AMD “Kabini” APU SOC

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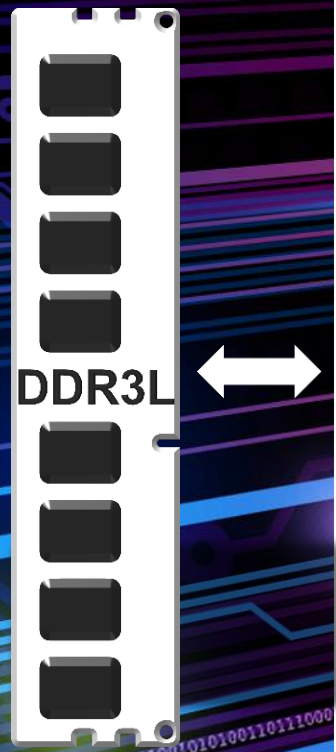
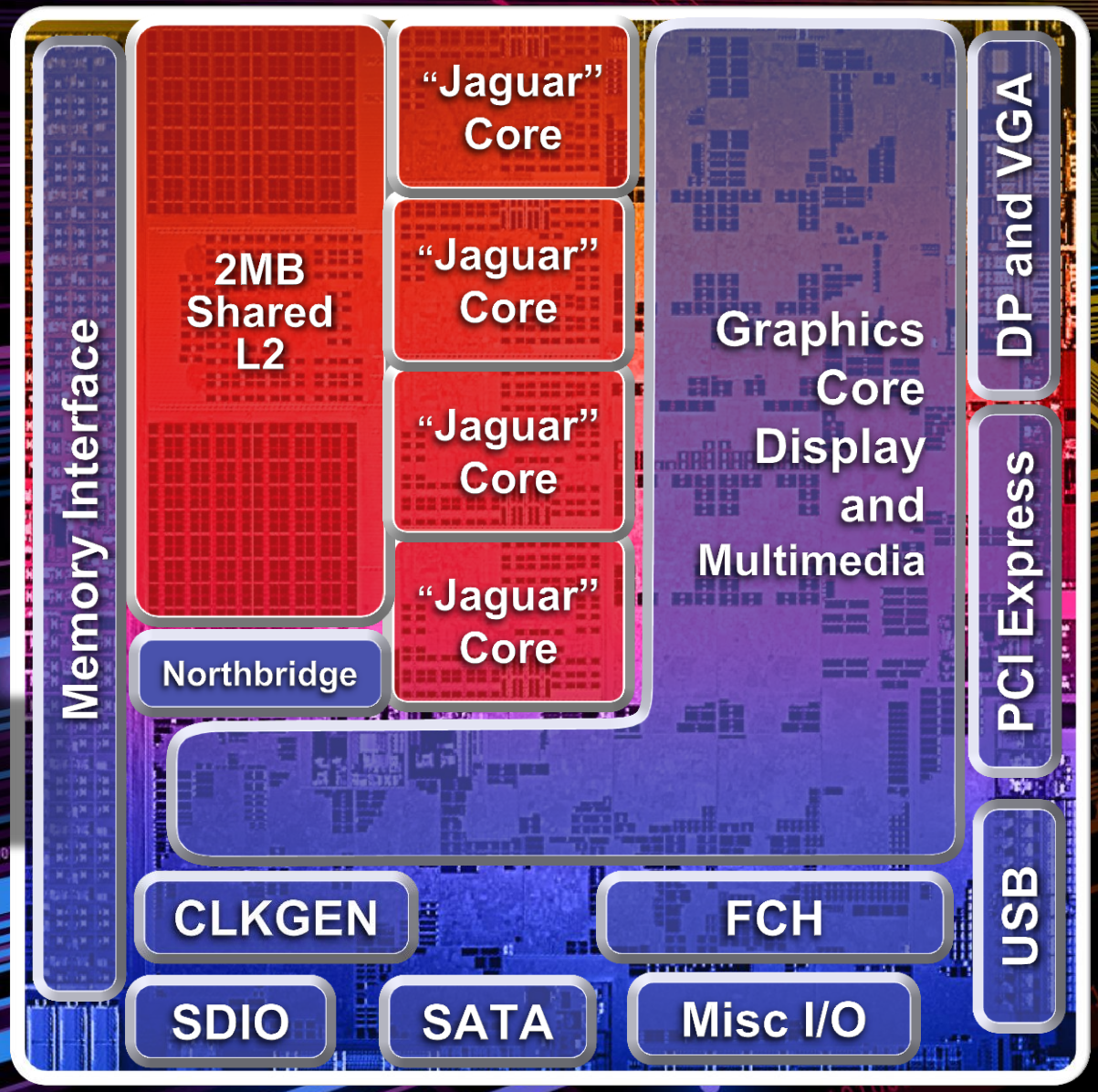
HOT CHIPS 25
AUGUST 2013

“KABINI” FLOORPLAN

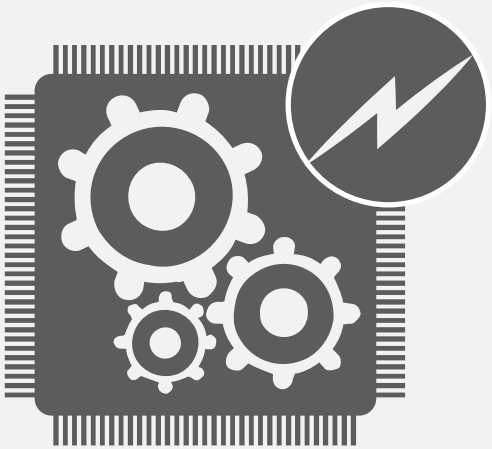




28nm technology, 105 mm^2, 914M transistors

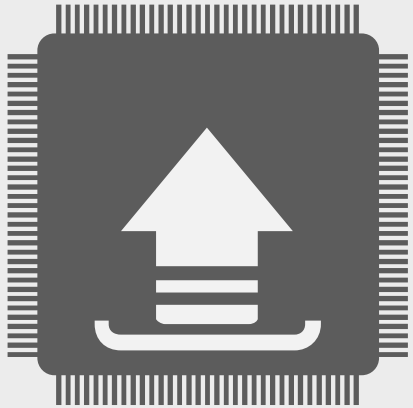
"JAGUAR" CORE DESIGN GOALS

IMPROVE ON "BOBCAT": PERFORMANCE IN A GIVEN POWER ENVELOPE



- More IPC
- Better frequency at given voltage
- Improved power efficiency through clock gating and unit redesign

UPDATE THE ISA/FEATURE SET



- "Jaguar" added:
  - SSE4.1, SSE4.2
  - AES, CLMUL
  - MOVBE
  - AVX, XSAVE/XSAVEOPT
  - F16C, BMI1
  - 40-bit physical address-capable
  - Improved virtualization

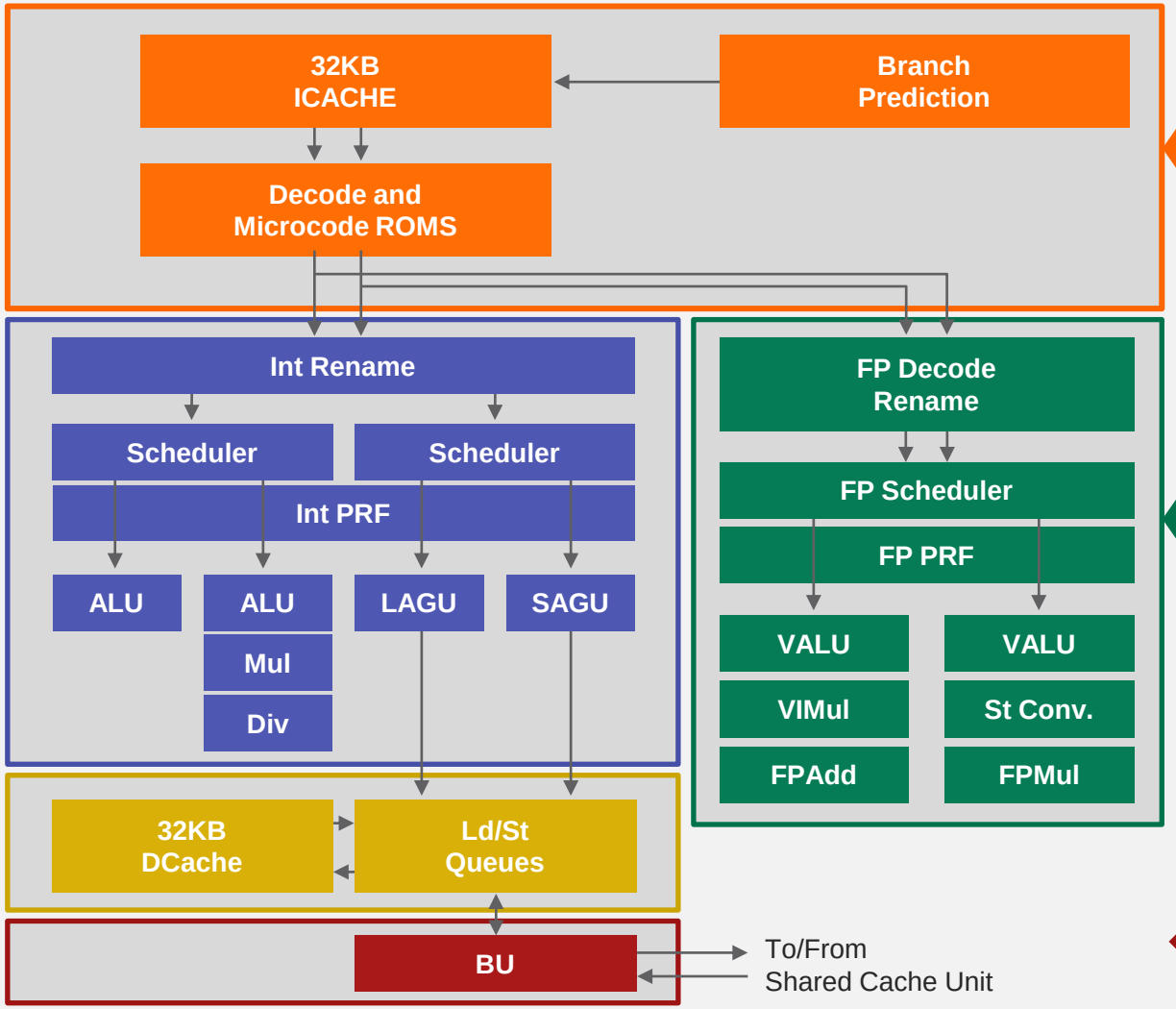
INCREASE PROCESS PORTABILITY

"JAGUAR" ENHANCEMENTS

AMD

- New hardware divider
- New/improved COPs: CRC32/SSE4.2, BMI1, POPCNT, LZCNT
- More OOO resources

