



Microsoft Dynamics NAV 2013 R2 Sizing Guidelines for Multitenant Deployments

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Microsoft Dynamics NAV 2013 R2 Sizing Guidelines for Multitenant Deployments

This whitepaper provides guidance on how to size a multitenant deployment of Microsoft Dynamics NAV 2013 R2 on Windows Azure when you want to optimize your solution and processes for scale and volume. The measurements in this document are based on multitenant deployments with few concurrent users accessing each tenant, with most scenarios below 10 concurrent users per tenant.

The sizing guidelines for multitenant deployments cannot be compared directly to single-tenant deployments with hundreds or thousands of concurrent users. You must take this into consideration when reading this document.

The sizing and performance recommendations are very specific. The performance result that you find in this document will differ from the results you have during customer implementations. If you need exact sizing and performance information, then we suggest that you do an in-depth proof-of-concept to answer specific questions.

Sizing recommendations and application performance are influenced by many factors such as the following:

- How the application is customized from the standard Microsoft Dynamics NAV out-of-the-box solution
- The amount of data in the Microsoft SQL Server database and how the underlying Microsoft SQL Server database is tuned for performance
- Usage patterns and how many users running the same business logic simultaneously
- The underlying architecture
- Other performance-influencing applications running in the same environment

The guidelines in this whitepaper are based on a series of sizing simulations of multitenant Microsoft Dynamics NAV 2013 R2 deployments on Windows Azure. The simulations included combinations of creating and posting documents (transactions) and data lookups (consultations). We used Windows Azure as our underlying platform for these sizing exercises. You can use the test results as an indication of what how to size your own multitenant solution as partner-hosted or on-premises deployment that is based on hardware similar to that of our Windows Azure virtual machines and with an application similar to our demonstration company.

The tests were configured to simulate how people actually work rather than setting up scripts that overload the server with processes.

Test deployment configurations

We performed a series of sizing scenarios on different Windows Azure virtual machine setups all running the Microsoft Dynamics NAV 2013 R2 demonstration database and company. The specification of the Windows Azure virtual machines might change over time.

The following table describes the specifications and price of the virtual machines that were used during the tests.

| Size | Cores | Memory | Price/hour | Price/month (approx.) |
|------------------|-------|---------|------------|-----------------------|
| Small (A1) | 1 | 1.75 GB | \$0.09 | ~\$67 |
| Medium (A2) | 2 | 3.5 GB | \$0.18 | ~\$134 |
| Large (A3) | 4 | 7 GB | \$0.36 | ~\$268 |
| Extra Large (A4) | 8 | 14 GB | \$0.72 | ~\$536 |
| A7 | 8 | 56 GB | \$1.60 | ~\$1,191 |

We simulated the execution of several scenarios performed by different types of user profiles on different Windows Azure virtual machine sizes. We worked with 4 user profiles:

- The occasional user profile
This profile will mainly consult Microsoft Dynamics NAV 2013 R2 information and will occasionally create and process documents.
In 1 hour, this type of user will create and post 10 documents and consult 24 entities.
- The regular user profile
This profile will mainly create and post documents and process other tasks on a regular basis in Microsoft Dynamics NAV 2013 R2.
In 1 hour, this type of user will create 30 documents and consult 18 entities.
- The frequent user profile
This profile will mainly create and post documents and process other tasks frequently in Microsoft Dynamics NAV

2013 R2.

In 1 hour, this type of user will create 60 documents and consult 36 entities.

- The intensive user profile

This profile will mainly create and post documents and process other tasks in very high amounts in Microsoft Dynamics NAV 2013 R2.

In 1 hour, this type of user will create and post 90 documents and consult 54 entities. It is almost unrealistic to do all these tasks in 1 hour.

When sizing your solution, please remember that in live production situations you will probably have a mix of the different usage patterns.

Every test series was performed with only one user profile in mind; and when initiating the test, each user performed the above workload every hour simulating human waiting time between operations. Every 5 minutes we added workload by adding batches of additional users to the implementation, each executing the specified scenarios.

Note: We did not include raw measurements for throughput, such as batch postings with no wait time between operations.

Every scenario consists of performing one or more tasks. For example, the transactional scenario for creating and posting a sales order, the following tasks are included:

- Opening the Sales Invoice page.
- Creating a new Sales Invoice header.
- Fill in Sales Invoice header info.
- Creating Sales Invoice lines.
- Posting the invoice.

For each task in a transactional or consulting scenario, we defined criteria for when a task has run within a good time frame or within an unacceptable time frame. The time frames are defined in milliseconds. For more information, see Appendix B: Tasks and time frames for the test scenarios.

The following tables illustrate the number of tasks/scenarios performed per hour for each user profile in our simulations.

Transactional scenarios:

| Task | Occasional user | Regular user | Frequent user | Intense user |
|-------------------|-----------------|--------------|---------------|--------------|
| Sales invoices | 2 | 6 | 12 | 18 |
| Customer receipts | 2 | 6 | 12 | 18 |
| G/L transactions | 2 | 6 | 12 | 18 |
| Purchase invoice | 2 | 6 | 12 | 18 |
| Vendor payment | 2 | 6 | 12 | 18 |
| Total | 10 | 30 | 60 | 90 |

