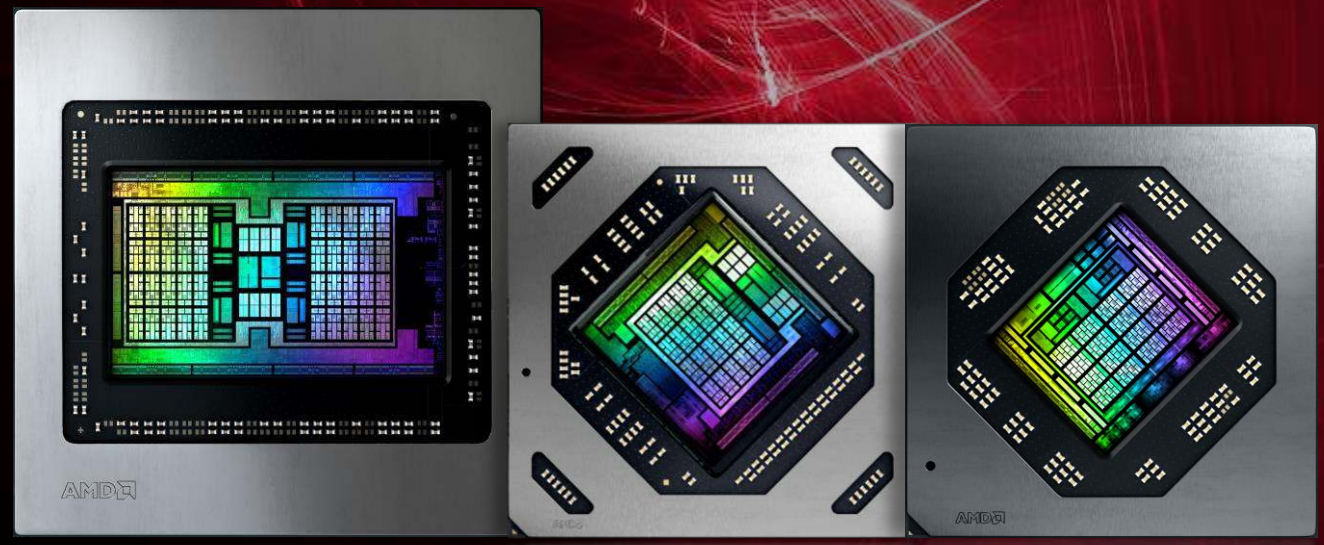
AMD

RDNA™ 2 GAMING ARCHITECTURE

ANDREW POMIANOWSKI
RADEON PRODUCT ARCHITECT



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AMD RDNA™ VISION

DESIGNED FOR THE FUTURE OF GAMING

PERFORMANCE	EFFICIENCY	SCALABILITY	FEATURES
For Diverse Modern Gaming Workloads	For Optimal Power and Bandwidth Utilization	From Mobile to Cloud Gaming	And Ecosystem Enablement

