71 45.97
Source: IC Insights

Ryzen Raphael (7000 series CPUs)

- Ryzen 5 7600X
- Ryzen 7 7700X
- Ryzen 9 7900X
- Ryzen 9 7950X



Ryzen 3 — Up to 4-core processors.
Ryzen 5 — Up to 6-core processors.
Ryzen 7 — Up to 8-core processors.
Ryzen 9 — Up to 16-core processors.
Ryzen Threadripper — Up to 64-core processors.

Ryzen 3 1xxx —1000 series CPUs

Ryzen 3 1xxxX —having high clock speed, power, consumption, and speed

Product timeline

➢AMD product timeline(to 4th generation)

Zen based(1st generation)

Summit Ridge (1000 series CPUs)

Fabrication process: GlobalFoundries 14

nm

Entry-level

Ryzen 3 1200
Ryzen 3 PRO 1200
Ryzen 3 PRO 1300
Ryzen 3 1300X

Mainstream

Ryzen 5 1400
Ryzen 5 PRO 1500
Ryzen 5 1500X
Ryzen 5 1600
Ryzen 5 PRO 1600
Ryzen 5 1600X

Performance

Ryzen 7 1700
Ryzen 7 PRO 1700
Ryzen 7 1700X
Ryzen 7 1800X

High-end desktop(HEDT)

Ryzen Threadripper 1900X
Ryzen Threadripper 1920X
Ryzen Threadripper 1950X

Raven Ridge (2000 series APUs)

Fabrication process: GlobalFoundries 14

nm

Includes integrated GCN 5th generation

GPU

Ryzen 3 2200GE
Ryzen 3 PRO 2200GE
Ryzen 3 2200G
Ryzen 3 PRO 2200G
Ryzen 5 2400GE
Ryzen 5 PRO 2400GE
Ryzen 5 2400G
Ryzen 5 PRO 2400G

Zen+ based(2nd generation)

Pinnacle Ridge (2000 series CPUs)

Fabrication process: GlobalFoundries 12

nm

Entry-level

Ryzen 3 1200(AF)
Ryzen 3 2300X

Mainstream

Ryzen 5 2500X
Ryzen 5 2600E
Ryzen 5 1600(AF)
Ryzen 5 2600
Ryzen 5 2600X

Performance

Ryzen 7 2700E
Ryzen 7 2700
Ryzen 7 PRO 2700
Ryzen 7 PRO 2700X
Ryzen 7 2700X

GlobalFoundries 12 nm

generation GPU

Zen 2 based(3rd generation)

nm FinFET

Peak (Threadripper)

Picasso (3000 series APUs)

Fabrication process:

Includes integrated GCN 5th

Ryzen 3 Pro 3200GE
Ryzen 3 3200G
Ryzen 3 Pro 3200G
Ryzen 5 Pro 3350GE
Ryzen 5 Pro 3350G
Ryzen 5 Pro 3400GE
Ryzen 5 3400G
Ryzen 5 Pro 3400G

Zen 3 based(4th generation)

Matisse and Castle Peak (3000 series CPUs)

Fabrication process: TSMC 7

Matisse (desktop), Castle

integrated GPU disabled

Entry-level

Ryzen 3 3100
Ryzen 3 3300X

Mainstream

Ryzen 5 3500
Ryzen 5 3500X
Ryzen 5 3600
Ryzen 5 Pro 3600
Ryzen 5 3600X
Ryzen 5 3600XT

Performance

Ryzen 7 Pro 3700
Ryzen 7 3700X
Ryzen 7 3800X
Ryzen 7 3800XT

Enthusiast

Ryzen 9 3900
Ryzen 9 Pro 3900
Ryzen 9 3900X
Ryzen 9 3900XT
Ryzen 9 3950X

High-End Desktop (HEDT)

Ryzen Threadripper 3960X
Ryzen Threadripper 3970X
Ryzen Threadripper 3990X

Workstation

Ryzen Threadripper Pro

Ryzen Threadripper Pro

Ryzen Threadripper Pro

Ryzen Threadripper Pro

High-end desktop(HEDT)

Ryzen Threadripper 2920X
Ryzen Threadripper 2950X
Ryzen Threadripper 2970WX
Ryzen Threadripper 2990WX

integrated GPU disabled

Renoir (4000 series CPUs)

Fabrication process: TSMC 7 nm FinFET

Based on the Ryzen 4000G series APUs with the

Ryzen 3

Ryzen 3 4100

Ryzen 5

Ryzen 5 4500

Renoir (4000 series APUs)

Fabrication process: TSMC 7 nm FinFET

Includes integrated GCN 5th generation GPU

Ryzen 3 4300GE
Ryzen 3 4300G
Ryzen 5 4600GE
Ryzen 5 4600G
Ryzen 7 4700GE
Ryzen 7 4700G

Vermeer and Chagall (5000 series CPUs)

Fabrication process: TSMC 7 nm FinFET

Vermeer (desktop), Chagall (Threadripper)

The Ryzen 5 5500 is a Cezanne APU with its

Mainstream

Ryzen 5 5500
Ryzen 5 5600
Ryzen 5 5600X

Performance

Ryzen 7 5700X
Ryzen 7 5800
Ryzen 7 5800X
Ryzen 7 5800X3D

Enthusiast

Ryzen 9 5900
Ryzen 9 5900X
Ryzen 9 5950X

High-end desktop/Workstation

Ryzen Threadripper PRO 5945WX
Ryzen Threadripper PRO 5955WX
Ryzen Threadripper PRO 5965WX
Ryzen Threadripper PRO 5975WX
Ryzen Threadripper PRO 5995WX

Cezanne (5000 series APUs)