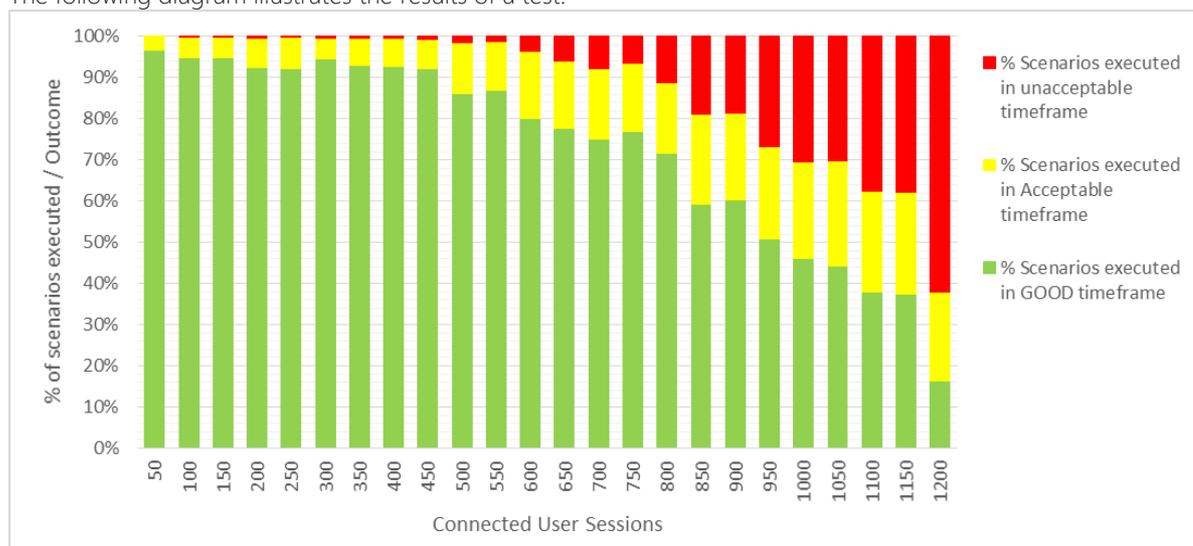
Consulting scenarios:

| Task | Occasional user | Regular user | Frequent user | Intense user |
|--------------------|-----------------|--------------|---------------|--------------|
| Customer | 4 | 3 | 6 | 9 |
| Item | 4 | 3 | 6 | 9 |
| Purchase documents | 4 | 3 | 6 | 9 |
| Sales documents | 4 | 3 | 6 | 9 |
| Vendor | 4 | 3 | 6 | 9 |
| Chart of accounts | 4 | 3 | 6 | 9 |
| Total | 24 | 18 | 36 | 54 |

To see which tasks were performed per consulting and transactional scenario and which timing target values were placed, see appendix B.

Test results

The following diagram illustrates the results of a test:



The result showed us that more than 90% of scenarios are executed within a good and/or acceptable timeframe for up to 750 concurrent users.

For more detailed charts on the several sizing exercises per profile, see appendix A. For more information about the timeframes that are good or acceptable for each scenario, see Appendix B: Tasks and time frames for the test scenarios.

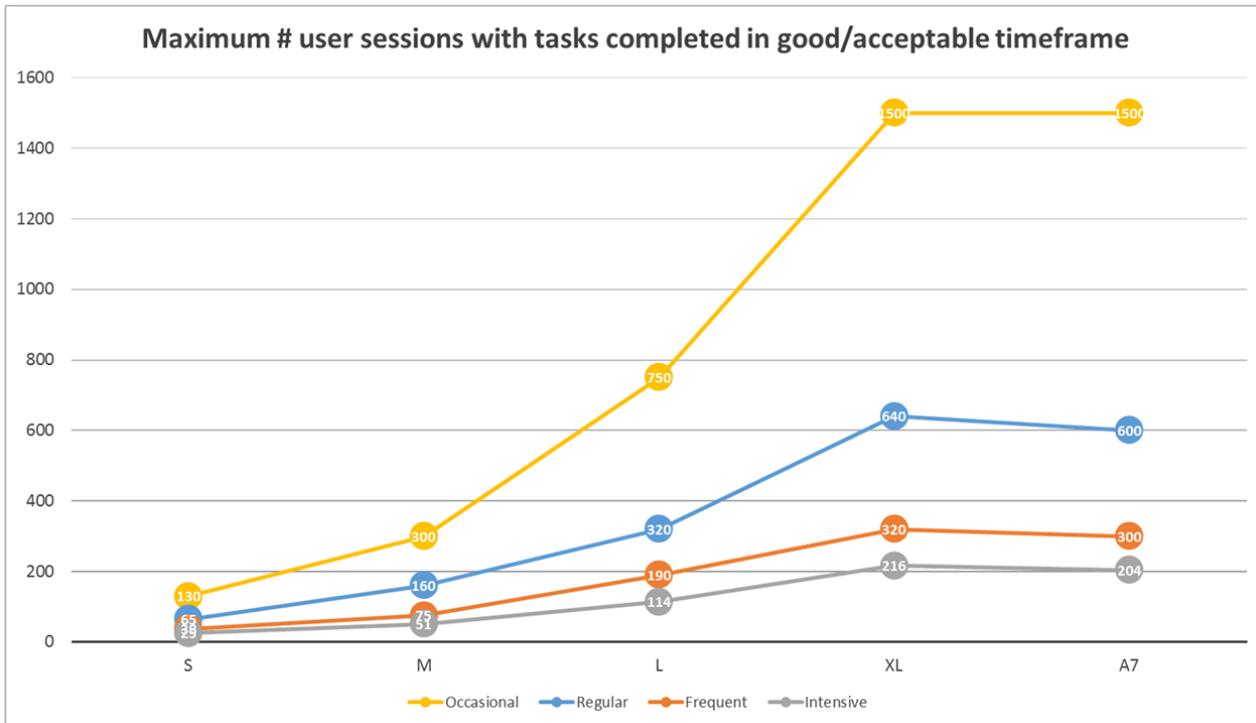
We ran the sizing tests for several hours, adding more and more users until the test showed significantly poor performance. Since we wanted to test how to size Microsoft Dynamics NAV Server, we did the following:

- Avoided locking during posting routines inside one company or tenant. Therefore, users were typically spread across 100 tenants.
- Microsoft Dynamics NAV Server and Microsoft SQL Server were spread over multiple Windows Azure virtual machines.
- These tests were not intended to measure SQL performance. As a result, all scenarios were run against an A7 Windows Azure virtual machine for the database tier.

All tests were run multiple times in order to eliminate stray results.

Microsoft Dynamics NAV sizing conclusions for multitenant deployments

The following chart illustrates the results of our tests. The chart shows the number of user sessions that completed tasks successfully within the timeframes that were set as either good or acceptable as described in the previous section. You can use the chart as an indication to help you decide on the deployment infrastructure for your own solution. However, tests are based on multitenant deployments on Windows Azure VMs, and so the results do not map directly on-premises single-tenant deployments.