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RDNA 2

GAMING ARCHITECTURE

BREAKTHROUGH HIGH-SPEED DESIGN

- High frequencies and superb power efficiency

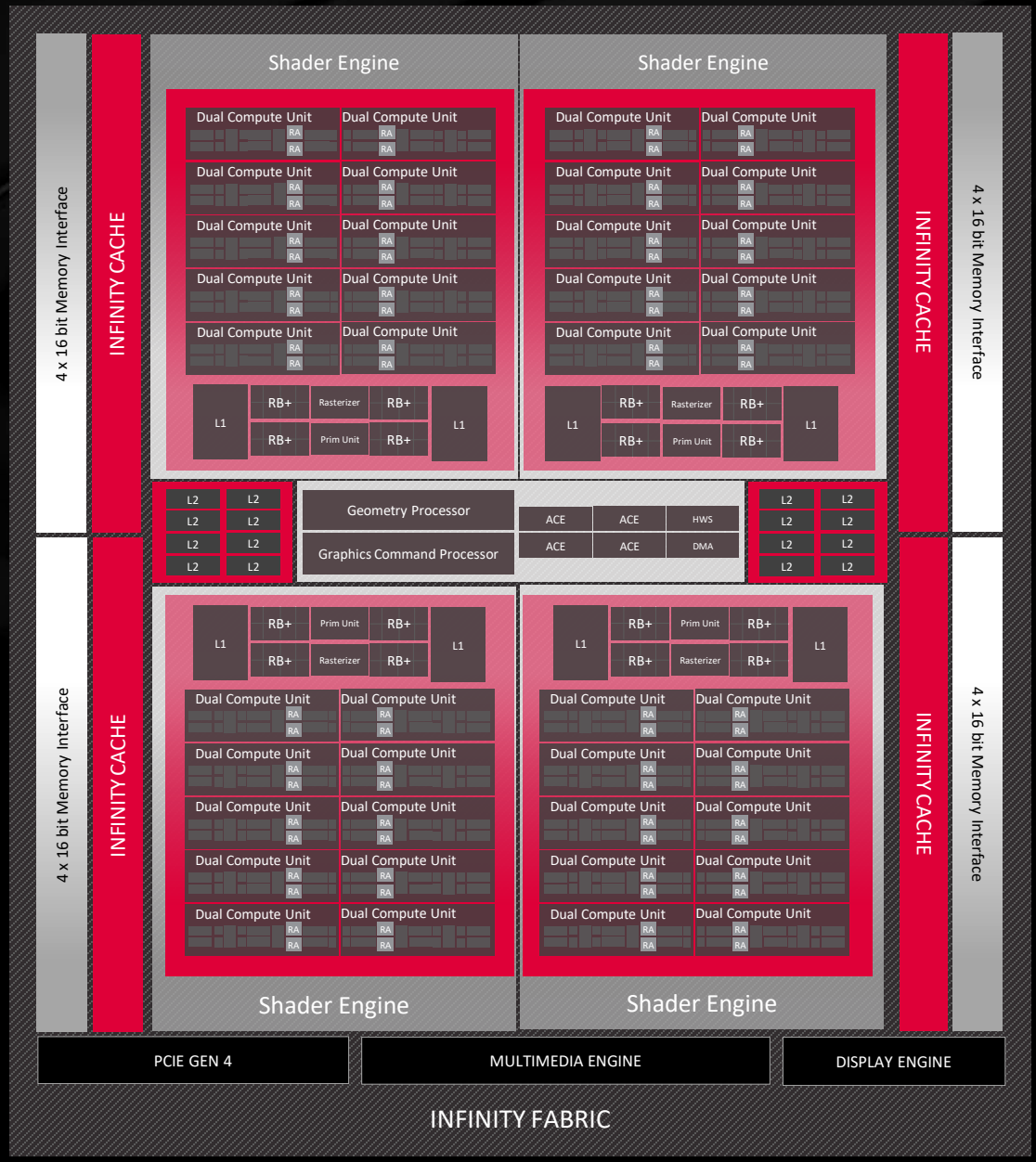
REVOLUTIONARY AMD INFINITY CACHE

- 128MB cache with extreme bandwidth at lower power

ADVANCED FEATURES

- DX12® Ultimate and support for DirectStorage API

MORE PERFORMANCE, LESS POWER!



See endnote RX-536.

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RDNA 2

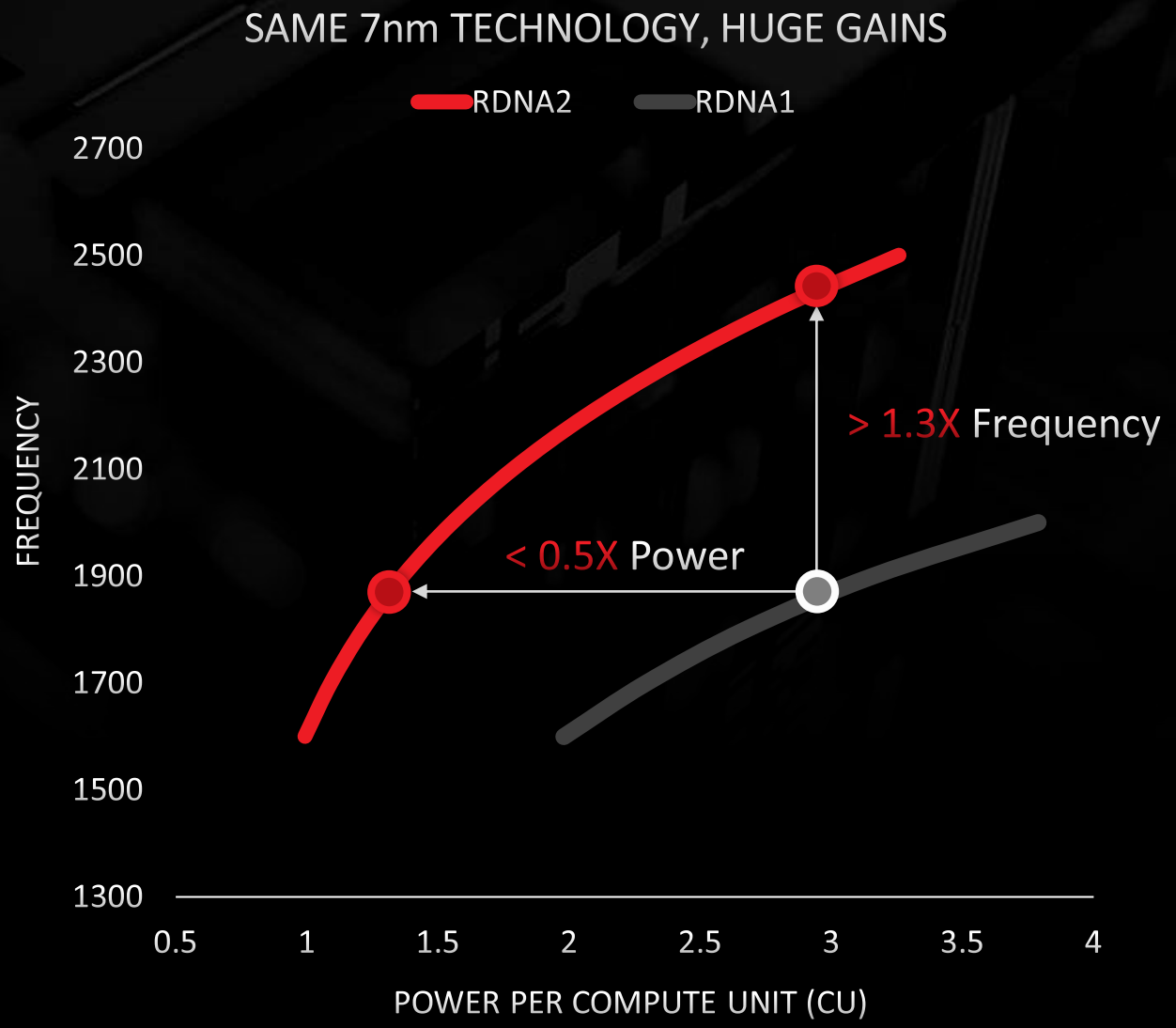
BREAKTHROUGH HIGH-SPEED DESIGN

HIGH FREQUENCY IN THE DNA

- Leverages world-class CPU design methodologies
- Streamlined micro-architecture with heavy emphasis on reduced switching capacitance

PERFORMANCE-POWER SCALABILITY

- Up to 1.3X frequency at same power per CU
- Up to 50% per CU power at same frequency



See endnote RX-536.

