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CUST 332 - PTC Creo 2
Benchmark Performance on HP Workstations, Laptops, Blade Work Stations, and Virtual Machines

Brian C. Walrath
Raytheon Missile Systems

June 10, 2015

So who is this guy and why is he talking…

Brian Walrath

Sr. Multi-Disciplined Engineer II
RMS IT Mechanical Engineering Solutions
Engineering Workplace Management
Shady Shores, Texas

Biography
- Former TV Repairman, Machinist, Teaching Assistant, and pizza chef
- Bachelor of Science in Technology, Southwest Texas State,
    - 6th person to get a Technology Degree at Southwest Texas State
    - Degree Concentrations in both **Computer Aided Design** and **Computer Aided Manufacturing**
- 5 Years with Martin Marietta's Mechanical Computer Aided Engineering Group
    - Trained literally thousands of engineers in 3D CAD
    - 3 years Adjunct Professor, Valencia College, teaching 3D CAD
    - Wrote 3 and edited 5 textbooks on CAD Design
- 6 years as Sr. Design Engineer for Behr Climate Systems
- 16+ years with Raytheon Missile Systems out of Tucson, AZ
    - Member of the IT Mechanical Engineering Solutions Group
    - 6+ Years "in the Cloud" as a full time (Texas to Arizona) Telecommuter
    - RTN Workstation Standards Ownership Team Benchmarking Lead.
    - Manages the WSOT Engineering Hardware Test Lab in SAS McKinney, Texas.

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Raytheon Corporate **End User Services** promotes common Operating System(s), Common Hardware, and Standard Applications (well, as much standardization in Engineering Applications and versions as *possible*…)

- **Desktop Standards Ownership Team** determines what standard desktops, laptops, tablets, etc. that RTN uses.
- **Workstation Standards Ownership Team** determines what engineering workstations, laptops, blade workstations, etc. that RTN uses
  - WSOT maintains an **Engineering Hardware Test Lab**
    - Benchmark configurations to optimize performance/dollars for the Standard Catalog.
    - Evaluate and recommend processors, memory, drives, graphics cards, and GPU Coprocessors for the Standard Catalog and Configure –To-Order (CTO)
    - Test OS Builds, Application Packages, Drivers, BIOS, and other patches on current and proposed hardware.
    - Evaluate new Use Cases for appropriate technology, including Variant and CTO (**Custom To Order**) Hardware justifications.
    - **Determine performance impact of changes to OS, Network, Application Version, or new tool on current and proposed hardware.**

> **Lots of Acronyms, but basically we do the
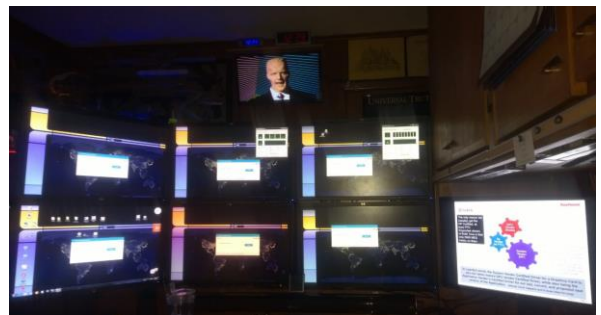> "what is the right computer" part of Computer Rocket Science**

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SAS Engineering Lab
McKinney, TX

RMS Hidden Valley
Shady Shores, TX

(14+) Sender Test systems
(8) 1920x1280 24" Screens
Channeled thru (2) 'RGS Servers'
Each connected to dual monitors
on the spine of ORION

(2) Receiver systems driving
(7) 1920x1280 24" Screens
60 mbps Charter Business Fiber Optic
VPN to Dallas (McKinney) Concentrator (34 miles)

> **Basically, I get one of every new Computer thing, and I make them race each other…**

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- Although the industry is going to a decentralized, shared model (one to many), in the Engineering Computing arena, unique Use Cases require diverse solutions
  - **Engineering Automation requires different Computing Assets than Office Automation** (Lotus/Office/IE, etc) ..
  - Anybody can build a good Computing Asset by buying the most expensive of everything, but then how many can you afford to buy?
  - Somebody has to determine how (once somebody has actually gotten something to Run once), to make it run repeat- ably, how fast it might run, and then **how fast we can afford to make it run for every user who needs it!**
  - Its all about Performance over Cost, and the **Right Computing Asset for the Use Case!**

- If you have a new Use Case, I have this Computer in my lab… (For Raytheon Attendees only!)
  - I have multiple Class 2-5 systems in my Lab for you to run "Test Cases" on.
  - I already have, or can get the Legacy, and the Very Latest cards, drives, and GPUs, for Variant and Use Case Testing
  - You can test your jobs on my systems remotely via RGS
    - I don't need to see what you are doing.
    - All I ask is that you share a 1 pager on how well it worked "I ran this software with this model and it took 'X' Minutes on my old system, and 'Y' Minutes on yours yadda-yadda-yadda"
    - I can help you with Objective Data for the Business Case Justification Process to get you the hardware you need to do your job.