- Ld/St Queues redesign
- Enhanced tablewalks
- 128b data path to FPU

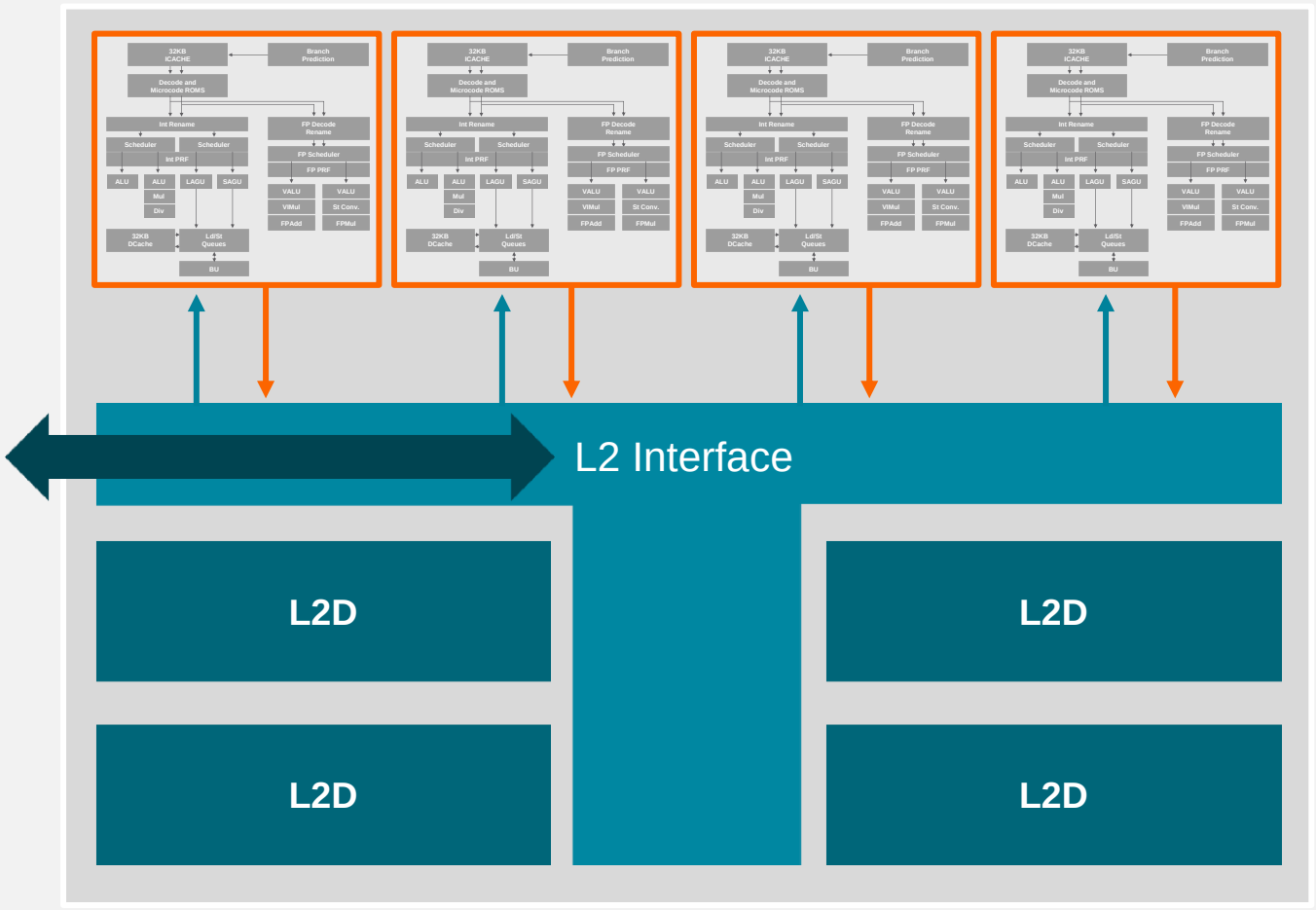


- Improved IC prefetcher
- Larger IB for improved fetch/decode decoupling

- 128b native hardware
  - 4 SP muls + 4 SP adds
  - 1 DP mul + 2 DP adds
- ISA: many new COPs
  - 256b AVX support
- New zero optimizations

- Improved write combining
- More outstanding transactions

"JAGUAR" SHARED CACHE UNIT



Shared cache is major design addition in “Jaguar”

- Supports 4 cores
- Total shared 2MB, 16-way
  - Supported by 4 L2D banks
- L2 cache is inclusive
  - Allows using L2 tags as probe filter
- L2 tags reside in interface block
  - Divided into 4 banks
  - L2D bank look-up only after L2 tag hit
- L2 interface block runs at core clock
- New L2 stream prefetcher per core

UNIFIED NORTHBRIDGE AND MEMORY

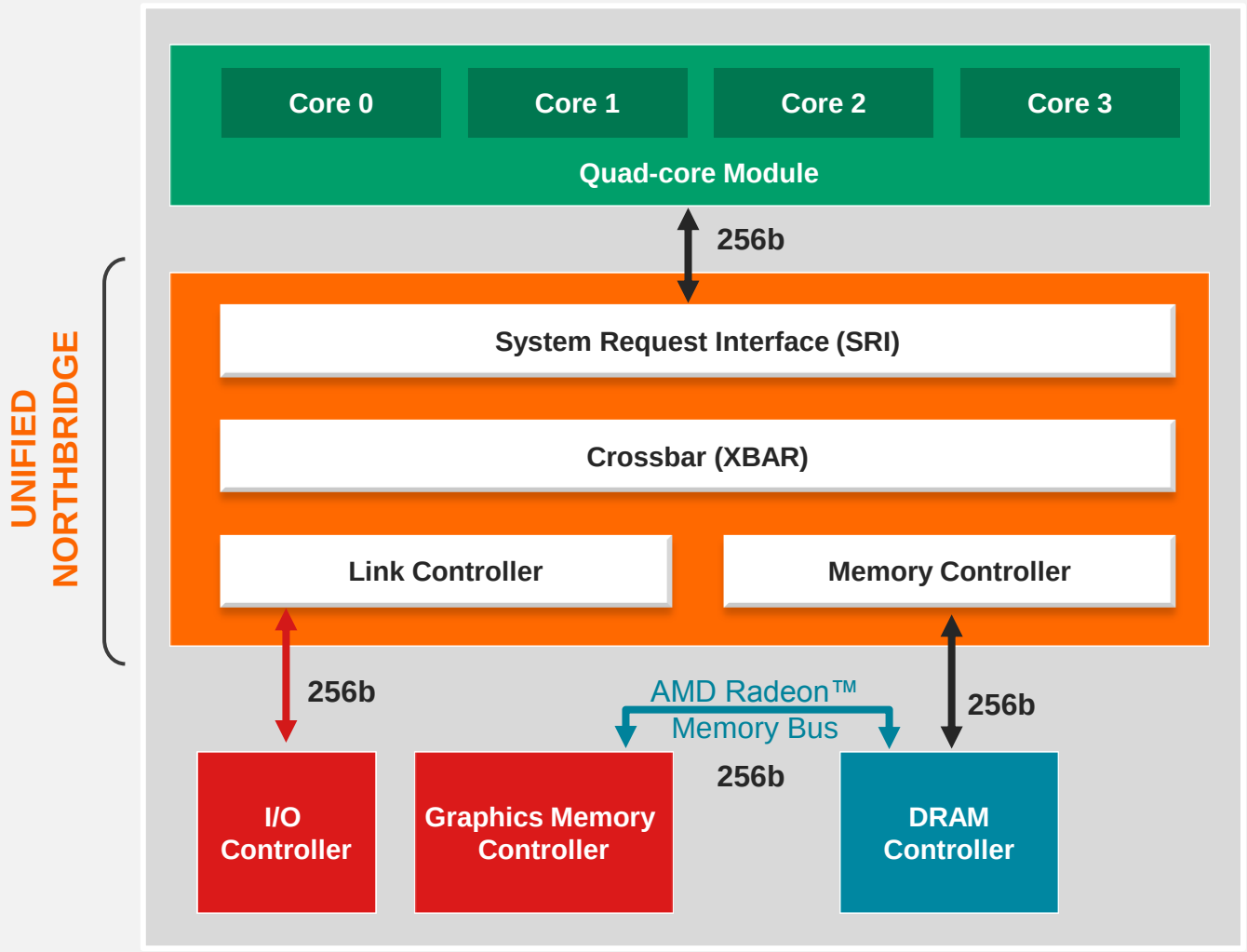
EFFICIENT BANDWIDTH DELIVERY TO DELIVER VISUAL EXPERIENCE

UNIFIED NORTHBRIDGE

- Supports
  - DDR3 interface
  - Interface to graphics memory controller
  - Interface to I/O subsystem
  - APU power management
- PCI is the interconnect to I/O devices

MEMORY SUPPORT

- 64-bit interface with 4 memory ranks
- Supports 1.25V, 1.35V, and 1.5V DIMMS
- Up to 10.3 GB/s with DDR3-1600
- Up to 32 GB capacity in notebook FT3 BGA package
- Supports memory P-states — with memory speed changes on the fly



GRAPHICS CORE NEXT ARCHITECTURE

AMD

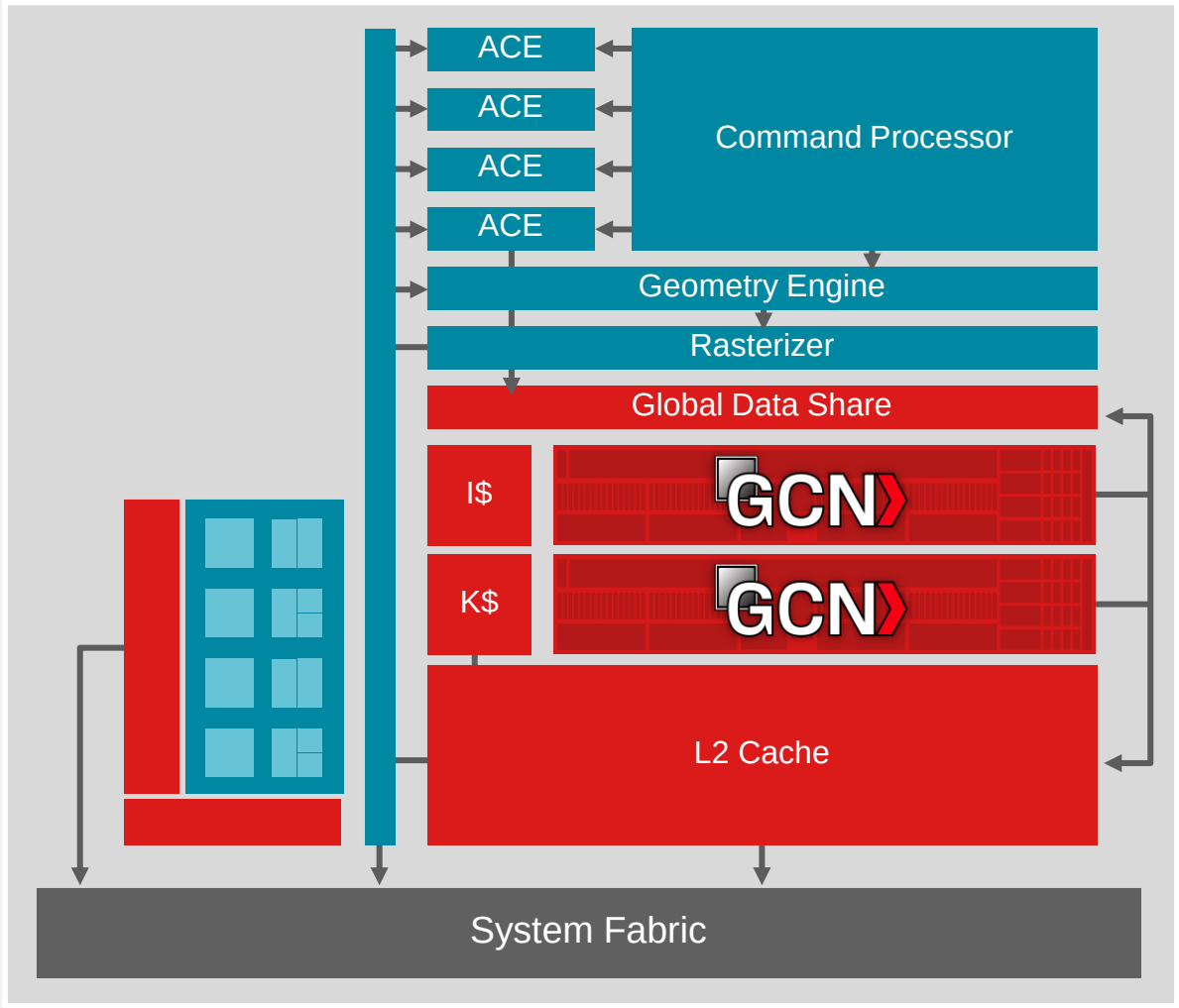
- Cutting-edge graphics performance and features
- High compute density with multi-tasking
- Built for power efficiency
- Optimized for heterogeneous computing
- Support for high-level language features for heterogeneous compute

