Advanced Rendering Technology

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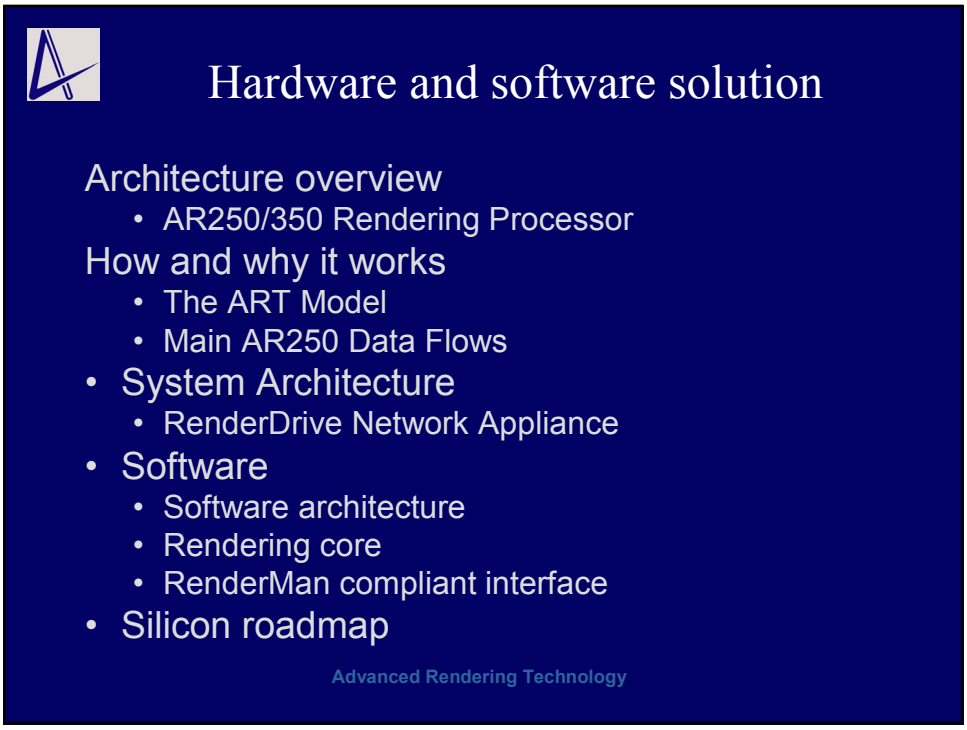
Co-founder

The AR350

Today's Ray Trace Rendering Processor


Hardware and software solution
Architecture overview
• AR250/350 Rendering Processor
How and why it works
• The ART Model
• Main AR250 Data Flows
• System Architecture
• RenderDrive Network Appliance
• Software
• Software architecture
• Rendering core
• RenderMan compliant interface
• Silicon roadmap
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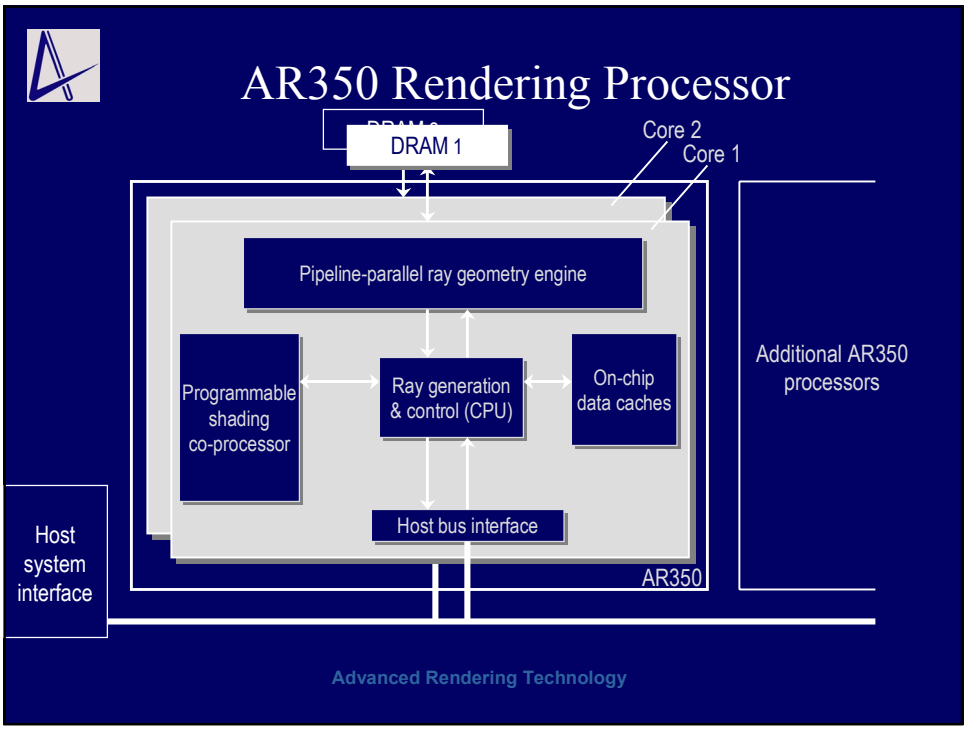
AR350 Rendering Processor
DRAM 1
Core 2
Core 1
Pipeline-parallel ray geometry engine
Programmable shading co-processor
Ray generation & control (CPU)
On-chip data caches
Host bus interface
AR350
Additional AR350 processors
Host system interface
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Problems with Parallelism

