Tivoli Storage Manager Version 5.3.2
Administration Center
Performance Evaluation Report

Tivoli software

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Executive Summary

This document provides performance data and analysis of the Tivoli Storage Manager (TSM) web administration interface known as the Administration Center. This interface provides capabilities such as single signon for management of multiple TSM servers, TSM server health monitoring, storage object filtering and sorting, and configuration wizards. The Administration Center is installed as an Integrated Solutions Console component. The Integrated Solutions Console, or ISC, is a component framework that allows multiple IBM applications to be accessed from a single Web interface.

This document includes performance results for an environment of the Integrated Solutions Console version 6.0.1 and TSM Administration Center 5.3.2. Administration Center server performance was measured during execution of a subset of TSM administration tasks using from 1 to 16 concurrently active administrators. The tasks included some that are very simple, consisting of a single step, and some that are more complex, consisting of several steps and including sub-tasks.

In general, the Administration Center server requires moderate processing power and a significant amount of real memory. The uni-processor systems used in these tests provided more than adequate processing power, as the highest CPU utilization observed was 17.5% on the AIX system, and 38.8% on the Windows system. The largest ISC process real memory utilization observed was 942 MB on AIX with 8 active administrators and 1785 MB on Windows with 16 active administrators. Significantly fewer resources were needed when fewer administrators were active. A single administrator test was conducted with the ISC process requiring 358 MB. Minimal system disk throughput and network throughput are required for Administration Center.

The mean task elapsed time was observed to increase only moderately (15% to 17%), as the number of concurrently active administrators was increased. The AIX server completed 3128 tasks during the 3 hour 8-administrator test, or 1042 tasks per hour. The Windows server completed 6419 tasks during the 3 hour 16-administrator test, or 2139 tasks per hour. However, the task success rate decreased as the number of active administrators was increased. The AIX server experienced a less than 98% task success rate when more than 8 administrators were active. The Windows server displayed a 98% task success rate, or better, for all tests. The reasons for better scalability and task success rate on Windows are still being investigated.

Installation of the Administration Center on a system coresident with a TSM server did not result in any degradation of Administration Center performance compared to the dedicated system installation when testing with a single active administrator. The coresident Administration Center server and TSM server were installed on a 2-way Windows system with only 1 GB of real memory.

In the case of an existing TSM version 5.2 server that is being upgraded to version 5.3, where the existing hardware cannot meet the additional requirements of Administration Center, then upgraded hardware or an additional system should be proposed for the Administration Center function. If additional applications are being deployed to the same Integrated Solutions Console infrastructure as the Administration Center uses, or if Administration Center will be used with multiple TSM servers and many administrators, an additional system should be used.

Introduction

Server administration is recognized as an important process in a Tivoli Storage Manager (TSM) installation. TSM must provide efficient administration to leverage an administrator's skills. The time required to complete an administration task needs to be adequate under a variety of conditions. Resource utilization (processor, memory, disk, and network) for administration processing needs to be maintained within limits acceptable for implementation in a maximum number of environments.

Given this understanding, the following performance measurements were made to:

- Identify the elapsed time required to perform a subset of typical administration tasks.
- Quantify the resource requirements of the Administration Center server.
- Determine the smallest amount of memory in which the Administration Center server can run reliably.
- Determine the scalability of a single Administration Center server with respect to the number of concurrent administrators that can be supported.
- Determine if there are any platform-specific performance differences for the Administration Center server.

Product Overview

The Administration Center is a new web-based interface for centrally configuring and managing IBM Tivoli Storage Manager Version 5.3 servers. This new task-oriented interface replaces the previous administrative web interface. The Administration Center provides wizards to help guide you through common configuration tasks. Properties notebooks allow you to modify settings and perform advanced management tasks.

The Administration Center provides the following key features:

- You only need to log in once to access multiple Tivoli Storage Manager servers from a single interface.
- You can easily monitor the health of your storage environment. Regular status updates are provided for scheduled events, the server database and recovery log, and storage devices, including information about offline drives and paths, and mounted volumes.
- You can filter and sort storage objects, such as client nodes and library volumes.
- You can use wizards to perform complex tasks, such as creating schedules to perform client node and administrative operations, creating a server maintenance script to perform database and storage pool backup, migration, expiration, and reclamation, and configuring storage devices including creating a library, adding drives, checking in media volumes, and creating storage pools.

The Integrated Solutions Console, or ISC, is a component framework that allows you to install components provided by multiple IBM applications, and access them from a single web interface. The Administration Center is installed as an Integrated Solutions Console component.

Measurement Configuration

The configuration used for server administration performance measurements is shown in **Figure 1**. The Integrated Solutions Console (ISC) and Tivoli Storage Manager (TSM) Administration Center were installed and measured on a Windows 2003 Server, Enterprise Edition system. Then both ISC and Administration Center were installed and measured on an AIX system. In this way, it is possible to determine if there are any Administration Center server performance differences due to the hardware platform and operating system.