In the chart, each line illustrates the number of sessions for a specific user profile across the Windows Azure VM sizes that we tested. For example, if you want to support a large number of users with frequent access, our test indicates that you might want to choose either large or extra-large VMs. Similarly, if you want to support lightweight users (occasional user profiles), you can choose a smaller VM size according to our test results. The user profiles and their tasks are described in the **Test deployment configurations** section.

For more detailed charts on the several sizing exercises for each user profile, see appendix A.

The impact of multitenant deployment of Microsoft Dynamics NAV

Configuring the Microsoft Dynamics NAV Server instance to be multitenant has no direct negative performance impact. By making the deployment multitenant, you can more easily add new customers to the solution, and you can roll out updates quickly with limited downtime for customers. In multitenant deployments, the application is shared across tenants, and so are memory, caches, and CPU. As a result, the expense for each customer is reduced. For more information, see Multitenant Deployment Architecture in the MSDN Library here: [http://msdn.microsoft.com/en-us/library/dn271675\(v=nav.71\).aspx](http://msdn.microsoft.com/en-us/library/dn271675(v=nav.71).aspx).

The impact of setting up several Microsoft Dynamics NAV Server instances

The tests show that the impact of running multiple Microsoft Dynamics NAV Server instances in one environment is resource intense – each Microsoft Dynamics NAV Server instance requires approximately 512 MB of memory and sufficient CPU power.

The need of cores versus memory

In the scenarios we tested with the Windows Azure A7 VM size, we have seen that only adding RAM is not sufficient to scale out; however, other scenarios might benefit.

In our scenarios, the limiting factor on the virtual machine size is not RAM, but the amount of available cores. In our tests, each core is capable of handling approximately 80 users.

When not limited by the number of cores, each user session that connects to a Microsoft Dynamics NAV Server instance was calculated to be approximately 10 MB of RAM (depending on the user activity).

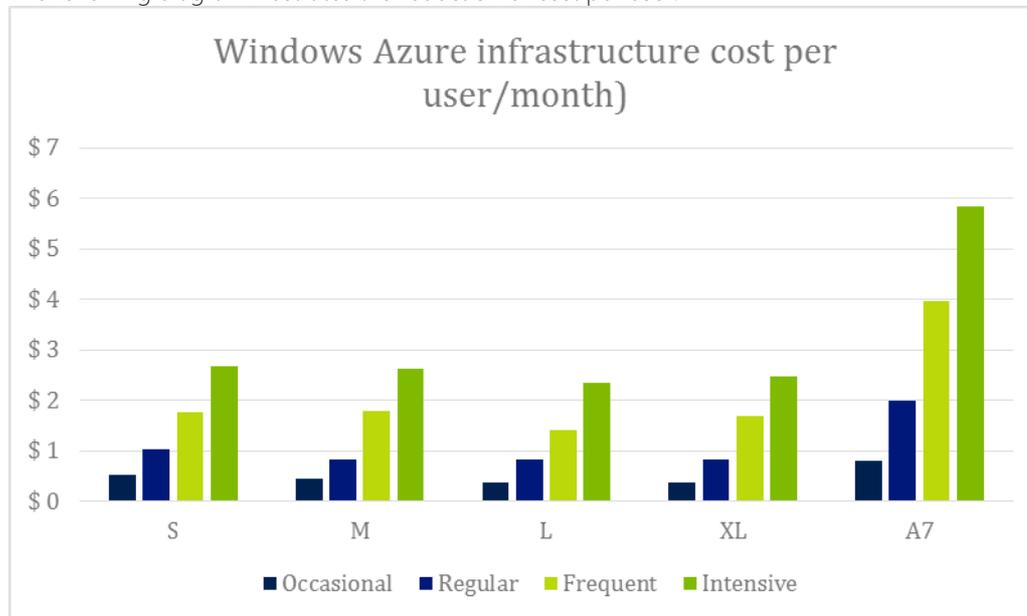
You must take into account the minimum server requirements of additional implemented components on your topology. For more information, see System Requirements for Microsoft Dynamics NAV 2013 R2 in the MSDN Library here: [http://msdn.microsoft.com/en-us/library/dd301054\(v=nav.71\).aspx](http://msdn.microsoft.com/en-us/library/dd301054(v=nav.71).aspx).

Fixed Windows Azure infrastructure costs when planning for scale

When focusing only on the infrastructure cost for the Microsoft Dynamics NAV Server instance, and not taking into account the infrastructure cost for Microsoft SQL Server or other necessary components, you will see that the more users you add to the system, the more the costs decrease as the costs are shared over more users. At maximum occupation and utilization of the Windows Azure infrastructure, the average cost per connected user is similar to each topology choice we calculated. For example:

- The cost for an occasional user profile could go down to .05 dollars.
- The cost for a regular user profile could go down to approximately 1 dollar.
- The cost for an intense user profile could go down to approximately 2 dollars.

The following diagram illustrates the reduction of cost per user.



Adding additional Microsoft Dynamics NAV Server instances to the topology

Throughout this sizing chapter, we have discussed the sizing based on multiple tenants and described how many users you can fit on the various models of Windows Azure virtual machines. Increasing the size of the virtual machine is called *scaling up*.

Scaling out is adding more virtual machines to the pool behind a load balancer.

We did a series of tests on scaling out and in general we've seen very promising results.

With scaling out the environment with one extra server instance we could double the capacity. One large instance is able to handle approximately 320 user sessions; 2 large instances can handle double that, i.e. around 640 users.

Windows Azure supports scaling out by adding multiple virtual machines to the same hosted service (<http://www.windowsazure.com/en-us/documentation/articles/load-balance-virtual-machines/>), adding them into one availability group and setting up the necessary load balanced ports.

For more information, see *Scaling the Microsoft Dynamics NAV Network Topology* in the MSDN Library at this location: [http://msdn.microsoft.com/en-us/library/dn271671\(v=nav.71\).aspx](http://msdn.microsoft.com/en-us/library/dn271671(v=nav.71).aspx).

