Modern Data Protection

Top 5 reasons to virtualize Exchange

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Introduction

This white paper presents the top five reasons to virtualize Microsoft Exchange Server 2010 and 2013, and includes the issues you should consider when deciding whether to install Exchange on physical servers or virtual machines (VMs).

You will learn about the expectations you can have with a virtual Exchange environment and learn from my own experiences running a virtual environment for Exchange Server.

The general scope of this document is as follows:

- Small to medium businesses (up to 1,000 clients) that are thinking about virtualizing their environment.
- Environments in which Exchange is fully virtualized—I will not consider a partial virtualization of Exchange, such as virtualizing only CAS server roles.
- I assume that you run Exchange Server with the latest Service Pack or Cumulative Update applied.

Top five reasons to virtualize Microsoft Exchange

When I started this white paper, I talked to a lot of people. I asked them the question: "what are your top five reasons for virtualizing Exchange?" The most common answer always was: "it's easy to come up with one reason, but it is hard to come up with five."

The more I investigated, however, I was able to more clearly identify the top five reasons to virtualize Exchange:

- Effectively utilize hardware
- Dynamically adjust resources
- Implement Database Availability Groups (DAG) for small to medium enterprises (SME)
- Achieve quicker disaster recovery, backup and restore
- Take advantage of a flexibile test environment

Effectively utilize hardware

Today, many dedicated physical servers are not fully utilized in companies that run Exchange on dedicated physical servers. Memory or CPU on physical servers run on average at less than 10% of their utilization; thus the hardware

would be able to take much more load than is currently put on the servers. As hardware becomes more powerful and less costly, purchasing a standard server provides much more performance than is required for the service you want to run. For example, if you purchase a standard server with 32 GB of memory, you can easily host 2,000 mailboxes on it. Hosting only 200 mailboxes would mean that you are not fully leveraging the server hardware.

Under-utilized hardware consumes rack space, cooling and power, and it also incurs server maintenance costs after your three-year supplier warranty expires.

Virtualization allows you to better utilize your hardware. You can consolidate many services on a few physical servers and optimize based on the number of servers, NICs, storage and datacenters. You can even replace outdated servers with a smaller number of more powerful and up-to-date servers.

Virtualizing Exchange allows you to place it along with other virtualized applications on one server to save power, cooling and rack-space in your datacenter. This allows you to reduce the costs of hardware because you utilize the hardware more effectively by combining many VMs on a single physical server rather than spreading the applications over many servers. Reduced hardware also allows you to save costs in rack space, cooling and power. Many supporters of virtualization characterize these combined benefits as "green IT."

Your effort for server maintenance is also greatly reduced when you virtualize services on common hardware, because you will have fewer physical servers that receive common maintenance. This means that your administrators do not need to spend their costly time on hardware maintenance and can instead use it somewhere where it is more beneficial.

The reason for this is because you have only a single management requirement on your physical host servers—for one or a limited number of hardware vendors. Needless to say, you also can consolidate support and maintenance contracts when you are able to reduce the number of physical servers.

Instead of purchasing and setting up new hardware in your datacenter, you can use the existing virtual infrastructure, which has the capabilities for Exchange. Your virtualization administrators will also have enough experience to run a virtualized environment. These benefits allow you to lower the total cost of ownership (TCO) of your hardware as you use the very same hardware for multiple virtual services, and you use the hardware more effectively.

After virtualizing, you will see even more benefits; for example, a system boot or a system restart of a virtual Exchange Server is much faster than a restart on a physical machine. Virtual servers normally reboot within one minute, whereas physical servers generally take up to five minutes or more for a reboot.

In the case of a hardware failure, you can run your Exchange servers with the minimum amount of resources, which can be much less than in normal operations. Exchange administrators do not need to take care of hardware, but just define their requirements. And they do not need to consider any network cards, disks or server hardware.

