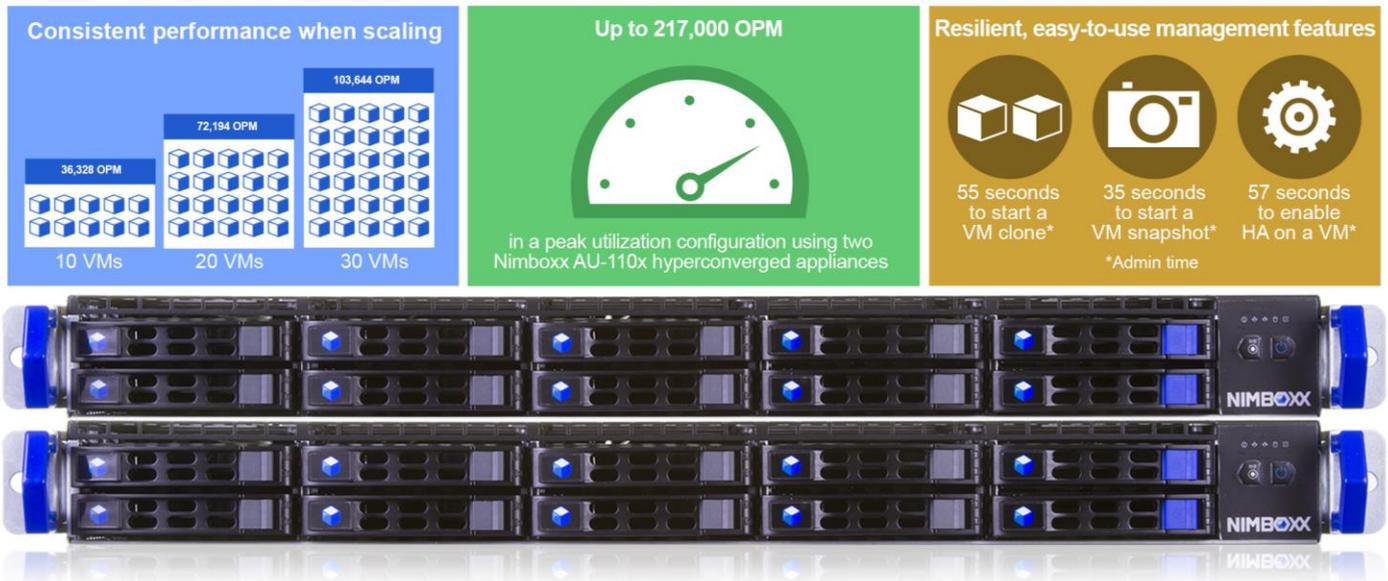


NIMBOXX HCI AU-110X: A SCALABLE, EASY-TO-USE SOLUTION FOR HYPERCONVERGED INFRASTRUCTURE

Great performance, scalability and ease-of-use with the Nimboxx AU-110x hyperconverged infrastructure solution



How much will your business grow over the next couple of years? Reaching this goal from where your business is now requires a space-efficient data center that can scale to meet your application performance demands as your services and user base grow. A hyperconverged appliance can unite the necessary compute, I/O, storage, networking, and virtualization resources to become an integral part of the scalable data center. In addition to delivering reliable performance and scalability, your hyperconverged appliance should be easy to manage.

Enter the Nimboxx AU-110x hyperconverged infrastructure (HCI) appliance: a 1U, easy-to-use solution. In the Principled Technologies data center, two AU-110x nodes demonstrated peak performance of up to 217,676 orders per minute (OPM) and up to 112,188 OPM from a single node. When running a real-world representative application workload, the two AU-110x nodes delivered scalable and consistent database performance from 10, 20, and 30 virtual machines (VMs). In addition, the AU-110x appliances easily completed three usability tasks regarding data protection.

Running its proprietary MeshOS™ software, the Nimboxx AU-110x HCI appliance can bring a solid HCI platform into your data center to help your business realize its growth potential.



THE POWER OF HYPERCONVERGENCE WITH THE NIMBOXX AU-110X

Hyperconvergence is a type of architecture that combines a software UI with a dense hardware solution integrating compute, fast I/O, high storage capacity, networking, and virtualization resources into a unified platform. Although the benefits of hyperconvergence have traditionally applied to enterprises, products such as the Nimboxx HCI AU-110x can deliver the same benefits to small- and medium-sized organizations.

