

Grafický subsystem AMD

Alexander Brezina

2025/2026



Obsah

- Čo je to Grafická karta a jej časti
- História Radeon
- Jednotlivé architektúry Radeon
- Technológie
- Softvér
- Budúcnosť

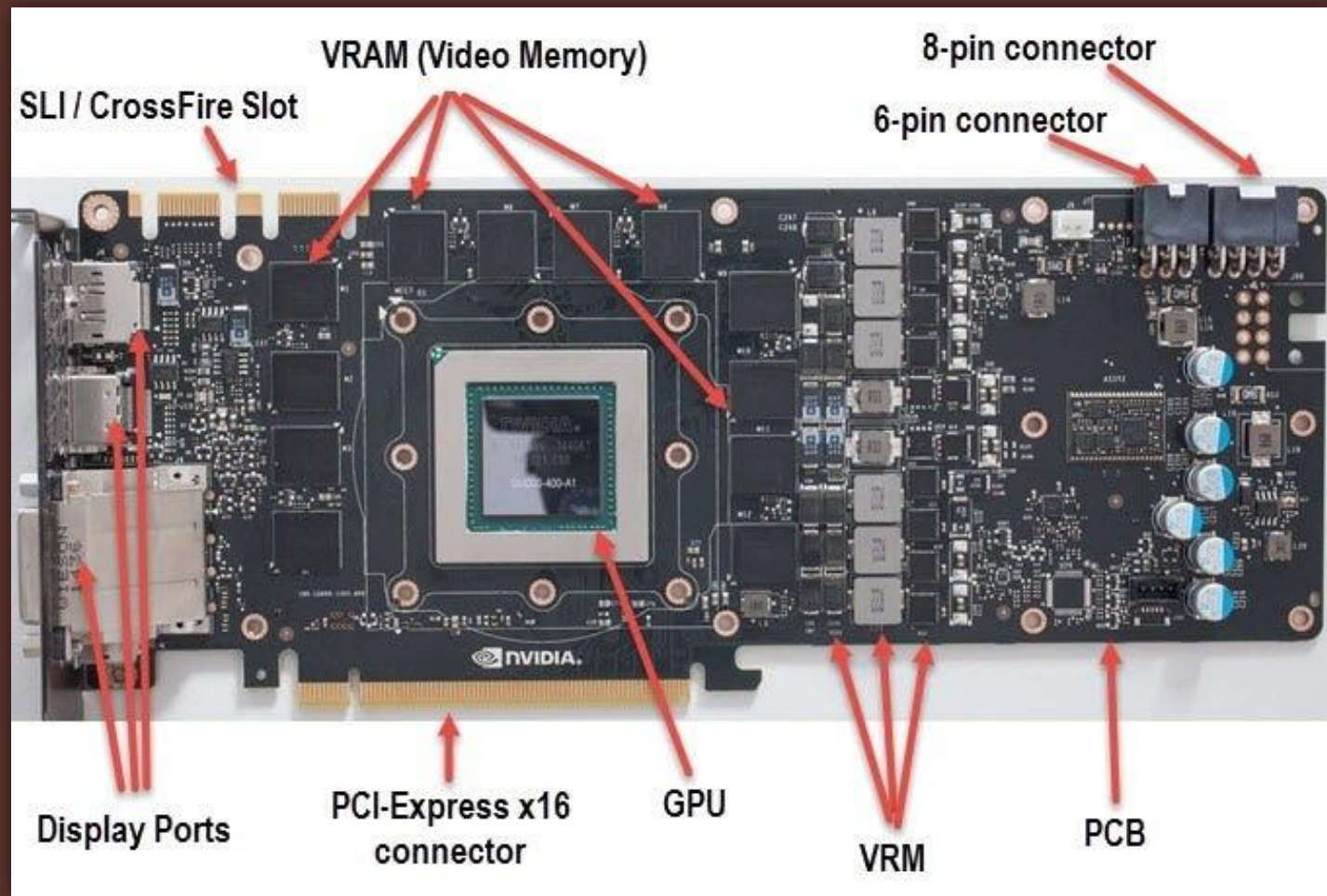
Čo je to grafická karta?

- Hardvérový komponent počítača určený na spracovanie obrazu, videa a 3D grafiky
- Hlavný výpočtový prvok - GPU teda procesor optimalizovaný na masívne paralelné výpočty
- Navrhnutá tak, aby naraz spracovala veľké množstvo podobných operácií

