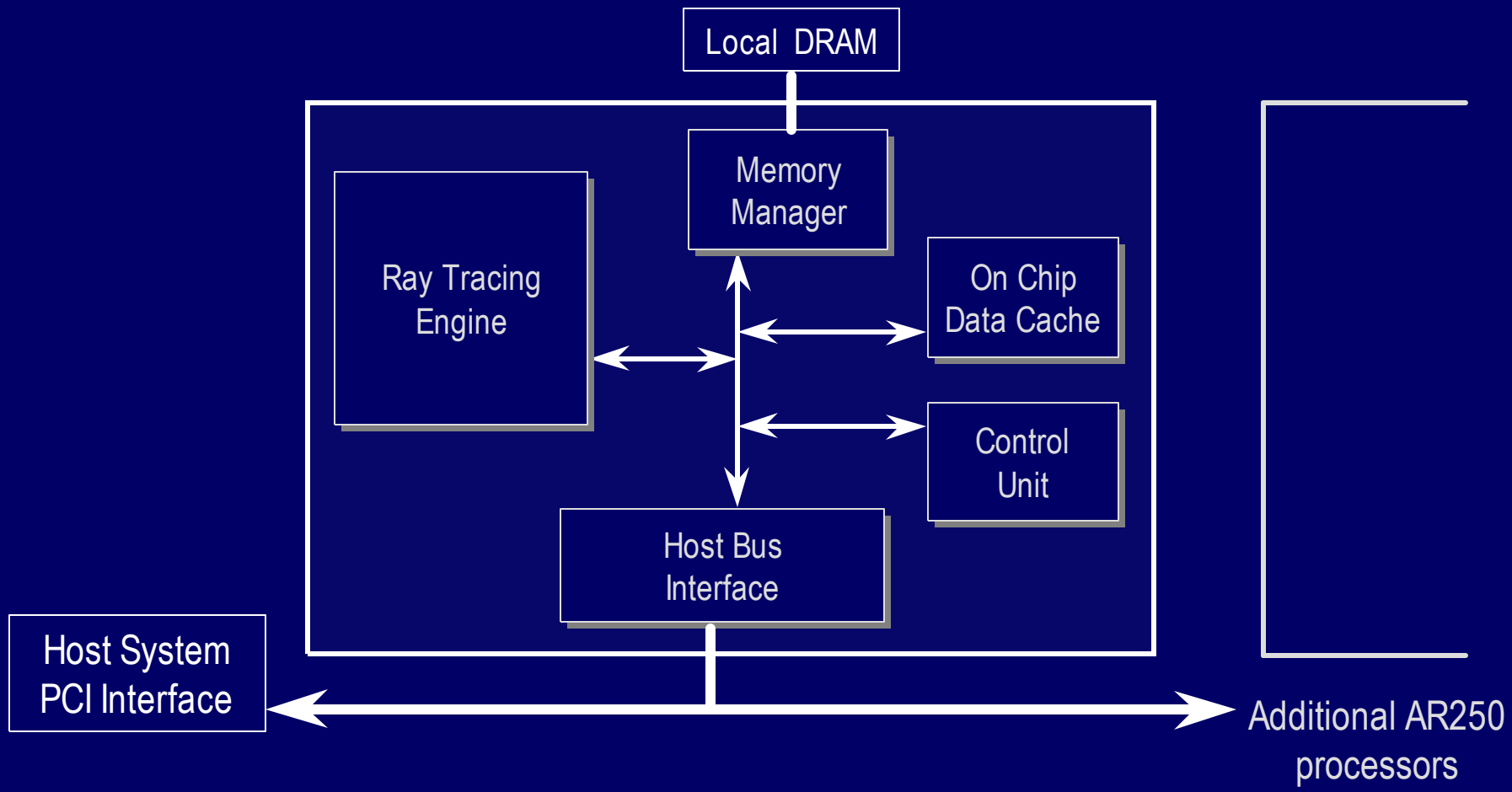
The AR250

A New Architecture for Ray Traced Rendering

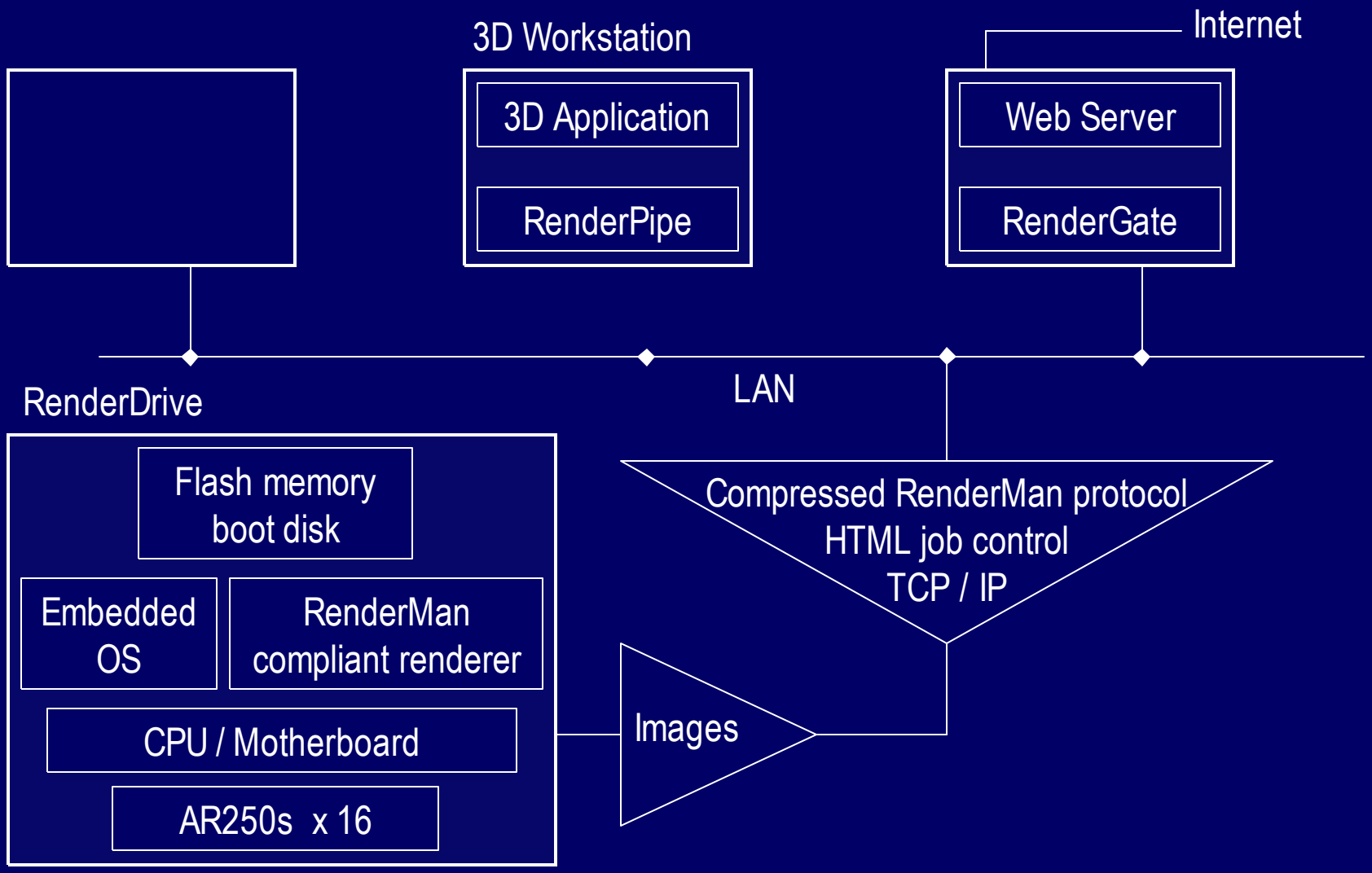
SIGGRAPH ‘99 – Slides

- Architecture overview
  - AR250 Rendering Processor
  - RenderDrive Network Appliance
- How and why it works
  - Problems with Parallelism
  - The ART Model
  - Main AR250 Data Flows
  - AR250 Statistics
  - Analysis
- Performance
  - Functionality
  - Rendering Speed

AR250 Rendering Processor



RenderDrive Network Appliance



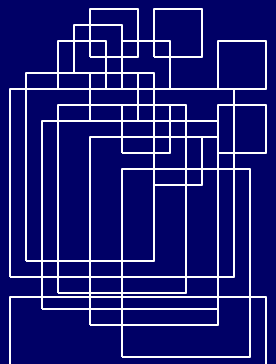
Problems with Parallelism

- Data distribution
- Load balancing
- Scalability of calculation
- Complexity

The ART Model

- Hardware intersection pipeline
- Ray-parallel data distribution
- Broadcast parallelism of geometry
- Hierarchical geometry
- Distributed concurrent shading
- Vector parallel programmable shading acceleration

Main AR250 Data Flows



Hierarchical geometry

Host system interface

Programmable shaders

DRAM

Rays

Fine grain distribution of rays between AR250s for load balancing

Pipeline-parallel ray geometry engine (permutes multiple geometry and rays)

Intersections

Geometry

Programmable shading co-processor

Shader ops.

