BRINGING PASCAL TO PROFESSIONALS

Allen Bourgoyne
Sr. Product Marketing Manager, NVIDIA Corporation
VISUAL COMPUTING IS OUR SINGULAR MISSION
THE MARVELS OF PASCAL

ARCHITECTURE

PROCESS TECHNOLOGY

MEMORY

G5X
10 GHz

CRAFTSMANSHIP

NEW GRAPHICS & COMPUTE FEATURES
THE POWER OF QUADRO PASCAL FOR PROFESSIONALS

PERFORMANCE

MEMORY

VISUAL WORKSPACE
PERFORMANCE
SIMULTANEOUS MULTI-PROJECTION
Polymorph Engine 4.0

Input Assembler

Vertex Shader
Tessellation Shader
Geometry Shader

Simultaneous Multi-Projection

Setup
Raster

Pixel Shader
SIMULTANEOUS MULTI-PROJECTION
Up to 2x Performance Improvement for VR

PREVIOUS GENERATION
Create Right Eye Perspective
Create Left Eye Perspective
Render Right Eye View
Render Left Eye View

PASCAL
Create Scene
Render Right Eye View
Render Left Eye View

PASCAL Enables 2X Geometry Throughput!
PASCAL DYNAMIC LOAD BALANCING

Brain Diagram:

- **Static Partitioning**
  - 100% GPU Resource Allocation
  - 0% Graphics
  - 0% Compute
  - 0% Idle

- **Dynamic Balancing**
  - 100% GPU Resource Allocation
  - 75% Graphics
  - 25% Compute
  - 0% Idle
PASCAL PREEMPTION
Enables Real-time Workloads

- First ever pixel-level graphics preemption
- Pixel level graphics + thread-level compute preemption
- Instruction level preemption: maximize robustness

sub-100us preemption

Graphics Preemption – Pixel Level
- COMMAND
- PUSHBUFFER
- TRIANGLES
- PIXELS
- PREEMPT

Compute Preemption – Thread Level
- COMMAND
- THREADS
- COMMIT

Compute Preemption – Instruction Level
- COMMAND
- INSTRUCTIONS
- PREEMPT

- FADD R1, R2, R3
- FMUL R4, R1, R5
- IADD R7, R8, R7
- LD R6, R7
- FMUL R1, R1, R6
PASCAL PERFORMANCE
Better Performance for Better Visual Computing Experience

• Better workstation responsiveness
  • Graphics & compute interactions
  • Higher levels of interactivity
• Helps guarantee level of service
  • More predictable compute performance
  • Better VR experience
• People Want to do More
  • Larger models, bigger datasets, more complex visual effects
MEMORY
GDDR5X
The Next generation of High speed DRAM

NEW GPU CIRCUIT ARCHITECTURE
NEW BOARD CHANNEL DESIGN
RESULTS:
10 GBPS

GDDR5X: ~2x the bandwidth of GDDR5
PASCAL MEMORY TECHNOLOGY

• High Bandwidth Memory (HBM) support
  • Supported on GP100 GPUs (16GB)
  • High performance, high bandwidth memory integrated with GPU
  • 4096 bit bus
  • Up to 720 GB/s
  • ECC enabled by default, no performance penalty
PASCAL MEMORY TECHNOLOGY

• NVLINK
  • High-bandwidth, energy efficient interconnect that enables ultra-fast communication between CPU and GPU and between GPUs.
  • 5 to 12 times faster than PCIe Gen3
  • Available on GP100 GPUs

• Unified Virtual Memory
  • 49-bit virtual addresses - allows compute processes to over subscribe memory (supported on all Pascal GPUs)
  • Linux HMM will move pages to the GPU as need
  • NVLINK can move data between GPUs
VISUAL WORKSPACE
DISPLAY REVOLUTION

