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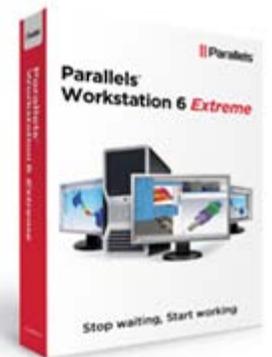
Workstation clusters combine power to save you time and money.

By Robert Green, *Cadalyst* Contributing Expert



You've probably faced the dilemma before: 3D CAD, analysis, and rendering applications demand lots of cores, RAM, and graphics power, but not all your users need all that power all the time. So, what do you do? Do you buy high-end workstations for everyone knowing that they'll sit idle part of the time? Do you let everyone struggle along with less power than they need to save money? It seems like the choice always comes down to power versus cost.

With workstation clustering, you may not have to make that choice anymore. By combining your HP Z Workstations with [Parallels Workstation Extreme software](#), you can turn your single user workstations into a flexible and powerful computing cluster that squeezes every bit of computing power out of each workstation. Think of it as your own private CAD cloud without the Internet.



Interested?

Clustering via Parallels Workstation Extreme

The concept behind Parallels Workstation Extreme (PWE) is deceptively simple: Create a cluster of machines that share computing resources with each other via a Virtual Machine (VM) architecture. Each machine in the cluster serves a user via the host operating system (Windows 7 64-bit¹), and also shares resources with the collective cluster via a guest VM account that is loaded by Windows 7 when the workstation boots up. Think of it as two workstations in one box — one that serves the host user, and another virtual workstation shared with the cluster.

To keep all the users in the cluster coordinated as computing jobs are routed around the cluster, Microsoft's High Performance Computing (HPC) Server 2008 and HPC Manager deploys along with the PWE software. Below is a graphical representation of

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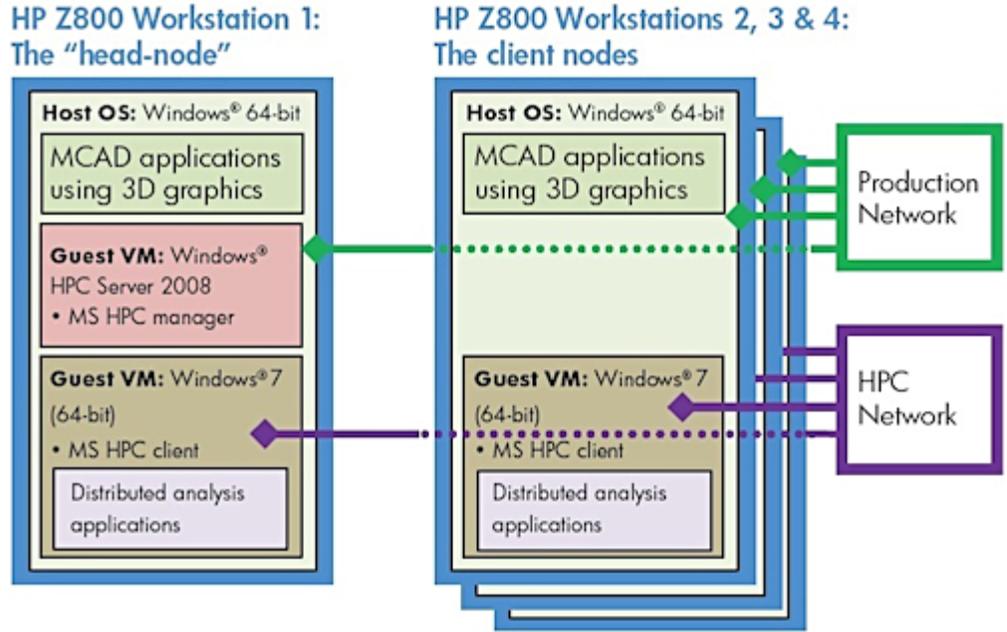
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an imaginary four-node workstation cluster with all the host, guest, and software components labeled for each workstation.

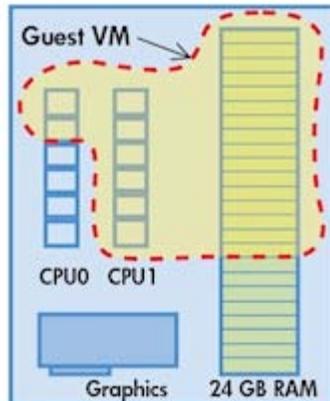


Note that one workstation in the cluster must serve as the "head node" which hosts Microsoft's HPC server and HPC manager that communicates with all the other workstations in the cluster (member workstations in the HPC network). While this setup does mean that some additional computing load is placed on the head node, the burden isn't high and can essentially be overlooked on well configured workstations with plenty of cores and RAM. The HPC network is simply the referee that allows the computing resources of all the cluster machines to be shared with one another to tackle high demand software applications.

One final note: cluster members are not only members of the HPC network, but members of your corporate network as well. We'll explore configuring the resulting network traffic below.