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CACHE IN RADEON™ RX 5000 SERIES

GREAT BANDWIDTH BUT LOW HIT RATES

L0 localized to each CU

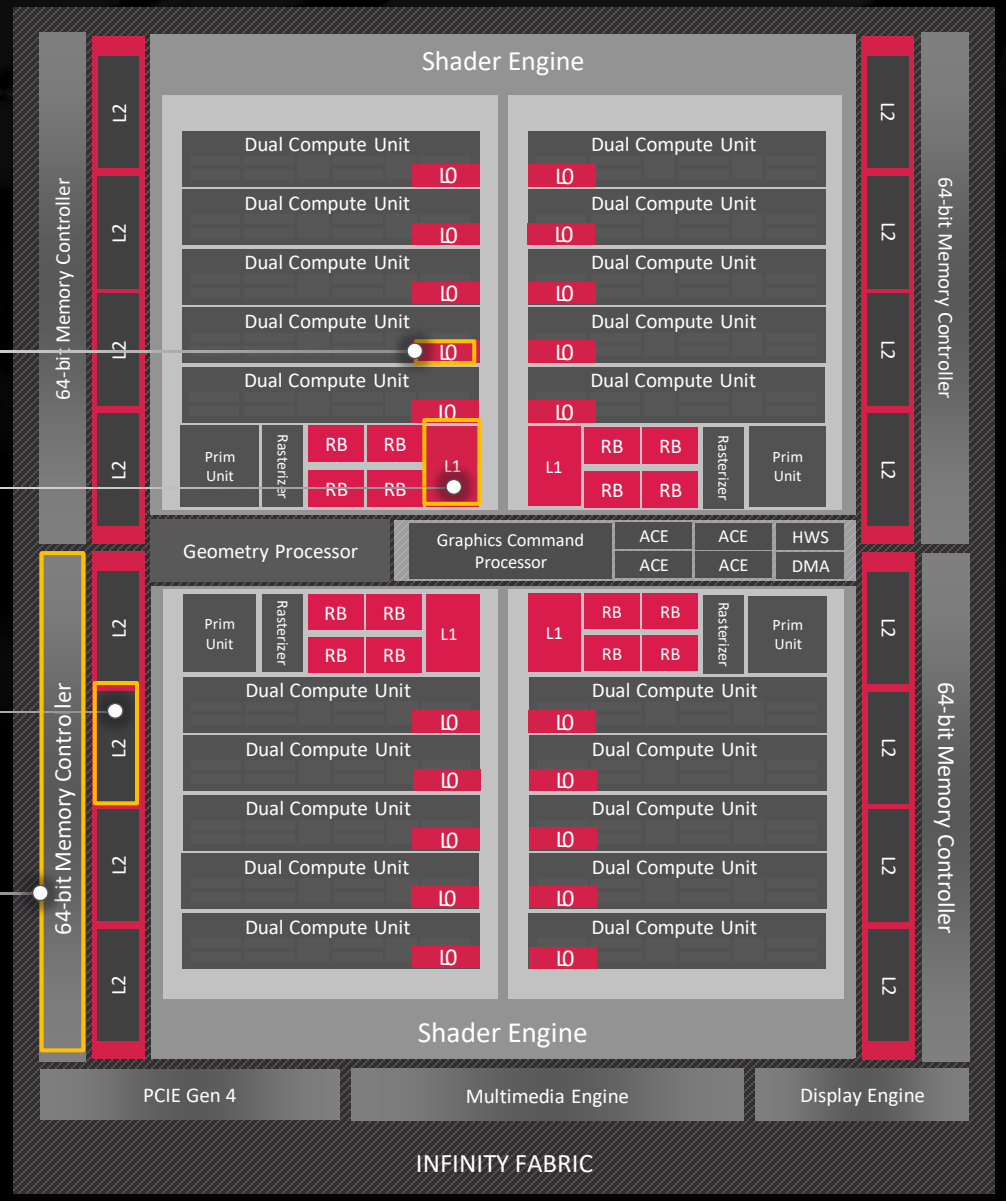
L1 private in each shader engine with exclusive L2 access

