



XBOX 360™

Console Architecture

By: Peter Hood & Adelia Wong

Overview

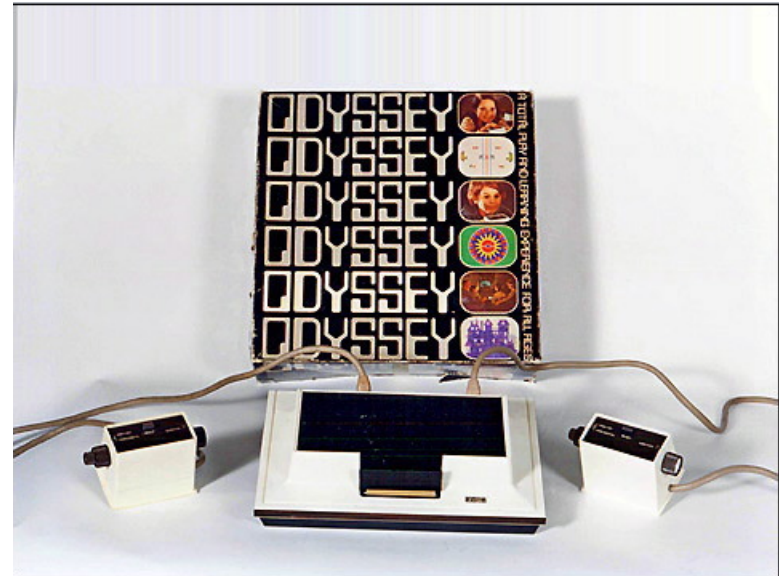
- Gaming console timeline and evolution
- Overview of the original xbox architecture
- Console architecture of the xbox360
- Future of the xbox series
- Questions

Early Games

- The earliest believed video game was created in 1947 when Thomas Goldsmith patented an invention known as the “cathode ray amusement device”.
 - This would use knobs and buttons to shoot targets
- Moving into the 50s and 60s, computer hardware was scarce but some of the first interactive graphical programs were created for the TX-0 machine.

1st Generation (72-77)

- Consoles would use vector displays.
- Games were already hardwired in and cartridges were just jumpers.
- Magnavox Odyssey ->



2nd Generation (77-83)

- They had programmable microprocessors
- ZOMG PONG
- Lead into the video game crash of 1983
- Atari 2600 ->



3rd Generation (83-95)

- Introduced sprites and tiled backgrounds
- Transition from flip screen to scrolling graphics
- Recovery from the crash
- Savior of consoles and video games the NES ->



4th Generation (89-99)

- Introduced polygons and the processing of thereof to the market
- Here comes Sonic
- Began to see interest in video game industry from other companies
- Sega Genesis ->



5th Generation (93-06)

- Introduction of discs instead of cartridges for some consoles
- 64-bit and mostly 3D graphics
- Nintendo 64 ->



6th Generation (98-present)

- Online gaming
 - Introduction of noob pwning
- Additional media
- Xbox live has huge success
- PlayStation 2 (best-selling console of all time at 150 million) ->



7th Generation (04-present)

- Expansion on additional media. Big time.
- Motion input
- HD resolutions
- Nintendo Wii ->



8th Generation (11-present)

- The future generation of consoles
- Not really xbox720 but it looks cool ->



The first Xbox, Why?

- With Sony's continued and dominating success in the video game market, game developers were migrating away from the windows platform.



Unacceptable!

The first Xbox, How?

- Lets use our DirectX graphics technology!
- Microsoft's game publishing business approves the idea and moves to create a "DirectX Box" console
- Xbox for short



The first Xbox, Announcement

- Bills Gates unveils the Xbox at the 2000 Game Development Conference
- Displays additional media capabilities and crowd is impressed



NOT BAD

The first Xbox, Launch

- Upon launch, the Xbox proves itself with the best online capabilities for a console at the time.
- As well as a defining video game release: Halo