- Contact me at:
  - bcwalrath@raytheon.com
  - 520-545-6328 VPN Phone
  - 940-293-3871 Cell

So I am a kind of Computer Food Taster, but I may be able to help you get the right Computing Asset for the task.

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A "Computing Asset" can be a Tablet, Thin Client, Laptop, Desktop, Workstation, Blade Workstation, and now "Virtual Machine with (Virtual) Hardware Accelerated Graphics" accessed by Anything!

- **Class 1**: **Standard Business Class Systems** *(DSOT Hardware) good for Office Automation, no dedicated graphics card or ECC memory, very light graphics but getting better.*

- **Class 2**: **Standard Engineering (Low Graphics) System** *single Processor, Multi-spindle, ECC memory, small dedicated graphics card. Good for occasional/small CAD use, as an RGS Receiver system or Linux box. Can usually be upgraded to decent even excellent Class 3 with a good graphics card.*

- **Class 3**: **Standard Engineering (High Graphics) System**. *Single Processor, Multi-spindle, ECC memory, Optimum graphics card. Good for Creo and other largely non-multi-threaded Engineering Applications*

- **Class 4**: **Standard Analysis System:** *Largest Power Supply, Multi-Processor, Multi-spindle, Large ECC memory, Optimum graphics card. Good for conventional CPU multi-threaded (non-HPC) Analysis and Simulation*

- **Class 5**: **HPC Analysis System:** *Largest Power Supply, Multi-Processor, Multi-spindle, Large ECC memory, Graphics Co-Processor board(s). Good for HPC Analysis and Complex Simulation*

We figure out not only if it will work, but how well, and on what. 6

- Standard WSOT Benchmarks
  - OCUS 5 (Wildfire 4) and OCUS 6 (Wildfire 5, PTC Creo1, and PTC Creo2 (PTC Creo3 TBD)
    - Olaf Corten's ProEsite http://www.proesite.com/ RMS Mechanical Engineering Solutions has OCUS benchmark data going back over a decade (2001), continuously maintained and updated, interpolated thru each version upgrade, operating system change, across dozens of platforms, going back to our original HPUX install.
    - "Our Data with Our Software testing: Actual RMS models used in edited versions of this benchmark to test our systems (currently discontinued)
      - RMS ceded this data to RTN EUS in 2009 as the core database for WSOT
    - The primary difference between OCUS 5 and OCUS 6 is the inclusion of a new Graphics Mode, Interactive Photorealistic Shading with reflections, added to the OCUS 6 test, replacing one of the interactive Shaded Tests in OCUS 5 (essentially a new "most intense graphics rendering test").

OCUS is one of several Standard Benchmarks, used for a decade
Results from OCUS 6 can be reasonably interpolated with OCUS 5

Transition from Wildfire and Intralink to PTC Creo 2 and PTC Windchill PDMLink.

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MCAD Long road for Raytheon

IDS

Live on Nov 29, 2010
~3.1 million objects migrated
WF2 to WF5/Windchill 9.1
PTC Migrator
5 days downtime

SAS

Live on Sep 14 2014
~ 3.2 Million objects migrated
WF4 to PTC Creo2/Windchill 10.1
Live Migration over 9 months
24 hour downtime