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

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The ART Model

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

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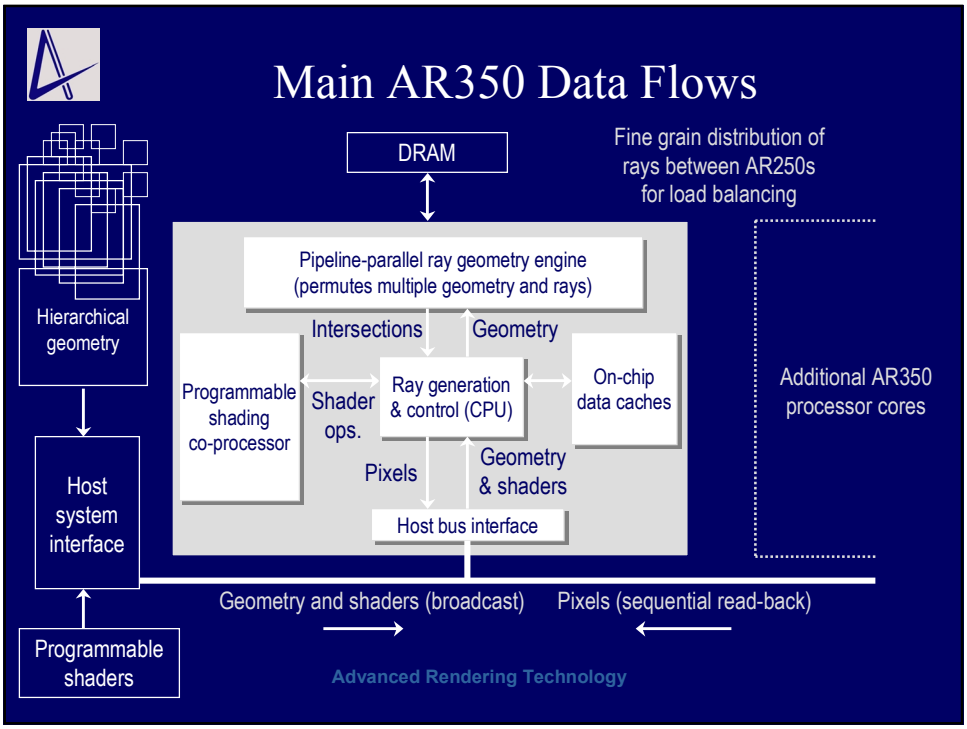
Main AR350 Data Flows
DRAM
Fine grain distribution of rays between AR250s for load balancing
Pipeline-parallel ray geometry engine (permutes multiple geometry and rays)
Intersections
Geometry
Hierarchical geometry
Programmable shading co-processor
Shader ops.
Ray generation & control (CPU)
On-chip data caches
Additional AR350 processor cores
Pixels
Geometry & shaders
Host bus interface
Host system interface
Geometry and shaders (broadcast)
Pixels (sequential read-back)
Programmable shaders
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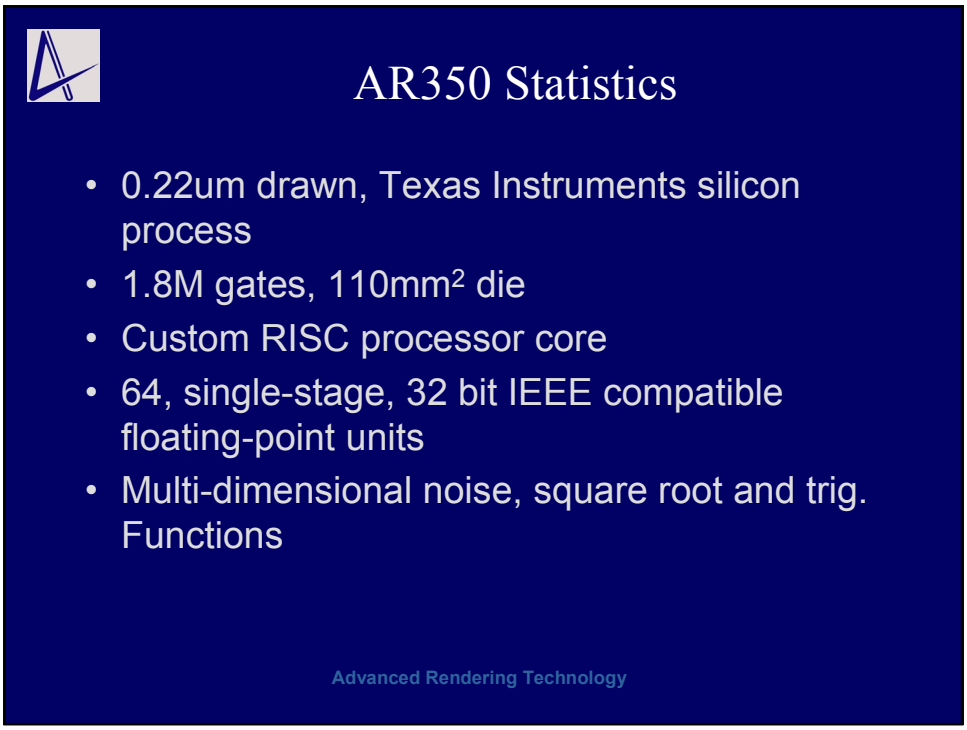
AR350 Statistics
• 0.22um drawn, Texas Instruments silicon process
• 1.8M gates, 110mm² die
• Custom RISC processor core
• 64, single-stage, 32 bit IEEE compatible floating-point units
• Multi-dimensional noise, square root and trig. Functions