Fabrication process: TSMC 7 nm FinFET

Includes integrated GCN 5th generation GPU

Ryzen 3 5300GE
Ryzen 3 5300G
Ryzen 5 5600GE
Ryzen 5 5600G
Ryzen 7 5700GE
Ryzen 7 5700G

3945WX

3955WX

3975WX

3995WX

➢AMD product timeline

Zen based(1st generation)

- Summit Ridge (1000 series CPUs)
  - Fabrication process: GlobalFoundries 14 nm
- Raven Ridge (2000 series APUs)
  - Fabrication process: GlobalFoundries 14 nm
  - Includes integrated GCN 5th generation GPU

Zen+ based(2nd generation)

- Pinnacle Ridge (2000 series CPUs)
  - Fabrication process: GlobalFoundries 12 nm
- Picasso (3000 series APUs)
  - Fabrication process: GlobalFoundries 12 nm
  - Includes integrated GCN 5th generation GPU

Zen 2 based(3rd generation)

- Matisse and Castle Peak (3000 series CPUs)
  - Fabrication process: TSMC 7 nm FinFET
  - Matisse (desktop), Castle Peak (Threadripper)
- Renoir (4000 series CPUs)
  - Fabrication process: TSMC 7 nm FinFET
  - Based on the Ryzen 4000G series APUs with the integrated GPU disabled
- Renoir (4000 series APUs)
  - Fabrication process: TSMC 7 nm FinFET
  - Includes integrated GCN 5th generation GPU

Zen 3 based(4th generation)

- Vermeer and Chagall (5000 series CPUs)
  - Fabrication process: TSMC 7 nm FinFET
  - Vermeer (desktop), Chagall (Threadripper)
  - The Ryzen 5 5500 is a Cezanne APU with its integrated GPU disabled
- Cezanne (5000 series APUs)
  - Fabrication process: TSMC 7 nm FinFET
  - Includes integrated GCN 5th generation GPU

Zen 4 based (5th generation)

- Raphael (7000 series CPUs)
  - Fabrication process: TSMC 5 nm FinFET
  - Includes integrated RDNA2 GPU

Ryzen 5

Ryzen 5 7600X

Ryzen 7

Ryzen 7 7700X

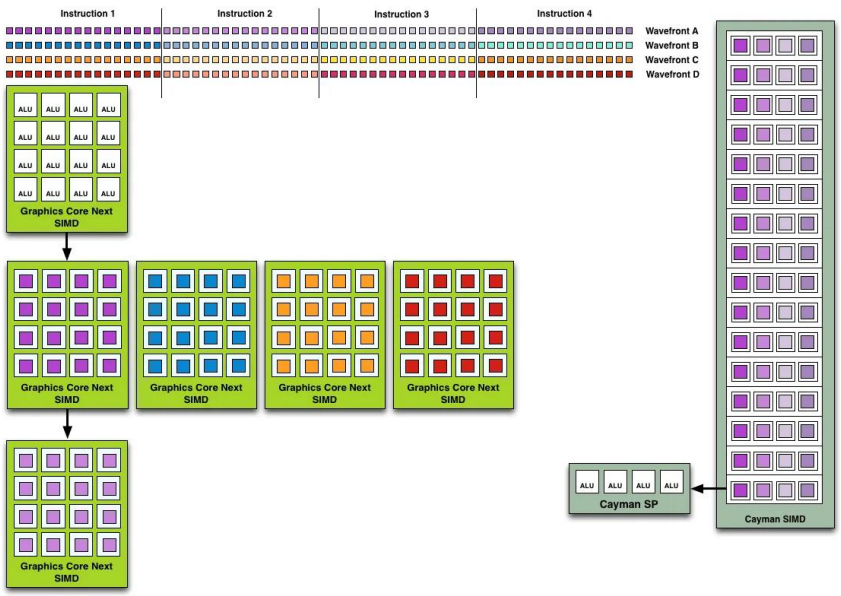
Ryzen 9

Ryzen 9 7900X

Ryzen 9 7950X

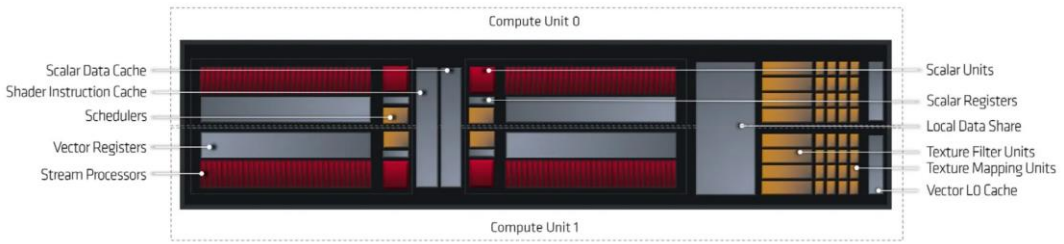
➢AMD GPU

GCN

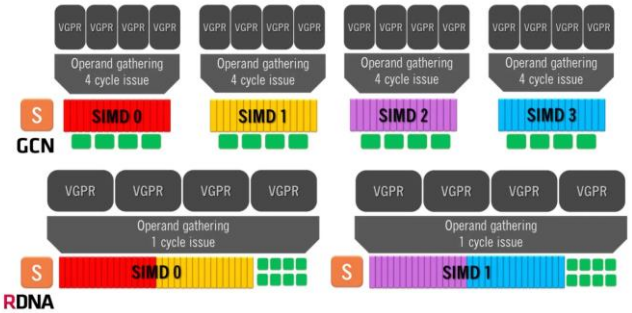


- ✓ 64 wavefronts or work-items (and ALUs/cores) per Compute Unit.
- ✓ divided into four SIMDs (Single Instruction On Multiple Data Types), each packing 16 ALUs (SP)

RDNA2 GPU



- ✓ two CUs working in tandem with shared local data.
- ✓ The RDNA SIMDs consist of 32 shaders or ALUs, twice that of GCN. There are two SIMDs per CU and four in a Dual Compute Unit.