The TSM servers included versions 5.3.0 and 5.3.2 and were installed on separate systems from the Administration Center servers, although this is not a requirement. The actual administration tasks were initiated using a web browser on the PCs running Windows XP. All of these systems were connected via a single 100 Mb Ethernet switch. In this environment, minimal TSM server activity was occurring. Production environments may exhibit slower performance due to resource contention on the TSM servers.
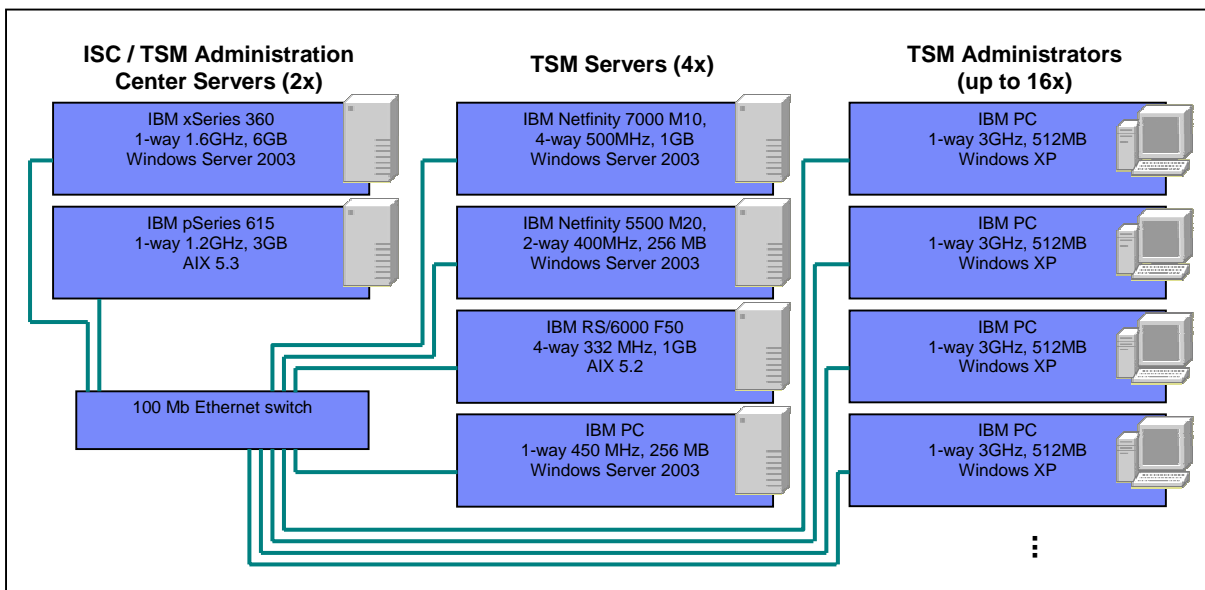

Figure 1. Measurement Configuration

Operating system tuning was kept to a minimum in this environment. Specifically, the only tuning changes made to the ISC / Administration Center systems were the following:

AIX - Used the `no -o tcp_sendspace=65535` and `no -o tcp_recvspace=65535` commands to increase the TCP/IP socket buffer sizes for network communications.

Windows - Used the `/3gb` and `/pae` boot.ini flags so that applications could use up to 3GB of private memory and so the operating system could use the full amount of memory installed on the system (6GB). These settings were implemented for other applications under test in this environment, had no impact at all on the performance of the Administration Center server, and it is not necessary that they be used in production installations of Administration Center.

Workload Description

The Administration Center performance testcase executes a set of administrative GUI tasks that are described in **Table 1** below. This testcase makes use of Rational Functional Tester to perform the GUI automation, the Microsoft Internet Explorer version 6.0 web browser, and a set of PERL scripts to execute the test across multiple administrative clients and collect and analyze the desired performance data.

High level variables such as the Administration Center server platform, the number of concurrent administrators, and the size of the Administration Center Java heap memory were changed without changes to the underlying performance testcase. Each test was executed for 3 hours to be certain that measurements are representative. Unless otherwise indicated, all tests used a "think" time of 10 seconds, which identifies the amount of time delay after a panel is presented and rendered at the browser until an action such as clicking a button or typing in a text field is performed.

