An Architectural Design Firms Journey Through Virtual GPU Technology for Global Collaboration
What are we going to learn today?

- Why CannonDesign decided to virtualize our infrastructure
- What struggles we encountered specific to the tools we use
- What are the various configurations of virtual desktops we used over the years, and what were their shortcomings
- How we measured performance of virtual desktops in order to develop our future infrastructure
- What the plan is for our new infrastructure which uses GRID 2.0 technology
- What are the benefits we expect from our new design
I’m Jimmy Rotella
I live at the Crossroads of Architecture & Technology
an integrated global design firm that unites a dynamic team of strategists, futurists, researchers, architects, engineers, and industry specialists
our JOURNEY through virtualization begins here.
**Why virtualize?**

| Cost | Security |
why virtualize?

**Cost**
- startup costs are high
- cost savings at the desktop level are typically redirected to servers, network, and storage
- some virtual desktop infrastructure setups allow for reduced license requirements and costs, but not all
- ROI takes longer than server virtualization project

**Security**
- data tends to be more secure, as it all resides on virtual desktops however it’s only as secure as you make your environment
- gives you more control over setting permissions and restrictions, however some cultures and environments claim that hinders their work
- “all your eggs in one basket”

**robbing peter to pay paul**

**only as secure as your restrictions**
why did we virtualize?

Management

- easier workstation provisioning with standard desktop images (this ended up not being a benefit for us later)
- IT support does not need to happen at end user’s desktop location
- unified backup and recovery

Collaboration

- SFMO (Single Firm Multi Office)
- Workstation access from anywhere
- greater flexibility and mobility for project teams
- ability to share and reallocate resources as users need them
why did we virtualize?

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only reap benefits if you are leveraging identical images

ALL HUGE BENEFITS FOR US
16 offices worldwide all tied back into data center globally share projects and work on the same files

ability to invite outside consultants into our network for collaboration
What REVIT wants....
What **WE** want revit to do for **US**!

What **REVIT** wants....
How REVIT works.

bring the PEOPLE to the DATA
REVIT + WAN = ☹️
Virtual Desktop Design

- 2 vCPU @
- 140GB hard drive space
- 8GB RAM
- vSGA software graphics accelerations

Version 2 - GPU VDI (2013)
- 2 vCPU @
- 150GB hard drive space
- 12GB RAM
- vSGA hardware graphics GPU acceleration

Version 3 - CHUM VDI (2014)
- 2 vCPU @
- 180GB hard drive space
- 24GB RAM
- vDGA passthrough GPU graphics acceleration
Why didn’t vSGA work for us?
we needed more power.

racked workstations

- 2u servers
- 12 core xeon cpu
- dedicated graphics card
- PCoIP pass through graphics
- 1 user per system
What we ended up with was a very mixed environment.

{circa early 2015}
How can you efficiently manage an environment like this?
“In God we trust. All others must bring data”.

W. Edwards Deming
What is our bottleneck?
Revit is capable of multi-threading for about 12 processes.

Revit is single threaded for most processes.

Processor

HIGHER CLOCK SPEED > MORE CORES

Graphics

Microsoft® DirectX®

V11 for 2014+

Autodesk Certified

Memory

Minimum

4 gb

Recommended

16 gb

Amount of RAM required to open your model

The size of your compacted central file

5 gb

Collaboration

30 gb

Hard drive

Recommended SSD best performance

Minumum

SSD recommended for 2014+

Hard drive

Certified

Fun Facts
RFObenchmark
The “Taylor Swift” Test
so how did we stack up?

Not where we want to be.

Other physical machines.

What our users consider “good”.

(lower is better)
It’s important to set your own baseline to define user experience.

For us, our baseline was all about feel and we found RFOBENCHMARK HW ACCELERATION TESTS and CINEBENCH TESTS compared with actual end users data gave us our baseline.
Introducing GRID 2.0
New capabilities for accelerated virtual desktops