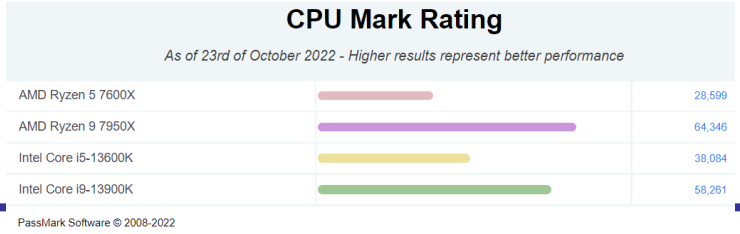
This arrangement allows the execution of one whole wavefront in one clock cycle

Product timeline

series		1000 series	5000 series	5000 series	7000 series	7000 series	7000 series
Model		Ryzen 3 1300X	Ryzen 7 5800X	Ryzen 9 5950X	Ryzen 5 7600X	Ryzen 7 7700X	Ryzen 9 7950X
Release date and price		2017/07/27 US$129	2020/11/05 US$449	2020/11/05 US$799	2022/09/27 US$299	2022/09/27 US$399	2022/09/27 US$699
Fab		GloFo 14LP	TSMC N7	TSMC N7	TSMC N5	TSMC N5	TSMC N5
Chiplets		1xCCD	1xCCD 1xI/OD	2xCCD 1xI/OD	1xCCD 1xI/OD	1xCCD 1xI/OD	2xCCD 1xI/OD
CPU	Cores(threads)	4 (4)	8 (16)	16 (32)	6 (12)	8 (16)	16 (32)
	Core config	2x2	1x8	2x8	1x6	1x8	2x8
	Clock rate (GHz) Base/ Boost	3.5/ 3.7	3.8/ 4.7	3.4/4.9	4.7/ 5.3	4.5/ 5.4	4.5/ 5.7
	Cache L1/L2/L3	64 KB/2 MB/8 MB	512 KB/4 MB/32 MB	1MB/8MB/64MB	384 KB/6 MB/32 MB	512 KB/8 MB/32 MB	1 MB/16 MB/64 MB
GPU	Architecture	-	-	-	RDNA 2	RDNA 2	RDNA 2
	CUs	-	-	-	2	2	2
	Clock rate (GHz) Base/ Boost	-	-	-	0.4/2.2	0.4/2.2	0.4/2.2
	Processing power(GFLOPS)	-	-	-	563	563	563
Socket		AM4	AM4	AM4	AM5	AM5	AM5
PCIe lanes		24 (20+4) PCIe 3.0	24 (20+4) PCIe 4.0	24(20+4) PCIe 4.0	28 (24+4) PCIe 5.0	28 (24+4) PCIe 5.0	28 (24+4) PCIe 5.0
Memory support		DDR4-2667 dual-channel	DDR4-3200 dual-channel	DDR4-3200 dual-channel	DDR5-5200 dual-channel	DDR5-5200 dual-channel	DDR5-5200 dual-channel
TDP		65 W	105 W	105 W	105 W	105 W	170 W

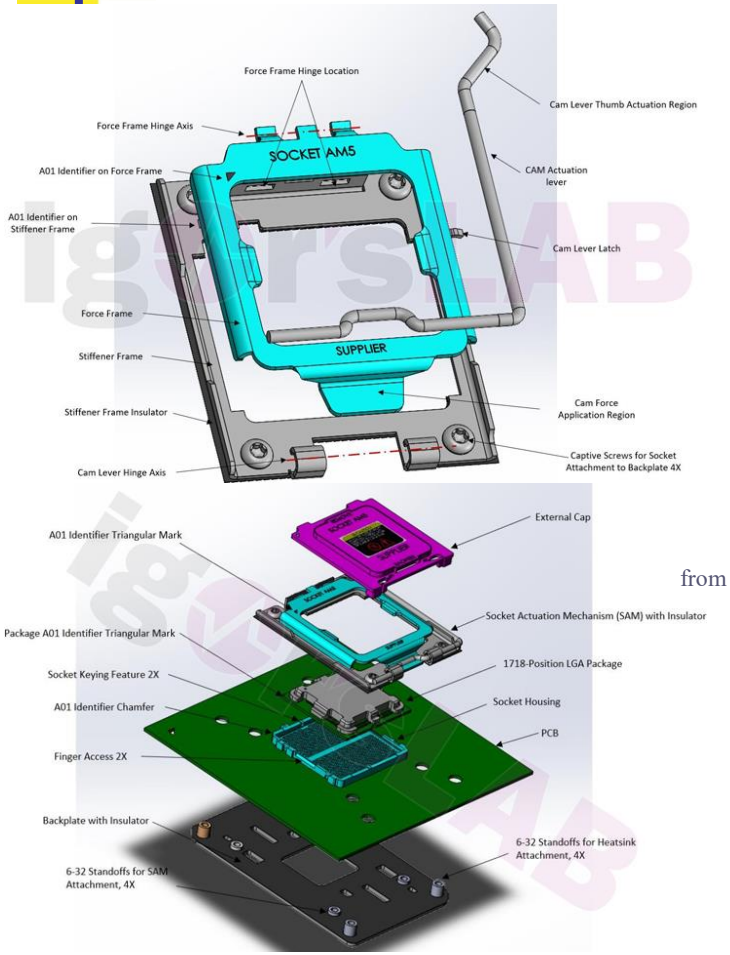
晶粒種類	主要功能	製程技術	面積
CCD (Core Complex Die)	8個Zen3核心，32MB L3快取	台積電7nm	84.4
SIOD (Server I/O Die)	8通道記憶體控制器，I/O界面	GF 12nm	416
CIOD (Client I/O Die)	2通道記憶體控制器，I/O界面	GF 12nm	125
"Renoir" APU	8個Zen2核心（2個四核心CCX），8個Vega CU繪圖核心，8MB L3快取，2通道記憶體控制器，各式各樣的I/O界面	台積電7nm	149

