



Xbox 360 Architecture

Lennard Streat
Samuel Echefu

Overview

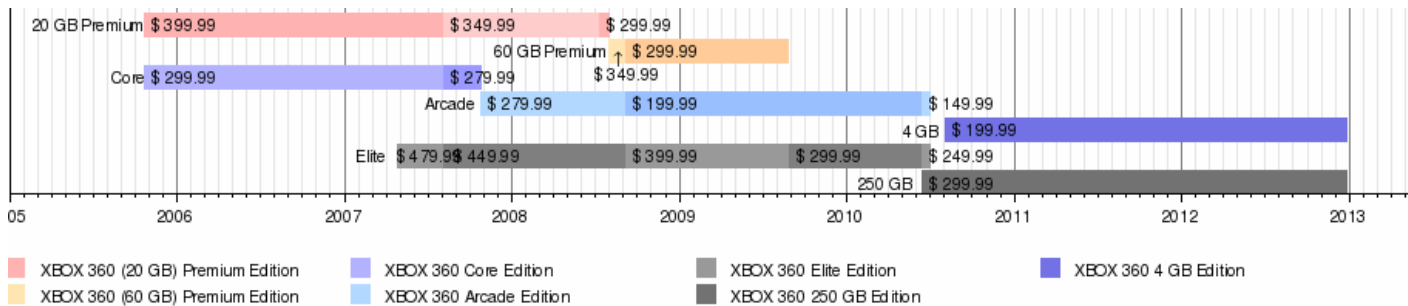
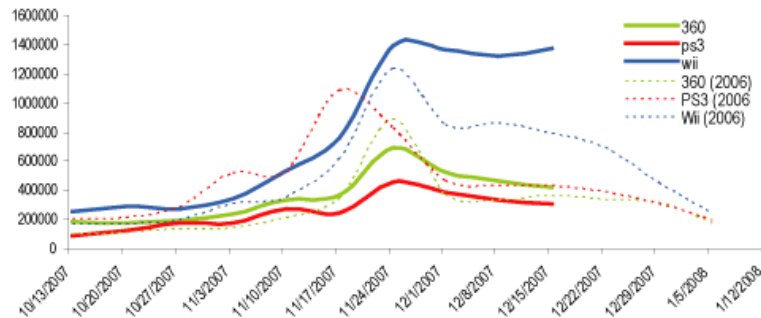
- **Introduction**
- Hardware Overview
- CPU Architecture
- GPU Architecture
- Comparison Against Competing Technologies
- Implications of Technology



Introduction

- Robust architecture
- Xenon microprocessor
- ATI Xenos GPU
- Traditional multi-core design paradigm

U.S. Weekly Video Game Console Demand
Week ending 10/13/07 through 1/12/08



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- Performance Analysis
- Against Competing Technologies
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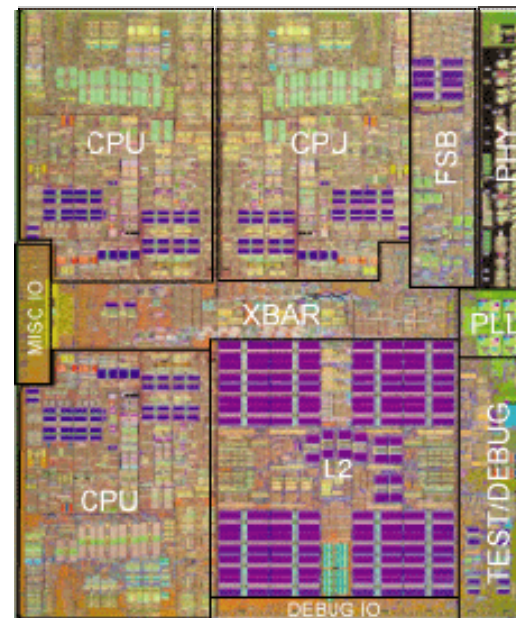
Hardware Overview