Host vs. Guest

For each workstation in the HPC network, the Parallels PWE software lets you choose how much of the workstation resources you want to allocate to the cluster, by creating a virtual machine (VM) that is constrained to use only a certain number of cores and RAM.



If we imagine a workstation with two 6 core Intel® Xeon® processors (12 cores total), 24 GB of RAM and a high-speed graphics accelerator that can be allocated to the host and guest, a scenario such as this (see left) could be constructed. In this case, a Windows 7 guest VM would be constructed to take advantage of 8 cores and 16 GB of RAM leaving 4 cores and 8 GB of RAM strictly for the host user sitting at the machine.^{1,2}

Only the host machine uses the graphics accelerator, so only it experiences full graphics acceleration speed as the cluster has no access to it.

For specialized GPU applications, certain software applications may require a dedicated graphic processing unit (GPU) in order to run. In these cases, you can place



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a second graphics card within a workstation and assign it to the virtual machine as you would cores or RAM. When this happens, the HPC manager allocates computing tasks to the virtual machines with GPU devices to perform not only core-based computing, but graphical computing tasks as well!

It's not Overkill

While the head node machine in our example might seem like overkill for a user who only needs four cores and 8 GB of RAM, it really isn't and here's why: Consider that you can easily upgrade the computing power of your entire cluster by dropping in a powerful workstation like this one and making its power available to all cluster users — all without touching the other cluster member's workstations at all!

In short, the cluster lets you throw cores and RAM at the problem whenever you'd like, by adding cores and RAM anywhere within the cluster rather than at each workstation. In our example scenario of four users in a cluster, the addition of another 6 core processor and RAM lets us deploy 8 cores and 16 GB of RAM to the entire cluster — the equivalent of two 8 GB quad core workstations.²

Offloading the LAN

We can further enhance the functionality of our cluster by using the head node HP Z800 Workstation's second network port to create a separate subnet to handle the processing load shared amongst only the clustered machines.

By allocating a dedicated subnet to the cluster, you'll speed the data transport between cluster nodes. This makes your CAD users more productive because they won't be competing for general network bandwidth. Also, because the heavy CAD data traffic inherent to cluster users is off the general network, other users will see a faster, less clogged network environment. This offloading scenario can be a real win-win scenario for all users for essentially zero incremental cost.



If you opt for higher speed network devices than the standard 1 Gigabit interface, you can expand the cluster with network storage devices such as Ethernet hard drives that can boost cluster storage capacity without having to upgrade the general office network servers. Again, more function with less impact on the general network, while speeding up CAD processes.

The more you kick around the possibilities of subnetting your CAD users into their own private cluster, the more it makes sense. Just make sure to have a hot rod workstation (such as the HP Z800 Workstation shown above) to anchor the cluster as the head node and a fully functional cluster will emerge.



Analysis software such as ANSYS Mechanical from ANSYS Corporation (shown running on an HP Z800) are the types of applications that can take advantage of clustered computational resources on your network.

Return on Investment

As always, management won't spend the money required to establish a computing cluster unless it makes financial sense. Interestingly enough, workstation clustering delivers great potential for return on investment because it can contain costs while it provides greater power for your CAD users. Consider the following possibilities:

Efficient sharing of computing resources around the cluster lets you purchase workstations for normal individual scenario use while the cluster shares resources as high-user demand necessitates. This load balancing effect means no computer cycles are ever wasted and no processor core sits idle on one user's desktop while another user endures slow performance. What is it worth to you to know that each user has the horsepower they need without having to pay extra for it?

Adding more workstations to the cluster is simple and everyone in the cluster can benefit immediately. What is it worth to have flexible, affordable scalability of your CAD computing resources to help when you land a big project or grow your company?

If a cluster has its own subnet, your company data center and network no longer must be sized to carry the huge data burden brought on by 3D analysis and rendering applications. What is it worth to conserve your corporate network bandwidth (thus speeding up non-CAD users) while giving your CAD users better speed within the computing cluster?

Wrapping Up

Is clustering worth it? The answer depends on your use patterns, project needs, and budget. Consider the following:

If you can afford to give every user in your workplace a workstation that will meet 100% of his or her computing needs for any job and your network servers could handle that entire load, then clustering is redundant. *Note that I've only seen a couple of companies in the last 20 years that are like this.*

If you are, however, like almost every company using 3D CAD tools, you can't equip all your users with ultimate workstations, but would love to share computing capacity so users get the processing they need, when they need it, at a reasonable cost. If you

fit this profile of CAD use, then clustering is a very viable methodology to get the best performance per dollar invested.

If you do extensive rendering or other applications that require short bursts of massive amounts of computing power, clustering makes great sense from a financial as well as timeframe point of view.

If your company is using, or will use, high end CAD, analysis, or rendering software, yet needs to control costs, workstation clustering using Parallels Workstation Extreme and HP Z Series Workstations is an option you should explore.

About the Author

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Robert provides CAD implementation, consulting, and programming services for a variety of companies throughout the United States and Canada. He holds a degree in mechanical engineering from the Georgia Institute of Technology and is the author of *Expert CAD Management: The Complete Guide*. Reach him via his web site at www.cad-manager.com.

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