FLAT

LENTICULAR

SURROUND

LIGHT FIELD

CURVED

SPHERICAL

VR

AR

HOLOGRAM
PASCAL DISPLAY TECHNOLOGY

- Display Port 1.4
  - Twice the bandwidth of 1.2
  - Can drive 5K monitor with a single cable
    - $(5120 \times 2880)$ at 60 Hz

- Encode Decode:
  - GP100: 3x encode, 1x decode
  - GP 102/104: 2x encode, 1x decode
HDR
BIGGEST ADVANCE IN DISPLAY QUALITY IN 20 YEARS

2x Visible Colors (75% of visible spectrum)

Brighter Displays (1000nits)

More Saturated Colors

>10000 to 1 Contrast Ratio
PASCAL HDR
NEW PASCAL HDR FEATURES

HDR Video
  4K@60 10/12b HEVC Decode

HDR Record / Stream
  4K@60 10b HEVC Encode

HDR Interface Support
  DP1.4
QUADRO PASCAL: IDEAL FOR MULTI DISPLAY

- ✔ Performance
- ✔ Memory
- ✔ Display Synchronization
FLEXIBLE DISPLAY CONFIGURATIONS

4K and Higher Resolutions @ 60Hz

Quadro Sync II cards can synchronize the output of up to 8 Pascal GPUs in a single chassis
QUADRO VR: AS REAL AS IT GETS

The ultimate in presence with Iray VR. Photorealistic experience with Light Fields rendered on DGX-1 or Quadro VCA and viewed with NVIDIA Quadro Pro VR Viewer.
NVIDIA VRWorks – Pro VR Features

Comprehensive SDK for VR Developers

GRAPHICS
- Lens Matched Shading
- Single Pass Stereo
- MultiRes Shading
- VR SLI

HEADSET
- Context Priority
- Direct Mode
- Front Buffer Rendering

AUDIO
- VRWorks Audio
- PhysX

PROFESSIONAL
- Warp & Blend
- Synchronization
- GPU Affinity
- GpuDirect for Video
QUADRO PASCAL
**NVIDIA Quadro Desktop Products**

**Most demanding rendering and GPGPU compute applications**

- Large/complex CAD models, CAE, Photorealistic rendering, Seismic exploration, GPGPU compute

**Largest CAD models, CAE, Photorealistic rendering, Seismic exploration, GPGPU compute**

- Large/complex CAD models, Seismic exploration, complex DCC effects, 3D Medical Imaging Recon

**Large/complex CAD models, Advanced DCC, Medical Imaging**

**Medium size/complexity CAD models, Basic DCC, Medical Imaging, PLM**

**Small/simple CAD models, video, Entry PLM**

---

Office, Sketchup, PACS/Diagnostics, Schlumberger, Halliburton, DeltaGen, Catia Live Rendering, Ansys, Abaqus, Simulia

AutoCAD, Revit, Inventor, Solidworks, NX, Creo, Catia

Adobe CC Photoshop, Illustrator, Adobe CC Premiere Pro, After Effects, Autodesk Maya, 3ds Max, Mari, Nuke
<table>
<thead>
<tr>
<th><strong>GPU ARCHITECTURE</strong></th>
<th>Pascal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CUDA CORES</strong></td>
<td>3840</td>
</tr>
<tr>
<td><strong>MEMORY CAPACITY</strong></td>
<td>24 GB GDDR5X</td>
</tr>
<tr>
<td><strong>DISPLAY CONNECTORS</strong></td>
<td>4x DP 1.4 + 1x DVI</td>
</tr>
<tr>
<td><strong>DISPLAY SUPPORT</strong></td>
<td>4 x 4096x2160@120HZ</td>
</tr>
<tr>
<td></td>
<td>4 x 5120x2880@60HZ</td>
</tr>
</tbody>
</table>
P6000 PERFORMANCE - PRELIMINARY