A new GPU design
for a new era
of computing

AMD RADEON™ HD 8000 GRAPHICS CORE NEXT ARCHITECTURE

First APU with GCN architecture

- API support:
  - Graphics: DirectX 11.1, OpenGL 4.3, OpenGL ES 3.0
  - Compute: OpenCL1.2, DirectCompute, C++ AMP
- Hardware configuration:
  - Geometry engine
    - ¼ prim/clock
  - Two GCN compute units (CUs)
  - 1 render back-end
    - 4 pixel color raster operation pipelines (ROPs)
    - 16 depth test (Z) / stencil ops
    - Color cache (C$) / Depth cache (Z$)
  - 128KB read/write L2 cache
  - 4KB global data share with global synchronization resources
- Advanced power management:
  - Fine-grain clock\clock tree gating
  - PowerTune – dynamic V/F scaling with power containment
  - Zero core power – power gating

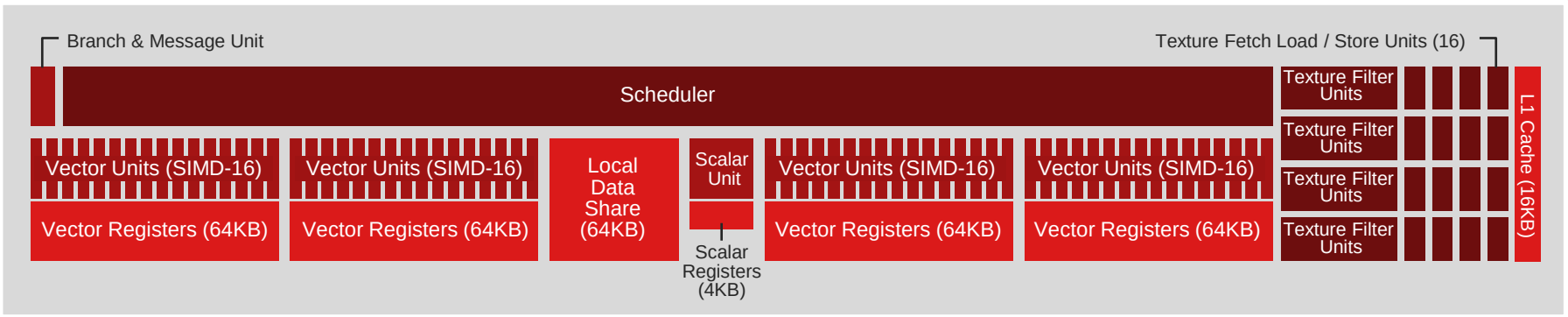


GCN COMPUTE UNIT

Basic GPU building block of unified shader system

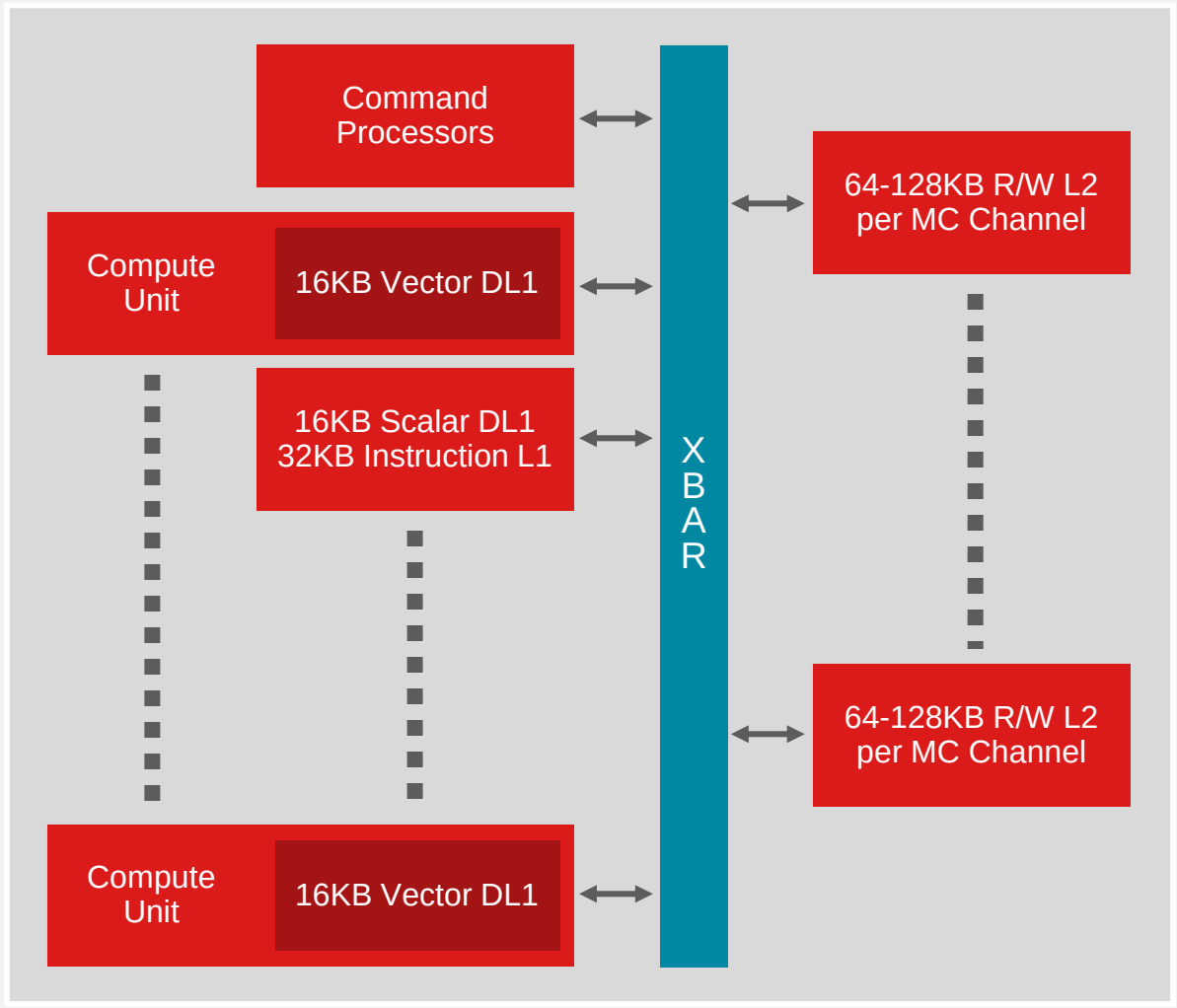
- New instruction set architecture
  - Non-VLIW
  - Vector unit + scalar co-processor
  - Distributed programmable scheduler
  - Unstructured flow control, function calls, recursion, exception support
  - Un-typed, typed, and image memory operations
  - Flat address support
- Each CU can execute instructions from multiple kernels simultaneously
- Designed for programming simplicity, high utilization, high throughput, multi-tasking
- Consistent with AMD dGPU architecture so kernels developed for GCN run anywhere

GCN Compute Unit



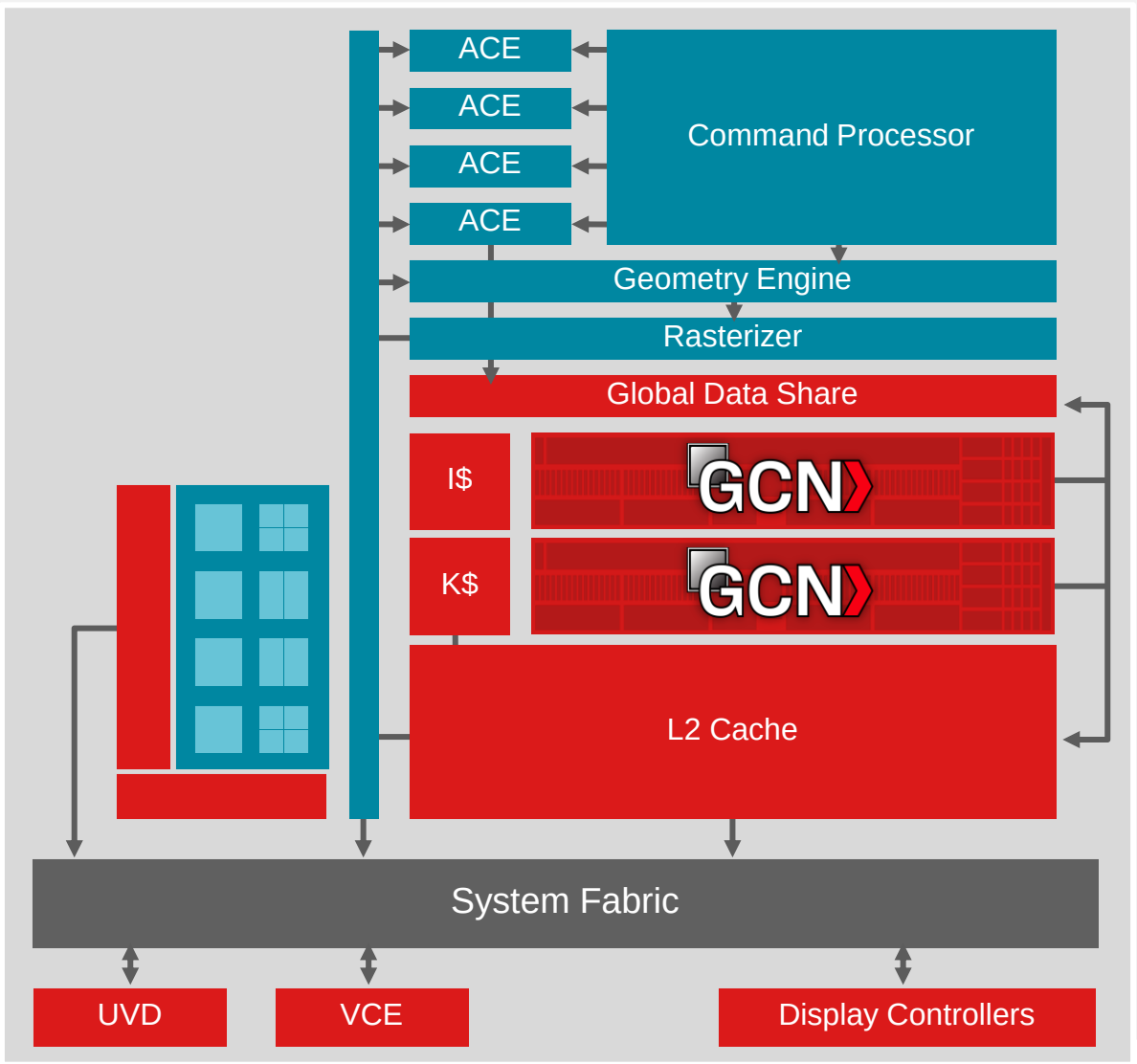
GCN R/W CACHE

- Reads and writes cached
  - Bandwidth amplification
  - Improved behavior on more memory access patterns
  - Improved write-to-read re-use performance
- Relaxed consistency memory model
  - Consistency controls available to control locality of load/store
- GPU-coherent
  - Acquire/Release semantics control data visibility across the machine
  - L2 coherent = all CUs, ACE, and command processors can have the same view of data
- Global atomics
  - Performed in L2 cache



