Converged data centers:
Coming your way

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A converged data center takes familiar technologies, such as data storage devices (SANs), networking equipment and software for virtualization, management and automation, and combines them into a single solution.

The benefits of the converged data center flow from the centralized management of IT resources: the ability to take those technologies that had been housed in multiple closets within buildings and cities and bring them into a centralized facility. There, they can be managed with a single pane of glass, with one management tool handling multiple technologies. Other benefits include:

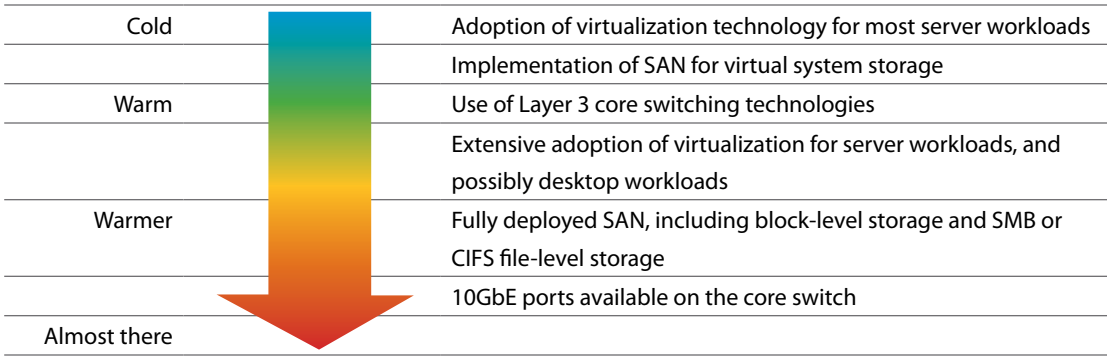
- Lower total cost of ownership (TCO)
- More agility and flexibility
- Increased resource utilization
- Less risk

What's happening now is the latest of several waves of change in the data center. This table summarizes the evolution:

First generation	• Massive, isolated systems • No server-server connectivity • Direct-attached storage (tape reels)
Second generation	• Limited networking between systems • Direct-attached storage (first hard drives)
Third generation	• Huge growth in adoption of network technologies • Some shared storage among servers
Fourth generation	• Network speeds increase • Introduction of network attached storage (NAS) and network file systems
Fifth generation	• Storage area network (SAN) adopted for block storage • NAS is used wide-scale
Sixth generation	• Server virtualization • Increase in SAN usage • Introduction of cloud resources

Most of us are somewhere in the fourth to sixth generation of technologies. In this progression, the latest stage gives a starring role to software. The generic description of the key software that controls virtual machines is hypervisor, which includes VMWare, Microsoft Hyper-V and Oracle Sun's VM VirtualBox, as well as Citrix's Zen products.

This exhibit gives a heat map of steps toward a converged data center, from the first steps to the highest level of involvement.



Major players in this space have developed management tools that allow companies to manage disparate pieces of technology as if they were one integrated bundle in the same data center. Automation is also part of the converged data center; this involves doing things on the fly, or predetermining how you're going to leverage these technologies through profiles and automated scripting and automated conditional what-if analysis within your data center. As things occur, they can happen automatically, based on predetermined decisions you have made ahead of time, without having to worry about what to do when something does go wrong.

For the first time in the converged data center, the SAN and the local area network (LAN) are using the same protocol on the same bandwidth, the same highway. This is a major shift, because—just two or three years ago—separated networks served your SAN storage and your LAN needs, because the speeds did not allow for them to operate on the same wire, nor did the protocols. They could not communicate on the same wire, so they had to be segregated.

The new technologies and the new speeds that exist enable companies to use that same wire, so the system becomes simplified, reducing the number of components within networks, while gaining a 10x increase in speed.

Considering all these factors, converged data centers bring everything into a single platform, including the networking, the storage or the host in a single management. Several factors make this happen, as technology moves from one generation to the next. For one, speeds and capacities are increasing; 10-gigabit Ethernet (10GbE) is prevalent and enables cost reductions. Some companies are experimenting with 40-gigabit and 100-gigabit. We're seeing much more in the areas of cost reduction, availability and stability that are allowing that to happen.