2X
Users
Higher user density
More users can benefit

2X
Performance
Ultra high-end use cases
Performance above physical clients

2X
Platforms
Blade servers
Best server density

2X
OS
Oil & Gas
Government
M&E
<table>
<thead>
<tr>
<th></th>
<th>M60</th>
<th>M6</th>
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<tbody>
<tr>
<td>GPU</td>
<td>Dual High-end Maxwell</td>
<td>Single High-end</td>
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<tr>
<td>CUDA Cores</td>
<td>4096</td>
<td>1536</td>
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<tr>
<td>Viewperf 12*</td>
<td>62 x 2</td>
<td>54</td>
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<tr>
<td>Single Precision</td>
<td>7.4 TFLOPs</td>
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<tr>
<td>Memory Size</td>
<td>16 GB GDDR5</td>
<td>8 GB GDDR5</td>
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<td>H.264 1080p30 streams</td>
<td>36</td>
<td>18</td>
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<tr>
<td>GRID vGPU CCU</td>
<td>2 / 4 / 8 / 16 / 32</td>
<td>1 / 2 / 4 / 8 / 16</td>
</tr>
<tr>
<td>Form Factor</td>
<td>PCIe 3.0 Dual Slot</td>
<td>MXM</td>
</tr>
<tr>
<td>Power</td>
<td>240W / 300W (225W opt)</td>
<td>100W (75W opt)</td>
</tr>
<tr>
<td>Thermal</td>
<td>active / passive</td>
<td>bare board</td>
</tr>
</tbody>
</table>
worst case scenario.
so what did we do?
New HOTness.

Cisco UCS w/NVIDIA GRID 2.0

- Cisco B200 M4 Blade Servers
- Cisco 5100 Series Chassis w/ 8 servers per 6u rack space
- 1 Tesla M6 card per server
- 2x 2.6 GHz 14 core Xeon Processors per server
- 384GB RAM per server
- NetApp SSD storage array
Autodesk Revit 2015

UPS - Users per Server

Revit Large Peak Workload

16\textsubscript{UPS}

K240Q Users
6\textsubscript{vCPU} - 16\textsubscript{GB} RAM

2x NVIDIA GRID K2

Revit Balanced Workload

24\textsubscript{UPS}

K220Q Users
4\textsubscript{vCPU} - 8\textsubscript{GB} RAM

Lab host:
CPU: Dual Socket E5-2698 v3 2.3Ghz / 16 core
RAM: 320GB RAM
GPU: 2 NVIDIA GRID K2 cards
10G Core network
iSCSI SSD SAN
VMware vSphere 6
VMware Horizon 6.1 w/ vGPU
Tested 5/2015
Virtual Desktop Profiles

Knowledge Workers
- 2 vCPU @ 2.6 GHz
- 256GB hard drive
- 8GB RAM
- 512mb vGPU
- 16 users per blade

Designers
- 8 vCPU @ 2.6 GHz
- 512GB hard drive
- 48GB RAM
- 1GB vGPU
- 8 users per blade

Renderers
- 12 vCPU @ 2.6GHz
- 512GB hard drive
- 48GB RAM
- 4GB vGPU
- 2 users per blade
LOTS OF DATA AHEAD
The Contenders

- Standard VDI
- GPU VDI
- Cloud 2.0
- Dell GRID 1.0 Quad
- Cisco GRID 2.0 Knowledge
- Cisco GRID 2.0 Designer
- Cisco GRID 2.0 Renderer
- HP zBook 15 Studio
- HP z640 Desktop Workstation
Revit Performance (lower time is better)

Model Creation & Export
- CD - Standard VDI
- CD - GPU VDI
- CD - CHUM VDI
- CD - Cloud 2.0
- Dell GRID 1.0 Quad
- GRID 2.0 Knowledge
- GRID 2.0 Designer
- GRID 2.0 Renderer
- HP zBook Laptop
- HP z640 Desktop

Rendering
- CD - Standard VDI
- CD - GPU VDI
- CD - CHUM VDI
- CD - Cloud 2.0
- Dell GRID 1.0 Quad
- GRID 2.0 Knowledge
- GRID 2.0 Designer
- GRID 2.0 Renderer
- HP zBook Laptop
- HP z640 Desktop

User Experience
- CD - Standard VDI
- CD - GPU VDI
- CD - CHUM VDI
- CD - Cloud 2.0
- Dell GRID 1.0 Quad
- GRID 2.0 Knowledge
- GRID 2.0 Designer
- GRID 2.0 Renderer
- HP zBook Laptop
- HP z640 Desktop