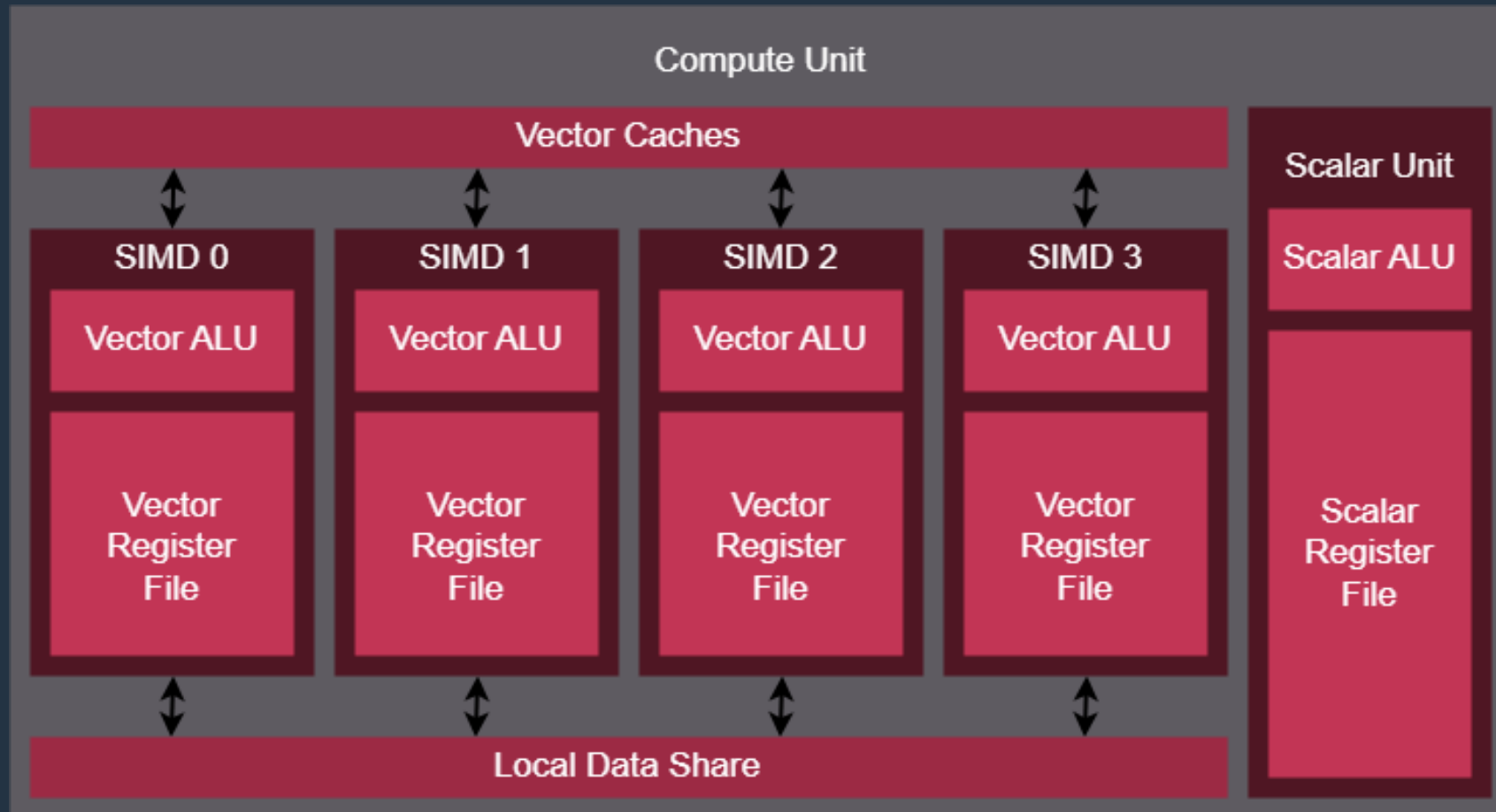


AMD
RADEON
RX 6000 SERIES

Základné Komponenty GPU



Compute unit – základný výpočtový blok GPU



Inštrukcie

- Aj GPU má ISA
- Napríklad RDNA má sedem základných typov inštrukcií:
- Scalar compute - skalárne výpočty pre riadenie programu a prácu s konštantami
- Scalar memory - načítanie alebo uloženie skalárnych dát
- Vector compute - hlavné shaderové inštrukcie
- Vector memory - prístupy do pamäte pre vektorové dáta
- Branches - vetvenie programu, podmienky, slučky, skoky
- Export - odovzdávanie výsledkov ďalším častiam grafickej pipeline
- Messages - inštrukcie na komunikáciu s inými hardvérovými blokmi GPU

4 kapitoly Radeon

- 1985-2006 ATI
- 2006-2010 Fusion era
- 2011-2018 GCN era
- 2019-súčasnosť RDNA era

ATI



- Kanadský výrobca grafických procesorov
- V 90. rokoch sa presadili série Wonder, Mach a Rage
- Vznik značky Radeon
- Radeon R100
- V roku 2006 odkúpené AMD