The Nimboxx HCI AU-110x packs 16 cores (32 vCores), 256 GB of memory, 9.6 TB of storage, and both 1GbE and 10GbE network ports into an appliance that takes up only 1U of rack space. It runs the MeshOS operating system, a KVM-based hypervisor that provides built-in virtualization and management capabilities through a simple UI (see Figure 1).

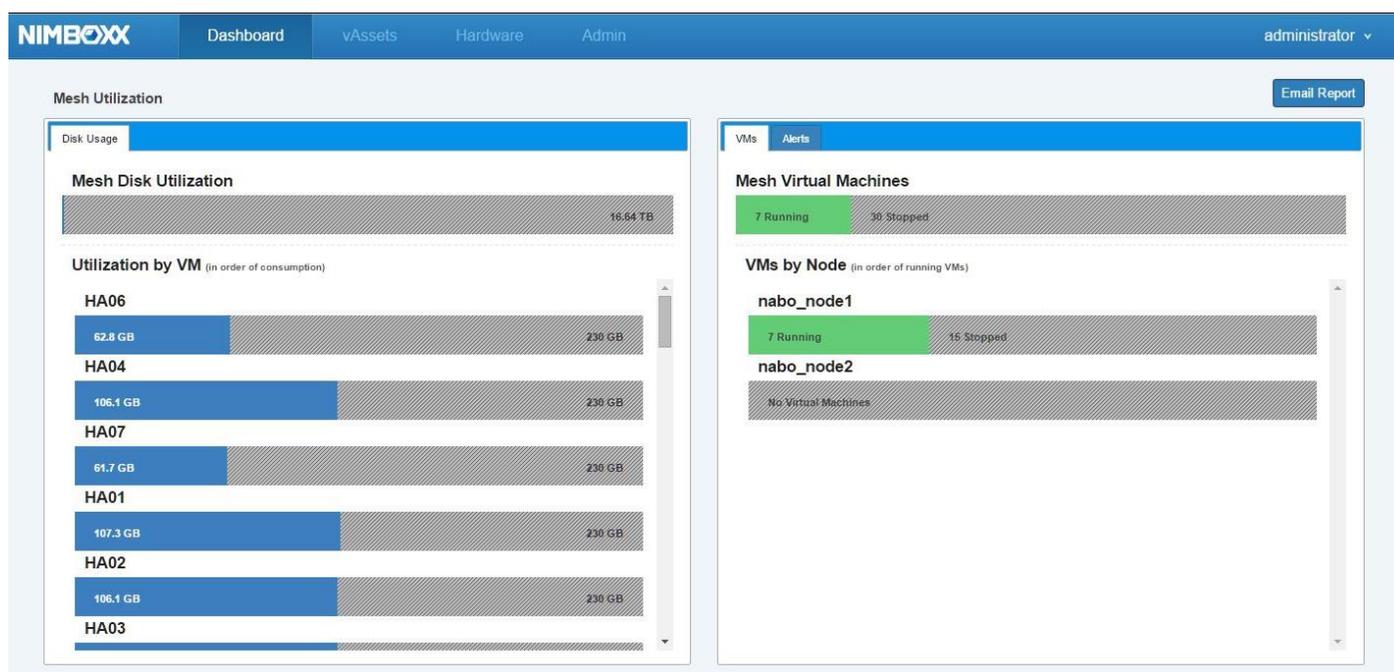


Figure 1: The user-friendly MeshOS UI showing utilization information for our VMs and Nimboxx AU-110x HCI appliances.

We tested two Nimboxx HCI AU-110x units with a DVD Store 2 (DS2) workload to gauge how well the appliance handles online transaction processing (OLTP) and how the solution scales with higher workloads. For more information on the Nimboxx HCI AU-110x and DS2, see [Appendix A](#). For configuration information of our AU-110x appliances, see [Appendix B](#). For detailed steps on how we tested, see [Appendix C](#).