Scaling out gives you a number of benefits, including the following:

- **High availability:** Having two or more servers in one availability group ensures that Windows Azure will not do scheduled maintenance of your virtual machines at the same time, thus giving you a higher availability.
- **Elasticity:** Scaling out allows you to run more servers during peak periods and less servers during nights and weekends. Adding servers to a hosted service does not incur downtime.
- **Cost:** On Windows Azure you only pay compute hours for the servers that are actually running. Having servers standing by is only charged by the storage they take up.
- **Disaster recovery:** If a server fails and for some reason is unable to boot, you can have other servers standing by to take over and then simply delete the failing server.

- **Flexibility in database maintenance:** You can take servers offline for maintenance without users losing connection.

Setting up servers in a scale-out environment adds some complexity, since all servers needs to be identical and autonomous.

Below is a non-exhaustive list of topics to consider when installing multiple Microsoft Dynamics NAV Server instances in one hosted service:

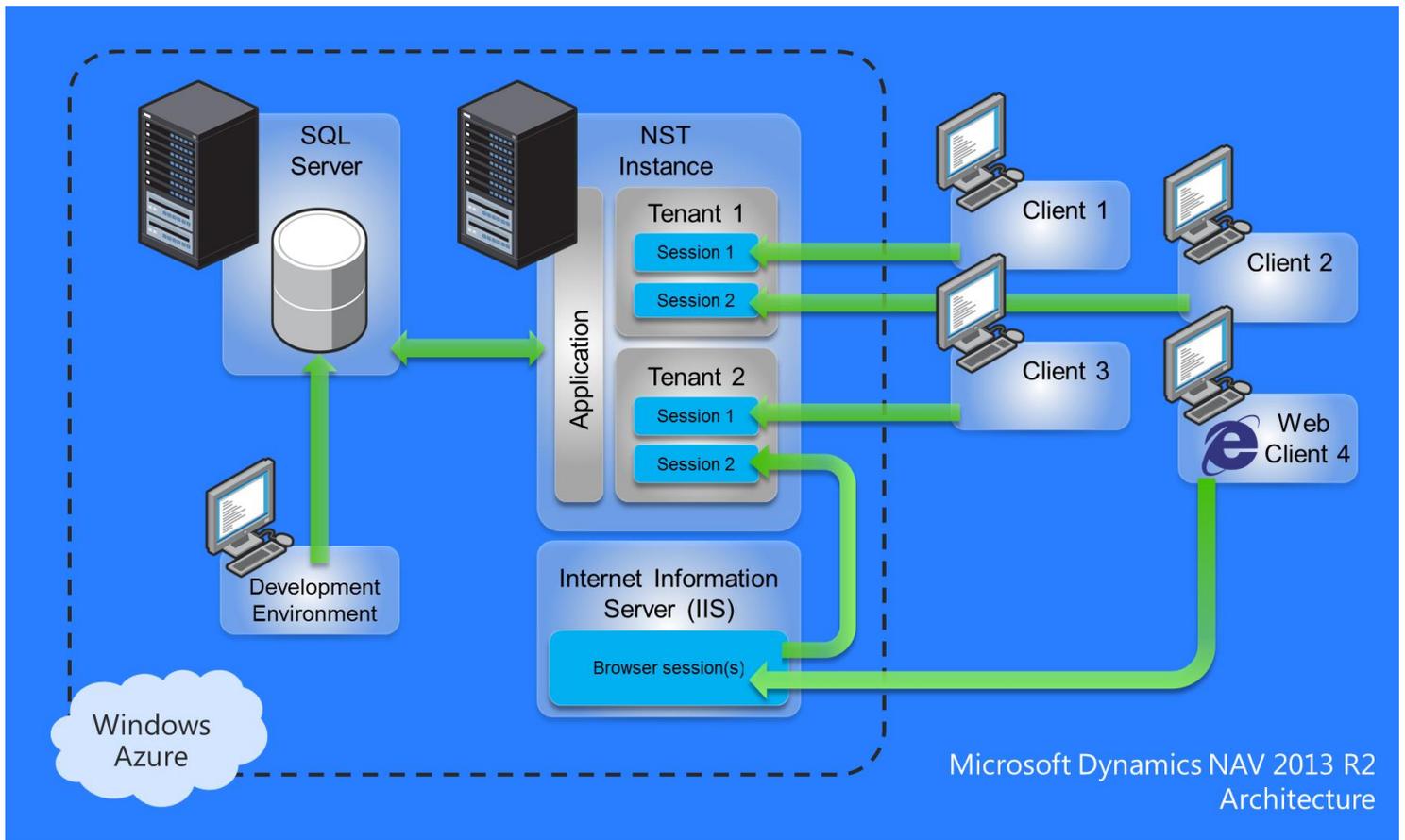
- **Load balancing the Windows client:** The Windows client requires a sticky connection to a service tier. The Windows Azure load balancer will close the connection after 4 minutes if no communication has happened. Once a connection has been established, the Windows client will send keep-alive packages to the service tier to keep the connection open.
- **Load balancing the Web client:** Web clients are also stateful, and once connected through a specific Web client instance, the user must stay on this Web client instance. This can be done by simple redirection.
- **Mounting and dismounting tenants:** When you have multiple service tiers and need to mount or dismount tenants, you need to make sure that all service tiers are informed about the configuration change. You need to consider that not all service tiers are running. We recommend installing the virtual machines in a way that allows them to discover these things automatically.

Deploying Microsoft Dynamics NAV on Windows Azure

You can deploy Microsoft Dynamics NAV solutions in the cloud in different ways. In our tests, we deploying on Windows Azure. You can deploy on Windows Azure yourself or through a hosting partner. Each approach has different advantages.