4MB L2 shares data between Shader Engines and Command Processor

256b of 14Gb/s GDDR6 for 448GB/s BW

CHALLENGE FOR AMD RDNA™ 2

Double the CU count at 1.3X the frequency without being bandwidth starved



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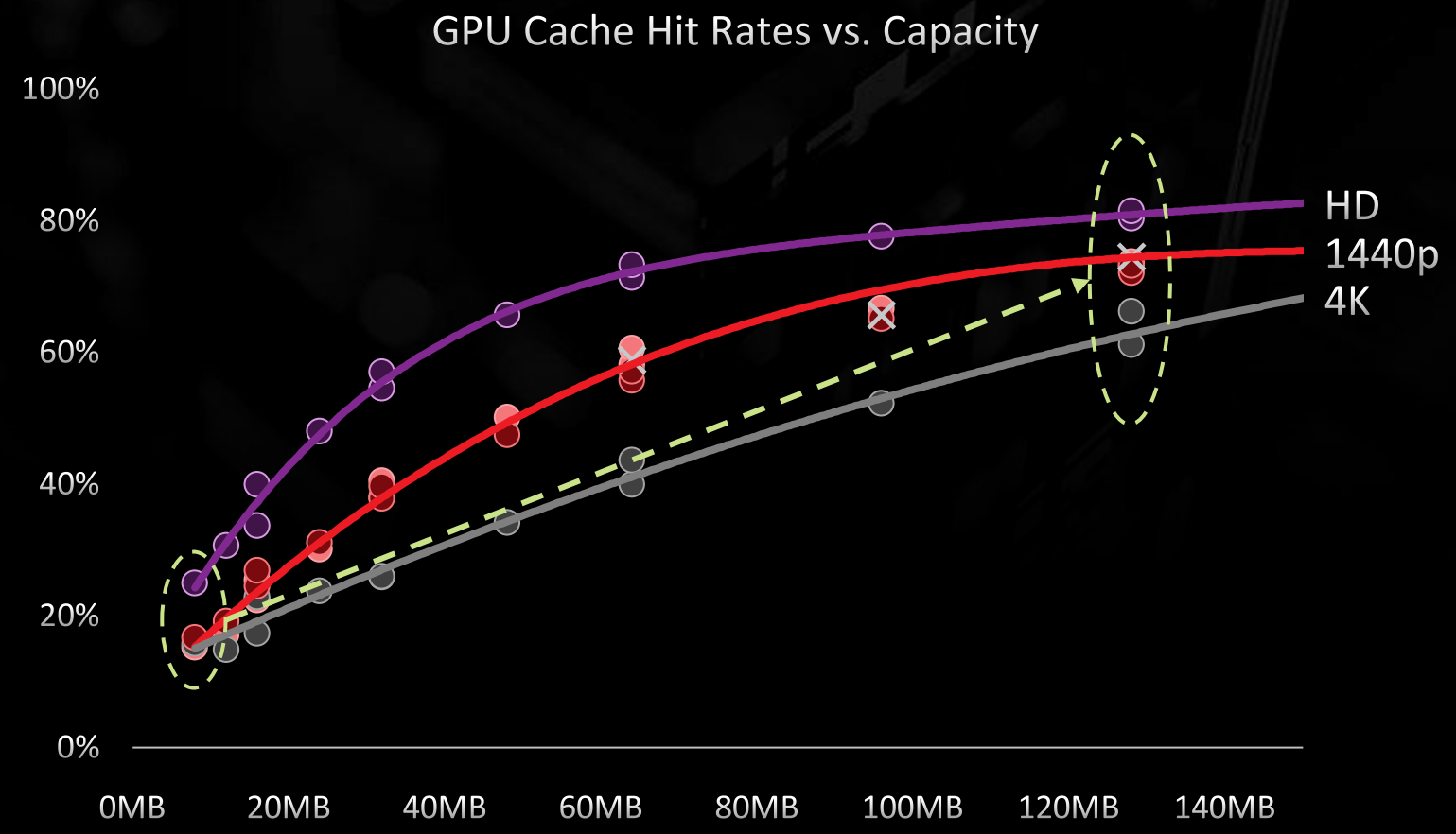
SOLVING THE BANDWIDTH PROBLEM

FRAME DATA CONTAINED IN A LARGE CACHE

- Our GPU Caches in RDNA were focused on supporting the high bandwidth demands of the engine
- The capacities were low, in the 4MB range
- A larger cache could provide compelling bandwidth amplification for common gaming



See endnote RX-548.

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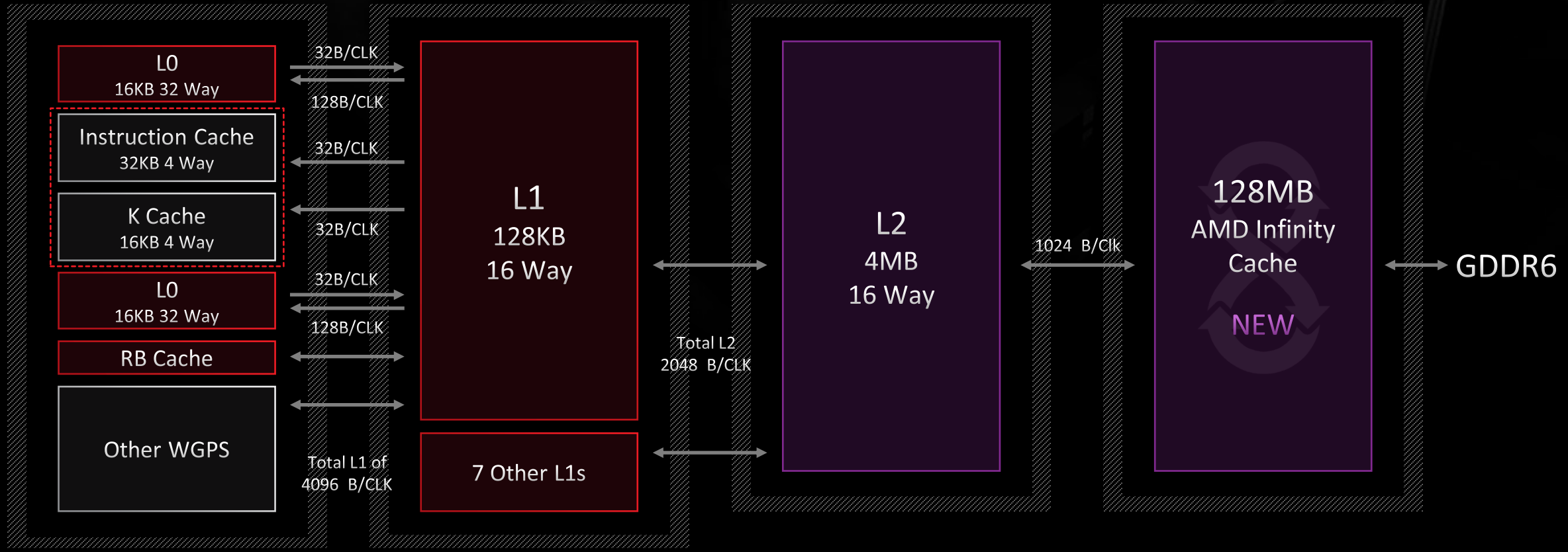
NEW CACHE HIERARCHY