The maturing of virtualization technologies is a key factor. This again is a new fact. Two or three years ago, vendors would say, "We don't support that, not if you're virtualized. That can't be virtualized for us to work on whether Exchange or SQL or Oracle." Those days are over.

Now, everybody allows virtualization and supports those technologies. The maturation reflects the growth of hypervisors and the stability and reliability that they've brought into data centers.

Previous limitations in SAN disk speed technology, which prevented placement of high-demand, transactional-based applications, have been addressed through advances in SAN technology. Previously, you could place lots of disks in a cabinet, but users were still limited by the slower SAS and SATA disks. Now, solid-state disks are operating in effect of 100 times faster than SATA disks. Plus, caching technologies are in use, so memory is actually used, and (because of the cost and density) we can now put applications in memory, and it acts as disk.

Apple has introduced a new computer that actually has memory as a front-end disk in front of a slow disk. It seems like it's 10 times faster than the last Mac you had, even though the disks are slower than the one you had last year, and that's because of caching technology.

And there is another big piece in this: the collaboration of best-of-breed vendors to create these solutions. Players in this space are trying to get all of this into one rack, one cabinet, with the same brand on all of the products. Converged data centers really began to develop when vendors got together and said, "Look, we make good storage, and you make really good networking, and you make a really good hypervisor. Why don't we work together to make sure that your product and my product work as well together as if they were developed in-house, under the same platform?"

How fast is technology changing? In 1978, we had 29,000 transistors in a chip. Today, we have 2.3 billion. We've gone from 1 core to 8 core, with 16 core and 32 core in the pipeline, and then memory. So, 1 megabyte for addressable memory core has advanced to 1.5 terabyte. That's a significant improvement in terms of the processing.

The problem: while computing power has increased dramatically, software developers have not kept pace. If you run Windows 7 or 8 on the latest, greatest machine, it cannot take advantage of that power, and that's because developers are not able to stay abreast of that, and they lack incentives to enhance the abilities of their software. Programmers writing the underlying operating system know that better, faster hardware is out there, so they'll just use it, and as a result, they do not write their code as efficiently.

This is the point where virtualization comes into play. Virtualization lets you take advantage of that hardware power without having to isolate all these systems; in essence, this ensures your investment is being leveraged as well as possible.

Looking at the benefits of converged data centers

Lower TCO

The benefits of hypervisors include lower total cost of ownership (TCO). It's a bit of a red herring, if looked at in too short of a time frame. You may incur higher upfront costs, but will ultimately realize much lower operational and maintenance costs over the life of the investment. IT managers who are starting to virtualize know that they can get more bang for their buck by buying fewer boxes than in the past by putting a virtualization layer in between those they already have.

Less network complexity and cabling is also possible through converged data centers. IT departments used to have multiple switches for multiple systems, but now they are getting by with a single blade or a single chassis that can handle all that connectivity, without the need to stack multiple devices and multiple paths out of that

device for it. Administrative costs are falling, since IT departments have less equipment to manage. Thanks to more intuitive and advanced management tool sets, departments don't need specialists for SANs, servers and networks. One person can do more with less, because of those advanced tool sets.

Finally, converged data centers provide a lower power and cooling cost. That's critical, because the largest expense of data centers today is not the hardware, but the power—the money you spend to keep the center on and to keep it cooled. Reduce the power requirements, and savings result. Real estate costs also decline, as hardware takes up less space, depending on whether you use your own data center or a colocation of a shared facility, the cost savings can vary widely.

This is most telling with some of the custom rebate programs available from local utilities. One of our manufacturing clients was considering whether to replace 15 physical servers when we began working with them. We proposed a converged data center solution that reduced the number of physical boxes they needed from 20 to 5, resulting in a lower physical footprint, lower electrical costs and a $23,000 rebate from their utility company, as they would be reducing their electrical use during the most critical time of the day.