The first Xbox, Specs

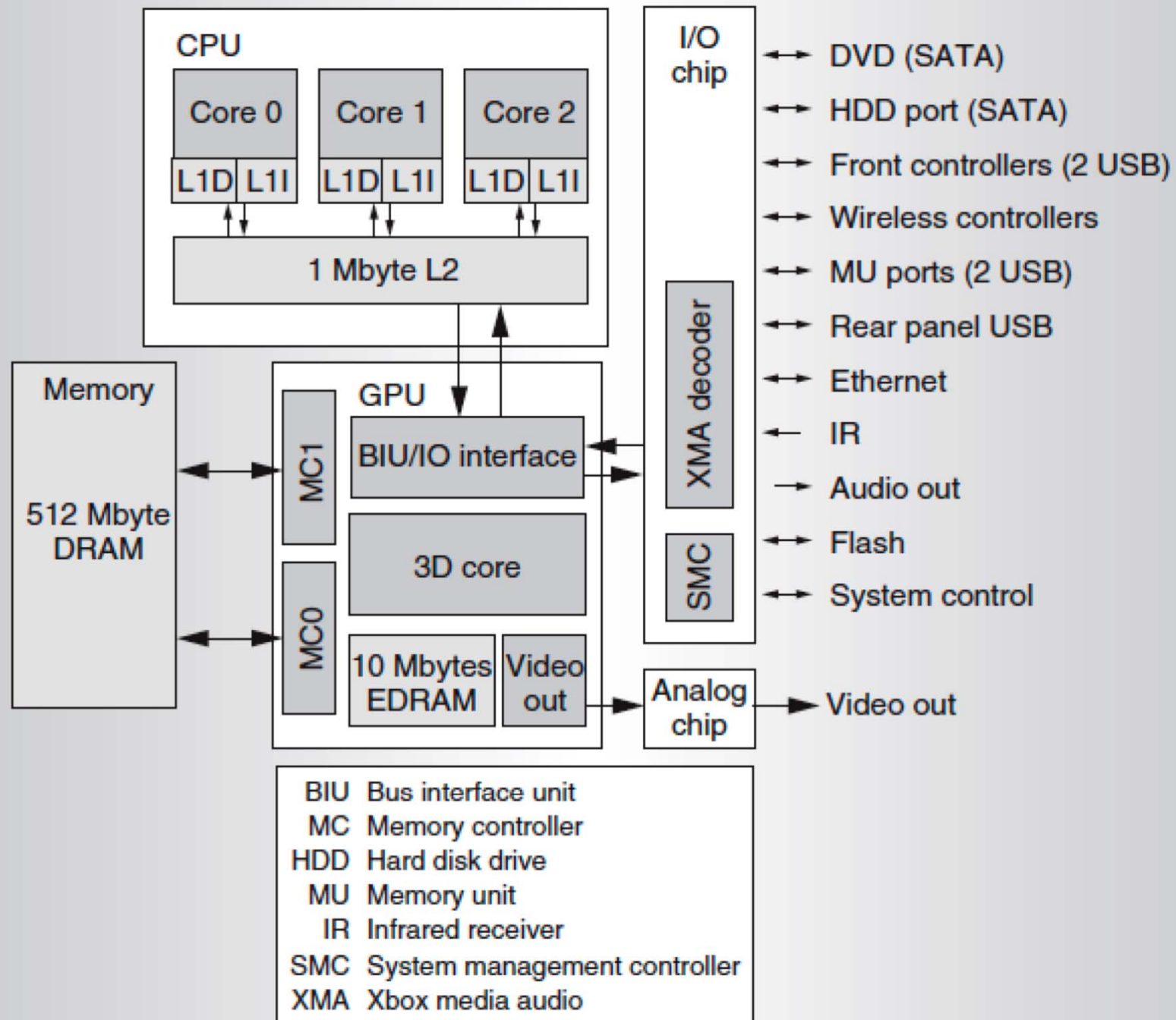
- 32-bit Micro-PGA2 Pentium 3 based processor at 733 Hz
- 64 MB DDR SDRAM
- 5x DVD-ROM media format
- 8.54 GB Dual-Layer DVD media capacity
- 8 GB 5400 RPM hard disk internal storage
- 733MHz Pentium III CPU with 128 Kb L2-cache
- nVidia NV2A ASIC 64MB GPU