System description



Model		Core i5 13600K	Core i7 13700K	Core i9 13900K	Ryzen 5 7600X	Ryzen 7 7700X	Ryzen 9 7950X
Release date and price		2022/09/27 US$319	2022/09/27 US$409	2022/09/27 US$589	2022/09/27 US$299	2022/09/27 US$399	2022/09/27 US$699
Fab		Intel 7	Intel 7	Intel 7	TSMC N5	TSMC N5	TSMC N5
Chiplets		-	-	-	1xCCD 1xI/OD	1xCCD 1xI/OD	2xCCD 1xI/OD
CPU	Cores(threads)	14 (20)	16 (24)	24 (32)	6 (12)	8 (16)	16 (32)
	Core config	-	-	-	1x6	1x8	2x8
	Clock rate (GHz) Base/ Boost	3.5/ 5.1	3.4/ 5.4	3.0/ 5.8	4.7/ 5.3	4.5/ 5.4	4.5/ 5.7
	Cache L1/L2/L3	24 MB Intel® Smart Cache	30 MB Intel® Smart Cache	36 MB Intel® Smart Cache	384 KB/6 MB/32 MB	512 KB/8 MB/32 MB	1 MB/16 MB/64 MB
GPU	Architecture	Gen12 UHD 770	Gen12 UHD 770	Gen12 UHD 770	RDNA 2	RDNA 2	RDNA 2
	Execution Units /Compute Units	32	32	32	2	2	2
	Clock rate (GHz) Base/ Boost	0.3/1.55	0.3/1.6	0.3/1.65	0.4/2.2	0.4/2.2	0.4/2.2
	Processing power(GFLOPS)	-	-	-	563	563	563
Socket		LGA 1700	LGA 1700	LGA 1700	AM5	AM5	AM5
PCIe lanes		20 PCIe 4.0	20 PCIe 4.0	20 PCIe 4.0	28 (24+4) PCIe 5.0	28 (24+4) PCIe 5.0	28 (24+4) PCIe 5.0
Memory support		DDR4-3200 /DDR5-5600	DDR4-3200 /DDR5-5600	DDR4-3200 /DDR5-5600	DDR5-5200 dual-channel	DDR5-5200 dual-channel	DDR5-5200 dual-channel
TDP		125 W/181 W (base/turbo)	125 W/253 W (base/turbo)	125 W/253 W (base/turbo)	105 W	105 W	170 W

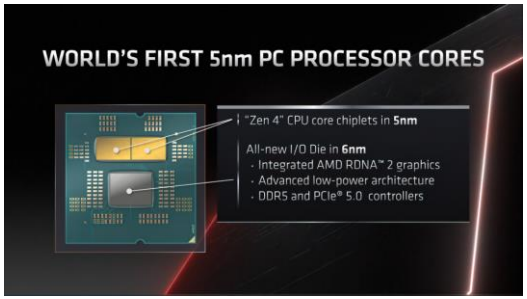
➢AM5 V.S. AM4



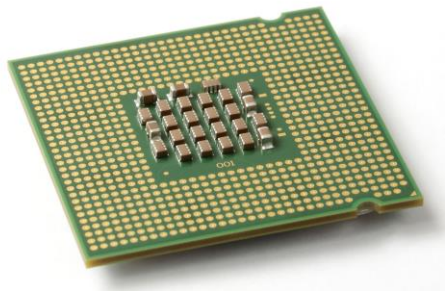
AMD expanded its maximum capacity from 142 watts to 230 watts
allowing the newest Ryzen 7000 CPUs to have a maximum TDP of 170 watts

49% more powerful while utilizing the same amount of power,
and it is 62% more efficient at the same performance

7000series have Integrated graphics RDNA 2

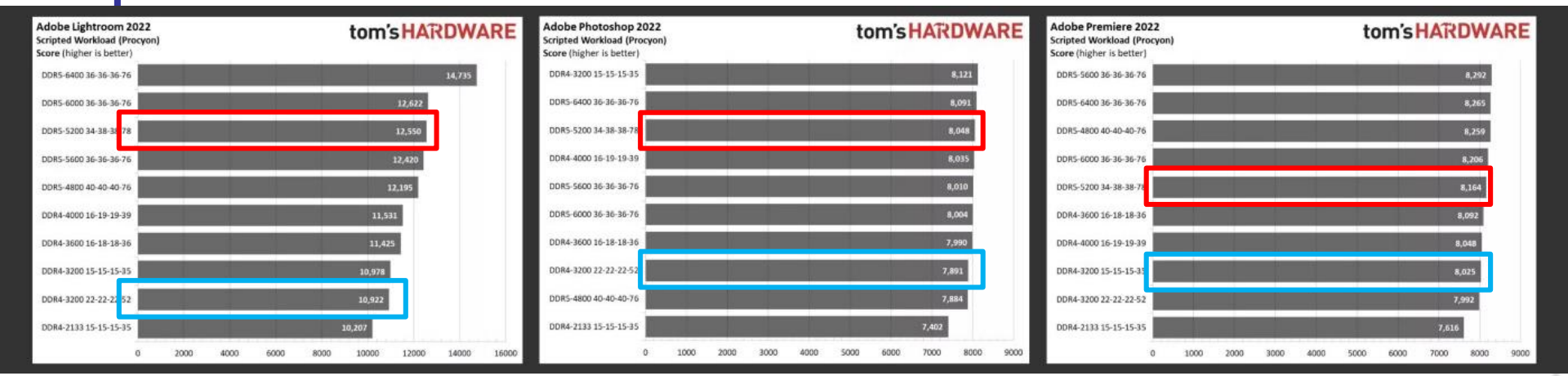


from the PGA(pin grid array) to the LGA(land grid array), 1,718 pins, AM5 is a significant upgrade over AM4's 1331