- Good reasons to collaborate with a hosting partner that provides Windows Azure Services include the following:
 - At this point in time, you don't want to invest in building up the cloud skill sets, tools and processes within your organization.
 - You want to collaborate with a subject matter expert in your first Windows Azure deals while building the skill set and provisioning tools internally.
 - You are implementing Microsoft Dynamics NAV 2013 R2 based on individual opportunities and do not plan to optimize your offerings towards a repeatable cloud service. In this case, it's beneficial and cost effective to collaborate with a hosting partner.
 - You don't want to provide the 24x7 support on cloud infrastructure that customers often demand, so you prefer to work with a business partner that shares the responsibility.
 - You are in a startup situation with limited ability to take on new costs.
- Good reasons to deploy Microsoft Dynamics NAV 2013 R2 on Windows Azure with your own team include:
 - You have optimized your business to offer Microsoft Dynamics NAV cloud services, and have invested in your own provisioning tools.
 - You have established a repeatable cloud model and do not want to be dependent on another business partner.
 - You are a hosting company and would like to extend your services by providing the Windows Azure infrastructure as a service option to your business partners.
 - You already have experience hosting solutions on your own hardware but want to move customers to the Windows Azure platform.

The following diagram illustrates a deployment of Microsoft Dynamics NAV on Windows Azure.



In our tests, the deployments were multitenant, and so we had multiple tenant databases and one application database connected to a Microsoft Dynamics NAV Server instance.

For more information, see [Deploying and Managing Microsoft Dynamics NAV 2013 R2 on Windows Azure](#) in the MSDN Library at the following location: [http://msdn.microsoft.com/en-us/library/dn271710\(v=nav.71\).aspx](http://msdn.microsoft.com/en-us/library/dn271710(v=nav.71).aspx).

Before you design your deployment, revise the latest version of the system requirements for Microsoft Dynamics NAV 2013 R2 in the MSDN Library at the following location: [http://msdn.microsoft.com/en-us/library/dd301054\(v=nav.71\).aspx](http://msdn.microsoft.com/en-us/library/dd301054(v=nav.71).aspx).

Licensing the various components of a Microsoft Dynamics NAV 2013 R2 solution that is deployed on Windows Azure is an important consideration in all deployment types. For deployments on Windows Azure, you should evaluate the licensing terms specific to Windows Azure, and the impact these may have on the overall cost of providing the hosted solution. For more information on licensing Microsoft Dynamics NAV 2013 R2 on Windows Azure, see the following locations:

- <http://www.windowsazure.com/en-us/pricing/licensing-faq/>
- https://mbs.microsoft.com/partnersource/northamerica/partner-essentials/guides-handbooks/MSDYERP_LicensingGuide

For more information, see [Microsoft Dynamics NAV 2013 R2 on Windows Azure](#).

Appendix A: Test results for each user profile across Windows Azure virtual machine instance sizes

This appendix describes the results of the sizing tests for Microsoft Dynamics NAV 2013 R2 on Windows Azure. For more information on how tests were performed and how to read the information below, see the section [Microsoft Dynamics NAV sizing conclusions](#).

For each chart, the axis are the following:

- X- Axis: % of scenarios executed / Outcome result
- Y-Axis: # User sessions that are connected to the Microsoft Dynamics NAV Server instance spread across multiple tenants.

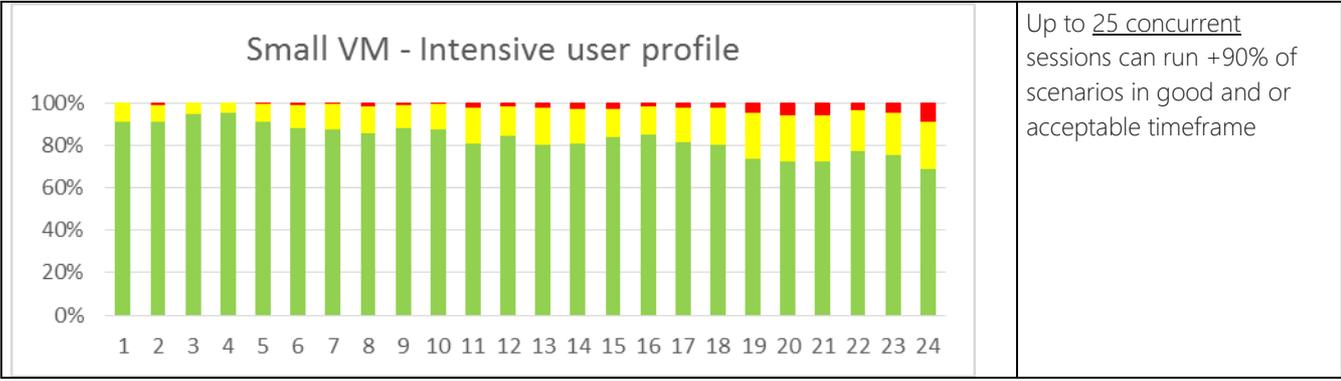
The following table describes the color coding in the test results:

| Color | Description |
|--------|---|
| Green | Task was fully executed within a good timeframe |
| Orange | Task was fully executed within an acceptable timeframe |
| Red | Task was fully executed but NOT within an acceptable timeframe. |