WHAT WE FOUND

Scalable performance

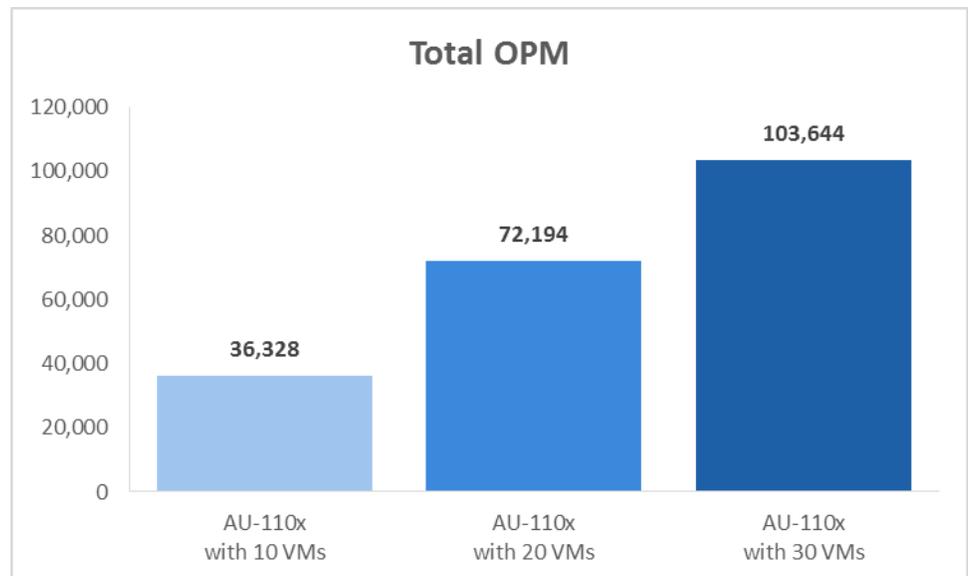
When shopping around for new hardware, it is a good practice to think beyond the immediate needs of your business. What will your users need six months from now? A year? Two? Your business needs scalability to meet your users' demands for the future.

Our first test ran an increasing number of VMs, each simulating 500 heavy database users, all running on two Nimboxx HCI AU-110x appliances. We used a 500ms think-time in our tests to simulate each of the 500 simultaneous users completing six or seven operations per minute.

To start, we ran this heavy, 500-user OLTP workload on 10 virtual machines. We then increased the workload by doubling the VM count to 20. For our final run, we increased the load yet again by ramping up to 30 VMs.

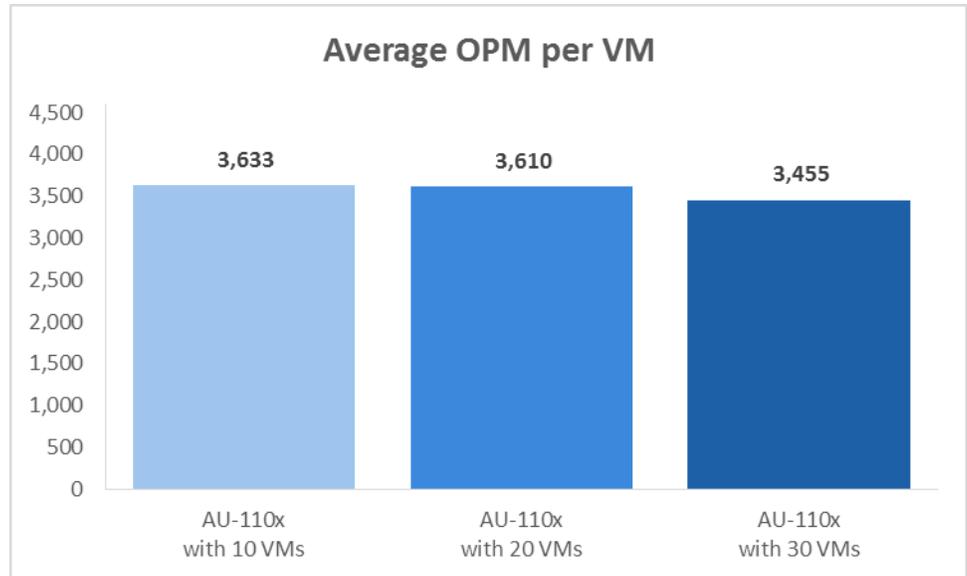
With each increment, the total operations per minute the servers handled grew proportionally with the number of VMs (see Figure 2). This shows that in our tests, application performance on the Nimboxx AU-110x solution scaled evenly, without VMs experiencing significant degradation in the number of OPM they needed to deliver to keep up with the workload demands.

Figure 2: When running an OLTP workload, the Nimboxx HCI AU-110x servers offered performance that scaled up with the number of virtual machines.