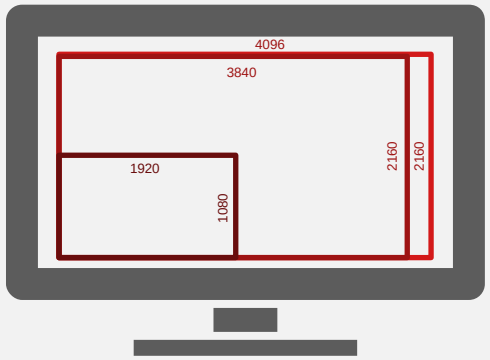
AMD RADEON HD 8000 GCN ARCHITECTURE

- Dual-display support
  - HDMI and DisplayPort™ support up to 4K x 2K 30Hz
  - Wireless display
  - Low-power self-refresh
- Video Codec Engine (VCE) fixed-function
  - Multi-stream hardware H.264 HD encoder
  - Power-efficient and faster than real-time 1080p@60fps
  - Scalable video coding (SVC)
- Universal Video Decoder (UVD) fixed-function with codecs for:
  - H.264
  - VC-1
  - MPEG-2
  - MVC
  - DivX
  - WMV MFT
  - WMV-native



DISPLAY TECHNOLOGY LEADERSHIP

ULTRAHD

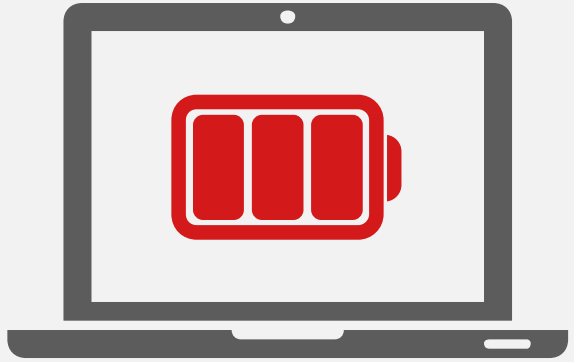


- Drive 4K x 2K resolution displays* via HDMI and DisplayPort

WIRELESS DISPLAY

- Wi-Fi CERTIFIED, Miracast™ Support
- Low latency & low power

PANEL SELF-REFRESH



- Significant power savings with embedded DisplayPort panel self-refresh*

DYNAMIC REFRESH RATE

- Automatically and seamlessly reduce panel refresh rate to save power*

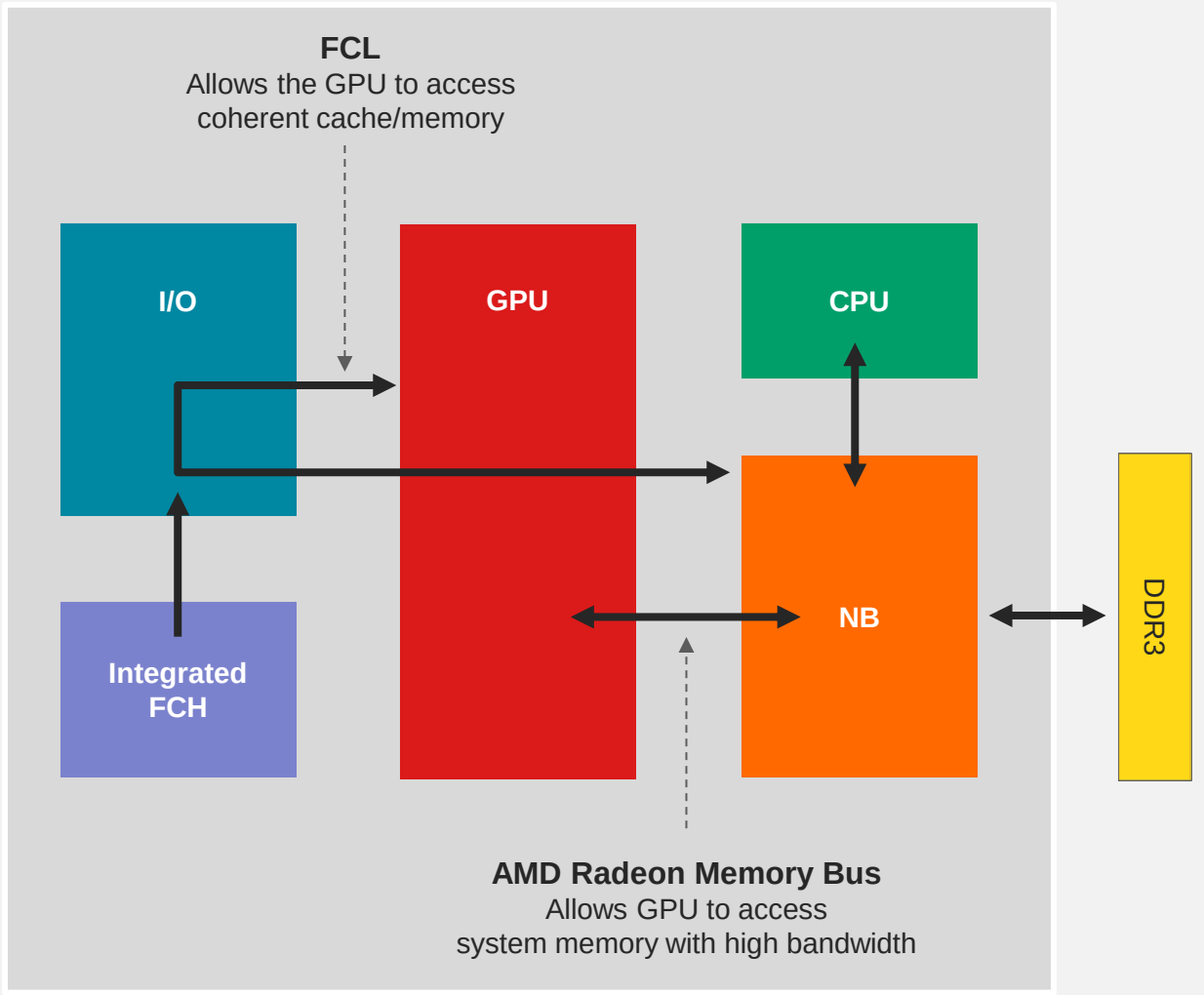
* Supported panel required

“KABINI” ACCELERATED COMPUTING
A COMPLETE SYSTEM-ON-A-CHIP SOLUTION

FCL
- 128b (each direction) path for I/O access to memory
- GPU access to coherent memory space
- CPU access to dedicated GPU framebuffer

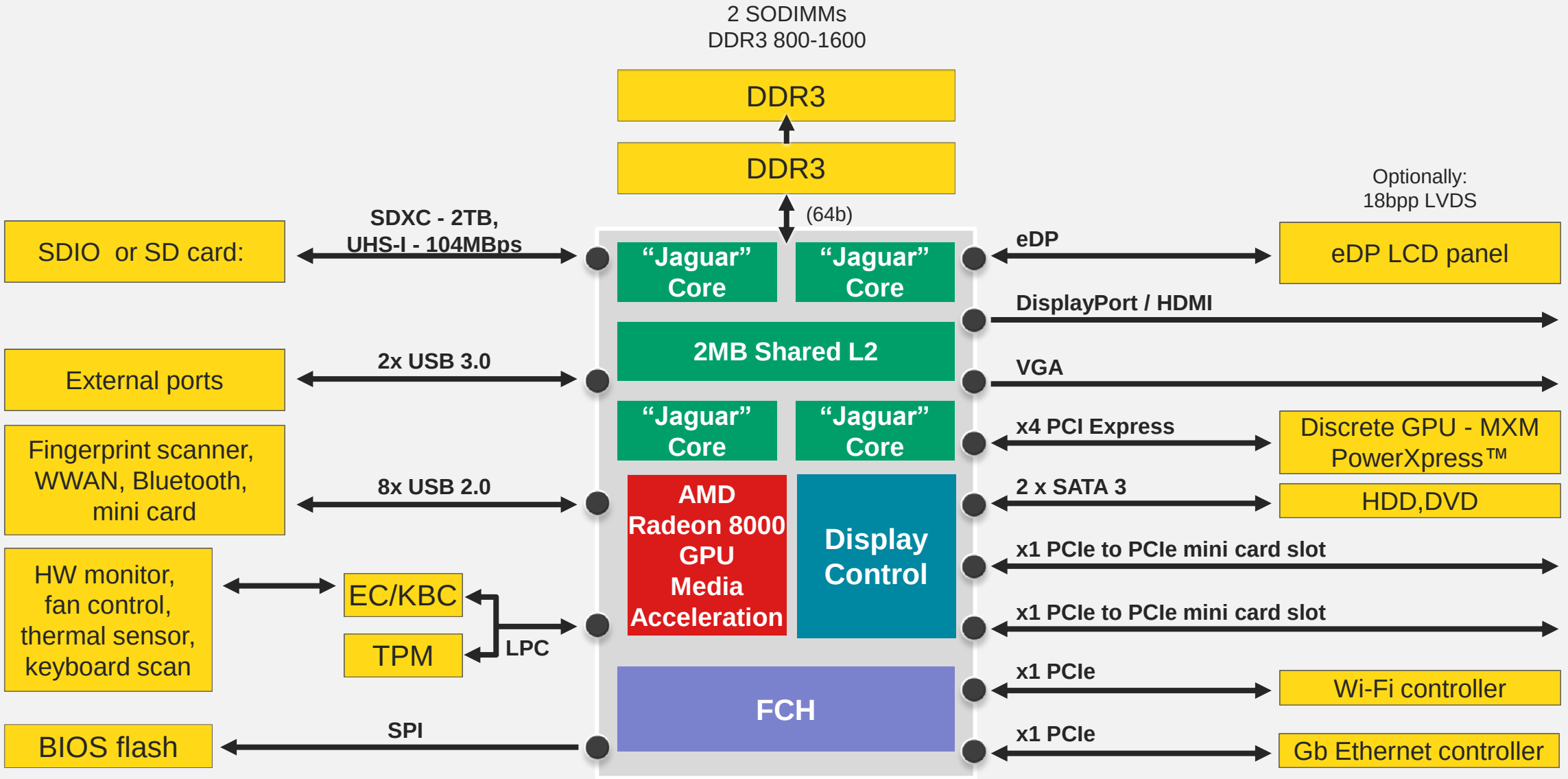
GRAPHICS MEMORY BUS
- 256b (each direction) for GMC access to memory
- Full-bandwidth path for graphics to system memory
- DRAM-friendly stream of reads and write
- Bypasses coherency mechanism

INTEGRATED SYSTEM CONTROL AND I/O (FCH)
- Provides complete system connectivity
  - USB 3.0, USB 2.0, SATA 3, GPIO
  - Integrated system clock generator
- Reduced motherboard footprint required
- Higher I/O performance at reduced power consumption