- Wait for it....online gaming

Xbox 360 S

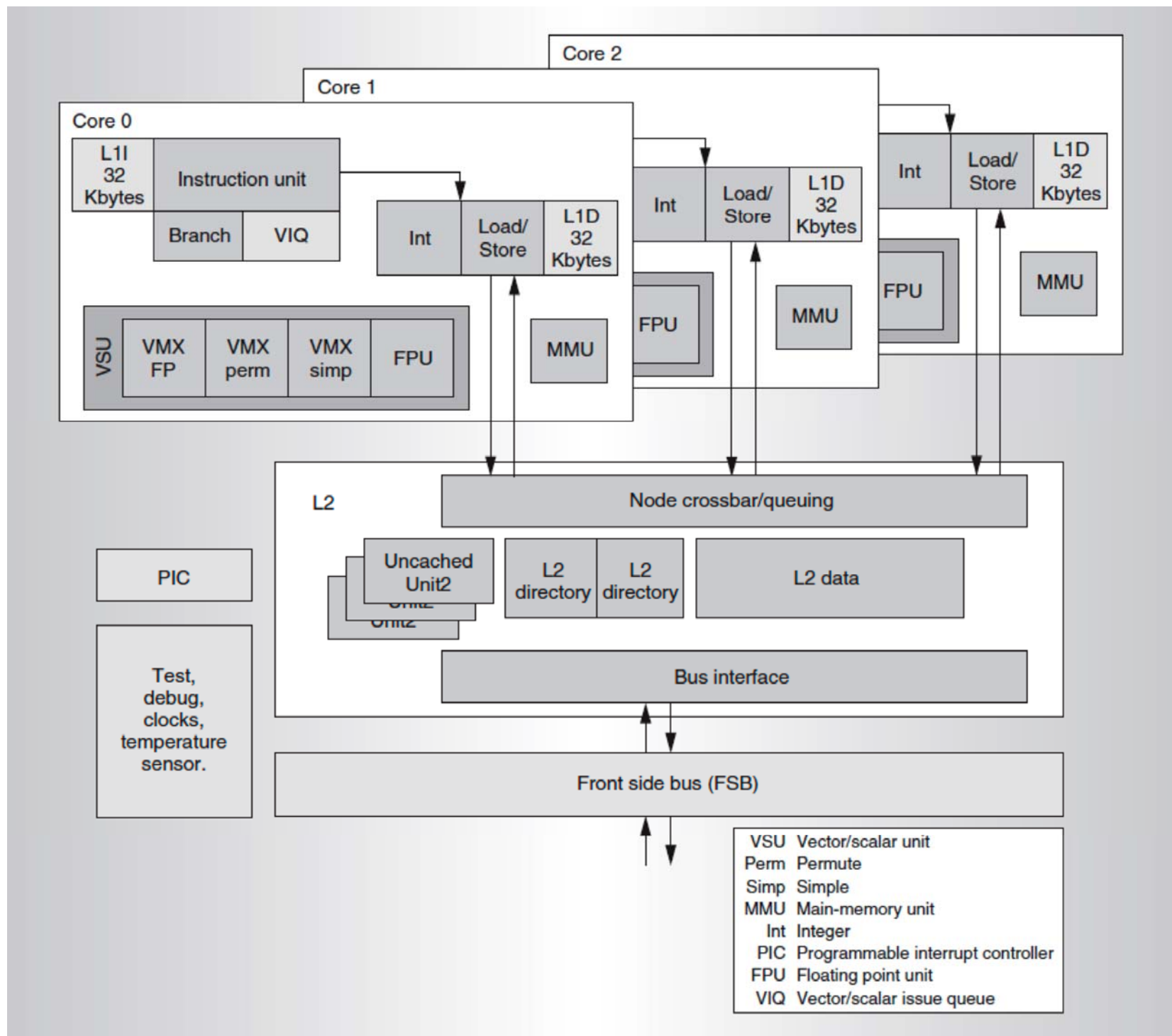
- XCGPU
 - CPU/GPU/eDRAM
 - Xenon (CPU)
 - Xenos (GPU)
 - 372 million transistors
 - “Front side bus replacement block” connects CPU and GPU internally exactly the same way, so there are no HW changes.
 - Power requirements are reduced by 60% and the physical chip area by 50%
- PowerPC (RISC)