Throughout the tests, each configuration delivered consistent performance, handling on average at least 3,400 OPM (see Figure 3). As your business adds VMs to a Nimboxx HCI AU-110x server, you can expect application scalability.

Figure 3: Despite the additional VMs and subsequent server load, the Nimboxx HCI AU-110x fulfilled a consistent number of requests.



Peak utilization performance

In our second test, we measured performance simulating peak utilization of our configuration with 30 VMs, each running a maximum performance workload. As Figure 4 shows, the two Nimboxx AU-110x units delivered up to 217,676 OPM. Each VM in this configuration delivered consistent database performance, with a 30-VM average of 7,255 OPM during the test.

| | Node 1 | Node 2 |
|--------------------|----------------|----------------|
| VM 1 | 5,718 | 6,974 |
| VM 2 | 7,983 | 7,485 |
| VM 3 | 8,471 | 7,760 |
| VM 4 | 7,586 | 7,221 |
| VM 5 | 7,937 | 7,243 |
| VM 6 | 7,844 | 7,488 |
| VM 7 | 7,969 | 7,269 |
| VM 8 | 7,964 | 7,124 |
| VM 9 | 7,881 | 6,483 |
| VM 10 | 7,819 | 7,136 |
| VM 11 | 6,567 | 6,963 |
| VM 12 | 8,076 | 7,412 |
| VM 13 | 7,416 | 6,240 |
| VM 14 | 6,517 | 6,709 |
| VM 15 | 6,440 | 5,981 |
| Total OPM | 112,188 | 105,488 |
| Average OPM | 7,479 | 7,032 |

Figure 4: Database performance in OPM per VM was consistent for both nodes in our peak-utilization testing.

Ease-of-use

Your business can benefit from a hyperconverged infrastructure that provides ample, scalable performance, and it can benefit from easy-to-manage solutions that minimize IT admin time requirements. Simple appliance management can mean:

- **Keeping a smaller IT staff**—Hiring full-time IT staff to maintain appliances can be unsustainable for small- and medium-sized businesses
- **Keeping costs low**—Financial savings can come from not paying for specialized hardware training and from limiting necessary IT time and labor
- **Making time for more important data center tasks**—Your IT admin will have time to address more pressing demands
- **Reducing the chance for human error**—The fewer the steps, the less opportunity IT admins have to make mistakes

Fortunately, in addition to providing great performance, the Nimboxx AU-110x also offers quick and easy VM management.

We performed hands-on testing to see just how easy it is for an administrator to clone a VM, take a snapshot of a VM, and enable high availability (HA) mode on a VM. Our tests included the time and steps it would take an IT administrator to initiate these tasks, and excludes any unmanaged time for the node to complete each task. For detailed steps of the use cases, see [Appendix C](#). Figure 5 shows the administrator times and steps for each of our usability scenarios.

| | Administrator time (seconds) | Steps |
|-------------------------------|---------------------------------|-------|
| Cloning a VM | 00:55 | 6 |
| Performing a snapshot of a VM | 00:35 | 5 |
| Enabling HA on a VM | 00:57 | 7 |

Figure 5: An overview of time and steps that our two Nimboxx AU-110x appliances needed to perform our usability scenarios.

Cloning VMs

The advantage of virtualization relies heavily on the ability to deploy quickly. Your IT admin can clone an existing VM in less time than it takes to install operating systems and applications on a new VM. Cloning a VM on your Nimboxx HCI AU-110x means replicating all of your vital workload configurations simply. It took only 55 seconds of administrator time and six steps to start cloning a VM with the Nimboxx HCI AU-110x.

Performing a snapshot of a VM

To prevent data loss, it pays to be prepared by taking regular snapshots of your virtual machines. Snapshots allow you to revert your VM to a safe state in case something goes wrong. Creating snapshots of a VM on the Nimboxx HCI AU-110x was simple and straightforward—it took only 35 seconds of administrator time and five steps to start creating a snapshot of a VM.

Enabling HA on a VM

To minimize any potential downtime of critical VMs in your environment, the Nimboxx HCI AU-110x offers the option to enable HA on your VMs when there are at least two appliances in your solution. Enabling HA on a single VM took only 57 seconds of administrator time and seven steps to initiate.