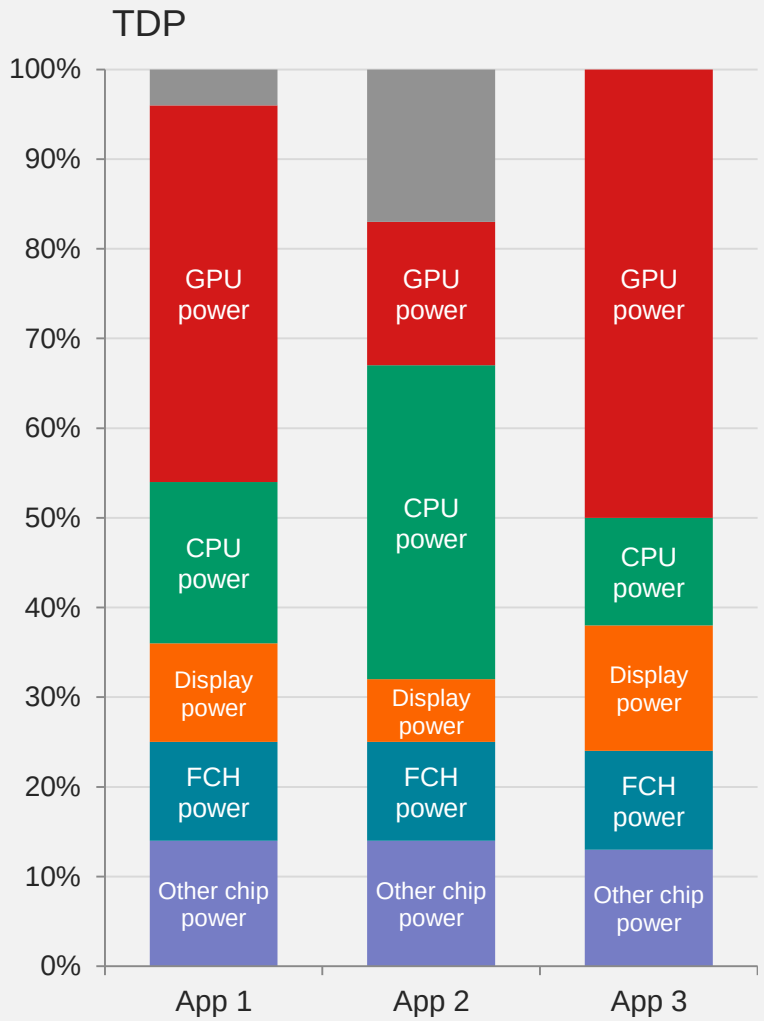
*Functional units not to scale

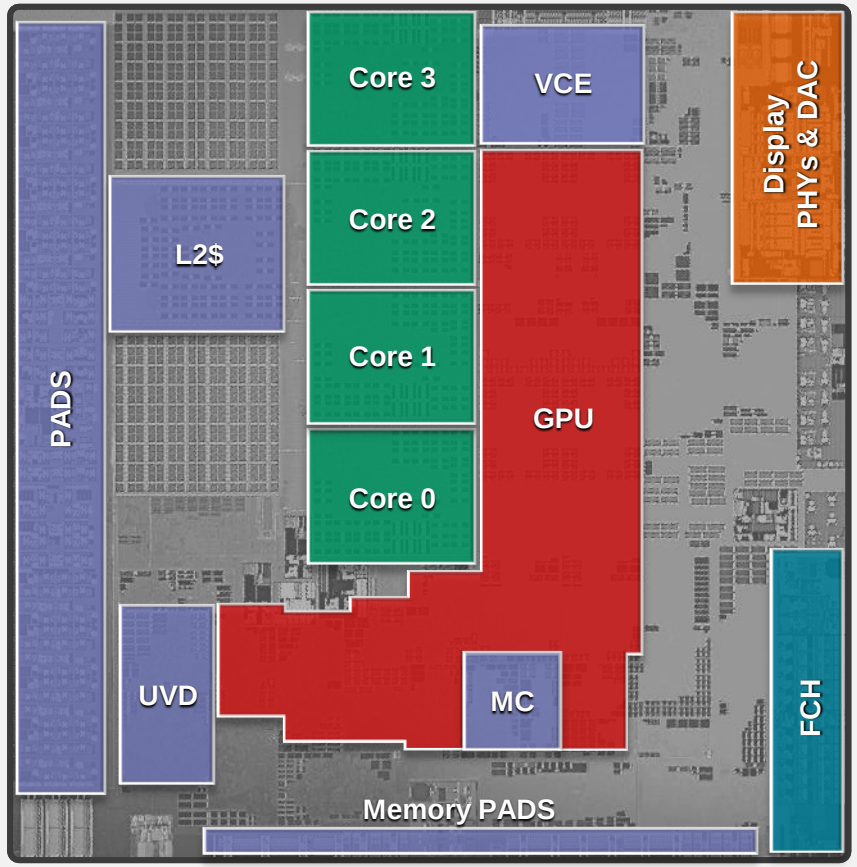
THE "KABINI" SYSTEM



CHIP-LEVEL POWER DISTRIBUTIONS

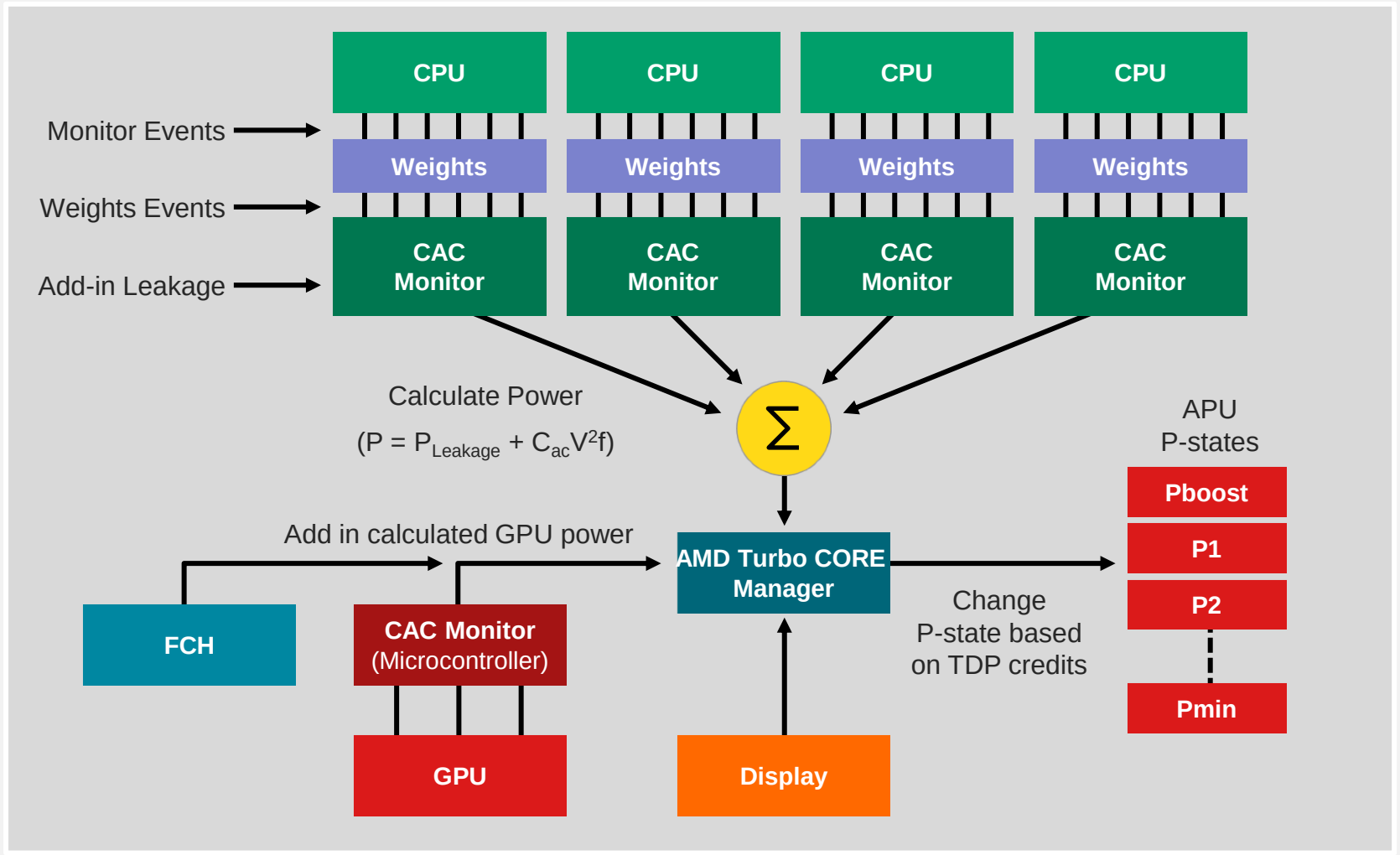
- Power consumption (and hence performance) is set by the cooling capabilities of the platform
- Power varies a lot by workload
- We measure and manage the power of each component on the chip to generate the best performance/watt



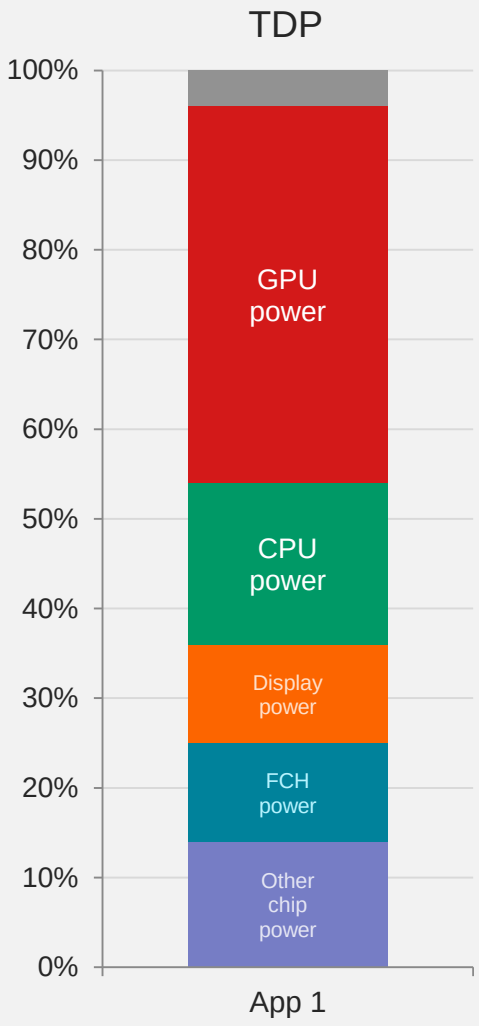


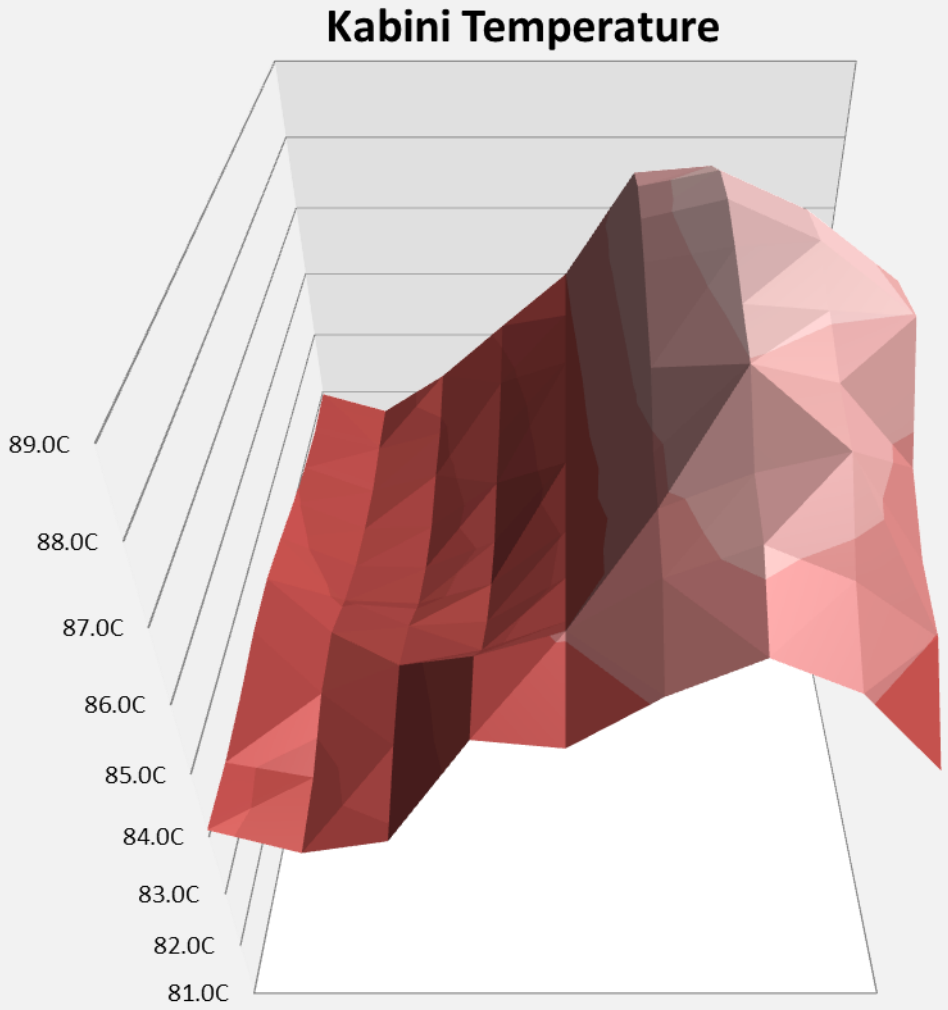
DIGITAL POWER MONITORING

- To manage temperature and send the power wherever it's needed, we use power monitors in all chip components
- "Kabini" and "Temash" have power monitors in each CPU, the GPU, the display interface, and the FCH
- The central controller uses this information to optimize performance within thermal constraints