LOCAL CACHE TO GLOBAL CACHE



CAPTURES SPATIAL AND TEMPORAL DATA RE-USE, MINIMIZING DATA MOVEMENT, LATENCIES, AND POWER

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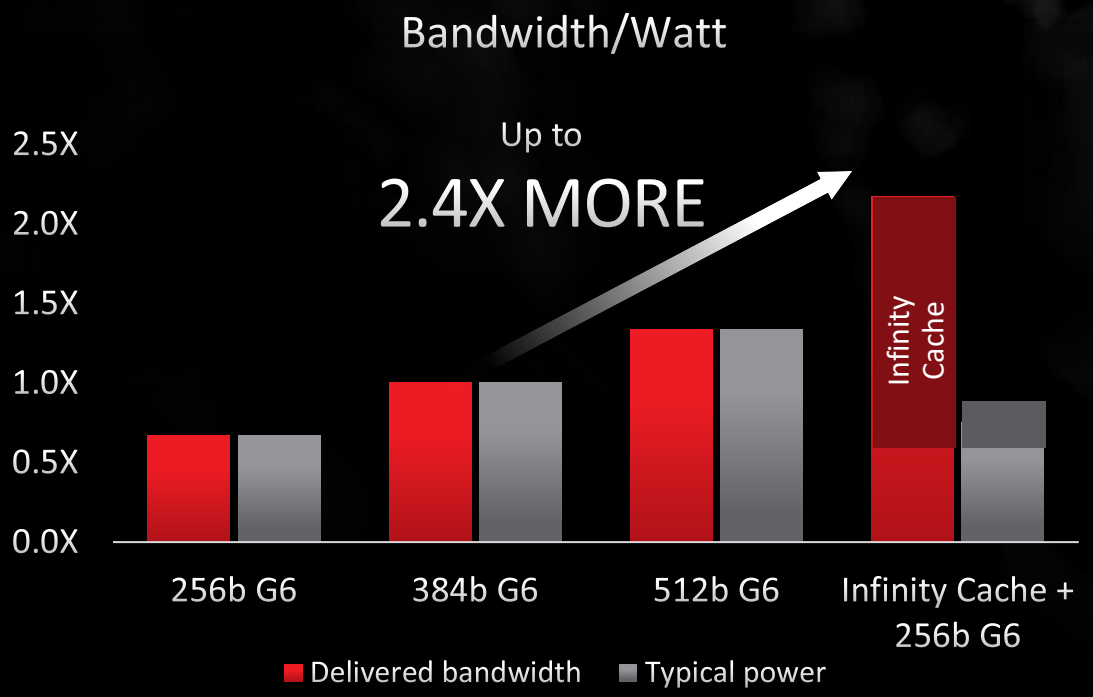
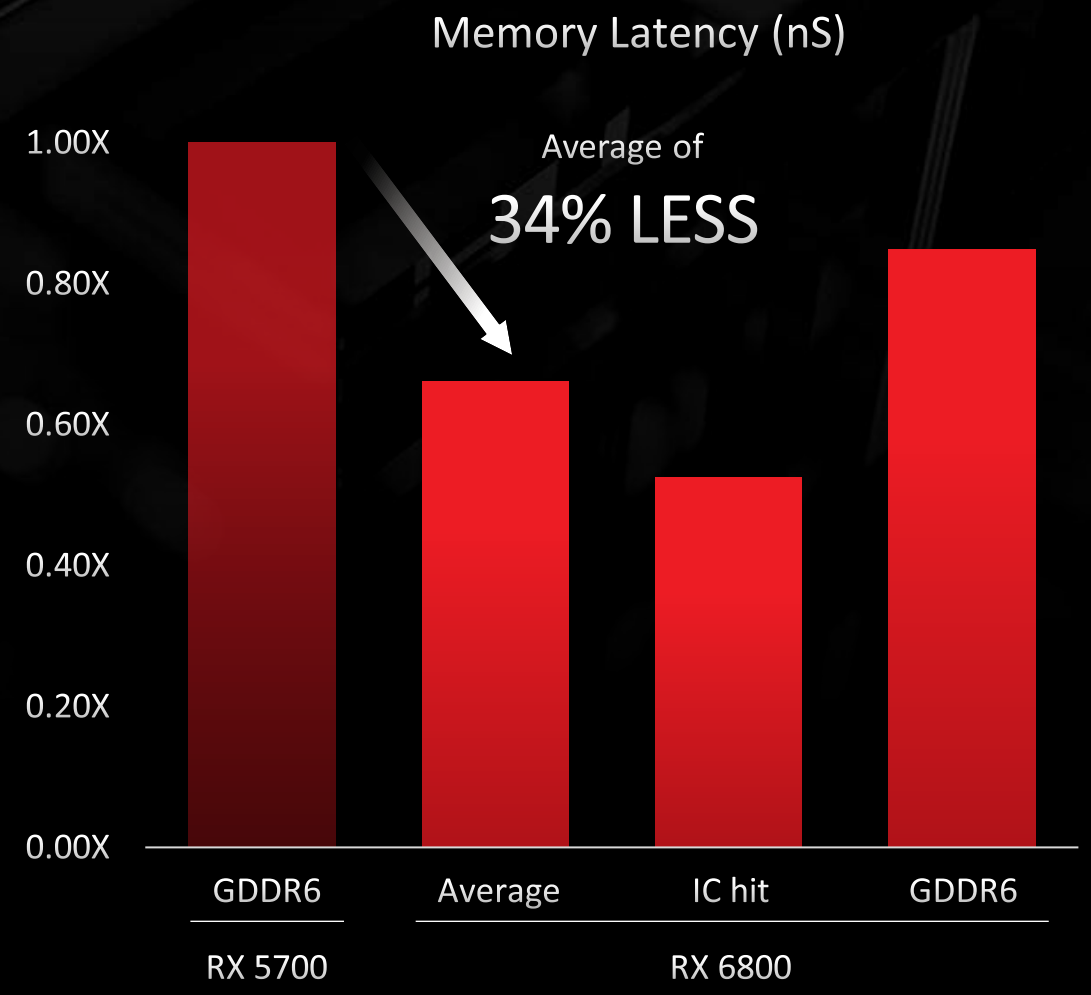
AMD INFINITY CACHE BENEFITS





1.3 pJ
Infinity Cache Access

VS

7-8 pJ
GDDR6 Access

Source: AMD internal lab measurements of GDDR6 phy + DRAM power. See endnotes RX-535, RX-548.