RMS

Live on Nov 24, 2014
~3.0 million objects migrated
WF4 to PTC Creo2/Windchill 10.1
Live Migration over 8 months
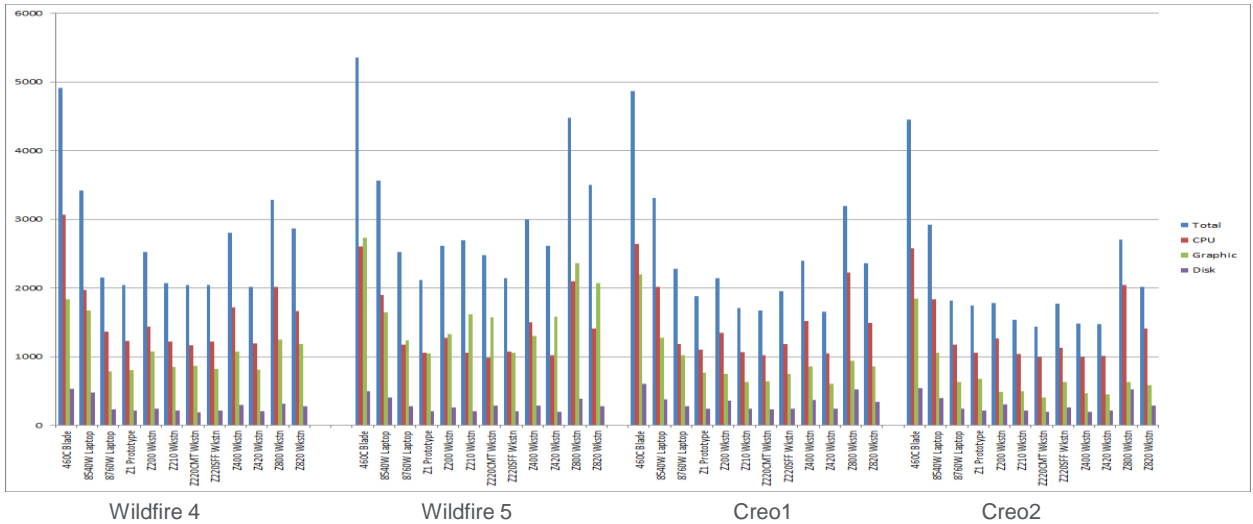0 downtime

Raytheon

CommonPDM
The new way to work

Over all
10,938,687 parts
12,302,987 CAD items
RMS
900,586 parts
3,249,830 CAD items
RMS PTC Largest single migration
RMS typical top level CAD assembly has over 5000 Creo Models
That is why performance is so important to RMS

Wildfire 4   Wildfire 5   Creo1   Creo2
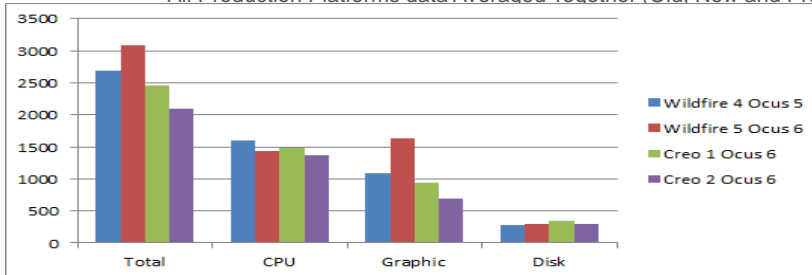
Every platform's individual graphs have the same general shape
(magnitudes vary but the relationship is constant)

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All Production Platforms data Averaged Together (Old, New and Proposed)

Comparisons	
WF4 to WF5	-13%
WF4 to C1	+9%
WF4 to C2	+22%
WF5 to C1	+21%
WF5 to C2	+32%
C1 to C2	+15%

- For the first time in my experience (16 years doing Pro/e benchmarking), a newer version of Pro/E is faster than an older one
  – Wildfire 5 follows the historical pattern, being bigger and 13% slower than Wildfire 4
  – PTC Creo 1 & 2 are significant improvements over Wildfire 4 & 5.
- Faster hardware and software does not necessarily predicate greater productivity, but slower hardware and software always predicates less productivity.
- Based on WSOT Hardware Test Lab data, our recommendation was to skip Wildfire 5 and PTC Creo 1, and go to PTC Creo 2 as soon as practical.
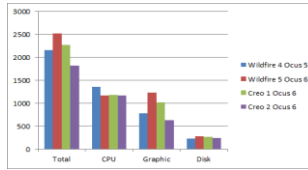
Wildfire 5 is 13% slower than Wildfire 4
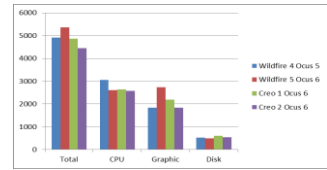Creo 2 is 22% faster than Wildfire 4 (32% faster than Wildfire 5)