Some best practices you should consider include:

- You need to make sure that Exchange admins trust that the hypervisor layer is mature enough and they understand the hypervisor's high-availability options in all virtualization-related areas, such as storage, network, memory and processors. Probably the #1 reason Exchange admins do not like to virtualize Exchange is that they are afraid they can't control the hypervisor and that it will be hard to determine the impact if the virtual hard disks are slow or not working as expected.
- Make sure your company already has a mature virtualization infrastructure in place—"mature" in the sense of process and procedures rather than technology. Combining the deployment of a virtualization infrastructure with an Exchange project at the same time is just asking for trouble. For example, don't deploy a DAG with umpteen database copies and then allow your virtualization admins to shuffle VMs around so that you end up with all your mailbox server VMs on the same virtualization host.

Dynamically allocate resources

Virtualization allows you to dynamically allocate resources such as memory or CPUs to your VMs. You can see the benefit of dynamically allocating resources to your services so they "grow with your business." You can increase or decrease resources such as memory or CPUs on your VMs on demand. When your company's requirements for messaging change, you can adjust the CPUs or memory so the virtual Exchange servers can handle the load.

To allocate resources when running physical Exchange servers, you normally add resources by adding storage or memory to your server, or you purchase another physical server. In addition to having to go through a lengthy procurement process to purchase and install the hardware, you also have to create database copies and move mailboxes between databases. When you are adding up to a hundred mailboxes to your existing Exchange environment, then dynamically adjusting resources for your virtual Exchange server does the job very well, without much effort for the administrator and without much additional cost.

Also, when you run into a massive hardware failure, you can run your Exchange servers with the minimal amount of resources—and that can be much less than in normal operations. The negative impact will be reduced performance, but at least the service will be running and users will be able to send and receive messages.

Additionally, by dynamically assigning resources to your Exchange system, you receive cost savings as you "don't overbuy" anymore! If you plan for physical Exchange servers, you need to make sure that your servers are sized in a way that considers peak periods and future company growth. Using virtualization, you can base resource allocation on your current needs and then dynamically allocate resources when your company's messaging users require it.

Some best practices you should consider include:

- Dynamically allocate and rebalance resources as needed—before purchasing additional hardware resources such as memory or CPU.
- Regularly monitor the performance of your Exchange servers to proactively prevent performance bottlenecks caused by other VMs running on the same host.
- Consider scaling out your virtual infrastructure with additional physical servers if your Exchange servers are consuming a large amount of your host resources.
- Take care when virtualizing Exchange's systems that support a large user base. Systems with more than 5,000 users might not be suitable candidates for virtualization, and systems with 3,000-5,000 users should be monitored closely to be sure they perform well when virtualized.

Implement Database Availability Groups for small to medium enterprises (SME)

Many SMEs run all Exchange roles on a single physical machine because using a DAG requires another machine and thus would be more expansive because of the extra hardware and licenses required.

Using virtualization allows even SMEs to create a DAG and replicate their databases to multiple disks. This of course increases availability in the event of system outages and also allows you to patch your Exchange system without affecting users. Exchange server 2010 or 2013 running on Windows Server 2012 allows you to use the Standard Edition of Windows, thus providing DAG functionality without extra Windows license fees.

With a DAG, you can have database copies on another Exchange server. The minimum requirement for a DAG is two Exchange servers, but you can add as

many as 16 Exchange servers to a DAG. However, from the financial perspective in SMEs, you may want to consider two Exchange servers to gain full high-availability features for the lowest cost.

You can take advantage of using a DAG instead of implementing hypervisor-based high availability (HA) such as vMotion or Live Migration. The benefit is that a DAG is application aware, whereas hypervisor-based HA is not. A DAG also does not require shared storage, such as a storage area network (SAN), and thus can save money and provide sufficient HA for your users.

Virtualization should also be considered if a company wants to use physical servers for its main datacenter and plans to have a second disaster recovery datacenter. The benefit of virtualizing Exchange at the disaster recovery site is being able to run a multi-site DAG without deploying a lot of hardware in the disaster recovery location.

Some best practices you should consider include:

- Implement a virtual infrastructure with at least two host machines, and make sure the Exchange VMs do not run on the same physical host at the same time.
- Deploy at least two multi-role Exchange servers (including all Exchange roles) as VMs and use them for the DAG.
- Multi-role servers do not allow Windows Network Load Balancing (NLB) to be used. Thus you either need to consider a physical network load balancer, a virtual network load balancer or a DNS approach such as round-robin. Using a single DNS record for your CAS server that points to one server is an inexpensive solution—especially for SMEs—and during an outage you can manually change the DNS record to point to the second Exchange server. This is the least expensive way to implement failover. If you want to consider a network load balancer, this provides real load balancing but has the disadvantage of requiring an additional piece of software or hardware.
- When you want to implement a DAG, don't forget to consider other components, such as storage devices and network interfaces, with regard to HA. Make sure these components are highly available on your host system, so an outage does not take all the VMs down.