Greater business and IT flexibility

We see increases in flexibility played out daily. In the past, clients came to us with a new application that needed a server. McGladrey consultants would talk to the vendor and find out what the specs were, then contact the hardware distributor to spec it out, order it, have it shipped, deliver it, set it up and load the application. This process could take two to three weeks.

Thanks to converged data centers, we have the flexibility to spin that system up in an afternoon, if we have a virtual environment. We find out what the specs are, then we go into our virtualization center or our management tool set, tell it the specs and spin it up, and we have that system going in minutes, as opposed to days or weeks.

The thing people do not realize is that virtualization is not just relegated to servers. We have many clients that are actually virtualizing network routing and switching. Cisco, for example, has a line of switches called their Nexus switches, and they are the most advanced switches available. Internet service providers are using them at the core, while enterprise users are using them in their data centers, and now small and medium-size businesses are using them as well. They have what they call the Cisco Nexus 1000V Switch for VMware vSphere, and it is a virtual switch.

Loaded into Microsoft Hypervisor or VMWare, this software enables you to have the same management capabilities on your virtual network adapters that you had on your physical switches. As a result, you now have the same strengths and capabilities in a $1,000 software switch that you previously had to spend tens of thousands on to achieve.

Storage is something we used to have to buy disks for. We would buy a server, we'd throw disks in it and away we would go. If we needed to change that, it was very difficult. If we had to grow it, we might have had to move everything off of that system, rebuild that system to take advantage of the additional disks and move everything back over. Now, through virtualization of storage technology and SAN technology, we can dynamically assign another terabyte or two to that server and, at worst, maybe have to reboot it. So within minutes now, we have been able to allocate a couple of terabytes of space in there.

So when you get the software provider, Microsoft or VMW, they are working hand-in-hand with the hardware vendors to say, "Hey, we have this management tool set called VCenter or System Center for Virtual Systems."

Sometimes we ask vendors, "Can you get us a plug-in, since our application programming interface (API) exists, so we can manage your physical host and your physical adapters and your storage right inside of my management platform?" And the vendors say, "Yes, your people already know that. That makes it easier. We can do 80 percent of what you need to do inside that existing platform."

So what we see with these systems is they become more clusterable, more like nodes. In the days when we used to set up a SQL cluster, we would have SQL servers and if we needed more computing power, we would add another server into the cluster, and that allowed us to scale. The only way we were allowed to do that is that we planned ahead and knew we needed to set it up as a cluster to begin with. If we set it up as a single node, and suddenly we needed more computing power, we had to go back to the drawing board.

With this unified computing infrastructure and converged data center, that scalability is built from the ground up. When it is time to add computing resources, we add a blade. When we need to add storage, we add a shelf. When we need to add network performance, we can add an additional component that allows us to do that.

We've experienced the following many times. In the final stages of a new product launch or service line expansion, a departmental head will send a request to the IT department for a new server with "XYZ" for the specs. In the past, that would require us to find the server, order, assemble, load the operating system and other software, and, finally, present it to the group for their use. With the flexibility and scalability of the converged data center, we can now "clone" an existing server image and have that same server available in minutes, as opposed to days or weeks.

Greater performance and faster speeds

Considering that multiple 10-gigabit network connections exist now, it's hard to imagine that, only a year ago, it was very common for many businesses to use single or four one-gig connections to connect their storage back into the rest of their network.

And that was arduous. They had to do an EtherChannel, or they had to bond those together. Tolerance was tricky to get, with a lot of complexity. Now, in the same technology, you are getting multiple 10-gig connections, so you are getting 2 1/2 speeds out of one connection, and you can run everything over that pipe.

I can use quality of service to tell the network what's important on that pipe, to make sure that for the applications and resources that my users demand when it's the end of the month, and reports are being run and processes are taking place, those systems get the computing resources that they need.

As a result, we have more bandwidth for those functions, like fault tolerance and V Motion (the process of migrating a live virtual machine from one physical host to another).