Revit Tests
Cost Comparison /user

Old VDIs
20 users/server (4u rack space) $1,000

Dell Appliances for Wyse
4 users/server (2u rack space) $4,000

Cloud 2.0 Racked Workstation
1 users/server (2u rack space) $5,900

HP zBook Studio
1 user/laptop (no rack space) $2,600

HP z640
1 user/desktop (no rack space) $4,800

Cisco UCS blades
2-16 users/blade (8 blades/ 6u rack space)

Knowledge $1,200
Designer $2,400
Renderer $5,800
## Cost Comparison /user

<table>
<thead>
<tr>
<th>Device</th>
<th>Users/Server</th>
<th>Rack Space</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old VDI</td>
<td>20</td>
<td>4u rack</td>
<td>$2600</td>
</tr>
<tr>
<td>Dell Appliance for Wyse</td>
<td>4</td>
<td>2u rack</td>
<td>$4800</td>
</tr>
<tr>
<td>Cloud 2.0 Racked Workstation</td>
<td>1</td>
<td>2u rack</td>
<td>$5900</td>
</tr>
<tr>
<td>HP zBook Studio</td>
<td>1</td>
<td>no rack</td>
<td>$2600</td>
</tr>
<tr>
<td>HP z640</td>
<td>1</td>
<td>no rack</td>
<td>$4800</td>
</tr>
<tr>
<td>Cisco UCS blades</td>
<td>2-16</td>
<td>8 blades/6u rack</td>
<td>$1000</td>
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**Notes:**
- Cheapest option is not good enough.

**Lowest Price**

- Knowledge: $1200
- Designer: $2400
- Renderer: $5800
## Cost Comparison /user

### Old VDIs
20 users/server (2u rack space) | Dell Appliance for Wyse
4 users/server (2u rack space) | Cloud 2.0 Racked Workstation
1 user/server (2u rack space) | Cisco UCS blades
1 user/laptop (no rack space)  | HP z640
1 user/desktop (no rack space) | HP zBook Studio
1 user/laptop (no rack space)  | Knowledge
$2600
$4000
$4800
$5900

### Highest Price
- Knowledge $1200
- Designer $2400
- Renderer $5800

*Highest price not necessarily highest performance and takes up significant rack space.*
### Cost Comparison /user

<table>
<thead>
<tr>
<th>Server Type</th>
<th>Users/Server</th>
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<tr>
<td>Old VDIs</td>
<td>20</td>
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<tr>
<td>Dell Appliance for Wyse</td>
<td>4</td>
<td>2u rack space</td>
<td>$4000</td>
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<tr>
<td>Cloud 2.0 Racked Workstation</td>
<td>1</td>
<td>2u rack space</td>
<td>$9900</td>
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<tr>
<td>HP zBook Studio</td>
<td>1</td>
<td>no rack space</td>
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### Easy Setup & Collaboration

- Desktops and laptops = easy setup + low cost + no additional data center space, but won’t bring the level of collaboration available in a virtual environment.

### Tools
- Knowledge: $1200
- Designer: $2400
- Renderer: $5800
CannonDesign values a high level of collaboration only made possible by a virtual environment.

A balance of collaboration, performance, flexibility and cost = value for us.

Cost Comparison /user

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Best Value for OUR Goals

- HP zBook Studio: 1 user/laptop (no rack space) - $1000
- HP z640: 1 user/desktop (no rack space) - $4800
- Cisco UCS blades: 2-16 users/blade (8 blades/ 6u rack space) - $5900

Knowledge $1200
Designer $2400
Renderer $5800
How do we expect to benefit from our new infrastructure?

Previous VDI users will see savings of **13.5 hours** per week using Revit, which equates to approximately **$2500** per week in billable hours.

**85%** REDUCTION IN SERVER SPACE

VDI users see a savings of **310 sec** when Rotating, Orbiting, & Panning, Zooming, and **86 sec** when creating models and exporting them.

RWS users see a savings of **10 sec** when Rotating, Orbiting, & Panning, Zooming, and **26 sec** when creating models and exporting them.

REDUCTION IN TIME PERFORMING REVIT TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Old GPU VDIs</th>
<th>Current Racked Workstations w/ GeForce</th>
<th>Cisco UCS Blades w/ GRID 2.0</th>
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<tbody>
<tr>
<td>Model Creation and Export</td>
<td>200</td>
<td>150</td>
<td>100</td>
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<tr>
<td>Rotate, Orbit, Pan, Zoom</td>
<td>300</td>
<td>250</td>
<td>150</td>
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questions?

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