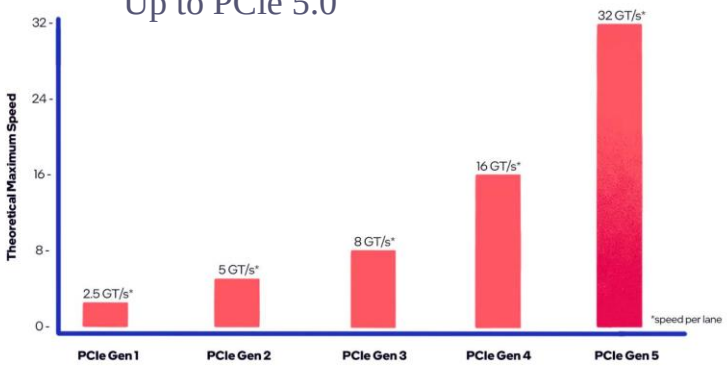


➢AM5 V.S. AM4

Up to DDR5 memory



Up to PCIe 5.0



AMD EXPO technology is available

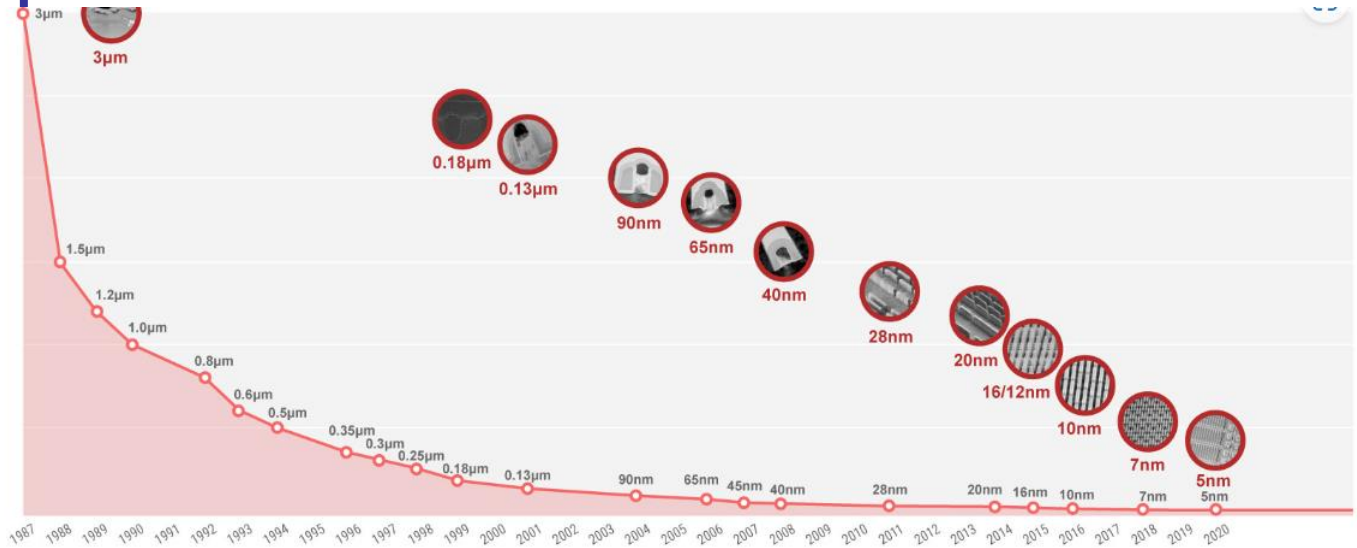
gaming experience that is up to 11% quicker. Reduce lag time to 63 nanoseconds or less

AMD EXPO
MEMORY OVERCLOCKING PROFILE

AM5 vs LGA 1700(intel)

AM5 has PCI-e Gen 5 storage
LGA 1700 has flexible DDR4 or DDR5 platform set

➢TSMC N5



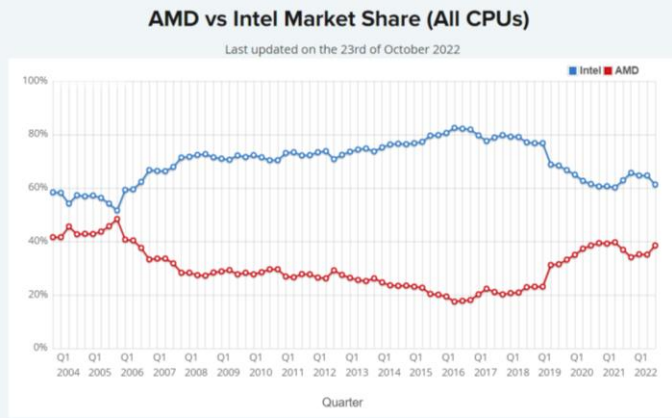
Process	N5	N7
Transistor density (MTr/mm2)	138.2	91.2–96.5
SRAM bit-cell size (µm2)	0.021	0.027
Transistor gate pitch (nm)	51	54
Interconnect pitch (nm)	28	40