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OCUS Benchmark Results (average of 10 runs)
Time in Seconds (lower is better)
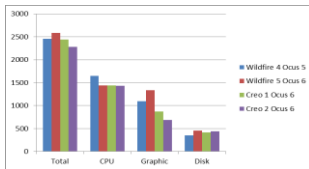
PTC® Live
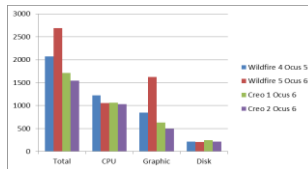Global
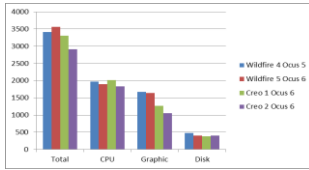
8540W Eng. Laptop

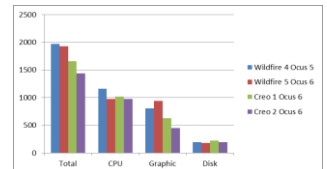8760W Eng. Laptop
(Fastest Laptop)

460C Gen 6 Blade Wkstn
(Pre-production R3 Build
Would not take 305.93 driver)

Z200 Wkstn
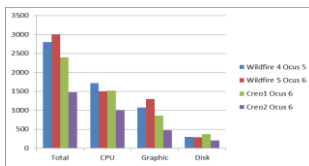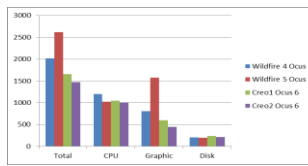

Z210 Wkstn

Z220 CMT Wkstn
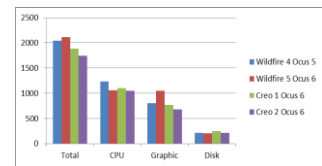(Fastest Overall and
Fastest Class 2)

OCUS Benchmark Results (average of 10 runs)
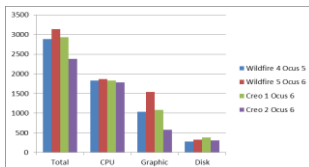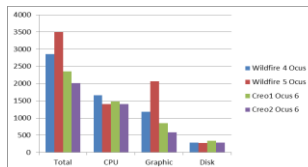## Time in Seconds (lower is better)

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Z400 Wkstn

Z420 Wkstn
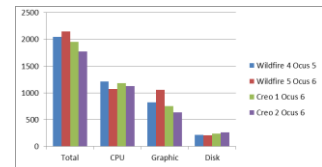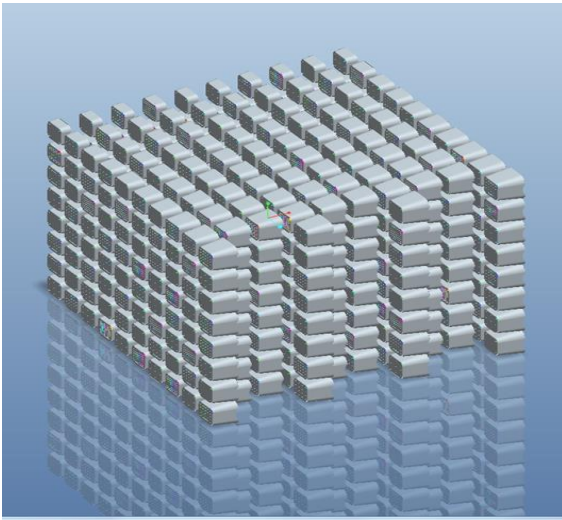(Fastest Class 3)

Z1 All-in-One

Z800 Wkstn

Z820 Wkstn
(Fastest Class 4)

Z220 SFF

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■ Interactive Photorealistic Shading with Transparency, Shadows and Reflections

– Photorealistic Shading has been available in the past, but only with a complicated manual setup of backgrounds, lighting sources, surface qualities like index of specular reflection and refraction, and a separate batch processing for "still" images

– Wildfire 5, PTC Creo 1, and PTC Creo 2 allow Designers to **Model** in this mode, automatically setting default values that can be modified at need, and pan, zoom and rotate in Real Time

– This new mode places a huge demand on the Graphics Card and more importantly the Graphics Card Driver

– New OpenGL Libraries in the Graphics Card Driver have been created to streamline this features operation. It works without them, but not nearly as fast

• The Nvidia Driver version 305.93 or better is necessary to realize these graphics improvements, even on older systems, with the new software versions.