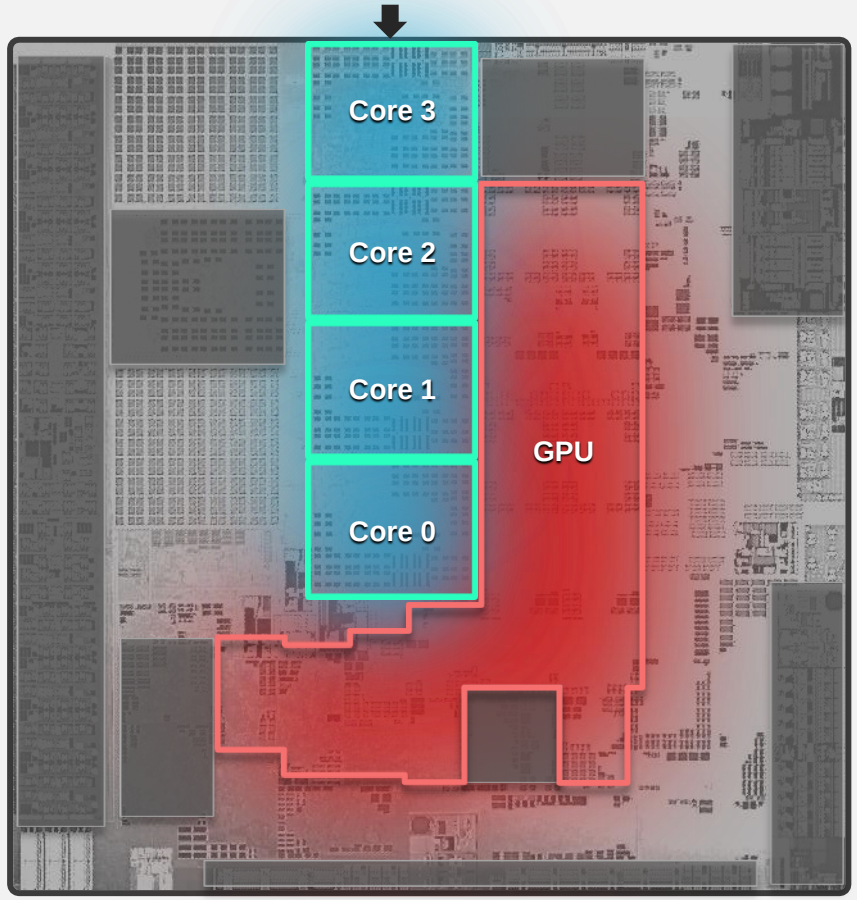


CHIP-LEVEL POWER DISTRIBUTIONS: GPU-CENTRIC

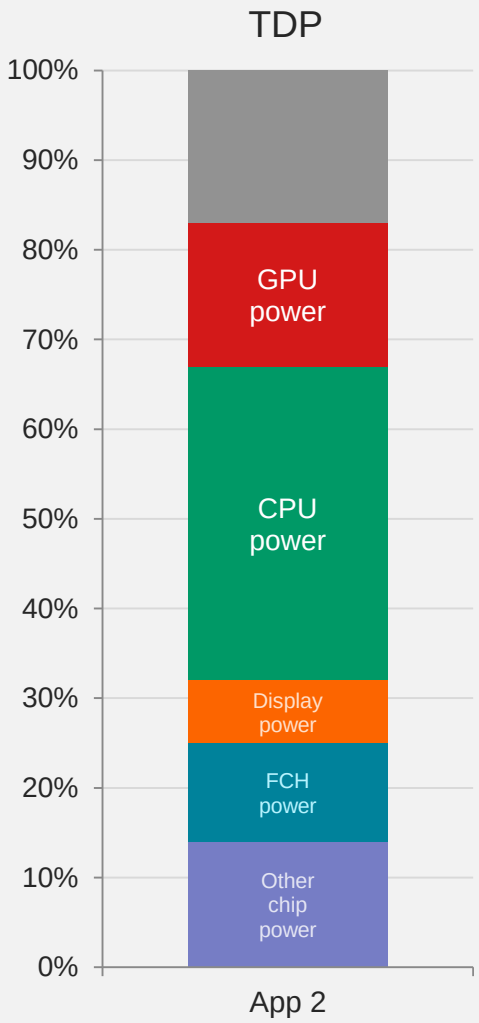


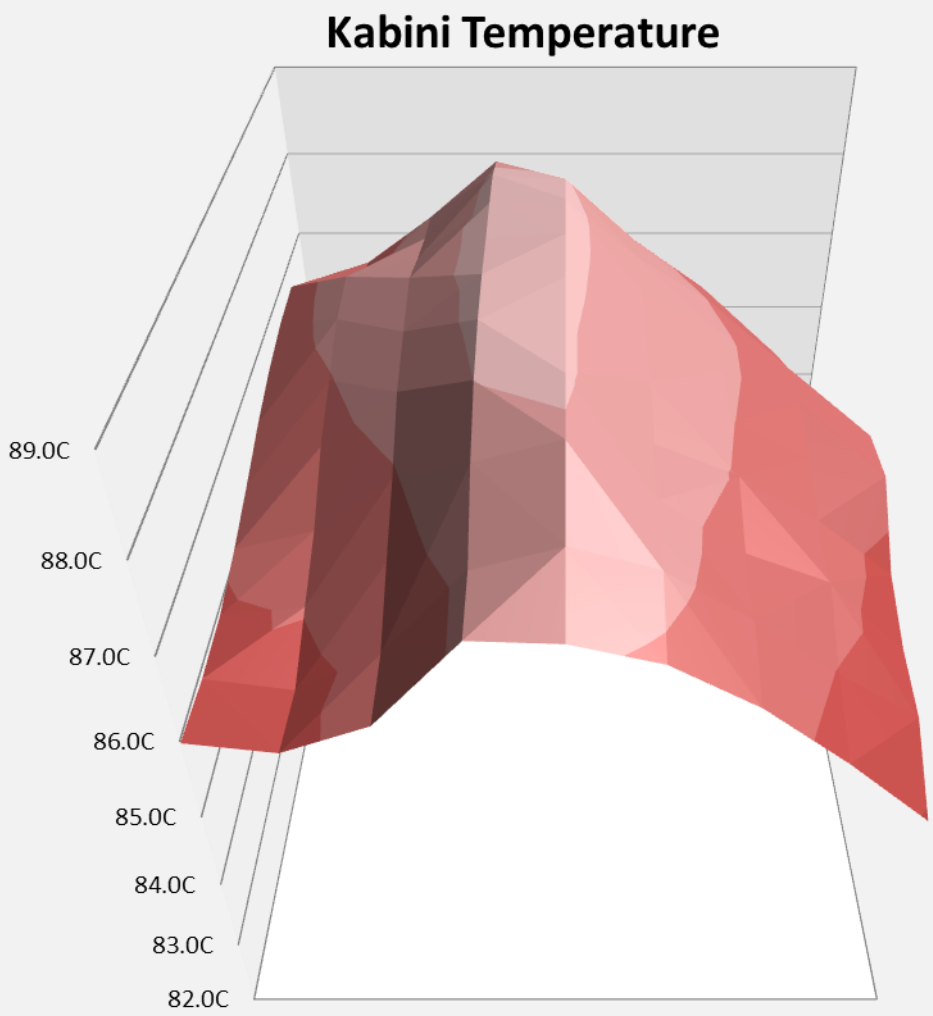


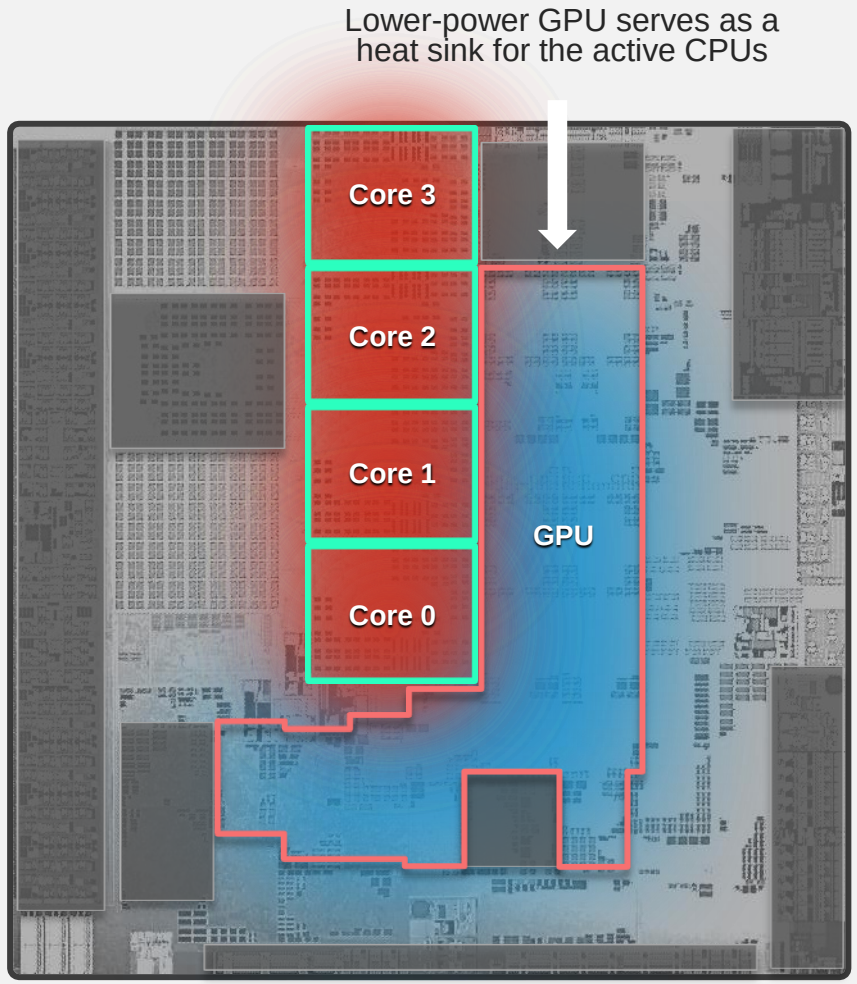
Lower-power cores serve as a heat sink for the active GPU