Custom IBM PowerPC-based CPU	<ul style="list-style-type: none">- 3 symmetrical cores (3.2GHz)- 2 hardware threads per core- 1 VMX-128 vector unit per core- L1 split cache (32kB/32kB)- L2 1024 kB unified cache
Custom ATI GPU	<ul style="list-style-type: none">- 500MHz- 10MB embedded DRAM- 48-way parallel FP shader pipelines- Unified shader architecture
Memory	<ul style="list-style-type: none">- 512MB GDDR3 RAM- 700 MHz DDR- Unified memory architecture
Memory Bandwidth	<ul style="list-style-type: none">- 22.4 GB/s memory interface bus bandwidth- 256 GB/s memory bandwidth to EDRAM- 21.6 GB/s front-side bus
I/O	<ul style="list-style-type: none">- 3 USB 2.0 ports- Wireless support
Mathematical performance	<ul style="list-style-type: none">- 1 TFLOP (<i>floating point performance</i>)- 48 billion shader operations per second- 500 million triangles per second- 9 billion dot product operations per second- 16 gigasamples per second fill rate using 4x MSAA
Storage	<ul style="list-style-type: none">- Detachable and upgradeable hard drive- 12X dual-layer DVD-ROM



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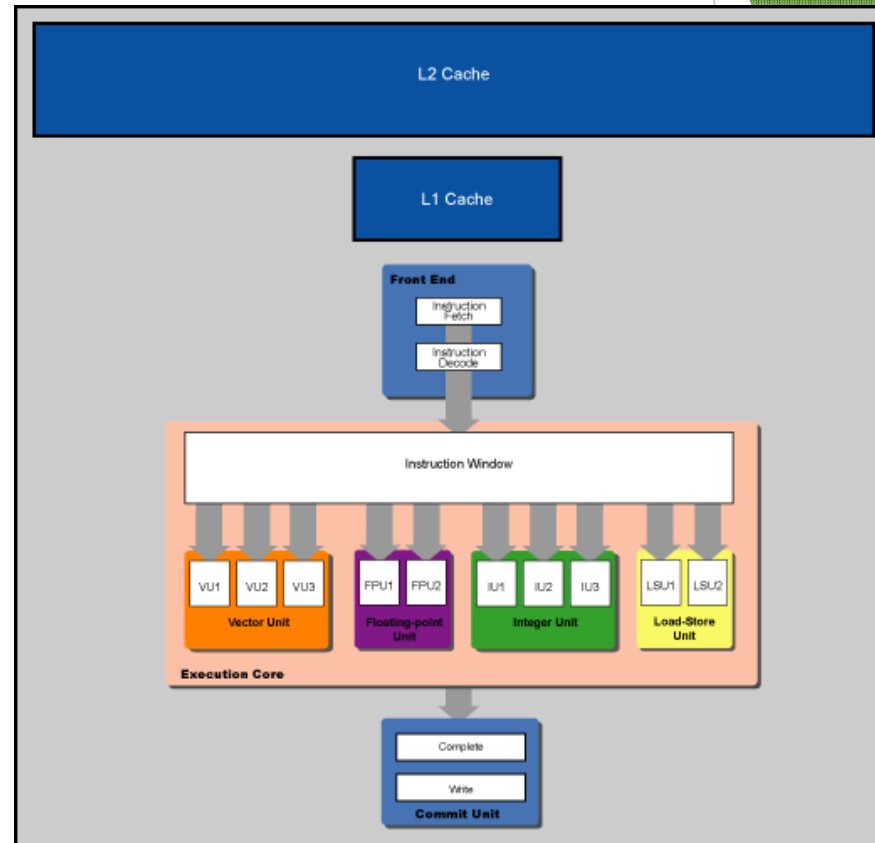
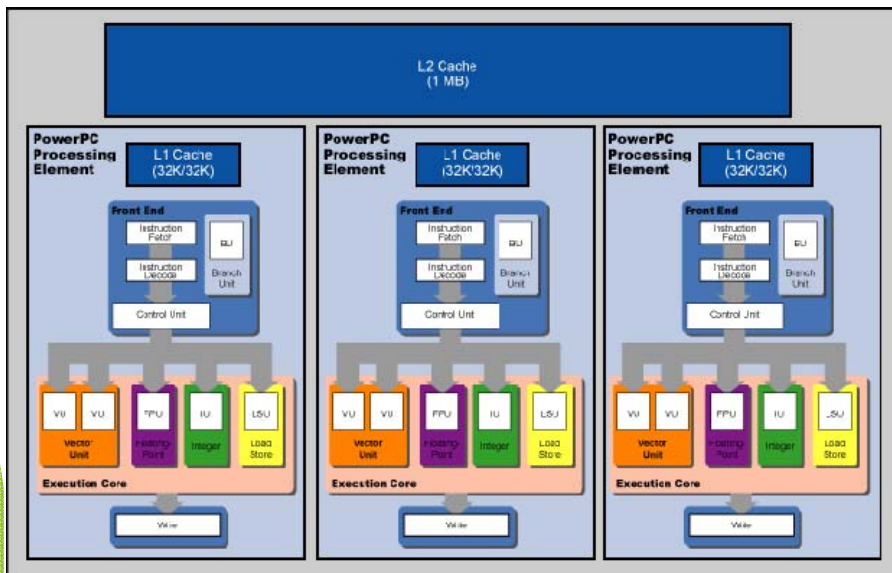
CPU Architecture ~ Overview