Ray generation & control (CPU)

On-chip data caches

Pixels

Geometry & shaders

Host bus interface

Additional AR250 processors

Geometry and shaders (broadcast)

Pixels (sequential read-back)

AR250 Statistics

- 0.35um drawn, LSI Logic G10 silicon process
- 650K gates, 106mm^2 die
- Custom RISC processor core
- 32, single-stage, 32 bit IEEE compatible floating-point units
- Multi-dimensional noise, square root and trig. functions
- 50 MHz operation

Analysis

- Load balancing through fine-grain parallelism
- Efficient data distribution by caching rays locally and broadcasting geometry
- Scalability by performing whole rendering calculation, including shading.
- Low complexity programming model by support for programmable shading in silicon

Functionality

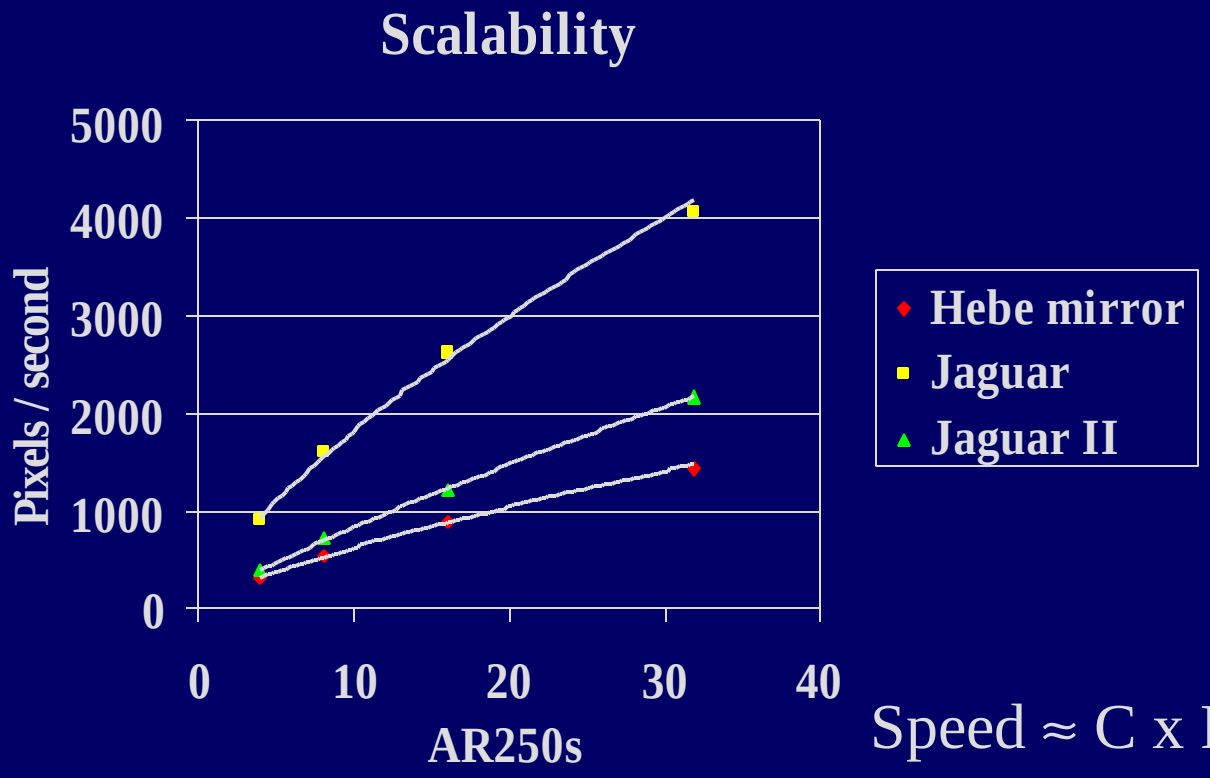
Current

- Full shading model
- Full ray-traced:
  - Camera motion blur
  - Depth of field
  - Area lights
  - Volumes

Planned

- Global illumination
- Completion of RenderMan support

Rendering Speed



Speed ≈ C x P $^{0.82}$

Hebe mirror (1322 x 2000)

RenderDrive (16 x AR250)	0 hrs 13 min 2 sec
BMRT (PII - 333)	22 hrs 8 min