Sizing outcome for a Small Windows Azure virtual machine

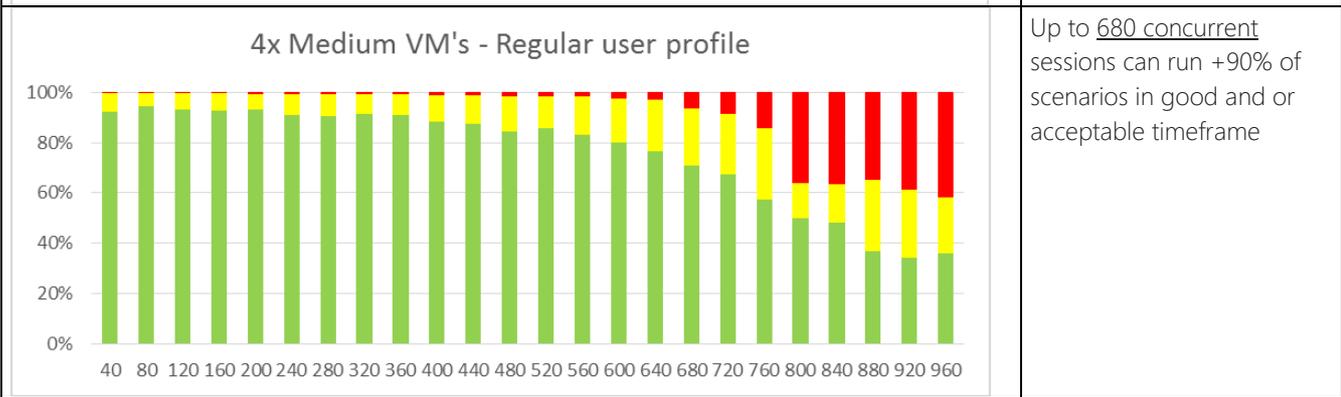
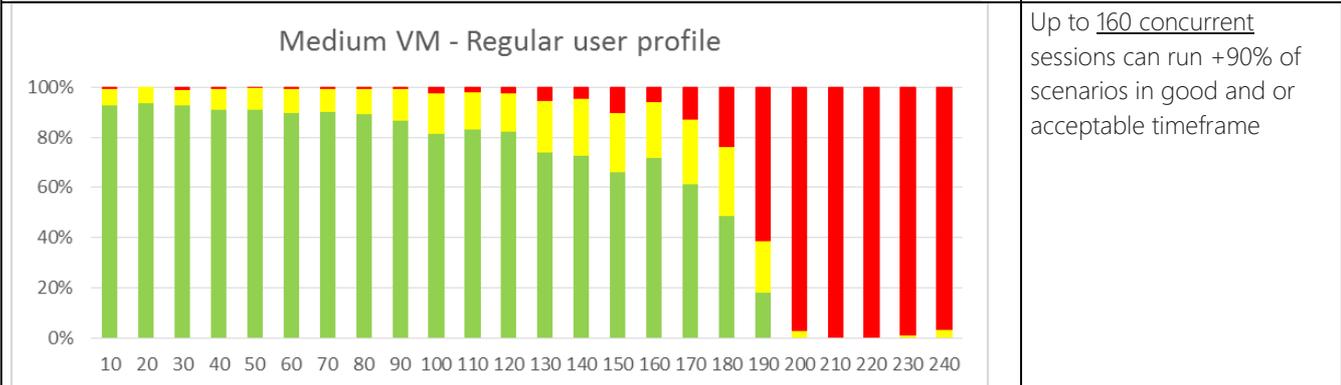
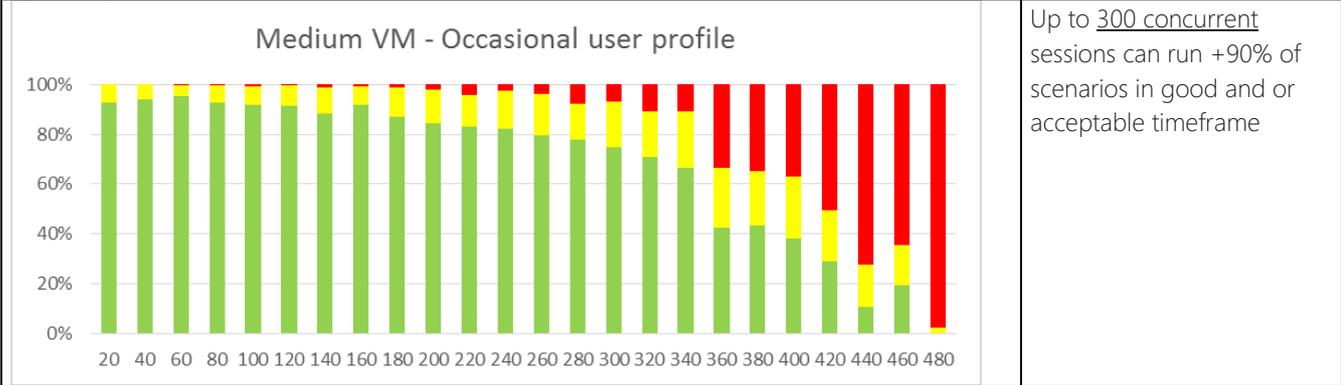
System specifications, CPU: 1 core, RAM: 1.75 GB Ram