APU

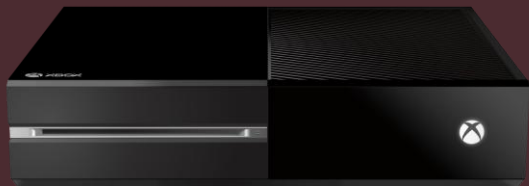
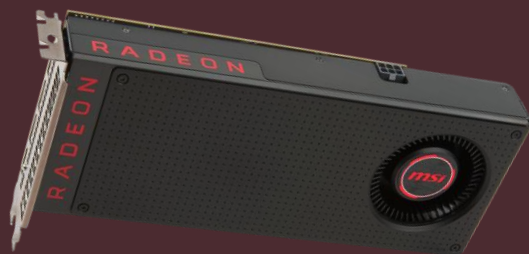


- Integrácia ATI do AMD
- Vznik APU (Llano)



- Radeon HD 4000 a 5000
- DirectX11 support

G C N



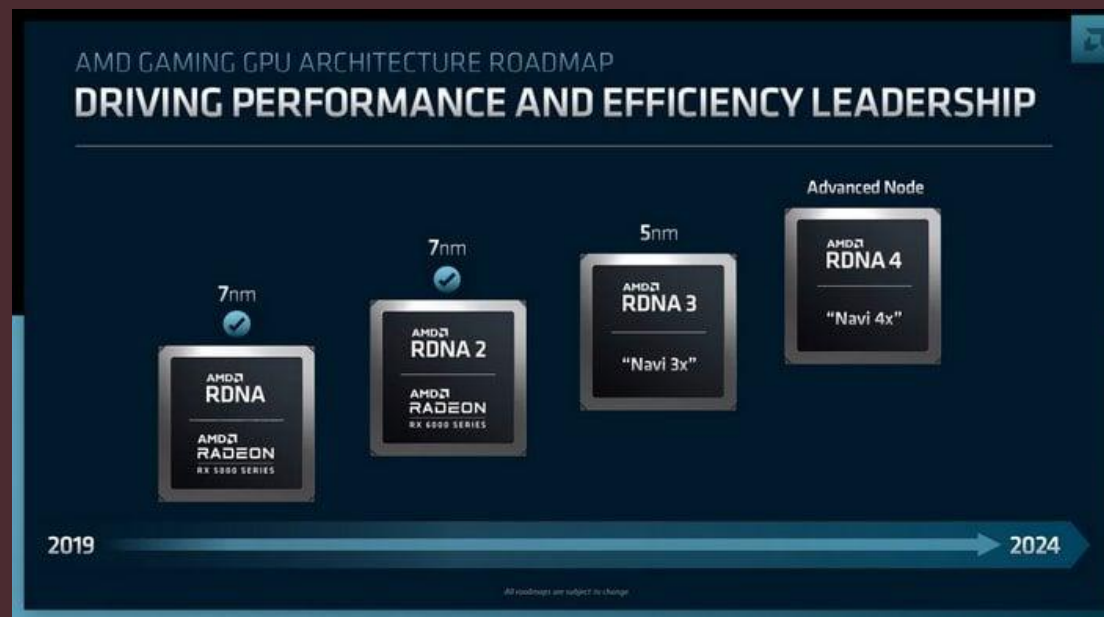
- VLIW je nahradený GCN(graphics core next)
- RISC – SIMD architektúra
- Radeon HD 7000
- Polaris a Vega(HBM)