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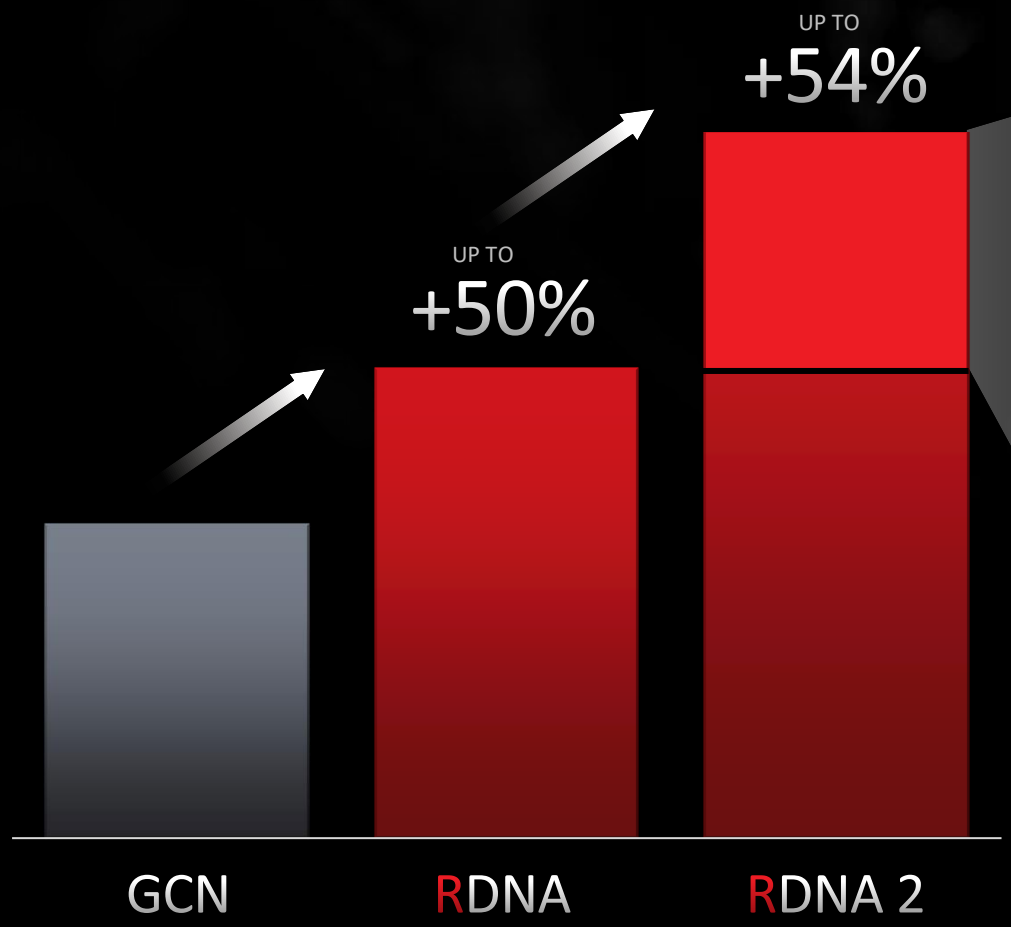
PERFORMANCE-PER-WATT ACHIEVEMENT

PERFORMANCE-PER-WATT GAIN



PERFORMANCE CONTRIBUTORS

16%

Design Frequency Increase

- Leverage CPU high frequency expertise
- High speed performance libraries
- Streamlined micro-architecture and design
- Aggressive re-pipelined logic for speed

17%

CAC and Power Optimizations

- Pervasive fine-grain clock gating
- Clock tree splitting and gating
- Redesigned for minimal data movement
- Aggressive pipeline rebalancing

21%

Performance per Clock Enhancement

- Infinity Cache amplified low latency/power bandwidth
- TLB streamlined for latency reductions
- Redesign 32b pixel pipe and included new HDR format
- Optimized geometry distribution and tessellation

See endnotes RX-325, RX-549, and RX-566.

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AMD RDNA™ 2 ENHANCED VISUALS

ARCHITECTED FOR DIRECTX® 12 ULTIMATE

MESH SHADERS

Unlocking more detailed environments

Ultra high-performance geometry pipelines

Advanced culling and work creation

SAMPLER FEEDBACK

Advanced data streaming

Moving beyond traditional memory limitations

Richly defined worlds

RAYTRACING

Increased realism

More accurate modeling of light interactions

Balance with rasterization for desired quality and framerate

VARIABLE RATE SHADING

High efficiency while maintaining quality

Focus work where it provides benefits

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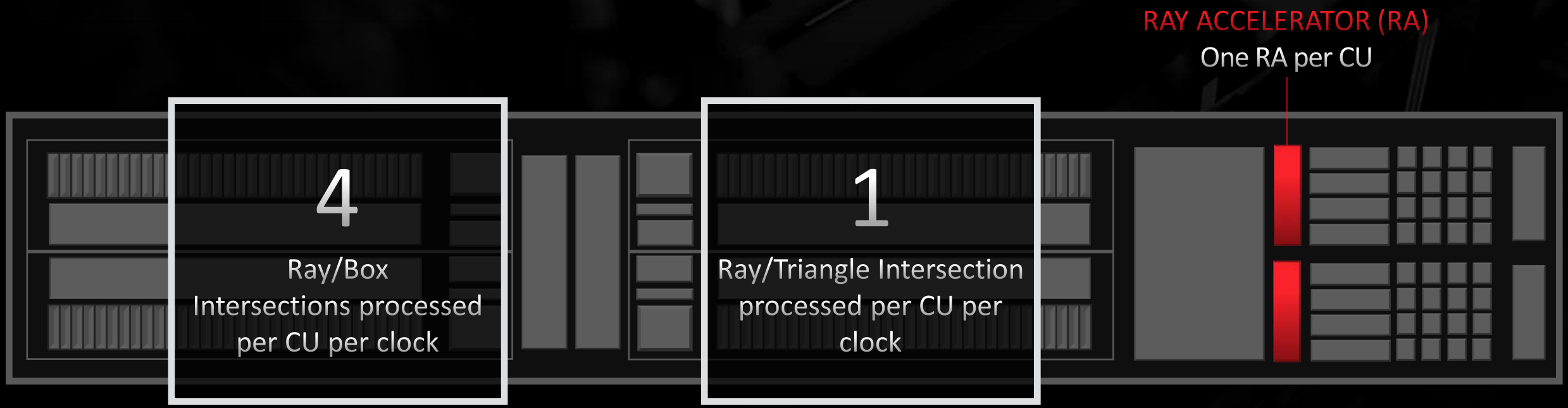
AMD RDNA™ 2 RAYTRACING