Wildfire 5, PTC Creo 1& 2 require greater Graphics Resources than Wildfire 4, and most importantly, a Graphics Driver version with the new OpenGL libraries

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Incredible Resource for PTC Creo 2 driver information

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• http://support.ptc.com/WCMS/files/138217/en/hp_creo2_p10.pdf
   • Here, ISV driver choices meet graphics card and system vendor choices. This can save you from a lot of Problems.

PTC Creo 2.0 Hardware Support – Hewlett Packard

Last updated: April 27, 2015

The Desktop Virtualization Environment Support – HP table displays at the end of this document, after the standard Creo certification table.

All drivers listed in this document are available from your workstation manufacturer. Do not attempt to search AMD(ATI) or NVIDIA websites as those hardware vendors often will only have current (latest) drivers available which in most cases HAVE NOT BEEN TESTED by PTC.
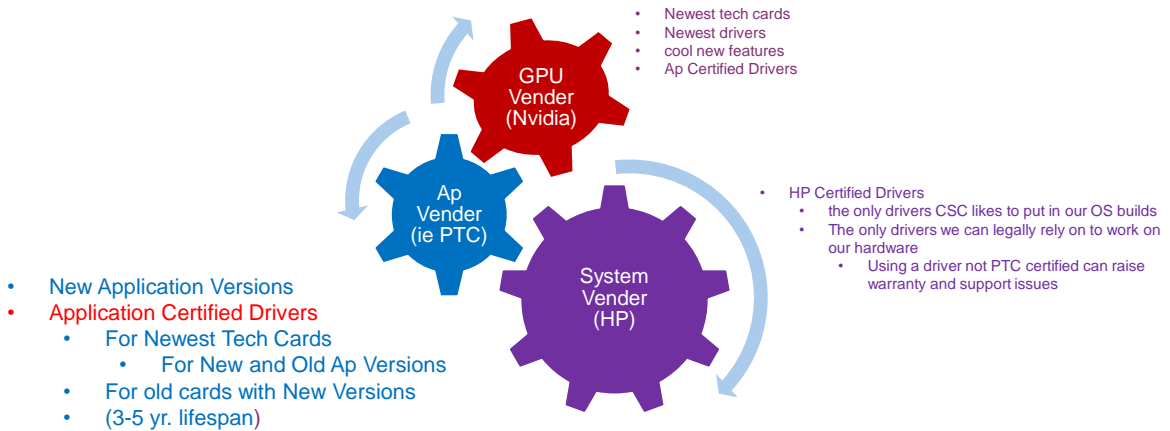
Graphics drivers certified for HP Z workstations and Elite Book mobile workstations are available for download from HP Performance Advisor. For more information about HP Performance Advisor go to http://www.hp.com/go/hpperformanceadvisor.

If multiple certified or supported drivers are listed for a particular hardware configuration, PTC recommends using the latest configuration posted.

PTC recommends customers planning on upgrading to Creo 3.0 should consider moving to 64-bit hardware as 32-bit platforms will not allow you to experience the best Creo performance and may not be supported on future versions of Creo.

Machine	O/S	Graphics Hardware	Driver Version	Date Certified or Supported	Minimum Supported Datecode	Status
Z1	Windows 7 32 and 64-bit	NVIDIA Quadro 1000M	276.28	24-May-2012	F000	Certified
		NVIDIA Quadro 3000M				
		NVIDIA Quadro 4000M				
		NVIDIA Quadro K3000M	306.68	14-Jan-2013		
		NVIDIA Quadro K4000M				
Z1 G2	Windows 8.1 32 and 64-bit	NVIDIA Quadro K610M	331.82	06-Mar-2014		

Wildfire 5, Creo 1& 2 require greater Graphics Resources than Wildfire 4, and most importantly, a Graphics Driver version with the new OpenGL libraries

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Application Specific Drivers can get you "free" additional performance…

GPU Vender (Nvidia)

- Newest tech cards
- Newest drivers
- cool new features
- Ap Certified Drivers

Ap Vender (ie PTC)

System Vender (HP)

- HP Certified Drivers
  - the only drivers CSC likes to put in our OS builds
  - The only drivers we can legally rely on to work on our hardware
    - Using a driver not PTC certified can raise warranty and support issues

- New Application Versions
- Application Certified Drivers
  - For Newest Tech Cards
    - For New and Old Ap Versions
  - For old cards with New Versions
  - (3-5 yr. lifespan)

In a perfect world, the System Vender Certified Driver for a Graphics Card is also the latest mature GPU Vender Certified Driver, while also being the Application Vender's Certified Driver for our last, current, and proposed next version of the Application.
(Almost never happens and it never lasts for long)

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My Last Presentation for PTC User was 6 years ago

At that time I talked to you about Thin Clients, Blade Workstations and Remote Graphics Software

PTC user 20th ANNIVERSARY WORLD EVENT

Look Ma', No Hard Drive!