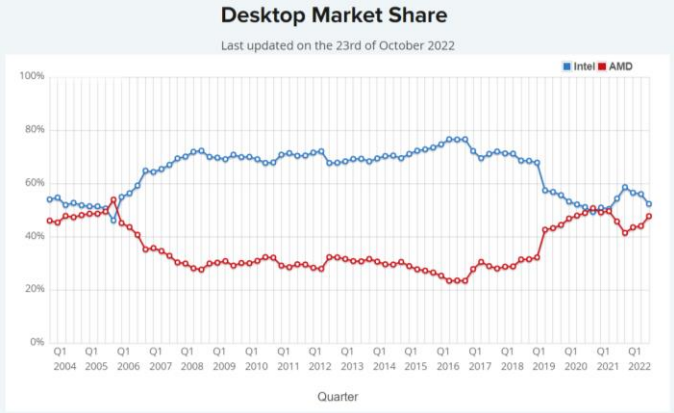
Process	N5	Intel 7
Transistor density (MTr/mm2)	138.2	100.76–106.1
SRAM bit-cell size (µm2)	0.021	0.0312
Transistor gate pitch (nm)	51	54
Interconnect pitch (nm)	28	30

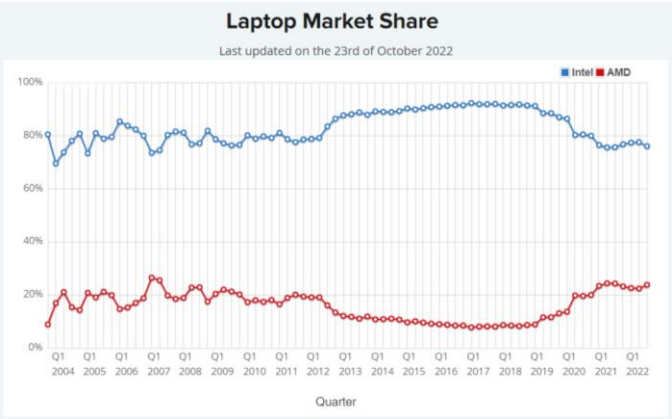
15% speed improvement or 30% lower power consumption

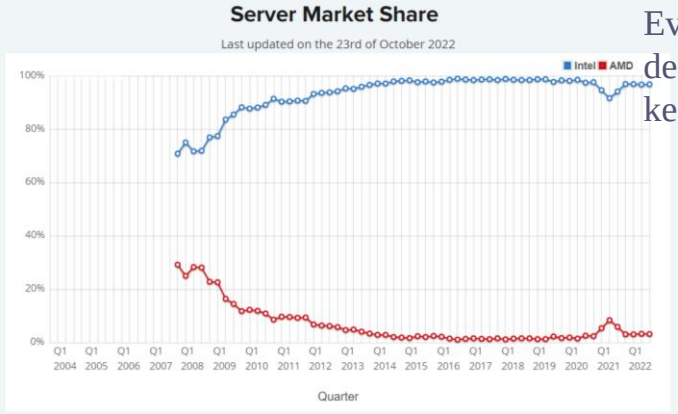
Industry analysis

➢Porter's 5 Forces analysis









Michael Porter's Five Forces Framework

Even though AMD may have similar desktop market share, intel tend to keep lead in the CPU market

➢Porter's 5 Forces analysis

Threats of New Entrants

By innovating new products and services

By building economies of scale so that it can lower the fixed cost per unit

Building capacities and spending money on research and development

Bargaining Power of Buyers

By building a large base of customers

By rapidly innovating new products

New products will also reduce the defection of existing customers of Advanced Micro Devices, Inc. to its competitors

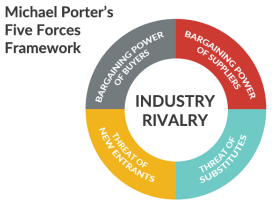
Rivalry among the Existing Competitors

By building a sustainable differentiation

By building scale so that it can compete better

Collaborating with competitors to increase the market size rather than just competing for small market.

Bargaining Power of Suppliers



By building efficient supply chain with multiple suppliers

Developing dedicated suppliers whose business depends upon the firm

By experimenting with product designs using different materials so that if the prices go up of one raw material then company can shift to another

Threats of Substitute Products or Services

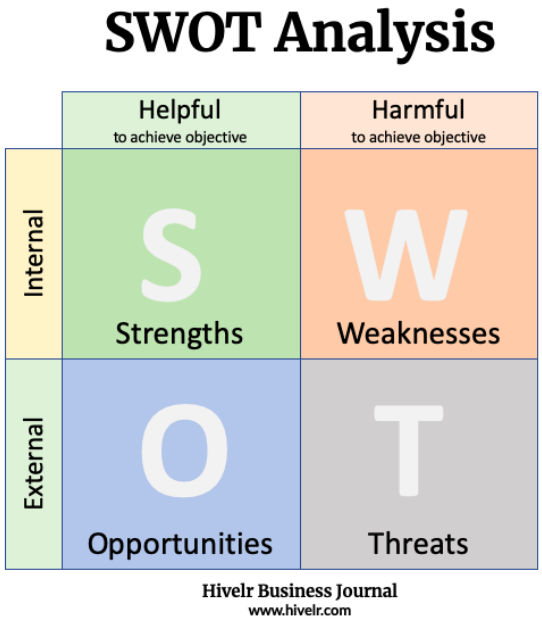
By being service oriented rather than just product oriented

By understanding the core need of the customer rather than what the customer is buying

By increasing the switching cost for the customers

➢SWOT analysis

1. High-Performance Computer
2. AMD Quality Policy
3. Key areas
4. Technology and Innovation
5. Global Operations
6. Strategic Sourcing
7. Outstanding research and Research and Development
8. With fewer competitors
9. Technologies
10. Achieving History
11. Guinness World Record Achievement