CONCLUSION

Hyperconvergence is a fresh way of looking at your data center. For small- and medium-sized businesses especially, it could be well worth your time to invest in a hyperconverged infrastructure. The MeshOS-operated Nimboxx HCI AU-110x offered scalability and great performance in our hands-on tests and was simple and straightforward to use, which could help your business meet user demands and potentially save money by avoiding things such as hiring expensive IT staff to maintain your data center.

APPENDIX A – ABOUT THE COMPONENTS

About the Nimboxx AU-110x HCI appliance

Hyperconverged infrastructure appliances, such as the Nimboxx HCI AU-110x, are designed to provide simpler virtual environment setup and management relative to the potentially more complex converged or disparate legacy hardware. HCI appliances were designed with scalability in mind. With a hyperconverged environment, you can start as small as you need—for example, a single AU-110x 1U appliance or two AU-110x appliances for high availability—and the more appliances you add, the greater your performance and capacity can become. For more details about the Nimboxx AU-110x HCI appliance, see www.nimboxx.com/products/au110x/.

About our test tool, DVD Store Version 2.1

To create our real-world eCommerce workload, we used the DVD Store Version 2.1 benchmarking tool. DS2 models an online DVD store, where customers log in, search for movies, and make purchases. DS2 reports these actions in orders per minute that the system could handle, to show what kind of performance you could expect for your customers. The DS2 workload also performs other actions, such as adding new customers, to exercise the wide range of database functions you would need to run your eCommerce environment. For more details about the DS2 tool, see www.delltechcenter.com/page/DVD+Store.

APPENDIX B – SYSTEM CONFIGURATION INFORMATION

Figure 6 provides detailed configuration information for the test systems.

| System | Nimboxx AU-110x |
|-------------------------------------|-------------------------|
| General | |
| Number of cores | 16 |
| Number of hardware threads per core | 2 |
| Rack units | 1U |
| Memory module(s) | |
| Total RAM in system (GB) | 256 |
| Operating system | |
| Name | MeshOS |
| System version release version | 1.3.2 |
| Build number | 91 |
| Solid-state drives | |
| Vendor and model number | PNY SSD9SC240GLC-PVE |
| Number of drives | 2 |
| Size (GB) | 240 |
| Type | SATA |
| Speed (Gbps) | 6.0 |
| Hard drives | |
| Vendor and model number | Seagate® ST1200MM0017 |
| Number of drives | 8 |
| Size (TB) | 1.2 |
| Type | 10k SAS |
| Speed (Gbps) | 6.0 |
| Ethernet adapters | |
| Type | 2 × 10 GbE 4 × 1 GbE |

Figure 6: System configuration information for the test systems.

APPENDIX C – HOW WE TESTED

Setting up the virtual environment

Node installation and configuration

1. Mount the servers in a rack.
2. Connect power to both nodes, but do not power on the servers.
3. Connect the primary port on the first node to your existing network.
4. Connect the setup port on the first node directly to a laptop using a crossover cable.
5. Configure the network connection on the laptop to the following:
 - IP Address : 169.254.1.1
 - Subnet mask : 255.255.0.0
 - Gateway : 169.254.9.9
6. Power on the first node.
7. After 10 minutes, browse to <http://169.254.9.9> on the laptop.
8. In the configuration wizard, select New.
 - Select Expand if this is the second node.
9. Configure options appropriate to access your existing network.
10. Configure a mesh and node name.
11. If this is the first node, configure the administrator account.
12. If this is the second node:
13. Open a separate web session to the first node.
14. Log in to the Nimboxx web interface.
15. Click on Hardware at the top of the page.
16. Click on New Node.
17. Copy the Passcode into the Security Configuration screen along with the first node's IP.
18. Continue to register the server with Nimboxx.
19. Once setup is complete, the login will appear.
20. Navigate to the server IP configured earlier using your existing network to verify connectivity.
21. Disconnect the crossover cable from the setup port, and connect it to a separate testing network.
22. Repeat steps 3-15 on the secondary node.

Testing network setup

1. Log in to the Nimboxx web interface.
2. Click Hardware at the top of the page.
3. Click on Networking under the Hardware tab.
4. Click on the first node to expand its options, and click on Disable Onboarding Interface.
5. Click on the second node, and click on Disable Onboarding Interface.

Creating the first VM

1. Log in to the Nimboxx web interface.
2. Click vAssets at the top of the page.
3. Click on vMedia under vAssets.
4. Click on Upload.