So when we had a 1-gig Internet connection or a 1-gig Ethernet connection, it was unclear whether that was going to work, depending how big the system was. We have 10 gigs of bandwidth, or potentially 20 gigs of bandwidth, because out of a converged data center, that makes it very simple and it happens in seconds. Moreover, our risk is greatly limited, because the chances of that system not getting transferred over from host to host, when there's a problem, are minimized.

A professional services organization client of ours had implemented a solution to virtualize both their servers and desktops with another company. Once installed, the system was much slower than it had been before, and the client was ready to scrap it and revert to physical servers or desktops. We were able to reuse most of their

investment. By implementing a converged networking component, the client was not only able to salvage the project, but expand the number of virtual desktops by a factor of three!

Lower latency

The new technology connecting the storage and the physical host, and then the uplink to the rest of the network, has gone from this extremely advanced, complicated Layer 3 technology back down to Layer 2-like hubs. We all remember those 3-pound hubs we all had, or white ones that had the curve. That's kind of what it's done, and that is the reason we can go into this network device, and we can tell it port by port, "You are storage. You are a physical server with virtual servers on you. You are the network uplink."

There is no more intelligence the device needs than that, and from that it is able to route traffic to the appropriate resource with much less latency and much quicker, without any of the overhead on the upside of the switch. We also have the ability to segregate network traffic.

For those in regulated industries, the need to be able to separate traffic—whether it's from management traffic, user traffic or external traffic—becomes more and more important. You can do that in a virtual NIC. You can also audit and manage that much more simply because you have an interface; you have a tool set to do that.

Quality of Service (QoS) is becoming more and more important, because companies want to make sure that our core applications, our ERP, our financial accounting, whatever our core systems, have the resources dedicated to them so they work as expected, since 95 percent of our users are using those at all times.

Reduced risk

Not only do Microsoft, VMWare, Cisco, Dell and Hewlett-Packard validate their hardware compatibility, they also validate the software that rides on top of it. So, we can go to these vendors and say, "I need to roll out 500 virtual desktop users," and they will respond, "Here's the system you need, we have it running in multiple configurations in multiple locations. We validated it in our design, and we will stand behind it. So if that's what you purchased to run for your 500 virtual desktop users, and it gives you performance issues, we'll stand behind it and make it work because we know it works."

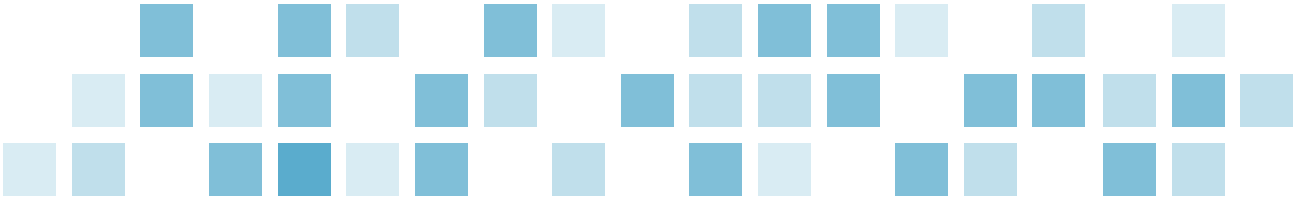
Also, companies have fewer devices to protect from power, flood and fire damage, resulting in easier disaster recovery options. Virtualization enabled that. Converging the data center enables that even further, by simplifying that network into fewer and fewer components. The center becomes easier to recover and replicate and also becomes more highly available. And fault tolerance is at the heart of it.

Nothing is built with a single point of failure within the system, and that's by design.

One of the neatest things I've seen is the ability to create profiles or persona, so if you have a blade system from Cisco, for example, with the UCS solution, and you're going to boot up from SAN or whatever it may be, you basically go in and say, "Slot C, this is your persona." So if you have a blade go bad, take that blade out, slap another one in, drag the persona on top of it and you boot and in two minutes you've replaced the hardware.

More control

It's not uncommon for me to go to a large bank and see these giant racks of networking equipment completely underpopulated, because the bank wanted to physically segregate applications. So, they will have a $40,000 switch with three devices. They've done that for segregation purposes only. What if we could do that virtually, and have the same $40,000 switch, but use every one of those ports? So now we're getting a thousand per port cost as opposed to a $13,000 per port cost.