RDNA



- Architektúra optimalizovaná na hry
- Čo znamená RDNA?
- FSR, AI, Chiplety



RDNA 1

- PCIE 4.0
- FPS/Watt
- GDDR6



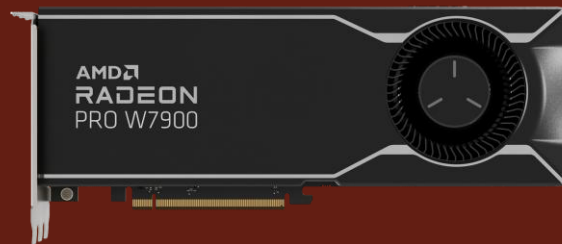
RDNA 2

- Ray Tracing
- Infinity Cache
- Vram focus



RDNA 3

- Chiptety
- AI akcelerátory
- RDNA 3.5



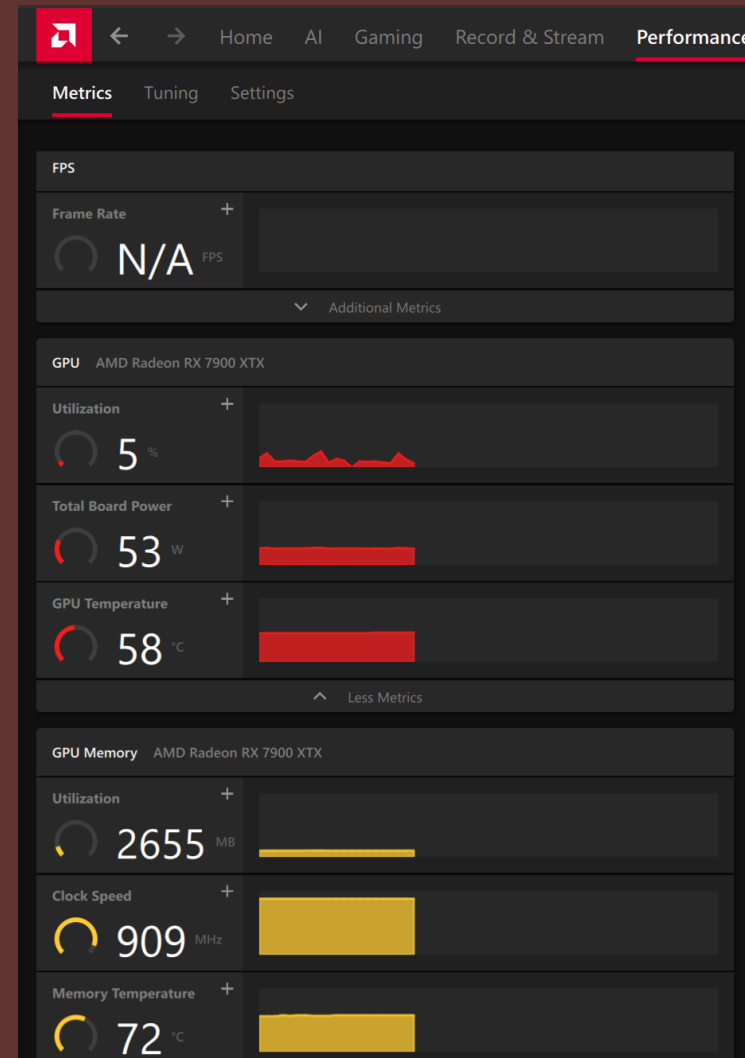
RDNA 4

- Focus na AI compute
- Prvé plne funkčné Radeon karty
- AI AI AI



Technológie

- SAM
- FSR
- HBCC
- ROCm



SAM

- Technológia umožňujúca prístup CPU pristupovať k celej Pamäti GPU
- ReBAR
- Nižšia záťaž pri prenose dát
- Nutnosť pre niektoré karty

AMD Radeon RX 7900 XTX (Primary/Discrete)