- Title: **Xenon/ XGPU/ Waternoose**
- Designer: **International Business Machines (IBM)**
- Instruction Set Architecture: **Power Architecture (PowerPC-Based)**
- Cores: **3 Physical Cores 3.2GHz**
- Pipeline Specification: **In-order execution**
- Cache Configuration: **L1 cache (32kB/32kB), L2 Cache (1024kB)**
- Manufacturer: **Globalfoundries**
- Technology: **90nm(Xenon), 65nm(Opus), 45nm(Valhalla)**
- Vector Unit: **VMX-128 (3x), 128 VMX-128 registers/thread**

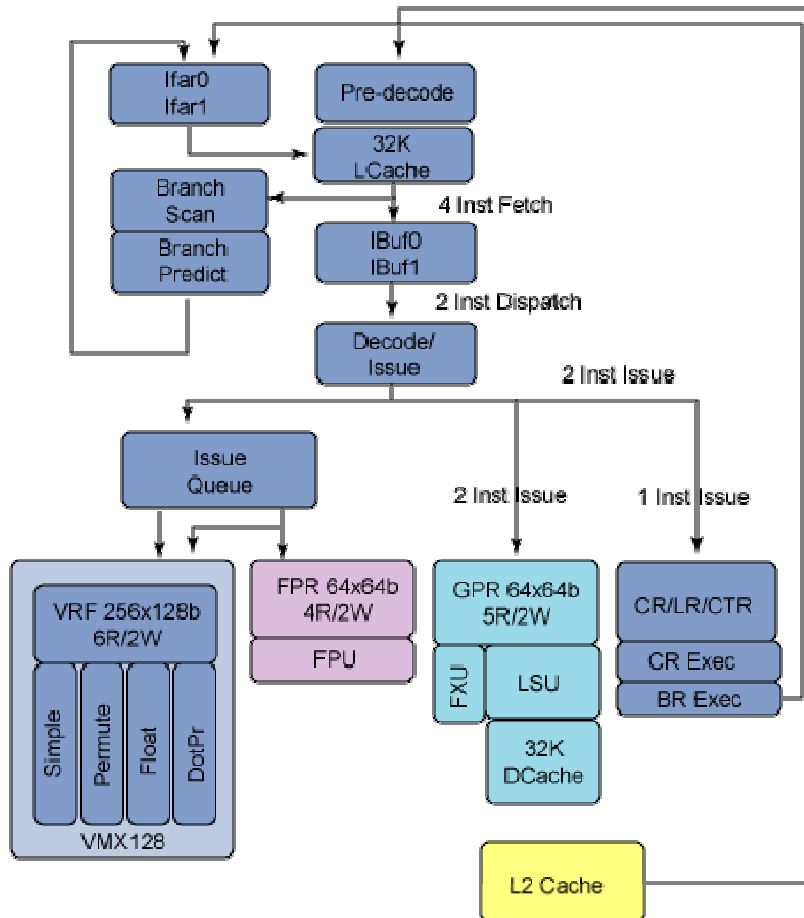
Structure of PowerPC CPU core

- Wide execution
- SMT-capable clocked at 3.2GHz
- Five execution pipes(branch, load/store, fixed point, floating point, VMX)