Test system: Intel E5 2697 V3 2.6GHz (3.6GHz Turbo), 32GB RAM, Windows 7 SP1 64-bit, P5000/P6000 NVIDIA graphics driver 368.37, M5000/M6000 24GB NVIDIA graphics driver 367.74. 3D Graphics performance based on publically available SPECviewperf 12 SNX-02 viewset, Volumetric Viewing performance based on SPECviewperf 12 Energy-01 viewset, Virtual Reality performance based on VRScore beta benchmark.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPU ARCHITECTURE</td>
<td>Pascal</td>
</tr>
<tr>
<td>CUDA CORES</td>
<td>2560</td>
</tr>
<tr>
<td>MEMORY CAPACITY</td>
<td>16 GB GDDR5X</td>
</tr>
<tr>
<td>DISPLAY CONNECTORS</td>
<td>4x DP 1.4 + 1x DVI</td>
</tr>
<tr>
<td>DISPLAY SUPPORT</td>
<td>4 x 4096x2160@120HZ</td>
</tr>
<tr>
<td></td>
<td>4 x 5120x2880@60HZ</td>
</tr>
</tbody>
</table>
P5000 PERFORMANCE - PRELIMINARY

Test system: Intel E5 2697 V3 2.6GHz (3.6GHz Turbo), 32GB RAM, Windows 7 SP1 64-bit, P5000/P6000 NVIDIA graphics driver 368.37, M5000/M6000 24GB NVIDIA graphics driver 367.74. 3D Graphics performance based on publicly available SPECviewperf 12 SNX-02 viewset, Volumetric Viewing performance based on SPECviewperf 12 Energy-01 viewset, Virtual Reality performance based on VRScore beta benchmark.
Come by the NVIDIA Booth #509 to see a technology preview of Quadro Pascal Mobile GPU technology

- Technology preview of a Quadro Pascal Mobile GPU in a Dell Precision laptop
  - VR technology demos: Quadro Pascal Mobile GPU bringing VR to mobile workstation platforms
“NVIDIA is leading the way with its latest Pascal architecture,” said Josh Peterson, vice president of product management, workstations, HP Inc. “Our Z Workstation customers will benefit from the enhanced capabilities of the Quadro P6000 and P5000, including professional VR capabilities and enough power to drive up to four, 5K displays.”

“NVIDIA Quadro with the latest Pascal GPU architecture is truly designed for professionals working with extremely large and complex datasets,” says Rob Herman, General Manager, Executive Director of Workstation at Lenovo. “The performance boost, coupled with our ability to support up to 3 P6000 class GPUs in the ThinkStation P910, makes it ideal for our workstation and mobile users across a range of industries. Together, Lenovo and NVIDIA Quadro continue to raise the bar for professional graphics.”

“We are excited to be the first to preview the latest NVIDIA Pascal-based architecture in a mobile workstation at Siggraph 2016,” says Rahul Tikoo, general manager of Precision workstations, Dell. “We look forward to offering on-the-go professionals the graphics power for their most demanding rendering and simulation intense workloads, as well as adding one of the first mobile workstations to be VR ready.”

“Often our artists are working with 50GB or higher datasets,” says Steve May, CTO at PIXAR. The ability to visualize scenes of this size interactively gives our artists the ability to make creative decisions more quickly. We’re looking forward to testing the limits of Pascal and expect the benefits to our workflows to be huge.”
QUADRO PASCAL IS HERE!
See Quadro P6000 in Action @ SIGGRAPH 2016

Booth demos:

Photorealistic Design Visualization in VR
Adobe Creative Cloud / Wetbrush demo
VRWorks 360 Live Video Stitching

VR Room demos:

Iray VR Light Field Photorealistic VR
Massive Architectural Visualization

COME DO YOUR LIFE’S WORK

We are looking for great people at all levels to help us accelerate the next wave of AI-driven computing in Research, Engineering, and Sales and Marketing.

Our work opens up new universes to explore, enables amazing creativity and discovery, and powers what were once science fiction inventions like artificial intelligence and autonomous cars.

Check out our career opportunities:

• www.nvidia.com/careers

• Reach out to your NVIDIA social network or NVIDIA recruiter at DeepLearningRecruiting@nvidia.com