Maximize Your PTC Environment roductivity Using Thin Clients and HP Blade Technology

Brian Walrath (RMS) and Israel Pabón (IDS)
Raytheon

We passed around a 12" Thin Client Laptop and let you manipulate Live an assembly you couldn't have even loaded on a laptop in those days…

We still have Use Cases for Thin Clients, but we still do Office Automation on Laptops and Desktops. Without Roaming Profiles and VMs for Office Automation, the Thin Clients never caught on, and newer versions of RGS like having an Nvidia graphics card to both pitch and catch the RGS stream…

Turns out, if you want to run a remote graphics card emulation, it helps to run it on an actual graphics card…

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Raytheon has hundreds of Blade Workstations and RGS Users across the US 17

Computing Asset doesn't just mean Hardware anymore 1

• A "Computing Asset" can be a Tablet, Thin Client, Laptop, Desktop, Workstation, Blade Workstation, and now "Virtual Machine with (Virtual) Hardware Accelerated Graphics" accessed by Anything!

• Virtual Machines can get "pass thru" graphics, essentially a dedicated graphics resource (one to one)

• Virtual Machines can 'share' fractions of a big graphics resource. (one to many)

• A Class 4 or 5 Workstation can be split in two, using dual graphics resources, to run two completely different Virtual Machines. Predictably the two VMs benchmark slower than the one build running on the iron, but not so much slower as that the average user would even be able to tell.

• Take one of our Production HP WS460C Blade Workstations, add a Sidecar with (6) Q3000M graphics processors in it. Now six different users can RGS into it and each get 80% of the max performance of the Blade with a single GPU. We are adding one layer of new software (in this case vSphere) and replicating and virtualizing a version of our Production Blade Workstation Build in a pass thru of multiples of the same graphics solution. The performance data is really consistent. Fidelity is Excellent.

• Our experience to date is that this works in a VM just like it did on the iron, somewhat slower for the extra software layer, but consistently within the range of our other current production Pro/e hardware.

Software pretending to be Hardware can be Computing Asset.

- A "Computing Asset" can be a Tablet, Thin Client, Laptop, Desktop, Workstation, Blade Workstation, and now "Virtual Machine with (Virtual) Hardware Accelerated Graphics" accessed by Anything!

- HP DL380Z Graphics Servers can provide multiple VMs with shared or pass thru graphics resources. Again, our RGS-ESXi VMs run just like our Production RGS-Blade Workstations, and I've had as many as (16) VMs doing OCUS 6 Creo 2 Benchmarks running simultaneously. This is still really experimental, and OCUS is pretty much the only benchmark we have been able to get to score on this new setup,

- Ideally, Engineering Applications are/will be designed to take advantage of Virtual Machines, and new versions will be Certified or Supported by the Application vendors
  - Software pretending to be hardware can "lie" to the software and get it to run even when there is no Certified or Supported version of the Software for that VM configuration
  - Technically, this is what we are doing with our RGS-ESXi VMs running Creo 2
    - So all this discussion of VMs running Creo 2 is still in Test, in our Unclassified Windows Production Environment. .

Our Experience is that, using RGS, we can inject either Citrix or Vmware between the hardware and the OS/Application/Driver stack, and do both pass thru and shared Remote Graphics, and generate OCUS 6 Creo 2 scores consistent with our Former, and reasonably close to our Current, Production Blade Workstation setup.

Machine	O/S	Graphics Hardware	Driver Version	Date Certified or Supported	Minimum Supported Datecode	Status
		NVIDIA Quadro FX2800M	192.14 RGS 5.4	27-Oct-2010		
ws460c G6	Windows XP 32 and 64-bit	NVIDIA Quadro FX3600M	191.97 RGS 5.3	12-Apr-2010	C000	Supported N+2

Desktop Virtualization Environment Support - HP

Server Hardware	Hypervisor	VDI Server Software Stack	VDI Software Stack OS	VM Client	Graphics Mode	Graphics Card	Driver Version	Date Certified or Supported	Minimum Supported Datecode	Status
DL380z	Citrix XenServer 6.2 SP1	Citrix XenDesktop 7.5	Windows Server 2008R2	Windows 7 64 bit	GPU Pass Through	NVIDIA Grid K2	332.76	07-Jul-2014	M110	Certified

Client Configuration

PTC has tested the above virtualized desktop environments with Windows 7 and Windows 8 desktops and laptops. Please consult your virtualization technology provider on the recommendations for the client hardware.