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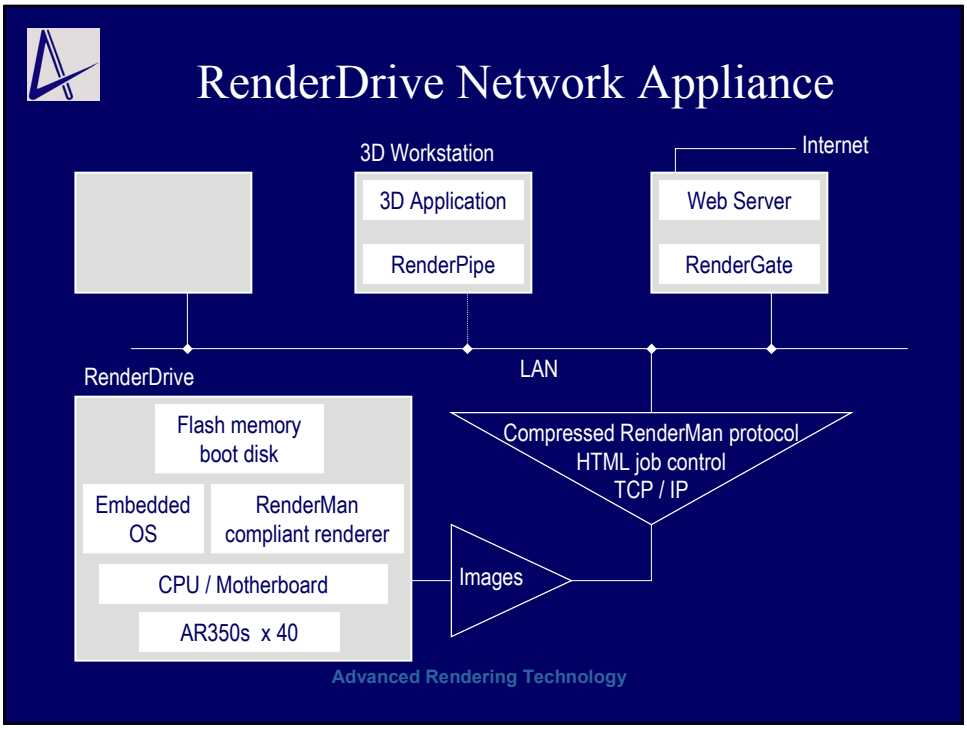
RenderDrive Network Appliance
3D Workstation
3D Application
RenderPipe
Internet
Web Server
RenderGate
LAN
RenderDrive
Flash memory boot disk
Embedded OS
RenderMan compliant renderer
CPU / Motherboard
AR350s x 40
Compressed RenderMan protocol
HTML job control
TCP / IP
Images
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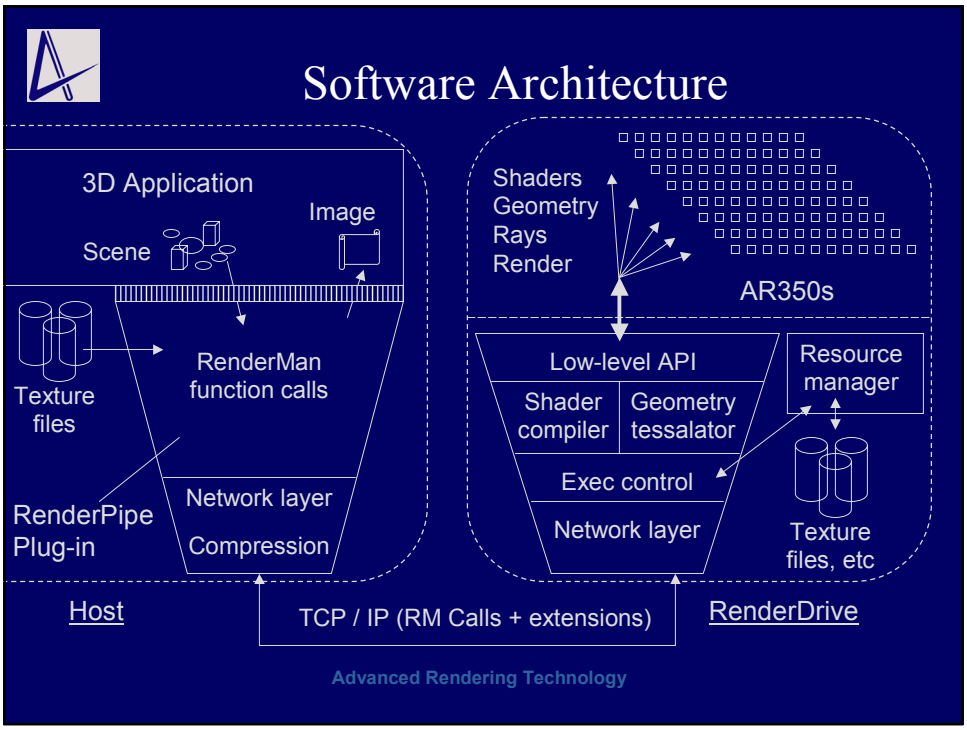
Software Architecture
3D Application
Image
Scene
Texture files
RenderMan function calls
RenderPipe Plug-in
Network layer
Compression
Host
Shaders
Geometry
Rays
Render
AR350s
Low-level API
Shader compiler
Geometry tessalator
Exec control
Network layer
Resource manager
Texture files, etc
TCP / IP (RM Calls + extensions)
RenderDrive
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Rendering Core

- Parallel Ray Tracer
- Regular Algorithms
- Physically Accurate
- Floating Point throughout
- Large geometry and image handling
- 9+M triangles, 16K line images
- Robust!

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Rendering Core Features

- High quality lighting & anti-aliasing
- True Camera and Object Motion Blur
- True Depth of Field
- Diffuse Reflection & Refraction
- Area Lights (true soft shadows)
- Programmable Shading (RenderMan S. L.)
- Displacement Shading
- Volumes
- Camera shaders & Lens effects

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RenderMan Compliant Interface

- Support RenderMan Shading Language
  - C like programming language
  - Total flexibility
  - Surfaces, Volumes, Lights & Cameras
- Directly support all standard geometry types
  - Polygons, Patches, NURBS, Primitives

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Silicon Roadmap

(Current Generation 1.8M gates at 0.22um)

- Next generation (AR450) probably at 0.13um
  - Major architectural evolution
  - Same functionality, greater performance
- IP for real time consumer
  - Silicon core and firmware components
    - Full Programmable Shading
    - Visibility Engine
  - Enabling Technologies

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