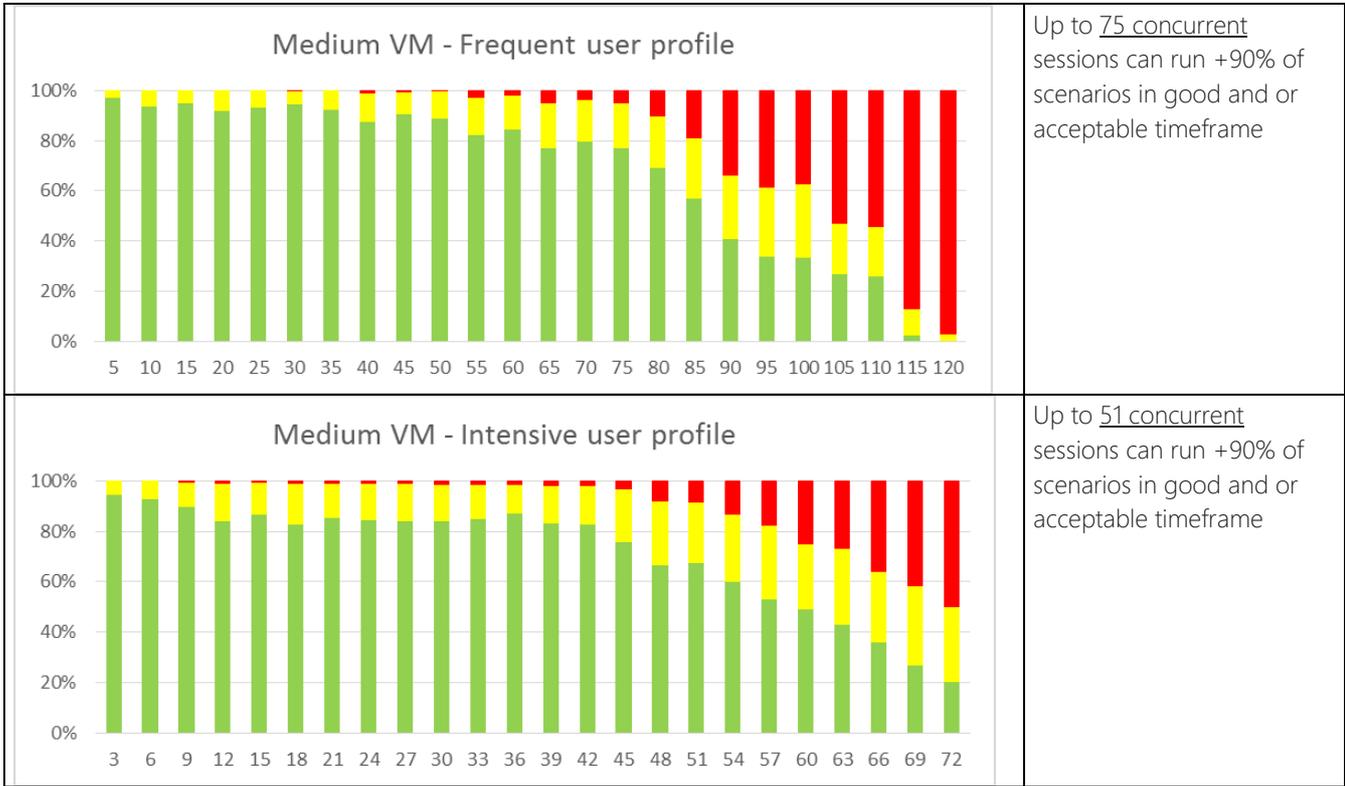




Sizing outcome for a Medium Windows Azure virtual machine

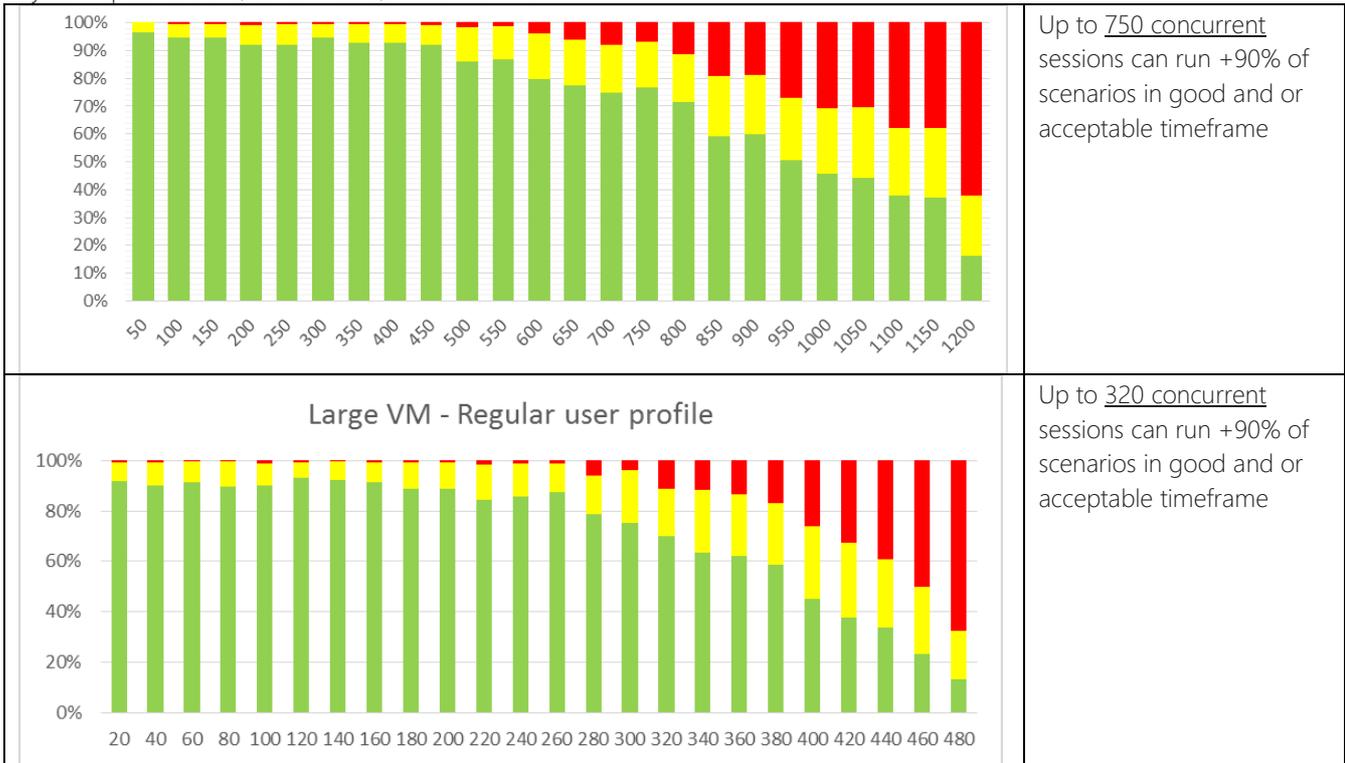
System specifications, CPU: 2 core, RAM: 3,5 GB Ram





Sizing outcome for a Large Windows Azure virtual machine

System specifications, CPU: 4 core, RAM: 7 GB Ram



| | |
|--|---|
| <p style="text-align: center;">2 Large VMs - Regular user profile</p> | <p>Up to <u>640 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">Large VM - Frequent user profile</p> | <p>Up to <u>190 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">Large VM - Intensive user profile</p> | <p>Up to <u>114 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |

Sizing outcome for an Extra Large Windows Azure virtual machine

System specifications, CPU: 8 core, RAM: 14 GB Ram

| | |
|---|--|
| <p style="text-align: center;">Xlarge VM - Occasional user profile</p> | <p>Up to <u>1500 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
|---|--|

| | |
|--|---|
| <p style="text-align: center;">XLarge VM - Regular user profile</p> | <p>Up to <u>640 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">XLarge VM - Frequent user profile</p> | <p>Up to <u>320 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">XLarge VM - Intensive user profile</p> | <p>Up to <u>216 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |