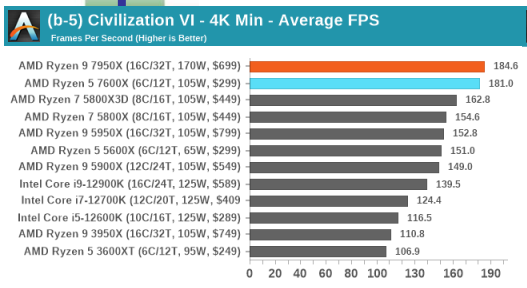


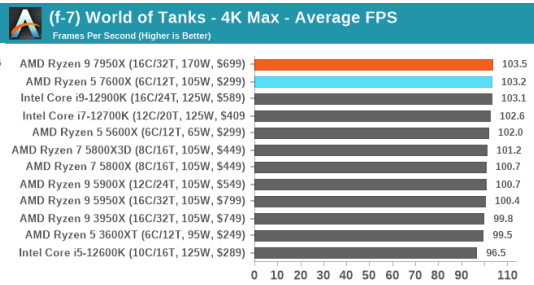
1. Lower Performance of the Computing Segment
2. The less seen in Mobile Market
3. Lower Market share
4. Quality Problems

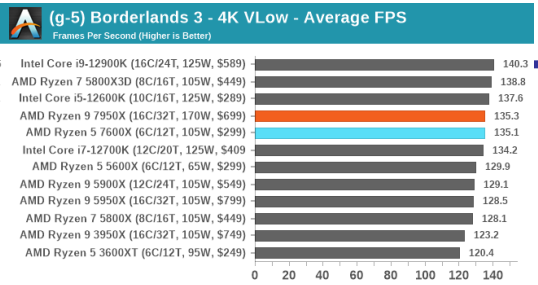
Strengths: Design Expertise □CPU power/performance □Graphics Relatively nimble	**Opportunities:** Continue Taking CPU MSS GfX/CPU Integration Low Cost CPU for emerging markets
Weakness: High Debt / Low Cash History of Quality problems Manufacturing capacity Manufacturing process technology	**Threats:** Competing against much bigger and better funded market leader Continued price war Debt servicing will prevent R&D Cyclical Downturn

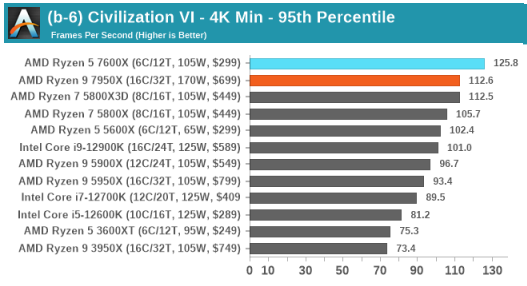
1. Permeate to Mobile
2. New product as well as Services
3. Virtualization Space
4. Lost cost CPU
5. New Trends in Consumer Behavior

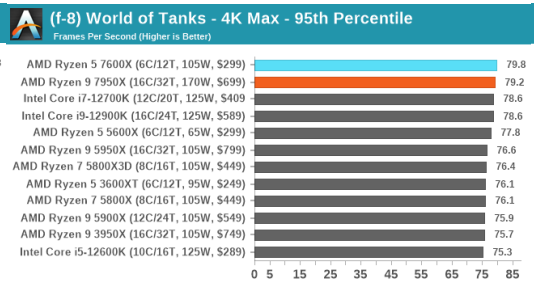
1. Rivals
2. Environmental Regulations
3. Rise in Raw Materials