Resizable BAR ⓘ

Unlocks dGPU memory for performance



Enabled

FSR

- Upscaling obrazu
- 720p na 1440p
- Frame generation



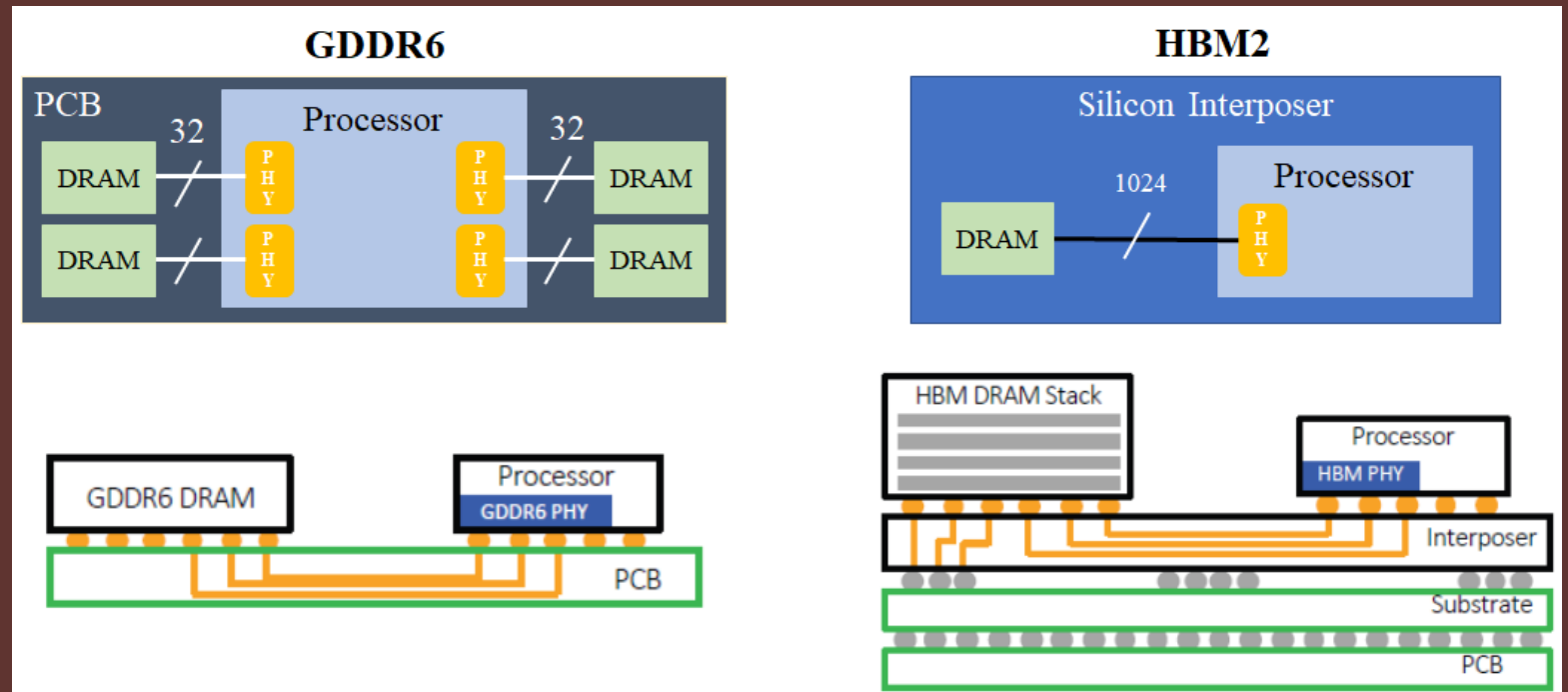
Porovnanie technológií FSR od AMD

HBCC

- Technológia predstavená s architektúrou Vega
- Používa pamäť HBM
- Karty Vega 56 a 64
- Radeon VII



Radeon VII



Porovnanie GDDR6 a HBM2

RYZEN 5 5600X 4525 MHz 47°C 59°C 53.5"
RAM 15816 MB 7898 MB
RX VEGA 64 1684 MHz 99°C 64°C 227.0"
VRAM 8301 MB 6555 MB 1075 MHz
D3D12 59 FPS 15.0 GB 59 FPS 49 FPS 38 FPS
Frontier 23.0 MB

THE LAST OF US PART I

AVG FPS: 1% LOW: 0.1% LOW:

44.9 37.4 9.7

1080P ULTRA
(HBCC OFF)

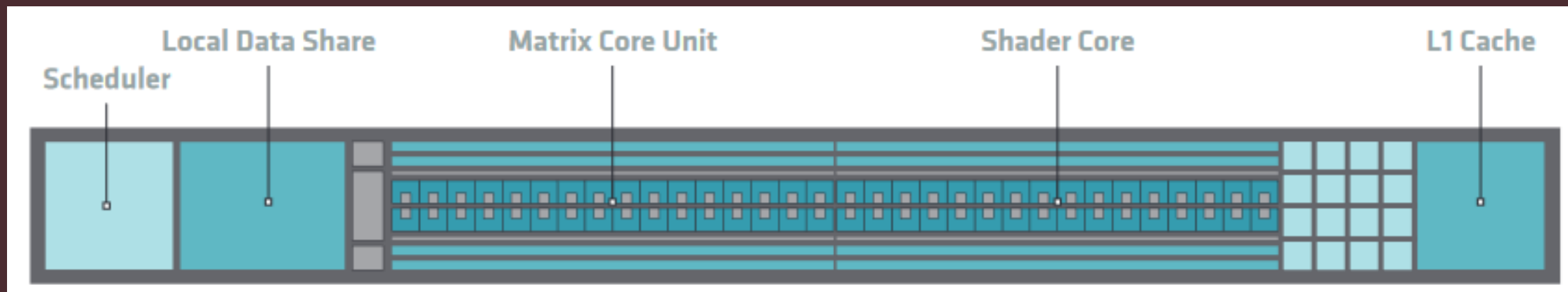
AVG FPS: 1% LOW: 0.1% LOW:

45.5 38.2 33.4

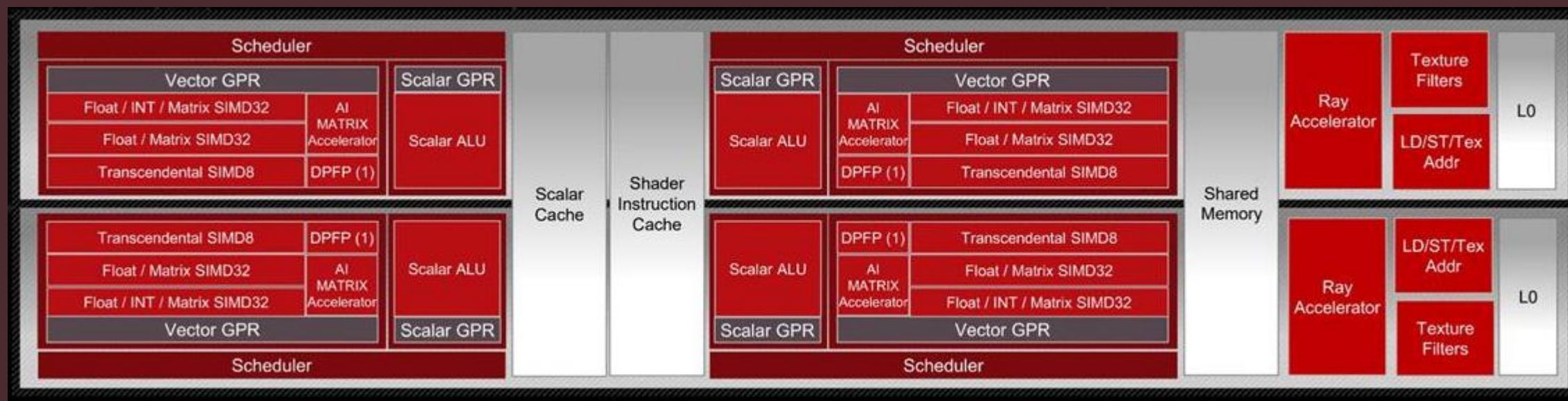
1080P ULTRA
(HBCC ON)

