Technical challenges associated with the development of Intel 440LX AGPset

Richard Malinowski
Director, Chipset Engineering
Platform Components Division
Intel

Agenda

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• System Architecture Overview
• 440LX AGPset Design Goals
• 440LX AGPset Microarchitecture
• 440LX AGPset Complexity & Design Challenges
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The Goal

Deliver High Performance 3D Graphics to the Mainstream PC

The system must manage the explosion in data flows that result

System Architecture Overview
Pentium® II Processor System with AGP

DIB and AGP are the key components of the Pentium® II Processor system architecture
440LX AGPset Design

Goals

Performance: The Problem

Effective Bandwidth Management

1.2 GB

533 MB/s

800 MB

533 MB

533 MB

132 MB/s

IDE

ISA

PAGE 1

PLAT1.

COMPONENTS

DIVISION

440LX AGPset Design

Goals

Performance: The Problem, 3D Example
440LX AGPset Design

Goals

Performance: The Solution

• 3-port Concurrency
  – CPU-L2 and the rest of the system
  – CPU-AGP and AGP-memory
  – CPU-AGP and PCI-memory

• Flexible Arbitration

• Deep Buffering and Pipelining

440LX AGPset Design Goals

Cost and Schedule

• Cost
  – 0.6u BiCMOS technology
  – 492 MiniBGA packaging

• Schedule
  – 1 year from AGP spec to production shipments
440LX AGPset Microarchitecture

- 3-port concurrency
- 2 AGP data streams:
  - snoopable
  - non-snoopable
- Distributed arbitration
- Deep, distributed queuing & buffering
- SDRAM Memory Controller
- GART
- Testability
- Circuits, PLL (133/66)

440LX Complexity and Design Challenges

- 2x complexity of the previous PC chipset generations
  - 3 port concurrency boundary cases
  - Complex arbitration
  - Deep pipelining and buffering architecture
  - AGP circuit design
  - SSO and noise
  - 492 BGA packaging
- Performance modelling
440LX AGPset Design

Goals

- Cost
  - 350 mil die size, 0.6u 4LM Bi-CMOS process
  - 492 MiniBGA, 60/120 mil pad pitch staggered I/O
  - ~140K gates, embedded array, ~50% layout utilization
    - PLL and RAM array embedded blocks, custom I/O

- Schedule
  - AGP Spec 1.0 - August'96
  - 440LX A-0 T/O - December'96
  - 440LX Production Shipments - July'97
  - 440LX Product Launch - August'97

440LX AGPset
Performance

Simulated bandwidth

![Graph showing simulated bandwidth performance](image-url)
Summary

- DIB and AGP are the key components of the Pentium® II Processor system architecture
- Intel 440LX AGPset is the most complex PC core logic developed to date
- Efficient memory bandwidth management via 3-port concurrency enables high performance 3D in the mainstream PC