Achieve quicker disaster recovery, backup and restore

Virtualization provides several benefits in the area of backup and restore, allowing you to more quickly back up your server and also quickly recover messages, databases and even complete servers.

Remember, VMs are just files on a disk. To successfully back up Exchange Server, you need to use an application-aware backup solution such as Windows Backup. Windows Backup uses Volume Shadow Copy Service (VSS) in Windows to ensure your Exchange databases are shut down cleanly and in a ready state for backup. Otherwise you might not be able to mount the database and data would be lost.

It is important to note that you should be careful using cloning or snapshot features provided by your hypervisor, as they may not be application aware and are thus not supported by Microsoft. You need a backup solution that is Exchange aware and capable of VSS to back up and restore Exchange Server databases.

A restore from a VM is much quicker than from a physical machine because you can restore the backup directly on the same or another host system. It takes more time to restore a physical machine because you not only need to set up the physical machine from scratch but also recover the data—and this takes many hours if the data is stored on tape drives—or present the recovered databases to the physical machines using quite expensive SAN software.

Using virtualization for failover also provides the benefit of quickly switching between physical host machines using functionality such as Live Migration or vMotion provided by your hypervisor. In the previous section I noted that DAG should be the primary means for HA, but combining it with hypervisor HA might add an additional level of protection. Of course this will add costs for your implementation as you might need additional licenses for the hypervisor HA option. Failover can be done on the hypervisor level and does not impact the messaging service at all. Exchange Server 2010 and 2013 supports Live Migration and vMotion as long as you do not interrupt the service running in the VM.

You can benefit from both Exchange's failover cpabilities, such as DAG, and the hypervisor's failover capabilities at the same time. This allows you to combine both capabilities for more powerful failover functionality for your messaging service.

Running multiple virtualized applications on a host machine also provides the benefit that you can back up one physical machine and include all VMs, and this is much simpler than installing backup agents on multiple physical machines and then storing all the backups somewhere, perhaps over the network.

Some best practices you should consider include:

- Plan your backup and restore carefully. You should consider which restore options you would like to have—server, database or even item-level restore that allows you to restore single email messages.
- Use a backup solution that is Exchange aware and suits your needs.
- Select a backup solution that is optimized for virtualized environments and is capable of backing up on an image level and also provides functionality to restore on a database or item level.
- Minimize the use of physical backup agents, which are additional software that must be installed on each host machine. The issue in a virtualized environment is that you may be backing up the data twice—one time on the backup agent level and another time on the image level. Of course, if your IT infrastructure or policy requires physical backup, you will need to fully support it.

Take advantage of flexibility in your test environment

Another reason to virtualize that applies to organizations of all sizes, including large enterprises, is to virtualize test environments. A virtualized test environment provides flexibility that allows you to add or remove servers very quickly and also to change the complete environment.

With virtualization, you can easily clone the production environment into the test environment so you can get the real domain controllers (DC) and Exchange servers in the test environment, and this makes any testing much more realistic. You can create a complete, isolated Exchange environment, and then you can start it up and use it as your test environment. Remember, a virtual environment consists only of files, so you can quickly and easily grab them and use them on another host machine.

So virtualization means portability. You can run several different Exchange environments in parallel, even on the same servers—and this is not possible when you run your test lab on physical servers. Also, you can quickly test your production Exchange without the impact of hardware or hardware drivers as you run multiple environments side-by-side.

Finally, a virtualized test environment that matches your production Exchange environment allows you to test patches and upgrades much faster than in physical environments.

Some best practices you should consider include:

- Use a backup solution that is capable of restoring a backup in an isolated environment, which you can quickly use as a test environment.
- Automatically provision VMs based on templates so they are set up and configured automatically. This also allows you to quickly deploy additional VMs for testing.