ROCm

- Rozširuje využitie GPU mimo hrania hier
- OpenSource platforma AMD pre GPGPU a akcelerované výpočty
- Vedecké výpočty, AI, HPC a machine learning
- Zbierka knižníc
- AMD CDNA architektúra
- Prepojenie Radeon hardvéru s výpočtovým softvérom



Block Diagram of a CDNA3 Compute Unit



Block Diagram of an RDNA3 work group processor

Diagnostika

• HWinfo64, 3DMark a GPU-Z

3DMark Score	20143
Graphics Score	20143
Graphics Test	140.86 fps
SETTINGS	
Rendering API	DX12
GPU	AMD Radeon RX 7900 XTX
Display	Generic PnP Monitor \.\DISPLAY5
GPU connected to display	Yes
GRAPHICS CARD	
Graphics Card	AMD Radeon RX 7900 XTX
Vendor	Sapphire
# of cards	1
SLI / CrossFire	Off
Memory	24,576 MB
Clock frequency	2,820 MHz (2,526 MHz)
Average clock frequency	2,562 MHz
Memory clock frequency	2,714 MHz (2,500 MHz)
Average memory clock frequency	2,700 MHz
Average temperature	61 °C
Driver version	32.0.22029.9039
Driver status	Approved

TechPowerUp GPU-Z 2.69.0

Graphics Card

Sensors

Advanced

Validation

Name

AMD Radeon RX 7900 XTX

GPU

Navi 31

Revision

C8

Technology

5 nm

Die Size

306 mm²

Release Date

Nov 3, 2022

Transistors

57700M

BIOS Version

022.001.002.031.000001



UEFI

Subvendor

Sapphire

Device ID

1002 744C - 1DA2 E471

ROPs/TMUs

192 / 384

Bus Interface

PCIe x16 4.0 @ x16 4.0

Shaders

6144 Unified

DirectX Support

12 (12_2)

Pixel Fillrate

514.4 GPixel/s

Texture Fillrate

1028.7 GTexel/s

Memory Type

GDDR6 (Samsung)