We'd really like to see more options here

HP Z820 Class 4
Engineering
Workstation
Hosted VM

- 2 Processors –
  - 2x E6-2650 v2 2.2GHz 6C
- Memory – 12 GB DDR 3
- Disk – Multiple SSD
- Graphics – 2x Quadro 4000
  - 1 Proc, 256 core, 2 GB DDR5 ea.
  - Driver – 347.52

- Host OS OS: Windows 7
- Hypervisor – Citrix XenServer 6.5
  - ESXi 6.0
- VM OS Windows 7R3
- RGS Version– 6.08 to 7

HP WS460c Gen8
Graphics Server Blade
Baremetal VM

- 2 Processors –
  - 2x E5-2680 2.7GHz 4C
- Memory – 16 GB DDR 3
- Disk – Multiple SSD
- Graphics – 6x Q3000M
  - Proc, 576 core, 2 GB DDR5 ea.
  - Driver – 347.52

- Hypervisor – Vmware vSphere 6.0
  - ESXi 6.0
- VM OS: Windows 7R3
- RGS Version – 6.08 to 7
  - Graphics Pass Thu

HP DL380z Gen8
Virtual Workstation
**Baremetal VM**

- Processors –
  - E5-2650v3 2.6GHz 6C
- Memory – 16 GB DDR 3
- Disk – Multiple SSD
- Graphics – 2x GRID K2
  - 2 Proc, 3072 core, 8 GB DDR5 ea.
  - Driver – 347.52
- Hypervisor – Vmware vSphere 6.0
  - ESXi 6.0
- OS: Windows 7R3
- RGS Version – 6.08 to 7
  - Virtual Graphics
    - K200   .25 GB
    - K220   0.5 GB
    - K240   1 GB
    - K260   2 GB
    - K280   4 GB
  - Graphics Pass Thu

**Three Different Hardware Configurations to Test
Each running as many as (6) VMs each**

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OCUS 6 PTC Creo 2 Benchmark Results (average of 10 runs)
Weighted Time in Seconds (lower is better)

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Single Processor Configurations are 10-30% Faster than the same CPU in a Multi-Processor Configuration
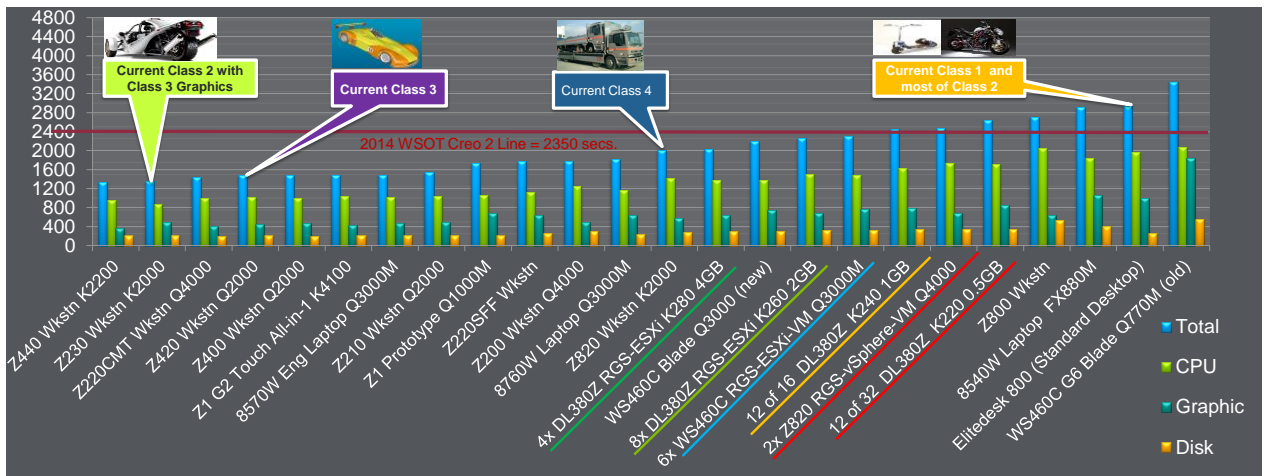
**The Fastest Computing Asset for Creo 2 is a purpose-built single processor workstation,
but some of the Virtual Machine Solutions produce reasonable performance levels…**

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Thankyou

Just a quick Shout Out to all those who helped make this presentation possible:

- Brian Chavez, my new boss, for putting up with long, historical answers to short questions, and for allowing me the time to prepare and present this.