AMD RDNA 2 implements a high-performance raytracing intersection acceleration architecture

- The Ray Accelerator handles intersection of rays with the BVH, and sorting of ray intersection times
- It provides an order of magnitude increase in intersection performance compared to a software implementation

Traversal of the BVH and shading of ray results is handled by shader code running on the Compute Units

AMD Infinity Cache can hold a very high percentage of the BVH working set, reducing intersection latency

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AMD RDNA™ 2 VARIABLE RATE SHADING

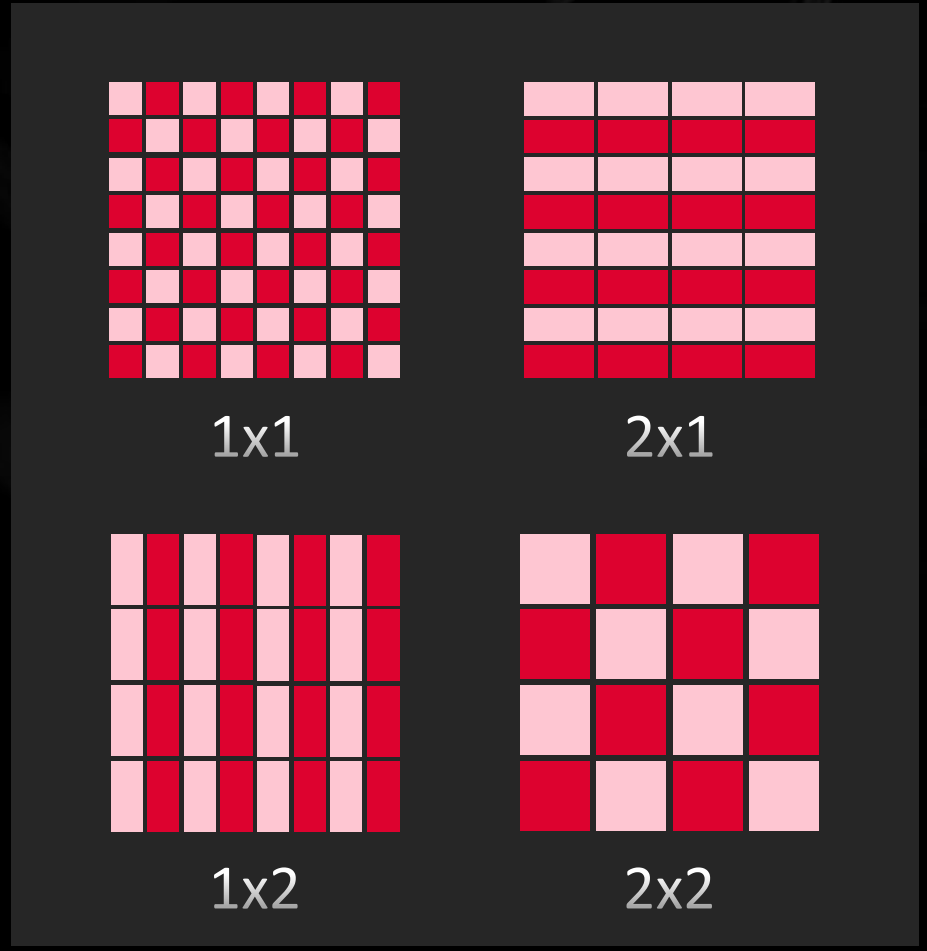
AMD RDNA 2 variable rate shading is designed to deliver the maximum usability and flexibility for developers

Fine grained rate selection (per 8x8 pixels) makes it easier to select the appropriate shading rate for each region

- Larger regions could cause more image quality or performance compromises

AMD RDNA 2 supports coarse shading rates up to 2x2 with consistent and predictable performance improvements