Getting ready for the next generation cloud technologies

All the factors leading to converged data centers point to the next generation of cloud technology. This is the most important reason to consider as you migrate or evolve into a new converged data center.

Users can seamlessly use internal and external cloud resources, giving the business the option of mixing owned and infrastructure solutions simultaneously.

Converged data center equipment can be cost-effectively colocated in large data center facilities for highly available Internet service, fire suppression and power redundancy.

How would you like the ability to have a system where, if you need computing on demand, you could go tap Amazon Elastic Compute Cloud (EC2) or any of the big players in Web services when you need to scale up, based on user loads and demands? And when business picks up, scale up your IT resources, without having to order equipment and paying only for what you need? If you scale up, take advantage of the public cloud services. Because you're using a private cloud that looks identical (except it's in your data center), as the cloud out in the public data center, you can do that. If you're in a seasonal business that peaks during the Christmas season and then declines, you can scale up for the holidays, then scale down immediately. Your bills go away, and you don't have computing resources sitting on the shelf idle, not being used.

Making it happen through joint tenancy

Data center resources can be subdivided and provisioned into smaller "virtual data centers." Chargeback options allow for the resale or accounting and billing of data center resources, enabling companies to recover some of the cost of the center. The complete separation of access and control of shared resources is ideal for diverse business units or subsidiaries.

This multi-tenancy allows you to take that converged data center, whether it be networking, computing resources or storage, and carve part of it out virtually. It can then be served up to a subsidiary or a different department or maybe a partner that you're providing an application use for.

This is done in several ways. One is the chargeback feature. For example, VMWare has a tool, a software license you can buy called Chargeback Manager, and it allows you to say, "Hey, keep track of the computing resources, CPU cycle, memory, networking bandwidth of these servers, and then tell me how much were they, so I can go back to the department and say, 'You used 32 percent of our data center last month. You're paying for 32 percent of the cost that it took to run that.'"

From a storage perspective, NetApp has multi-tenancy technology in their SAN technology that allows me to carve off virtual SAN technologies and present them to those end users or to those departments, and it looks like it is their own SAN.

With this technology, the management of the storage is exactly the same, but it's actually virtual right inside the physical SAN. This works well for diverse business units and those organizations that have multiple agencies or multiple departments that work within them. This has really been designed to be able to scale down the smaller and medium-sized businesses, so you do not have to be in the Fortune 1000 to take advantage of it.

You can take advantage of this right here.

Converged data centers: You're closer than you think

Most migrations to a converged data center model are gradual and organic. The "forklift" migration method is quite rare. Two factors influence converged data center readiness:

- Continue to keep technology infrastructure up to date: do not become "technology-poor"
- Careful planning: make technology decisions with a clear focus in mind

An incremental migration to a converged data center model favors a best-of-breed solution in most cases. Are you a continuous technology shop, meaning do you stay on top of things, and you have regular updated replacement cycles of three to four years, or are you like the car owner who drives a car for 17 years, until the engine falls out before being replaced? Are you buying technology to meet the demands of a department or user or because something is falling apart?

So, incremental migration favors a best-of-breed solution, because you may have an investment in NetApp storage.

Now you can start to layer technology on top of that, without having to go all in, or one way or the other.

It may also favor a single-vendor solution, so if you've invested in HP storage, and you're starting to go down that route, it might start to make sense if your switches are the next thing that you need to replace. Maybe you look at the pro curve that can support the InfiniBand technology set, so you can start to layer those components on top of it, as well.

What next?

Any organization looking to expand, replace, consolidate or migrate data center components should, at a minimum, be considering the converged data center concept. Even better, management should seriously consider what it would take to implement a center, and what benefits they could expect in terms of productivity, performance, TCO impact, manageability, etc. This technology is a proven, reliable, scalable solution that will provide immediate returns, and also positions organizations to be better able to leverage private and public cloud technologies, as well.

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