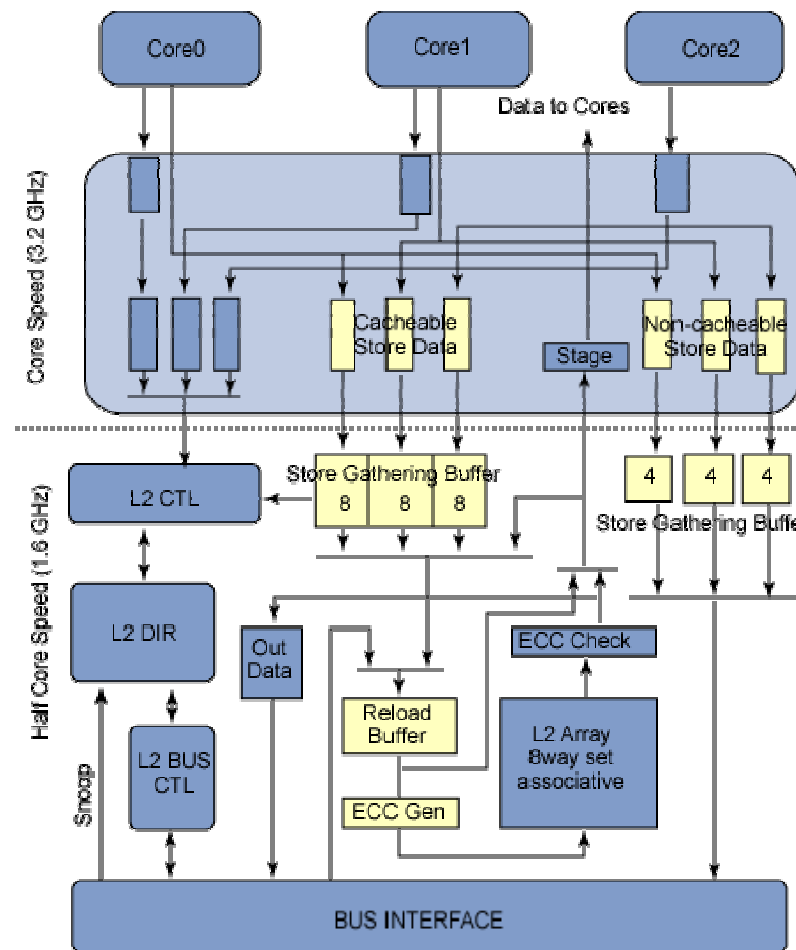
CPU Pipeline

- Two-issue, in-order execution
- SIMD: 2x VMX128 units
- In-order execution
- Unified VMX and FPU
- LSU linked to L1 Data Cache
- Instructions fetched into unified L2 Cache



Cache Architecture

- 32kB L1 Cache 2-Way
- 32kB L1 Cache 4-Way
- Unified L2 Cache (~1MB)
 - 51.2 GB/s L2 BW
 - Lockable by GPU
 - Half CPU speed
 - 256 bit bus
- 21.6 GB/s FSB





PowerPC ISA

- RISC ISA created in 1991 (Apple-IBM-Motorola)
- Popular in embedded applications
- Based upon IBM POWER architecture
- Big Endian
- 64-bit specification (backwards compatible)
- Requires deeper pipelines