5. Click on Choose File, select the OS installation ISO, and click Upload.
6. Once the upload is complete, click on vMachines.
7. Click on Create.
8. Enter a name for the VM.
9. Select the first node to host the VM.
10. Select Port 1 for Network (vNIC).
11. Select Microsoft® Windows® for the OS type.
12. Select the ISO you uploaded for Install Media.
13. Enter the number of vCores, RAM size, and Disk size.
14. Click Create.

Configuring the VMS

Configuring the SQL Server® VM

Modify the SQL VM to contain the following settings:

- Memory: 16GB
- Virtual Processors: 2
- Additional virtual disks:
 - 90GB virtual disks for SQL database data (Thick provisioned)
 - 50GB virtual disk for SQL log data (Thick provisioned)

Installing Microsoft Windows Server® 2012 R2

1. Mount the ISO for Windows Server 2012 R2.
2. Connect to the virtual machine console.
3. Choose the language, time and currency, and keyboard input. Click Next.
4. Click Install Now.
5. Choose Windows Server 2012 R2 Enterprise (Full Installation), and click Next.
6. Accept the license terms, and click Next.
7. Click Custom.
8. Click the Disk, and click Drive options (advanced).
9. Click New→Apply→Format, and click Next.
10. After the installation completes, click OK to set the Administrator password.

Configuring the VM storage

1. In the taskbar, click Server Manager.
2. In the left pane, expand Storage, and click Disk Management.
3. Right-click the first volume, and choose Initialize Disk.
4. In the right pane, right-click the volume, and choose New Simple Volume...
5. At the welcome screen, click Next.
6. At the Specify Volume Size screen, leave the default selection, and click Next.
7. At the Assign Drive Letter or Path screen, choose a drive letter, and click Next.
8. At the Format Partition screen, choose NTFS, and click Next.
9. At the Completing the New Simple Volume Wizard screen, click Finish.

Installing .Net Framework 3.5

1. Click Start→Server Manager→Manage→Add Roles and Features.

2. Select Role-based or feature-based installation, and click Next.
3. Under Server Pool, select the local server, and click Next twice.
4. Under Features, select .NET Framework 3.5 Features, and click Next.
5. Click Install.
6. Click Close.

Installing Microsoft SQL Server 2014

1. Attach the installation media to the server.
2. Launch setup.exe.
3. Choose the Installation section on the left, and click New SQL Server stand-alone installation or add features to an existing installation.
4. At the Product Key screen, enter the product key, and click Next.
5. At the License Terms screen, check I accept the license terms, and click Next.
6. At the Global Rules screen, allow the Global Rules check to finish, and click Next.
7. At the Microsoft Update screen, check Use Microsoft Update to check for updates (recommended), and click Next.
8. Once the updates have been downloaded and installed, click Next.
9. At the Install Setup Files screen, allow the setup files to install, and click Next.
10. At the Install Rules screen, allow the Install Rules check to run, and click Next.
11. At the Setup Role screen, select the SQL Server Feature Installation radio button, and click Next.
12. At the Feature Selection screen, select the features required for your installation. We selected Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tool Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete.
13. At the Feature Rules screen, allow the Feature Rules check to run, and click Next.
14. At the Instance Configuration screen, click Next to use the default instance named MSSQLSERVER.
15. At the Server Configuration screen, click Next.
16. At the Database Engine Configuration screen, select Mixed Mode (SQL Server authentication and Windows authentication), and enter a password for the SQL Server system administrator (sa) account.
17. Click Add Current User.
18. In the Data Directories tab, enter the directories to be used for SQL data and logs. We used E:\ and F:\, respectively, to place the data and logs on their appropriate virtual disks. Click Next.
19. At the Feature Configuration Rules screen, allow the Feature Configuration Rules check to finish, and click Next.
20. At the Ready to Install screen, click Install.
21. After the installation has completed, close the wizard.

Configuring the database workload client

For our testing, we used a virtual client for the Microsoft SQL Server client. To create this client, we installed Windows Server 2008 R2, assigned a static IP address, and installed .NET 3.5.