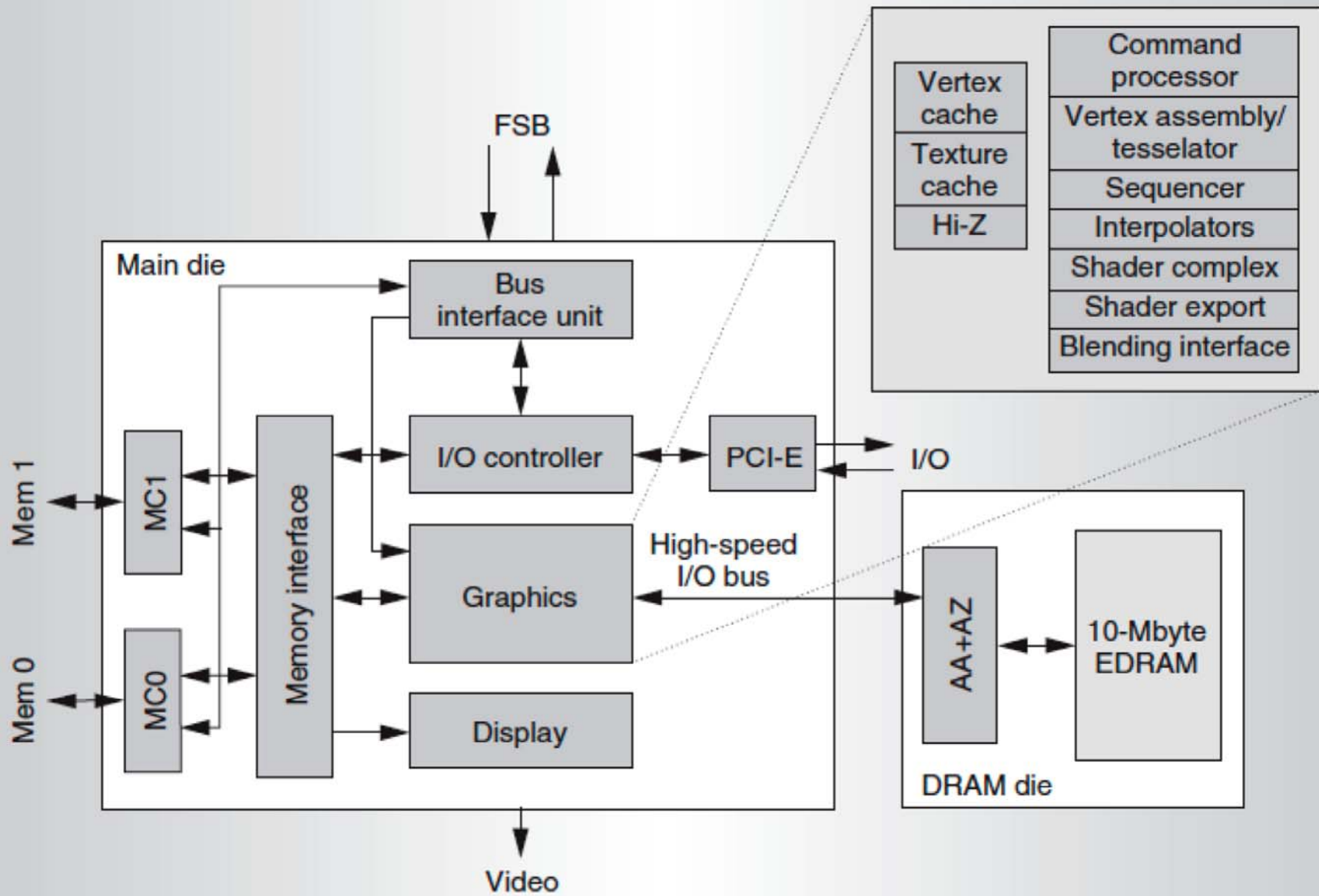
Xenon Specs

- 45 nm process since Xbox 360 S model
- 165 million transistors
- Three symmetrical cores, each two way SMT-capable and clocked at 3.2 GHz
- SIMD: VMX128 with $2 \times (128 \times 128 \text{ bit})$ register files for each core
- 1 MB L2 cache (lockable by the GPU) running at half-speed (1.6 GHz) with a 256-bit bus
- 51.2 gigabytes per second of L2 memory bandwidth ($256 \text{ bit} \times 1600 \text{ MHz}$)
- 21.6 GB/s front-side bus
- Dot product performance: 9.6 billion per second
- Restricted to in-order code execution
- eFuse 768 bits
- ROM (and 64 kbytes SRAM) storing Microsoft's Secure Bootloader, and encryption hypervisor
- Big endian architecture