- Jim Lentz for his incredible work in packaging these OCUS and other benchmarks, making them work with our Builds and thru our Security. He makes it possible for me to spend my days racing computers against each other.

- Kirk Evensen, my original co-presenter, who is otherwise committed or would be here, for devising our Engineering Virtual Machines and for putting up with my endless emails, texts and calls when we first tried to test them. Looks like he was right a lot more than I was, at least about Vmware and Citrix being different ways of talking to the same about the same thing after all.

- Ben Bailey and Chris Archuleta for the section on the Wildfire/Intralink to Creo/PDMLink, and for having my back here and always, for backing me up in Tucson. Every team member of a Telecommuter gets odd requests for help or information, and I appreciate it. I don't know a lot about the new software and processes, and it is good to have someone along who does.

- Kevin Carey and Cal Leuning of HP, and Craig Fullman of Nvidia, for making me look good, year after year, with "new hardware that giveth more than what the new software taketh away"

- And to my new Bride Martha, for putting up with me disappearing into my Lair for odd intervals at all times of the day and night "just to harvest some data and launch another set of runs".

Sneak Peaks for 2016
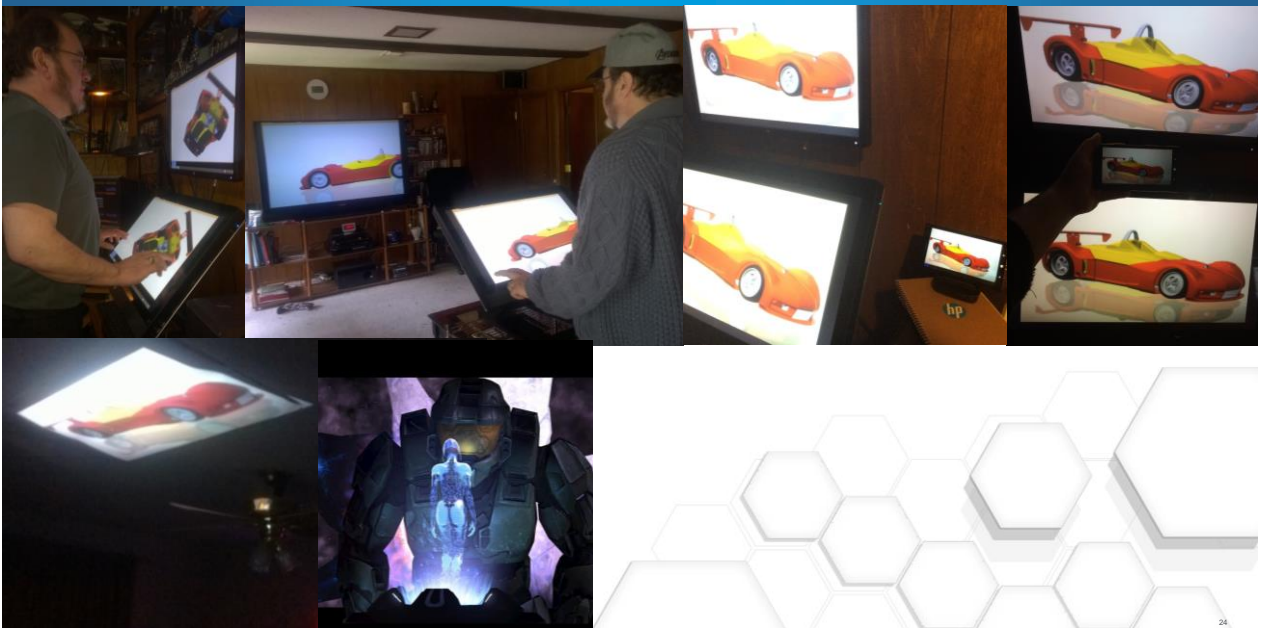
- Your feedback is valuable

- Don't miss out on the chance to provide your feedback

- Gain a chance to win an instant prize!

- Complete your session evaluation now

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