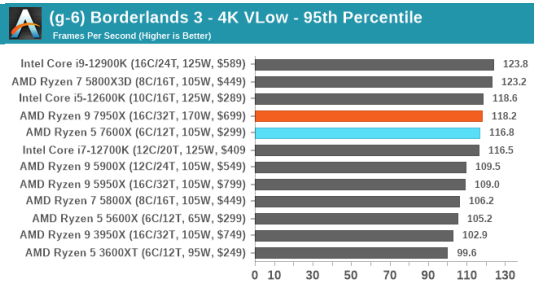


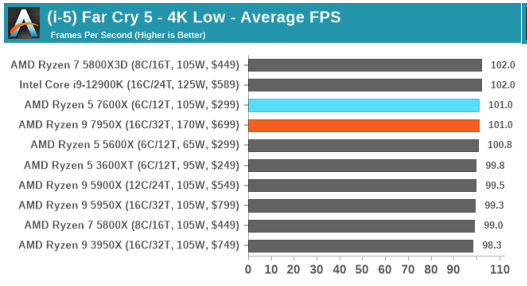


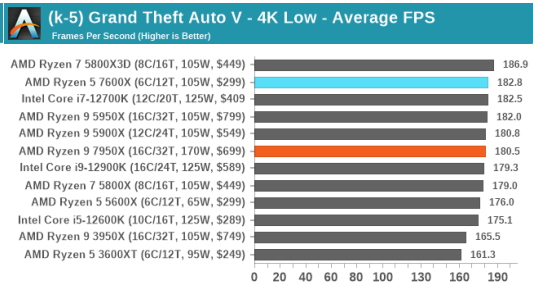


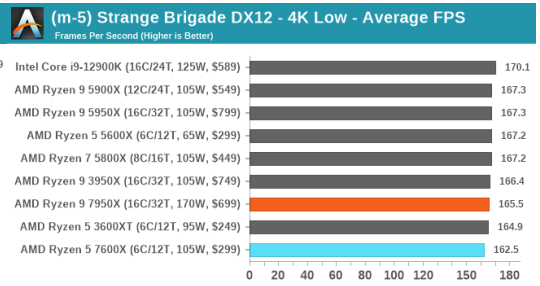


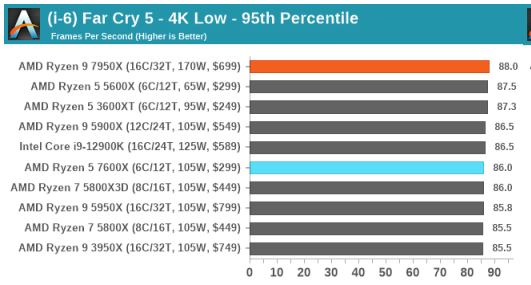


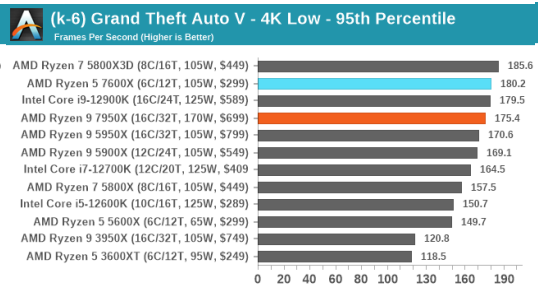


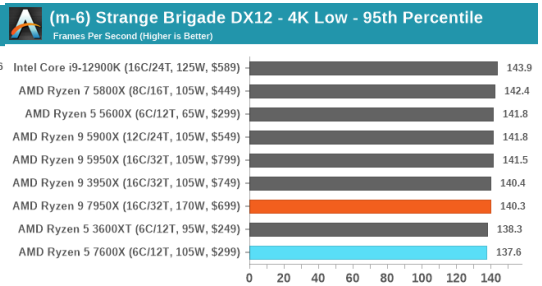




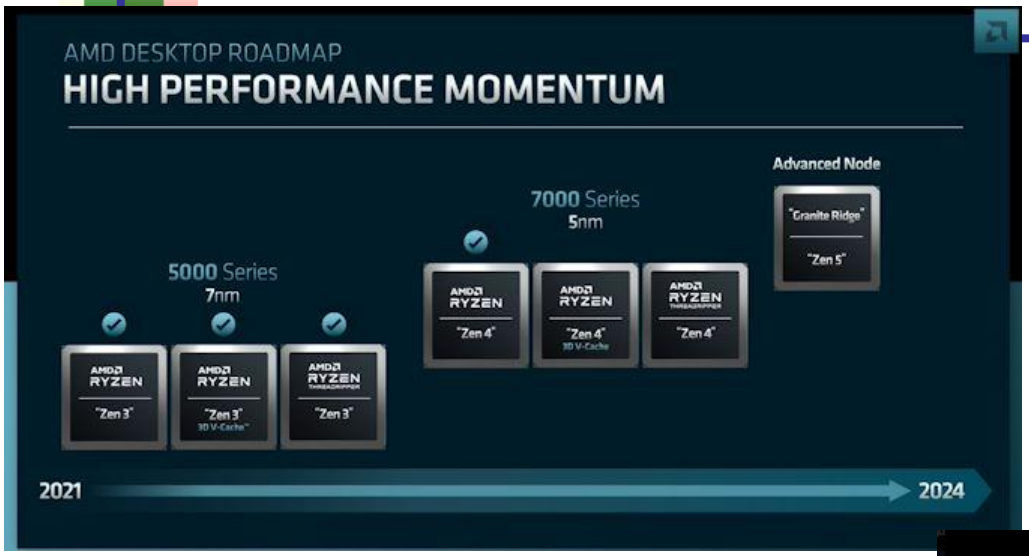




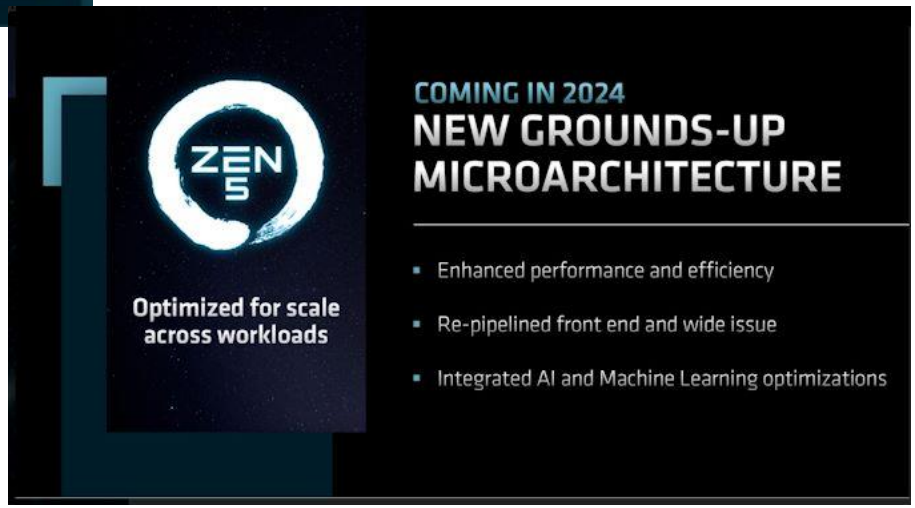




All gaming tests were with an RTX 2080 Ti



- ✓ Zen 5"-based "Granite Ridge" processors
- ✓ AMD's 3D V-Cache packaging technology will also come to client desktop Zen 4



Total MPU Sales Surprise With Strong Gains in 2020, More Upside in 2021 (design-reuse.com)
Raptor Lake – Wikipedia

AMD Ryzen 5 7600X vs AMD Ryzen 9 7950X vs Intel Core i5-13600K vs Intel Core i9-13900K [cpubenchmark.net] by PassMark Software

AMD Ryzen 3 1300X vs AMD Ryzen 7 5800X vs AMD Ryzen 9 5950X vs AMD Ryzen 7 7700X vs AMD Ryzen 9 7950X [cpubenchmark.net] by PassMark Software

AM5 vs. AM4: Worth The Upgrade? - Tech4Gamers

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Thank you