Xenos Specs

- 500 MHz parent GPU on 90 nm, 65 nm (since 2008) or 45nm (since 2010) TSMC process of total 232 million transistors
 - 48 floating-point vector processors for shader execution, divided in three dynamically scheduled SIMD groups of 16 processors each.
 - Unified shading architecture (each pipeline is capable of running either pixel or vertex shaders)
 - 10 FP ops per vector processor per cycle (5 fused multiply-add)
 - Maximum vertex count: 6 billion vertices per second (48 shader vector processors × 2 ops per cycle × 500 MHz) / 8 vector ops per vertex) for simple transformed and lit polygons
 - Maximum polygon count: 500 million triangles per second
 - Maximum shader operations: 96 billion shader operations per second (3 shader pipelines × 16 processors × 4 ALUs × 500 MHz)
 - 240 GFLOPS
 - MEMEXPORT shader function
 - 16 texture filtering units (TF) and 16 texture addressing units (TA)
 - 16 filtered samples per clock
 - Maximum texel fillrate: 8 gigatexels per second (16 textures × 500 MHz)
 - 16 unfiltered texture samples per clock
 - Maximum Dot product operations: 24 billion per second
 - Support for a superset of DirectX 9.0c API DirectX Xbox 360, and Shader Model 3.0+
- 500 MHz, 10 MiB daughter embedded DRAM (at 256GB/s) framebuffer on 90 nm, 80 nm (since 2008) or 65nm (since 2010).
 - NEC designed eDRAM die includes additional logic (192 parallel pixel processors) for color, alpha compositing, Z/stencil buffering, and anti-aliasing called “Intelligent Memory”, giving developers 4-sample anti-aliasing at very little performance cost.
 - 105 million transistors
 - 8 Render Output units
 - Maximum pixel fillrate: 16 gigasamples per second fillrate using 4X multisample anti aliasing (MSAA), or 32 gigasamples using Z-only operation; 4 gigapixels per second without MSAA (8 ROPs × 500 MHz)
 - Maximum Z sample rate: 8 gigasamples per second (2 Z samples × 8 ROPs × 500 MHz), 32 gigasamples per second using 4X anti aliasing (2 Z samples × 8 ROPs × 4X AA × 500 MHz)
 - Maximum anti-aliasing sample rate: 16 gigasamples per second (4 AA samples × 8 ROPs × 500 MHz)
- Cooling: Both the GPU and CPU of the console have heatsinks. The CPU's heatsink uses heatpipe technology, to conduct heat from the CPU to the fins of the heatsink. The heatsinks are actively cooled by a pair of 60 mm exhaust fans. The new XCGPU chipset redesign is featured in the Xbox 360 S and integrates the CPU (Xenon) and GPU (Xenos) in one chip and is actively cooled by a single heatsink rather than two.