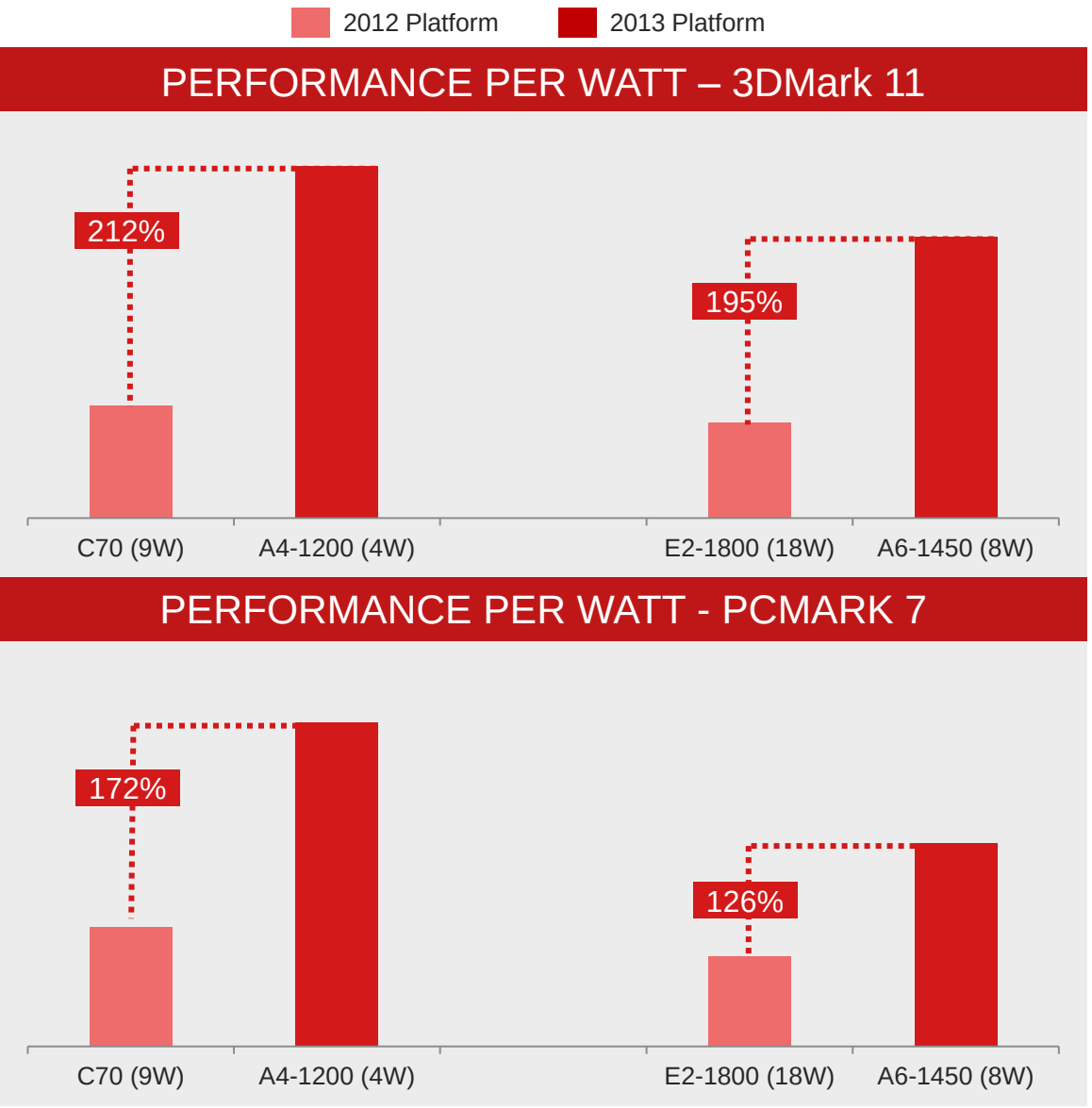
CHIP-LEVEL POWER DISTRIBUTIONS: CPU-CENTRIC







AMD INNOVATES WITH THE 2013 AMD ELITE MOBILITY APU PLATFORM

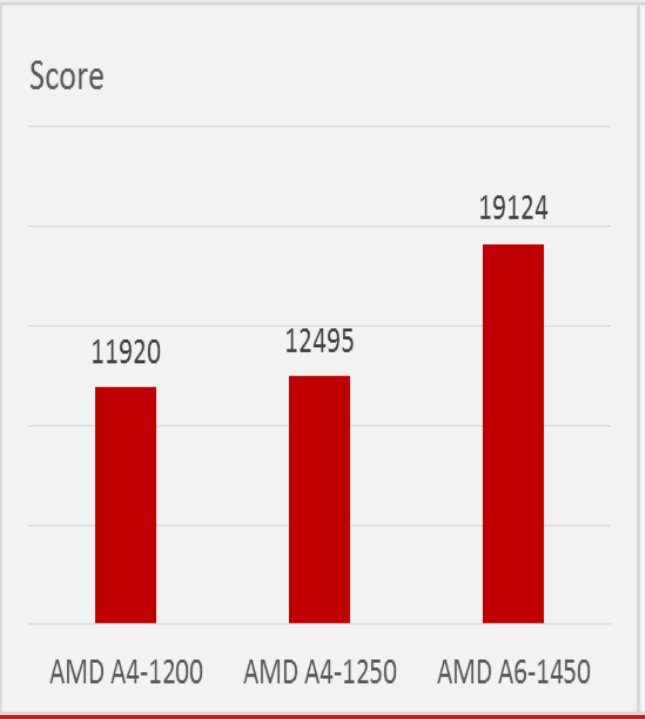


- From performance tablet to small-screen touch notebook, the AMD Elite Mobility APUs enable a whole new class of mobile devices.
- The performance of AMD Elite Mobility APUs resets user expectations for what they can do in tablets and hybrids.
- Notebook-class CPU and GPU performance at less than half the power.