Configuring the database (DVD Store)

Configuring the database

Data generation overview

We generated the data using the Install.pl script included with DVD Store version 2.1 (DS2), providing the parameters for our 20GB database size and the database platform on which we ran: Microsoft SQL Server. We ran the Install.pl script on a utility system running Linux®. The Install.pl script generated the database schema.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2014. We built the 20GB database in SQL Server 2014, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore the server between test runs.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We explicitly set the file sizes higher than necessary to ensure that no file-growth activity would affect the outputs of the test. Besides this file size modification, we created and loaded the database schema according to the DVD Store documentation. Specifically, we followed the following steps:

1. We generated the data and created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our 20GB database and the appropriate changes to drive letters.
2. We transferred the files from our Linux data generation system to a Windows system running SQL Server.
3. We created database tables, stored procedures, and objects using the provided DVD Store scripts.
4. We set the database recovery model to bulk-logged to prevent excess logging.
5. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
6. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
7. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, we created a ds2user SQL Server login using the following Transact SQL (TSQL) script:

```
USE [master]
GO
CREATE LOGIN [ds2user] WITH PASSWORD=N'',
    DEFAULT_DATABASE=[master],
    DEFAULT_LANGUAGE=[us_english],
    CHECK_EXPIRATION=OFF,
    CHECK_POLICY=OFF
GO
```

9. We set the database recovery model back to full.
10. We created the necessary full text index using SQL Server Management Studio.
11. We created a database user and mapped this user to the SQL Server login.
12. We then performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

Figure 7 shows our initial file size modifications.

| Logical name | Filegroup | Initial size (MB) |
|-----------------------|------------|-------------------|
| Database files | | |
| primary | PRIMARY | 5 |
| cust1 | DS_CUST_FG | 6,144 |
| cust2 | DS_CUST_FG | 6,144 |
| cust3 | DS_CUST_FG | 6,144 |
| cust4 | DS_CUST_FG | 6,144 |
| ind1 | DS_IND_FG | 2,891 |
| ind2 | DS_IND_FG | 2,891 |
| ind3 | DS_IND_FG | 2,891 |
| ind4 | DS_IND_FG | 2,891 |
| ds_misc | DS_MISC_FG | 200 |
| orders1 | DS_ORDERS | 3,072 |
| orders2 | DS_ORDERS | 3,072 |
| orders3 | DS_ORDERS | 3,072 |
| orders4 | DS_ORDERS | 3,072 |
| Log files | | |
| ds_log | | 18,141 |

Figure 7: Our initial file size modifications.

Running the DVD Store tests

Test start and run times

We ran all workloads concurrently to start and record all performance counters for this report. The specific testing parameters we used are included in the setup section, and the following section describes specifics for launching the test.

About running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store outputs an orders-per-minute metric, which is a running average calculated through the test. In this report, we report the last OPM reported by each client/target pair.

Each complete test cycle consisted of the following steps:

1. Move all VMs to the first host and the initial datastore.
2. Clean up prior outputs from the target system and the client driver system.
3. Drop the database from the target.
4. Restore the database on the target.
5. Shut down the target.
6. Reboot the host and client system.
7. Wait for a ping response from the server under test (the hypervisor system), the client system, and the target.
8. Let the test server idle for 10 minutes.

9. Start the DVD Store driver on the client. We used the following DVD Store parameters for testing. Note: for think time, we used 500ms (0.5 seconds) for the scalability testing, and 0 for the peak utilization testing.

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30 --n_threads=32 --db_size=20GB --think_time=0 --detailed_view=Y --warmup_time=5 --report_rate=1 --pct_newcustomers=20 --csv_output=<drive path>
```

Running the usability scenarios

Cloning a VM

1. Log in to the Nimboxx web interface.
2. Click vAssets at the top of the page.
3. Expand the target vMachine.
4. Ensure the VM is shut down, and has no attached vDisks.
5. Click Clone.
6. Enter a name for the VM, and click Clone.

After the yellow notification banner changes to green, the VM will be ready for use.

Creating a snapshot of a VM

1. Log in to the Nimboxx web interface.
2. Click vAssets at the top of the page.
3. Expand the target vMachine.
4. Click Snapshot.
5. Click Create Snapshot. The VM will pause while the snapshot is taken.

Once the VM is un-paused, the snapshot will be available in the snapshot dialog.

Configuring high availability on a VM

1. Log in to the Nimboxx web interface.
2. Click vAssets at the top of the page.
3. Expand the target vMachine.
4. Ensure the VM is turned on, and has no attached vDisks.
5. Click HA.
6. Toggle High Availability for this vMachine ON.
7. Select the Failover Target, and click Save. The HA column will display the icon for Replicating.

After the HA column displays the icon for Mirroring, HA will be ready for use.

ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
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