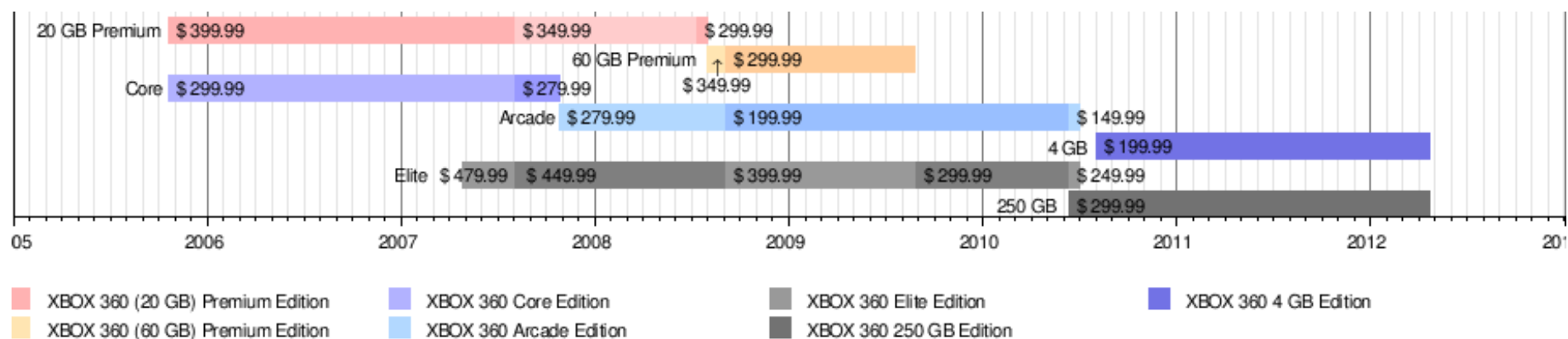
PowerPC

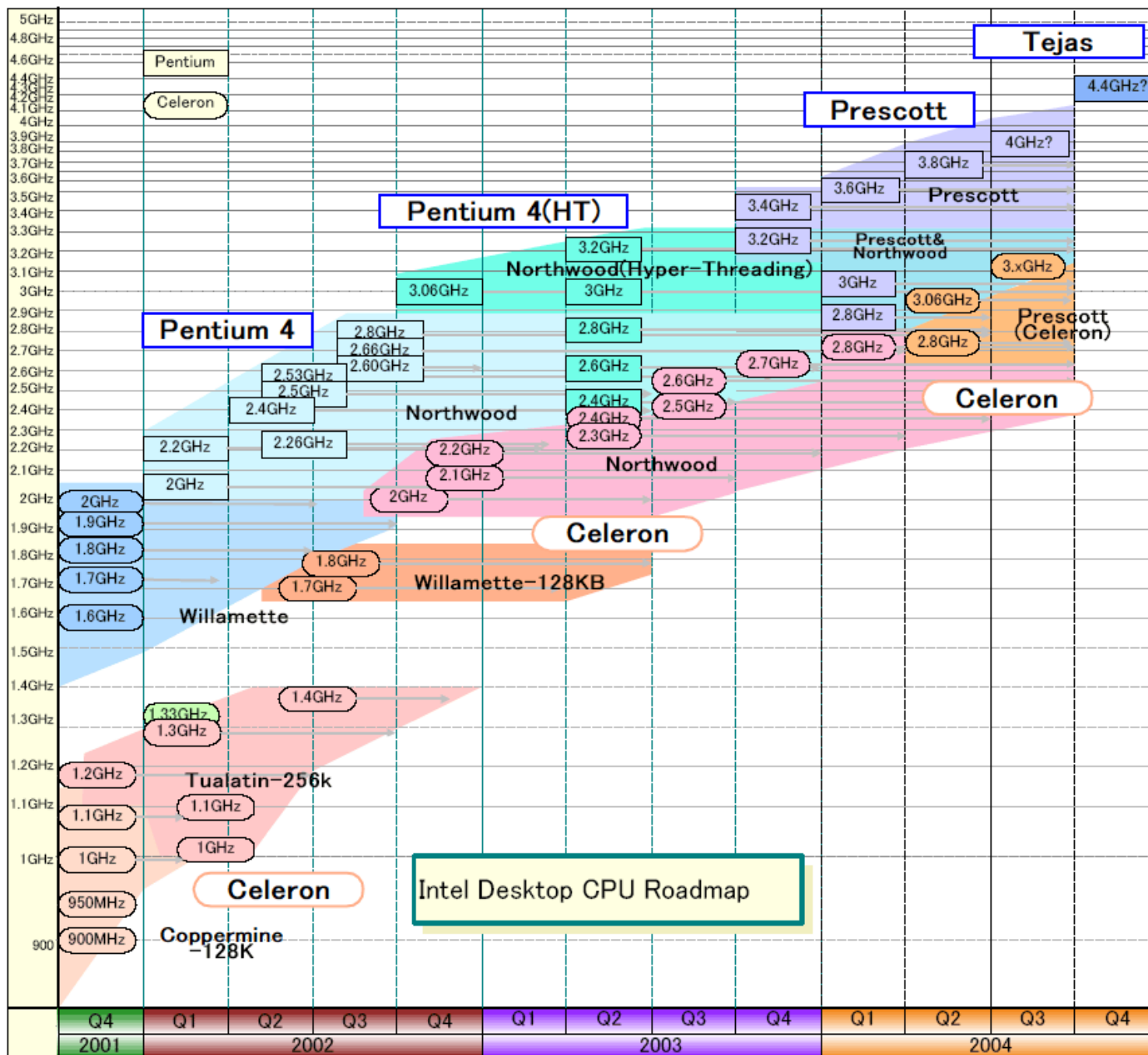
- PowerPC (RISC), created by Apple-IBM-Motorola alliance
- GameCube, Wii, PS3
- Allows for superscalar implementation
- Design Features:
 - Support for operation in both big-endian and little-endian modes; the PowerPC can switch from one mode to the other at run-time.
 - Single-precision forms of some floating point instructions, in addition to double-precision forms
 - Additional floating point instructions at the behest of Apple
 - A complete 64-bit specification that is backward compatible with the 32-bit mode
 - A fused multiply-add
 - A paged memory management architecture which is used extensively in server and PC systems.
 - Addition of a new memory management architecture called Book-E, replacing the conventional paged memory management architecture for embedded applications. Book-E is application software compatible with existing PowerPC implementations, but needs minor changes to the operating system.

Future Models?

- With the announcement of the Xbox 360 S, Microsoft have said that they believe that the console is only mid-way through its life-cycle and will continue through 2015
- Unnamed sources have claimed that Microsoft's next video game console is being slated for release as early as the 2013 holiday season, supported by Microsoft employee updated resumes
 - Xbox lite, ARM-based platform
- “Durango” rumors
 - 16-core IBM PowerPC CPU and AMD Radeon HD 7000-series graphics
 - 4-6 core processor, two GPUs







Questions