- Up to 4x improvements in effective shading throughput are attainable



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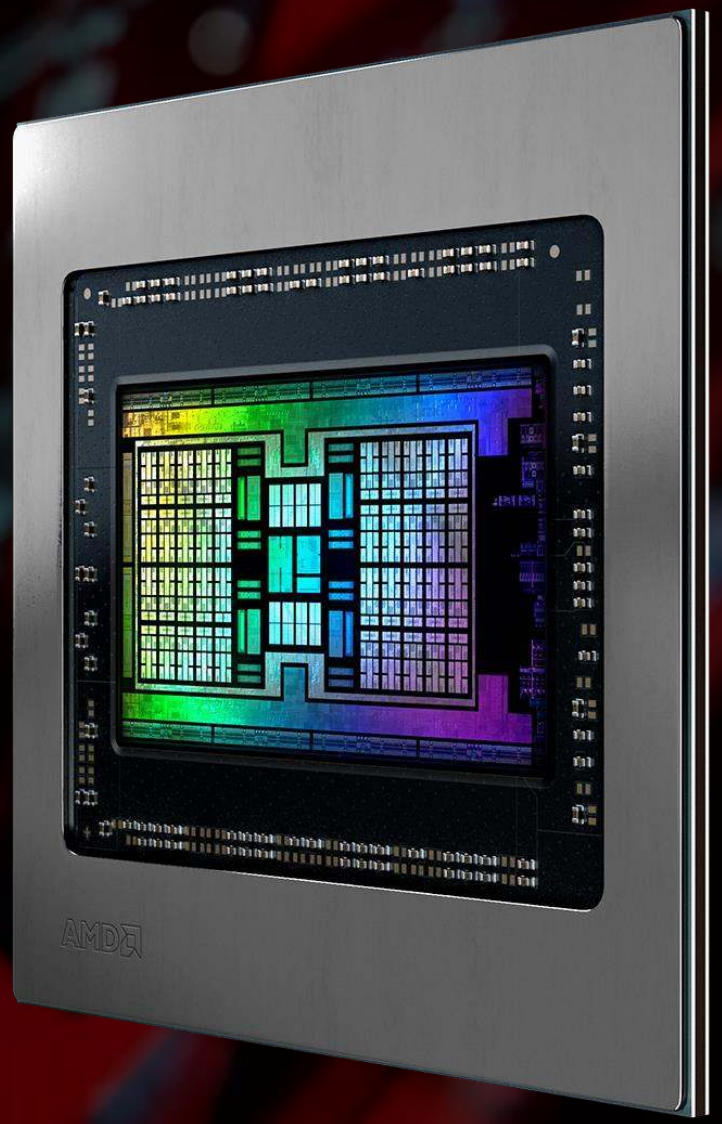
RDNA 2 VARIANTS

	RADEON RX 6800/6900 SERIES	RADEON RX 6700 SERIES	RADEON RX 6600 XT
			
Max Compute Units & Ray Accelerators	80	40	32
Game Clock (up to)	2015 MHz	2424 MHz	2359 MHz
Infinity Cache	128MB	96MB	32MB
Memory Bandwidth	256 bit	192 bit	128 bit
Max Board Power	300W	230W	160W
Transistor Count	26.8B	17.2B	11.1B
Process	7nm	7nm	7nm
Target Experiences	4K	1440p	1080p

WRAP UP



ENDNOTES

RX-325
Testing done by AMD performance labs 6/1/19, using the Division 2 @ 25x14 Ultra settings. Performance may vary based on use of latest drivers. RX-325

RX-535
Measurement calculated by AMD engineering, on a Radeon RX 6000 series card with 128 MB AMD Infinity Cache and 256-bit GDDR6. Measuring 4k gaming average AMD Infinity Cache hit rates of 58% across top gaming titles, multiplied by theoretical peak bandwidth from the 16 64B AMD Infinity Fabric channels connecting the Cache to the Graphics Engine at boost frequency of up to 1.94 GHz. RX-535

RX-536
AMD internal modeling based on graphics-engine-only measured average gaming power consumption and 3DMark11 power consumption vs. frequency for RX5700 XT and RX 6900 XT divided by the number of compute units (40 and 80 respectively). RX-536

RX-543
AMD internal modeling based on the average CAC of 33 apps tested on the RX 5700 XT and RX 6900 XT divided by the number of active compute units 40 and 80 respectively. Performance will vary. RX-543

RX-548
AMD internal modeling based measured AMD Infinity Cache uplifts and extrapolation based on CU count. Performance will vary. RX-548

RX-549
Testing done by AMD performance labs 10/16/20, using Assassins Creed Odyssey (DX11, Ultra), Battlefield V (DX12, Ultra), Borderlands 3 (DX12, Ultra), Control (DX12, High), Death Stranding (DX12 Ultra), Division 2 (DX12, Ultra), F1 2020 (DX12, Ultra), Far Cry 5 (DX11, Ultra), Gears of War 5 (DX12, Ultra), Hitman 2 (DX12, Ultra), Horizon Zero Dawn (DX12, Ultra), Metro Exodus (DX12, Ultra), Resident Evil 3 (DX12, Ultra), Shadow of the Tomb Raider (DX12, Highest), Strange Brigade (DX12, Ultra), Total War Three Kingdoms (DX11, Ultra), Witcher 3 (DX11, Ultra no HairWorks) at 4K. System comprised of an RX 6800 XT with AMD Radeon Graphics driver 27.20.12031.1000 and an RX 5700 XT with AMD Radeon Graphics driver 26.20.13001.9005. Performance may vary. RX-549

RX-558
Testing done by AMD performance labs October 18 2020 on AMD Ryzen 9 5900X (3.70GHz) CPU, 16GB DDR4-3200MHz, Win10 Pro x64. Radeon RX 6800 was using 20.45-201013n, RTX 2080 Ti using 456.71. Following games were tested at 4k at max settings: Battlefield V DX11, Doom Eternal Vulkan, Forza DX12, Resident Evil 3 DX11, Shadow of the Tomb Raider DX12. Performance may vary. RX-558

RX-564
Based on AMD internal modeling and testing done by AMD engineering labs 10/5/2020 on Radeon RX 6800 XT with 128 MB of AMD Infinity Cache vs a Radeon RX 5700 XT graphics card measuring memory latency. Performance may vary. RX-564

RX-565
Measurement calculated by AMD engineering, on a Radeon RX 6000 series card with 128 MB AMD Infinity Cache and 256-bit GDDR6. Multiplying 16 64B AMD Infinity Fabric channels connecting the Cache to the Graphics Engine with a boost frequency of up to 1.94 GHz and a base frequency of 1.4 Ghz. RX-565

RX-566
Based on AMD internal modeling and testing done by AMD engineering labs 10/5/2020 on a Radeon RX 6800 XT vs a Radeon RX 5700 XT, using measurements taken of Cac, frequency at same power uplifts, and AMD Infinity Cache uplifts. Performance may vary. RX-566

RX-568
Based on AMD internal modeling and testing done by AMD engineering labs 10/5/2020, measuring AMD Infinity Cache uplifts across 44 apps in 4K, using at 2100 Mhz engine clock and then extrapolating from that frequency point. Performance may vary. RX-568

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