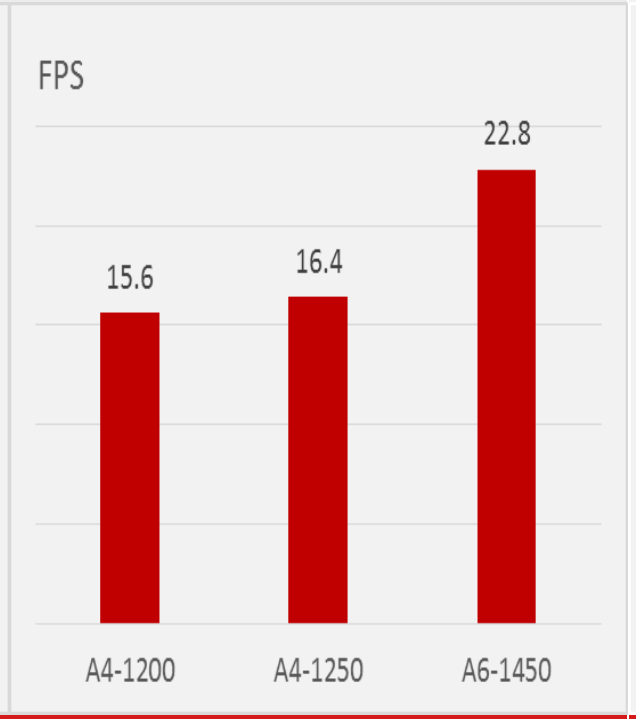
See backup for footnotes

2013 AMD ELITE MOBILITY PERFORMANCE

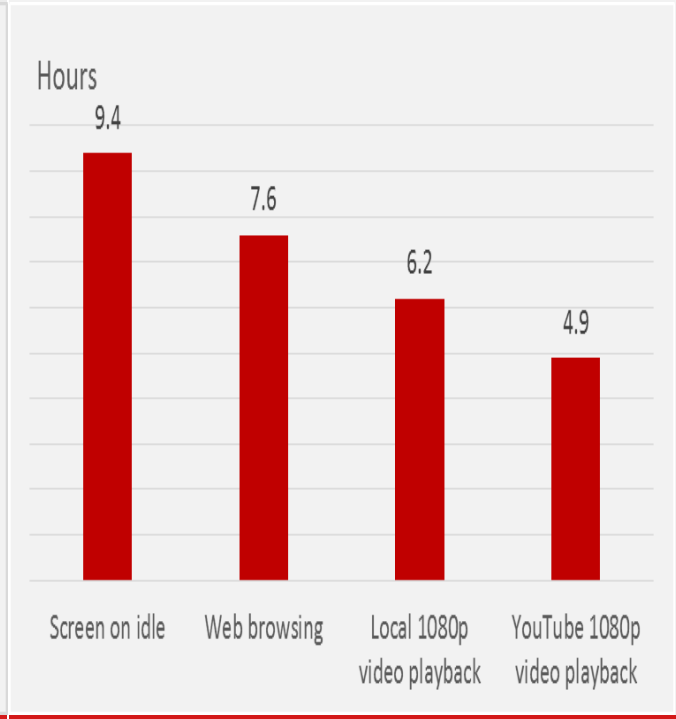
3DMARK ICE STORM



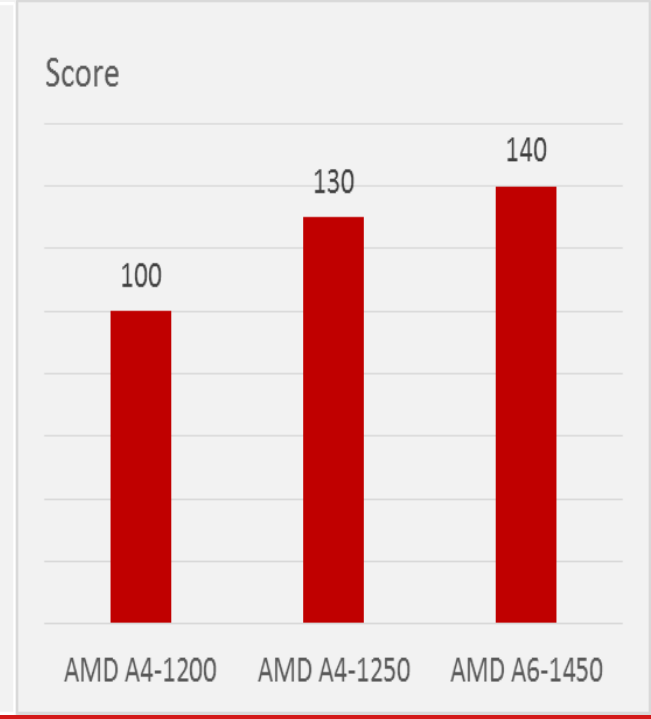
LEFT 4 DEAD 2



BATTERY LIFE
WITH 33WHR BATTERY



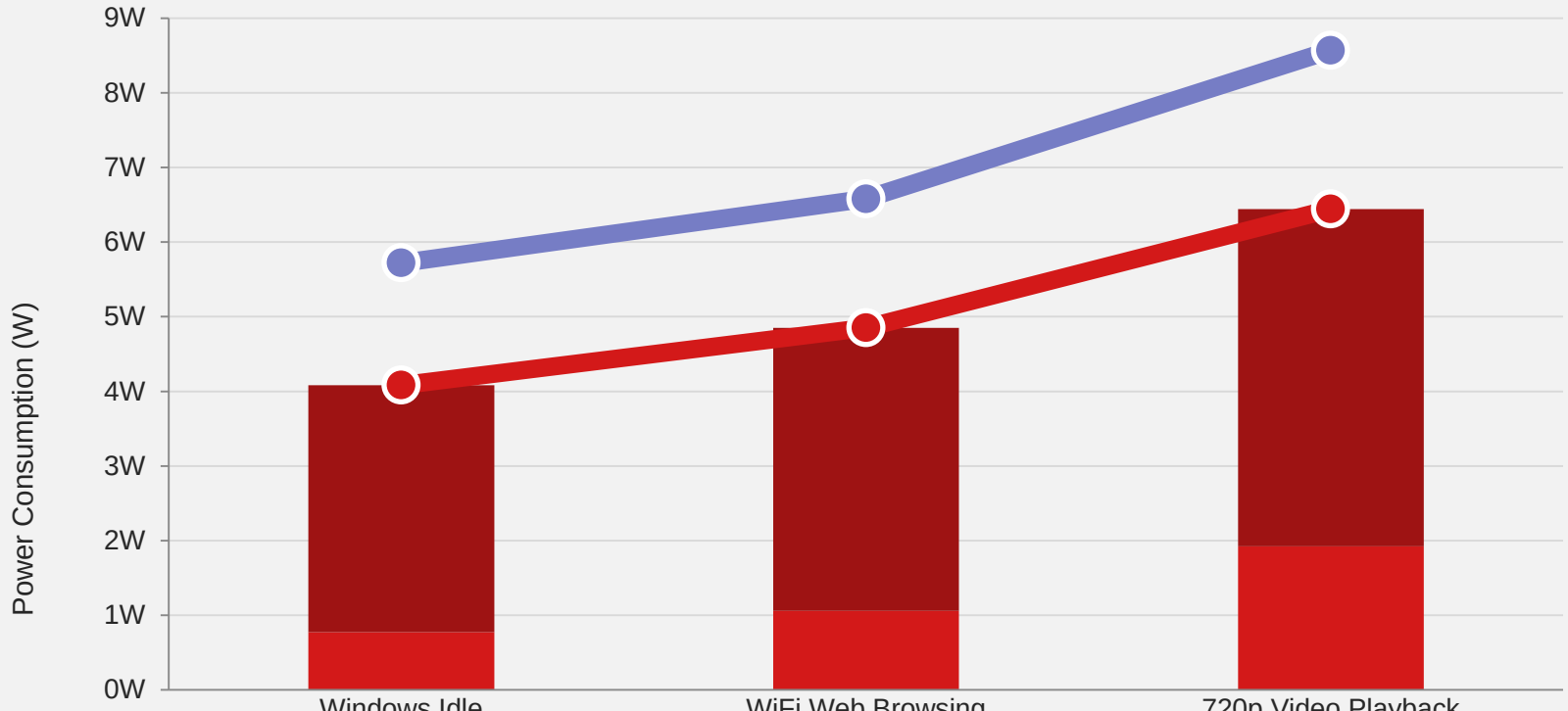
BASEMARK™ CL
OVERALL SCORE



2013 AMD MAINSTREAM APU PLATFORM
PLATFORM POWER

2013 MAINSTREAM APUs ARE **UP TO 25% MORE POWER EFFICIENT**

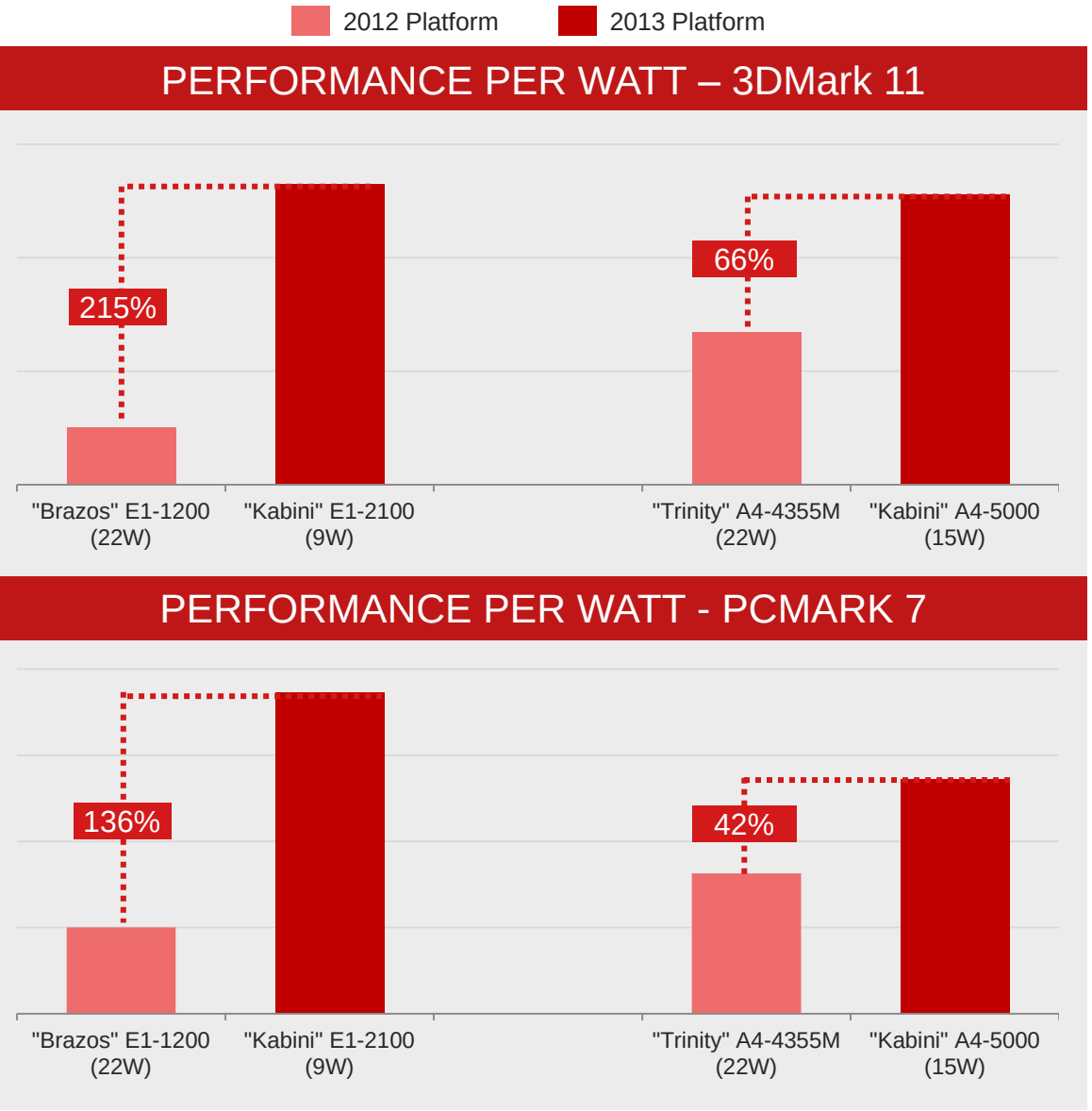
THAN THE PREVIOUS GENERATION, AND CAN SAVE UP TO 1.7 HOURS OF BATTERY LIFE ON TASKS LIKE 720P VIDEO PLAYBACK.



	Windows Idle	WiFi Web Browsing	720p Video Playback
Rest of System Power	3.31 W	3.79 W	4.52 W
Kabini 15W QC APU	0.77 W	1.06 W	1.92 W
Total Kabini System Power	4.08 W	4.85 W	6.44 W
Brazos 2.0 System Power	5.72 W	6.58 W	8.57 W

Brazos w/ 45Whr Battery	**7.9 hours**	**6.8 hours**	**5.2 hours**
Kabini w/ 45Whr Battery	**11.0 hours**	**9.3 hours**	**6.9 hours**

GENERATIONAL PERFORMANCE IMPROVEMENT



- Premium graphics experience.

- First x86 quad-core SOC for entry/mainstream.

- Better performance per watt for an improved experience and longer battery life.

See backup for configurations.

SUMMARY – 2013 AMD MAINSTREAM APU PLATFORM – “KABINI”

MORE CORES

Responsive Quad-core Performance

- Multi-task with ease on the first and only quad-core for entry/mainstream PCs.
- More responsive and better experience by increasing platform performance 88% compared to previous generation[4].
- Unique AMD features to accelerate applications and improve everyday usage[2].

BETTER GRAPHICS

Rich Graphics, Smart Price

- Experience smooth and stable HD video quality at a smart price.
- Better gaming with console-like graphics performance.
- Share it all wirelessly on your HDTV with AMD Screen Mirror[1].

ALL DAY

AMD AllDay™ Battery Life[3]

- Up to 10+ hours of idle battery life -- “all-day” battery life[5].
- Up to 9+ hours web browsing[6].
- Up to 6+ hours of 1080p playback[7].

FOOTNOTES

TESTING CONDUCTED BY AMD PERFORMANCE LABS ON OPTIMIZED AMD REFERENCE SYSTEMS. PC MANUFACTURERS MAY VARY CONFIGURATION YIELDING DIFFERENT RESULTS.

1. AMD Screen Mirror is designed to enable the transmission and display of your PC screen on other compatible networked "mirror" devices. Only available on upcoming AMD A10, A8 and A6 APUs codenamed "Richland" and upcoming AMD A6 and A4 APUs codenamed "Temash." Compatible Digital Media Renderer (DMR) devices are listed on the Digital Living Network Alliance (DLNA) website (http://www.dlna.org/consumer-home/look-for-dlna/product-search) with the "'Play To' Receiver" feature and must also include H.264 and AAC support. Both PC and DMR device must be connected to a network that will permit content streaming. AMD Screen Mirror supports almost all popular image, audio and video file formats as well as applications showing on your PC screen, but will not mirror protected content. Requires minimum screen resolution of 800x600. Performance may be degraded on networks with limited bandwidth, especially with high definition content.

2. AMD App Acceleration is a set of technologies designed to improve video quality and enhance application performance. Full enablement of some features requires support for OpenCL™ or DirectCompute (including AMD's Universal Video Decoder (UVD)). Not all products have all features and full enablement of some capabilities and may require complementary products.

3. AMD AllDay™ Power / AMD All Day Battery Life. AMD defines 'all day' battery life as 8+ hours of continuous use when measured with the Windows Idle or eReader test.

4. Test conducted in AMD Labs measuring productivity performance with PCMark Vantage. The "Kabini" A6 APU-based system scored 5271 while the "Brazos" APU-based system scored 2807. Configuration based off the "Larne" reference design with 2013 AMD A6-5200 APU with AMD Radeon HD 8400 graphics, 4G DDR3 1600, and Windows 8 64bit. "Brazos" PC configuration is based off the "Renmore" reference resign with 2012 AMD E2-1800 APU with AMD Radeon HD 7340 graphics, 4G DDR3 1333 and Windows 7 Ultimate. KBN-3

5. Test conducted in AMD Labs measuring battery life with Windows 8 idle performance. The "Kabini" A6 APU-based system idled for 604 minutes (10.1 hours). Kabini PC configuration is based off the "Larne" reference design with 2013 AMD A6-5200 with AMD Radeon HD 8400 graphics, 4G DDR3 1600, 14" 1366 x 768 eDP Panel / LED Backlight set at 100 nits, HDD (SATA) - 250GB 5400rpm, a 4 cell Li-Ion 45Whr battery pack and Windows 8 64bit. KBN-4

6. Testing conducted by AMD Performance Labs on optimized AMD reference systems. PC manufacturers may vary configuration yielding different results. The 2013 AMD A4-5000 platform browsed through 20 popular Websites via Broadcom Wi-Fi antenna connection with a system power draw of 4.85W for a calculated 557 minutes (~9.3 hours), 14" 1366 x 768 eDP Panel / LED Backlight set at 100 nits, HDD (SATA) - 250GB 5400rpm, a 4 cell Li-Ion 45Whr battery pack and Windows 8 64-bit. KBN-24

7. Testing conducted by AMD Performance Labs on optimized AMD reference systems. PC manufacturers may vary configuration yielding different results. The 2013 AMD A4-5000 platform played 1080p video from the HDD with a system power draw of 6.94W for a calculated 389 minutes (~6.5 hours), 14" 1366 x 768 eDP Panel / LED Backlight set at 100 nits, HDD (SATA) - 250GB 5400rpm, a 4 cell Li-Ion 45Whr battery pack and Windows 8 64-bit.. KBN-25

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