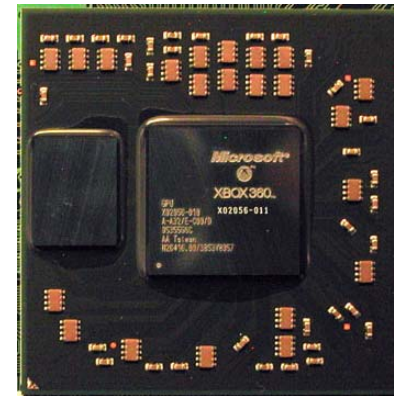
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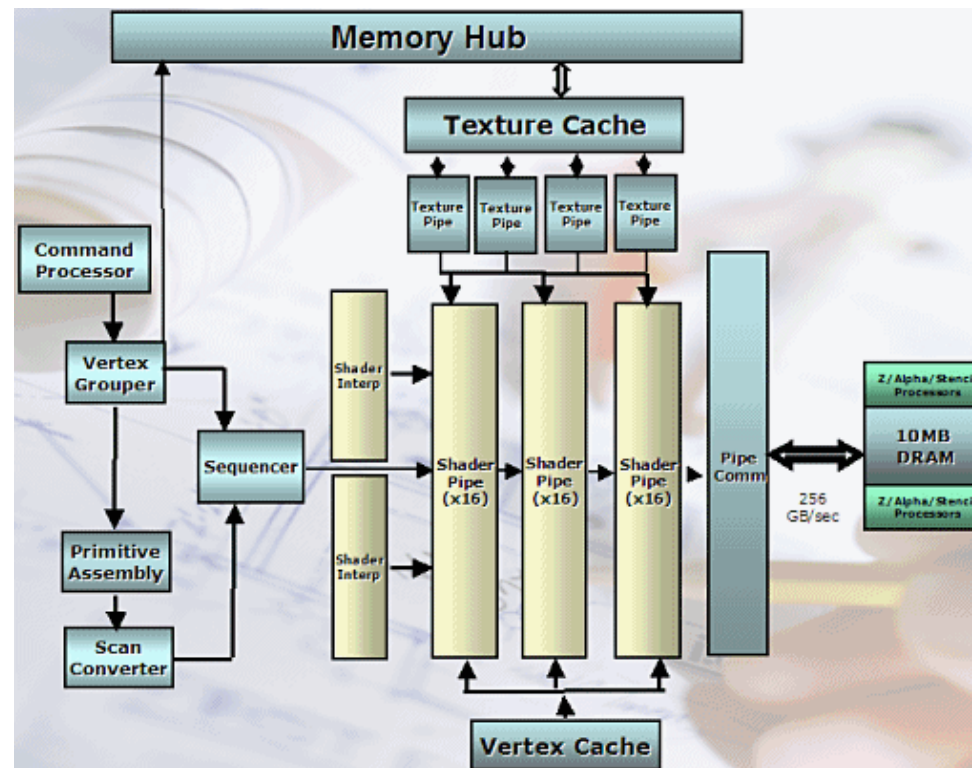
GPU Architecture ~ Overview

- Xenos “ATI Custom R520”
- ATI (Acquired by AMD)
- Clocked @500Mhz
- Unified Shader Core
- 48 Unified Shader Pipelines (for Vertex and pixel shading)
- 16 Filtered & 16 Unfiltered Texture samples per clock
- Embedded with EDRAM
- Offers Anti-aliasing



GPU Structure

- 2 Silicon ICs
 - GPU
 - Daughter Dye
- Bandwidth saving
- CPU-GPU link



Anti-Aliasing

- Aliasing
- Daughter Dye
 - Self-processing memory controller



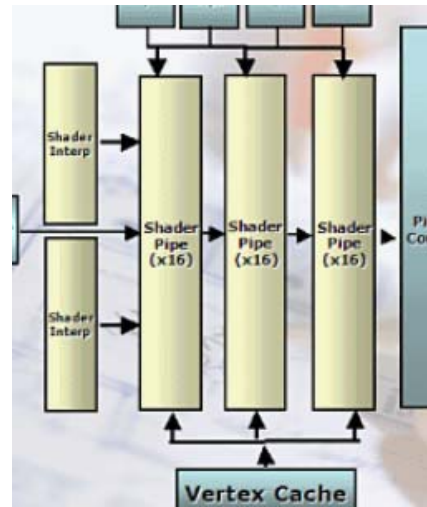
Unified Shader Architecture

- Shaders
 - Pixel Shaders
 - Vertex Shaders



Unified Shader Architecture (Cont.)

- Unified Shader Pipeline
 - Combining two different dedicated pipelines
 - Increased Performance
 - Texture Sampler



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CPU Performance Comparison

Xbox 360 CPU

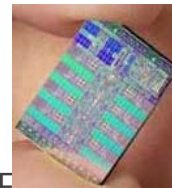


3x 3.3Ghz Cores

Easier to develop for

Multi Platform Games advantage

PS3 CPU



1x 3.2Ghz PPE

7x 3.2Ghz SPE

Developers : full core utilization

Graphics Processing

GPU Performance Comparison

Xbox360 GPU



Unified Shader Architecture

48 Unified Pipelines

Memory: 512MB 700Mhz GDDR3

PS3 GPU



Dedicated Shader core

24 pixel pipelines

8 vertex pipelines

Transition to Unified Architecture

Memory: 256MB 700Mhz GDDR3

256MB 3.2Ghz XDR Ram

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XBOX RUL3Z



ACHIEVEMENT UNLOCKED
Survived This Presentation



Sources

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