Bus Width

384 bit

Memory Size

24576 MB

Bandwidth

960.0 GB/s

Driver Version

32.0.23033.1002 (Adrenalin 26.3.1) / Win11 64

Driver Date

Mar 09, 2026

Digital Signature

WHQL

GPU Clock

2526 MHz

Memory

2500 MHz

Boost

2679 MHz

Default Clock

2526 MHz

Memory

2500 MHz

Boost

2679 MHz

AMD CrossFire

Disabled

Resizable BAR

Enabled

Computing

☒ OpenCL

☐ CUDA

☒ DirectCompute

☒ DirectML

Technologies

☒ Vulkan

☒ Ray Tracing

☐ PhysX

☒ OpenGL 4.6

Lookup





UEFI

AMD Radeon RX 7900 XTX

Close

Sensor	Current	Minimum	Maximum	Average
GPU [#2]: AMD Radeon RX 7900 XTX: Sapphire RX 7900 XTX Nitro+				
GPU Temperature	58.0 °C	56.0 °C	58.0 °C	57.2 °C
GPU Memory Junction Temperature	72.0 °C	70.0 °C	74.0 °C	71.3 °C
GPU VR VDDC Temperature	56.4 °C	55.1 °C	56.4 °C	55.7 °C
GPU Hot Spot Temperature	63.0 °C	61.0 °C	66.0 °C	62.3 °C
GPU VR SoC Temperature	56.9 °C	56.0 °C	56.9 °C	56.4 °C
GPU VR VDDIO Temperature	57.0 °C	56.0 °C	57.9 °C	56.6 °C
GPU VR VDDCI Temperature	57.1 °C	56.2 °C	57.3 °C	56.9 °C
GPU Hotspots	61.6 °C	57.1 °C	64.6 °C	60.9 °C
GPU Core Voltage (VDDCR_GFX)	0.674 V	0.674 V	0.700 V	0.697 V
GPU Memory Voltage (VDDIO)	1.353 V	1.352 V	1.353 V	1.353 V
GPU SoC Voltage (VDDCR_SOC)	0.727 V	0.727 V	0.853 V	0.746 V
GPU Memory Voltage (VDDCI_MEM)	0.703 V	0.703 V	0.779 V	0.718 V
GPU Fan	0 RPM	0 RPM	0 RPM	0 RPM
GPU Core Current (VDDCR_GFX)	12.838 A	11.689 A	13.042 A	12.061 A
GPU Memory Current (VDDIO)	12.151 A	12.128 A	17.581 A	13.484 A
GPU SoC Current (VDDCR_SOC)	7.778 A	5.900 A	12.693 A	7.525 A
GPU Memory Current (VDDCI_MEM)	5.672 A	5.649 A	15.402 A	7.421 A
GPU Core TDC Limit	328.000 A	328.000 A	328.000 A	328.000 A
GPU SOC TDC Limit	82.000 A	82.000 A	82.000 A	82.000 A
GPU USR TDC Limit	86.000 A	86.000 A	86.000 A	86.000 A
GPU Core Power (VDDCR_GFX)	8.633 W	8.149 W	9.093 W	8.413 W
GPU Memory Power (VDDIO)	16.440 W	16.408 W	23.761 W	18.240 W
GPU SoC Power (VDDCR_SOC)	5.633 W	4.286 W	11.095 W	5.734 W
GPU Memory Power (VDDCI_MEM)	3.988 W	3.975 W	12.177 W	5.452 W
GPU USR Power (VDDCR_USR)	0.470 W	0.283 W	0.731 W	0.406 W
Total Graphics Power (TGP)	42.865 W	41.791 W	63.622 W	45.945 W
Total Board Power (TBP)	54.556 W	53.291 W	79.029 W	58.188 W
GPU Power Maximum	55.670 W	47.241 W	87.666 W	61.119 W
GPU PPT (Sustained)	42.903 W	41.776 W	62.941 W	45.917 W
GPU PPT Limit (Sustained)	339.000 W	339.000 W	339.000 W	339.000 W
GPU PPT Limit (Short)	406.800 W	406.800 W	406.800 W	406.800 W
GPU Front End Clock	1,298.9 MHz	1,298.0 MHz	1,299.5 MHz	1,299.3 MHz
GPU Shader Clock	179.0 MHz	108.0 MHz	1,356.0 MHz	233.0 MHz
GPU Front End Clock (Effective)	229.5 MHz	113.9 MHz	229.5 MHz	151.1 MHz
GPU Memory Clock	909.0 MHz	909.0 MHz	2,487.0 MHz	1,125.4 MHz
GPU SoC Clock	750.0 MHz	750.0 MHz	1,086.1 MHz	800.0 MHz
GPU FCLK	1,201.0 MHz	1,201.0 MHz	1,702.9 MHz	1,275.7 MHz
GPU FCLK (Effective)	906.2 MHz	548.2 MHz	1,143.5 MHz	730.3 MHz
GPU Shader Clocks	1,355.8 MHz	1,332.5 MHz	1,381.5 MHz	1,360.8 MHz
GPU Shader Clocks (Effective)	217.3 MHz	107.7 MHz	219.1 MHz	144.2 MHz
GPU Shader Clock Frequency Limit	3,220.0 MHz	3,220.0 MHz	3,220.0 MHz	3,220.0 MHz
GPU Shader Clock Frequency Limit (User)	3,220.0 MHz	3,220.0 MHz	3,220.0 MHz	3,220.0 MHz
GPU Utilization	11.0 %	7.0 %	18.0 %	10.0 %
GPU D3D Usage	4.7 %	2.8 %	8.1 %	4.2 %
GPU Memory Controller Utilization	0.0 %	0.0 %	0.0 %	0.0 %
GPU D3D Utilizations	0.0 %	0.0 %	0.0 %	0.0 %
GPU PPT Limit (Sustained)	12.7 %	12.3 %	18.6 %	13.5 %
GPU Core TDC Limit	3.9 %	3.5 %	4.0 %	3.7 %
GPU SOC TDC Limit	9.5 %	7.2 %	14.8 %	9.2 %
GPU Thermal Limits	47.9 %	68.0 %	0.0 %	0.0 %
GPU Fan PWM	0.0 %	0.0 %	0.0 %	0.0 %
GPU D3D Memory Dedicated	3,185 MB	3,113 MB	3,196 MB	3,136 MB
GPU D3D Memory Dynamic	1,280 MB	1,280 MB	1,337 MB	1,296 MB
PCIe Link Speed	16.0 GT/s	16.0 GT/s	16.0 GT/s	16.0 GT/s
GPU Memory Usage	145,557 MB	145,135 MB	145,557 MB	145,290 MB
Framerate	0.0 FPS	0.0 FPS	0.0 FPS	0.0 FPS
GPU [#1]: Intel NPU				
NPU Clock	731.3 MHz	731.1 MHz	731.3 MHz	731.2 MHz

Budúcnosť

- Silnejší ray tracing – path tracing
- AI = súčasť GPU
- Upscaler a generácia snímkov
- Optimalizácia výkonu
- Rozvoj silnejších integrovaných grafík
- Vydanie novej Flagship karty