Summary

There are a lot of benefits to virtualizing your Exchange server, especially when you consider flexibility and scalability features.

However, the key to successfully running a virtual Exchange environment is to understand that running your VMs at their limits requires the additional effort of regularly tweaking and tuning them. You just do not have the same safety net as you would have in a physical implementation.

Appendices

Personal tips and tricks for virtualizing Exchange

I'm running quite a complex test environment, which includes multiple domains, multiple sites and all Exchange server roles in all the variations you can think of. Currently I can run up to 12 VMs on my Windows Server 2008 R2 with a low-budget Intel quad-core processor, 16 GB of memory, one Samsung SSD 830 drive (256 GB) and another hard disk drive. To keep it up and running, I spent quite some time investigating how to optimize performance and meet requirements. Here's what I have learned about running a virtual test environment:

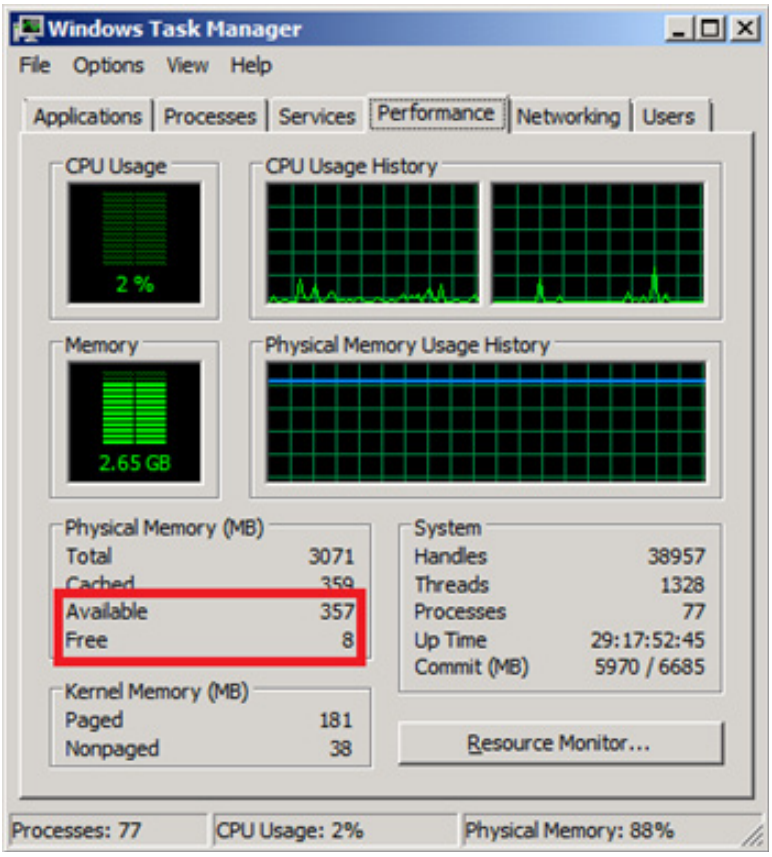
- **Run the Microsoft Exchange Server Jetstress 2013 tool to verify performance.**
  You can follow any design guides or best practices when planning for the performance requirements of your Exchange servers. The single tool I found most useful for verifying that my plan will work as expected is the Jetstress 2013 tool. This tool allows you to verify that memory, CPU and disk subsystems actually can handle the load that you are planning. In my experience the main bottleneck is usually the disk subsystem; with Jetstress, you can identify it upfront, before you place too many mailboxes in the databases.

- **Regularly check your VM resources and adjust them if needed.**
  Depending on your environment, I recommend that you regularly check your VMs running Exchange server to adjust their resource allocations. CPU and memory utilization change over time; thus if resources are scarce, your VMs will get slower the longer they run.