Sizing outcome for an A7 Windows Azure virtual machine

System specifications, CPU: 8 core, RAM: 56 GB Ram

| | |
|---|--|
| <p style="text-align: center;">A7 VM - Occasional user profile</p> | <p>Up to <u>1500 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
|---|--|

| | |
|--|---|
| <p style="text-align: center;">A7 VM - Regular user profile</p> | <p>Up to <u>600 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">A7 VM - Frequent user profile</p> | <p>Up to <u>300 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |
| <p style="text-align: center;">A7 VM - Intensive user profile</p> | <p>Up to <u>204 concurrent</u> sessions can run +90% of scenarios in good and or acceptable timeframe</p> |

Appendix B: Tasks and time frames for the test scenarios

The following table lists the tasks that were performed in each scenario. These tasks are not listed in the right execution order. Target values are represented in number of milliseconds.

| Scenario | Task | Target Value for GOOD Outcome | Target Value for UNACCEPTABLE Outcome |
|----------------------------------|---------------------------|-------------------------------|---------------------------------------|
| Chart Of Account | Open Page 16 | 500 | 1000 |
| Chart Of Account | Close Page 16 | 500 | 1000 |
| Create And Post Customer Receipt | Press Yes | 200 | 500 |
| Create And Post Customer Receipt | Set Bal. Account No. | 200 | 500 |
| Create And Post Customer Receipt | Set Amount | 200 | 500 |
| Create And Post Customer Receipt | Set Account Type | 200 | 500 |
| Create And Post Customer Receipt | Press Post | 200 | 500 |
| Create And Post Customer Receipt | Set Batch Name | 200 | 500 |
| Create And Post Customer Receipt | Close Page | 200 | 500 |
| Create And Post Customer Receipt | Set Account No. | 200 | 500 |
| Create And Post Customer Receipt | Open Page 39 | 500 | 1000 |
| Create And Post Customer Receipt | Set Document No. | 200 | 500 |
| Create And Post Customer Receipt | Press OK | 200 | 500 |
| Create And Post GLTransaction | Set Amount | 200 | 500 |
| Create And Post GLTransaction | Press Yes | 2000 | 5000 |
| Create And Post GLTransaction | Press OK | 500 | 1000 |
| Create And Post GLTransaction | Set Account No. | 200 | 500 |
| Create And Post GLTransaction | Set Account Type | 200 | 500 |
| Create And Post GLTransaction | Set Document No. | 200 | 500 |
| Create And Post GLTransaction | Press Post | 500 | 1000 |
| Create And Post GLTransaction | Close Page | 500 | 1000 |
| Create And Post GLTransaction | Set Bal. Account No. | 200 | 500 |
| Create And Post GLTransaction | Set Batch Name | 200 | 500 |
| Create And Post GLTransaction | Open Page 39 | 500 | 1000 |
| Create And Post Purchase Invoice | Close Form | 500 | 1000 |
| Create And Post Purchase Invoice | Set Vendor Invoice No. | 200 | 500 |
| Create And Post Purchase Invoice | Open Page 9308 | 500 | 1000 |
| Create And Post Purchase Invoice | Press Post | 500 | 1000 |
| Create And Post Purchase Invoice | New Card | 500 | 1000 |
| Create And Post Purchase Invoice | Set Type | 200 | 500 |
| Create And Post Purchase Invoice | Set No. | 200 | 500 |
| Create And Post Purchase Invoice | Set Expected Receipt Date | 200 | 500 |
| Create And Post Purchase Invoice | Set Posting Date | 200 | 500 |
| Create And Post Purchase Invoice | Press Yes | 2000 | 5000 |
| Create And Post Purchase Invoice | Set Buy-from Vendor No. | 500 | 1000 |
| Create And Post Purchase Invoice | Release | 500 | 1000 |
| Create And Post Purchase Invoice | Set Quantity | 200 | 500 |
| Create And Post Sales Invoice | Open Page 9301 | 500 | 1000 |
| Create And Post Sales Invoice | Set No. | 200 | 500 |
| Create And Post Sales Invoice | Set Quantity | 200 | 500 |
| Create And Post Sales Invoice | Close Form | 500 | 1000 |
| Create And Post Sales Invoice | New Card | 500 | 1000 |

| | | | |
|--------------------------------|--------------------------|------|------|
| Create And Post Sales Invoice | Set Sell-to Customer No. | 500 | 1000 |
| Create And Post Sales Invoice | Press Yes | 2000 | 5000 |
| Create And Post Sales Invoice | Set Shipment Date | 200 | 500 |
| Create And Post Sales Invoice | Set Type | 200 | 500 |
| Create And Post Sales Invoice | Press Post | 500 | 1000 |
| Create And Post Sales Invoice | Set Posting Date | 200 | 500 |
| CreateAndPostVendorPayment | Press Yes | 2000 | 5000 |
| Create And Post Vendor Payment | Set Document No. | 200 | 500 |
| Create And Post Vendor Payment | Set Account No. | 200 | 500 |
| Create And Post Vendor Payment | Press Post | 500 | 1000 |
| Create And Post Vendor Payment | Press OK | 500 | 1000 |
| Create And Post Vendor Payment | Set Bal. Account No. | 200 | 500 |
| Create And Post Vendor Payment | Set Batch Name | 200 | 500 |
| Create And Post Vendor Payment | Close Page | 500 | 1000 |
| Create And Post Vendor Payment | Open Page 39 | 500 | 1000 |
| Create And Post Vendor Payment | Set Amount | 200 | 500 |
| Create And Post Vendor Payment | Set Account Type | 200 | 500 |
| Customer Lookup | Open Page 22 | 500 | 1000 |
| Customer Lookup | Close Page 22 | 500 | 1000 |
| Item Lookup | Open Page 31 | 500 | 1000 |
| Item Lookup | Close Page 31 | 500 | 1000 |
| Purchase Doc Lookup | Open Page 9308 | 500 | 1000 |
| Purchase Doc Lookup | Close Page 9308 | 500 | 1000 |
| Sales Doc Lookup | Open Page 9301 | 500 | 1000 |
| Sales Doc Lookup | Close Page 9301 | 500 | 1000 |
| Vendor Lookup | Open Page 27 | 500 | 1000 |
| Vendor Lookup | Close Page 27 | 500 | 1000 |

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