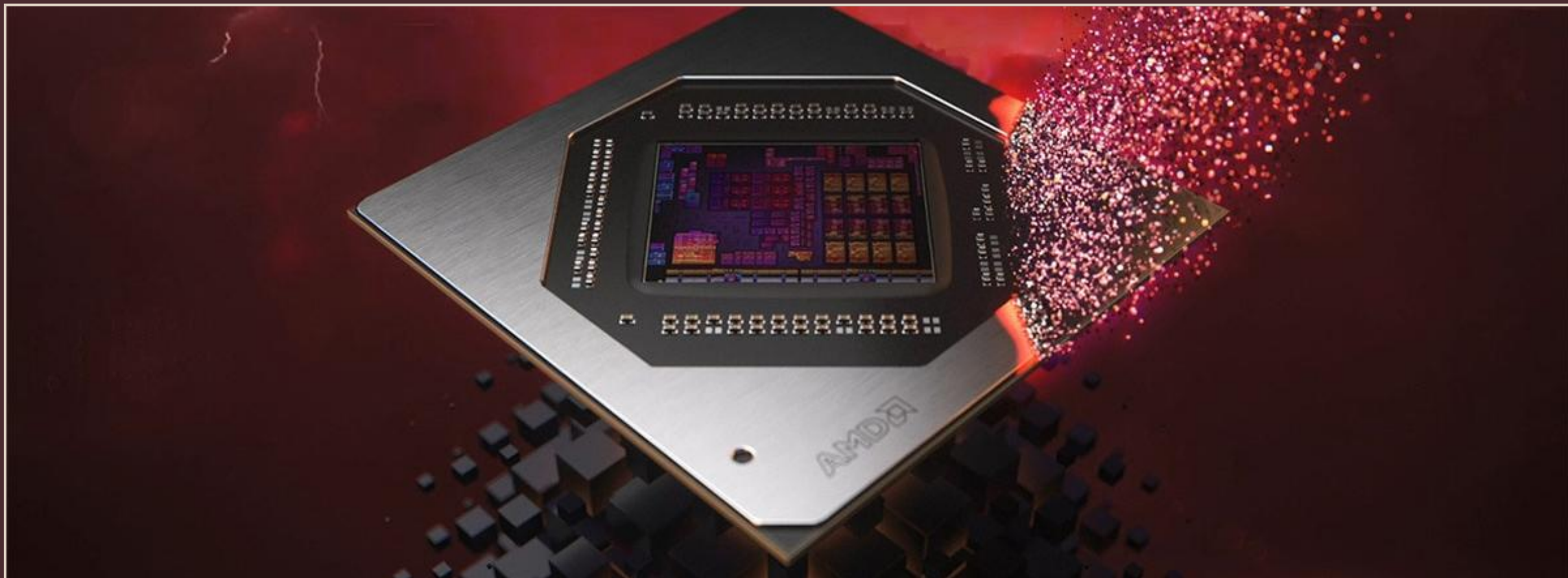




Produkty s AMD GPU

Zdroje:

- [1] AMD. AMD RDNA Architecture. Dostupné online: <https://www.amd.com/en/technologies/rdna>
- [2] AMD. AMD FidelityFX Super Resolution. Dostupné online: <https://www.amd.com/en/products/graphics/technologies/fidelityfx/super-resolution.html>
- [3] AMD. Smart Access Memory Technology. Dostupné online: <https://www.amd.com/en/gaming/technologies/smart-technologies.html>
- [4] AMD. HBCC Memory Segment. Dostupné online: <https://www.amd.com/en/resources/support-articles/faqs/DH3-012.html>
- [5] AMD. ROCm Platform. Dostupné online: <https://www.amd.com/en/products/software/rocm.html>
- [6] AMD. AMD CDNA Architecture. Dostupné online: <https://www.amd.com/en/technologies/cdna.html>
- [7] GPUOpen. RDNA 3 ISA Reference Guide now available. Dostupné online: <https://gpuopen.com/news/rdna3-isa-guide-now-available/>
- [8] AMD Docs. RDNA 4 Instruction Set Architecture. Dostupné online: <https://docs.amd.com/v/u/en-US/rdna4-instruction-set-architecture>
- [9] AMD ROCm Docs. Hardware Implementation. Dostupné online: https://rocm.docs.amd.com/projects/HIP/en/docs-6.1.1/understand/hardware_implementation.html
- [10] HWiNFO. HWiNFO – System Information and Monitoring. Dostupné online: <https://www.hwinfo.com/>
- [11] UL Solutions. 3DMark benchmark for Windows, Android and iOS. Dostupné online: <https://benchmarks.ul.com/3dmark>
- [12] Wikipedia. ATI Technologies; Radeon; Graphics Core Next. Dostupné online: <https://en.wikipedia.org/>



Ďakujem za pozornosť

Priestor na vaše otázky