- **Solid State Drives (SSDs) will speed up your test environment by as much as 1000%.**
  The first time I built my test environment, I used normal hard disk drives with spindles. The result was OK but the more VMs I ran simultaneously, the slower they ran. So I decided to move to SSDs and I was pleasantly surprised about the change. The OS boots in a matter of seconds, not minutes, and my six VMs start in minutes. Working in the VMs also became much faster than before. The opening time needed for OWA or the Exchange Management Shell is similar to, if not quicker than the high-end servers I've installed for various customers. Of course, for this you need to install your Server OS on the SSD as well as the virtual disks for your VMs.
  Still, SSDs are not as safe as physical hard disks, so I follow these rules to make sure I do not lose my Exchange data if the SSD crashes:

- Use them only in test environments, not in your production environment.
- Don't purchase the cheapest SSD. Remember, SSDs can cause data failures very quickly when you run them 24x7. In my personal environment, I have used the Samsung SSD 830 for more than 18 months now, and I am very pleased as no errors have been found on the disk yet. Also, don't forget to check your SSDs regularly to prevent the total loss of your data in the event of a failure.
- For additional security, I created a database copy of my Exchange databases on a VHD that is located on a physical hard disk drive. Even if I lose the databases on the SSD, I still have a copy available on the physical disk.
- Don't run the SSD at its limit. Make sure that you always have approximately 15-25% of free disk space on your SSD, because filling it with data will have a negative impact on performance.

- **Use the Windows Task Manager to optimize memory usage for your test environment.**
  The Windows Task Manager is a crucial tool for planning CPU utilization and memory availability. On the host machine, it is important to reserve sufficient resources so the OS does not start to page out too much memory. Always reserve 1 GB of memory for your Windows Server 2008 R2 in addition to what you allocate to your VMs. Windows Server 2012 requires more memory—I normally start with 2 GB and figure out what is really required, depending on the roles and features installed. Within the VMs, it is critical to consider the amount of Available and Free memory (shown in the Physical Memory panel under the Performance tab of Windows Task Manager). Make sure that the amount of Free physical memory is not permanently zero and the Available physical memory can satisfy peak performance requirements. In my experience, you can go well below Microsoft's memory requirements—but remember you should do this only on your test system, not on production systems. The figure below shows a multi-role Exchange server—you can see that you can free up some additional memory if required.



Additional information

- Windows Server Virtualization Validation Program
  http://www.windowsservercatalog.com/svvp.aspx?svvppage=svvp.htm
- Understanding Exchange 2010 Virtualization
  http://technet.microsoft.com/en-us/library/jj126252(v=exchg.141).aspx
- Exchange 2013 Virtualization
  http://technet.microsoft.com/en-us/library/jj619301(v=exchg.150).aspx
- Best Practices for Virtualizing Exchange Server 2010 with Windows Server 2008 R2 Hyper-V
  http://www.microsoft.com/en-us/download/details.aspx?id=2428
- Microsoft Exchange 2010 on VMware - Availability and Recovery Options
  http://www.vmware.com/files/pdf/exchange-2010-on-vmware-availability-and-recovery-options.pdf
- Using VMware HA, DRS and vMotion with Exchange 2010 DAGs
  http://www.vmware.com/files/pdf/solutions/VMware-Using-HA-DRS-vMotion-with-Exchange-2010-DAGs.pdf
- Microsoft Exchange Server Jetstress 2013 Tool
  http://www.microsoft.com/en-us/download/details.aspx?id=36849

About the Author

Siegfried Jagott is a Principal Consultant for the Communication and Collaboration team at XIOPIA, Germany. His team plans and implements Microsoft Exchange and Lync for global customers.

He is an award-winning author of Microsoft Exchange Server 2010 Best Practices (Microsoft Press), and his latest book (available November 2013) is Microsoft Server Exchange Best Practices. He has authored as well as technically reviewed several Microsoft Official Curriculum (MOC) courses on various topics such as MOC 10165: Updating Your Skills from Microsoft Exchange Server 2003 or Exchange Server 2007 to Exchange Server 2010 SP1 and all Exchange 2013 courses. He has coauthored various other Windows, SCVMM and Exchange books and is a frequent presenter on these topics at international conferences, such as the Microsoft Exchange Conference 2012 in Orlando, TechEd 2013 in New Orleans, and IT & Dev Connections Spring 2012 in Las Vegas.

Siegfried has planned, designed and implemented some of the world's largest Windows and Exchange Server infrastructures for international customers. He received an MBA from Open University in England and has been a Microsoft Certified Systems Engineer (MCSE) since 1997.

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