Task name	Task description
`login`	Checks for the ISC login panel, types the administrator id and password, clicks the login button, and expands the TSM links.
`openHealthMonitor`	Clicks the Health Monitor link, waits for the Health Monitor portlet to be displayed, selects a server, clicks View Health Details... from the dropdown list, and waits for the Health Monitor Details portlet to be displayed.
`viewScheduleInformation`	Opens the Schedule Information twistie, checks all boxes, clicks the Update table button, and waits for the table to be displayed.
`viewStorageDevices`	Opens the Storage Devices twistie, and waits for the table to be displayed.
`viewActivityLog`	Opens the Activity Log twistie, checks the 'Severe Errors', and 'Errors' boxes, clicks the Update table button, and waits for the table to be displayed.
`viewDatabaseRecoveryLogInfo`	Opens the Database and Recovery Log twistie, and waits for the information to be displayed.
`openPolicyDomains`	Clicks the Policy Domains and Client Nodes link, waits for the Policy Domains portlet to be displayed, and selects a server.
`viewPolicyDomains`	Clicks View Policy Domains... from the dropdown, and waits for the server Policy Domains portlet to be displayed.
`selectDomain`	Selects a policy domain.
`createClientNode`	Clicks Create Client Node... from the dropdown on the Policy Domains portlet, waits for the Create Client Node Wizard General panel to be displayed, enters the nodename, contact, and password on the appropriate panels, clicking Next until the Summary panel is displayed and then clicks Finish.
`searchForClientNode`	Clicks Search for Client Node... from the dropdown on the Policy Domains portlet, waits for this panel to be displayed, enters a nodename, clicks Update table, selects the node when the table is displayed, clicks Modify Client Node... from the dropdown, and waits for the Node Properties notebook General panel to be displayed.
`openClientNode`	Executes the `openPolicyDomains` and `searchForClientNode` tasks.

Task name	Task description
changePassword	Clicks on the Node Properties Notebook Security link, enters the new password in the appropriate text fields, clicks Apply, and waits for the Operation Completed Successfully message.
modifyPolicyDomain	Clicks Modify Policy Domain... from the dropdown on the Policy Domains portlet, and waits for the Policy Domain panel to be displayed.
deleteClientNode	Executes the openPolicyDomains, viewPolicyDomains, selectDomain, and modifyPolicyDomain tasks and clicks the Client Nodes twistie to display the Client Nodes table. Note that this task does not include deleting the client node.
openServerProps	Clicks the Server Maintenance link, waits for the Server Maintenance portlet to be displayed, selects a server, clicks Server Properties... from the dropdown list, and waits for the Server Properties notebook General panel to be displayed.
viewProcesses	Clicks on the Server Processes link from the Server Properties notebook and waits for the Server Processes table to be displayed.
viewSessions	Clicks on the Sessions link from the Server Properties notebook and waits for the Sessions table to be displayed.
viewAdministrators	Clicks on the Administrators link from the Server Properties notebook and waits for the Administrators table to be displayed.
displayDbProperties	Clicks Database Properties... from the Database table dropdown, waits for the database properties page to be displayed, and then clicks OK.
displayLogProperties	Clicks Log Properties... from the Recovery Log table dropdown, waits for the recovery log properties page to be displayed, and then clicks OK.
viewDbLog	Clicks on the Database and Log link from the Server Properties notebook, waits for the Database and Recovery Log tables to be displayed, and executes the displayDbProperties and displayLogProperties tasks.
openStorageDevices	Clicks the Storage Devices link, waits for the Storage Devices portlet to be displayed and selects a server.
viewStoragePools	Clicks View Storage Pools... from the Storage Devices table dropdown, and waits for the Storage Pools table to be displayed.
viewVolumeHistory	Clicks View Volume History... from the Storage Devices table dropdown, and waits for the Volume History table to be displayed.
logout	Clicks the ISC session logout link and waits for the ISC login panel to be displayed.

Table 1. Administration Center Performance Testcase Tasks

The performance test implements a pattern of usage such that each administrative client performs login once, executes the complete set of the other activities above for three iterations, and then performs logout. This pattern is then repeated until the 3 hour testcase duration is reached. In the case where the GUI automation software fails to properly recognize a GUI object, or to properly handle a resource action (i.e. click on a button, fill out a text field, etc.), or if the TSM Administration

Center server replies with a "Portlet Not Available" message, the performance test manager component recognizes the failure and will attempt to recover the administrative client. It does this by first executing `logout` so that any session resources on the Administration Center server are freed up. If the logout fails, the browser is restarted on the administrative client. Then the test manager restarts the performance test on that administrative client. The overall test success can be measured in terms of the performance variables such as server resource usage and task elapsed time, as well as by how many tasks have been successfully completed.

During a session, the performance testcase does not close any portlet pages when it is finished with them. Each execution that requires a portlet other than the currently open portlet opens a new portlet by clicking on the appropriate link on the left side of the Integrated Solutions Console panel, as shown in **Figure 2** below. The rationale for doing this is that this action results in a more conservative measurement of the number of administrators that can be concurrently logged in and executing work at any given time. Real administrators may or may not use existing open portlets, according to their own preferences. Opening a new portlet increases the overall memory consumption on the Administration Center server for that session, and the higher memory consumption is one factor that may limit the number of concurrent administrators. The number of open portlets with any given session is limited by the periodic logout that the performance testcase performs.
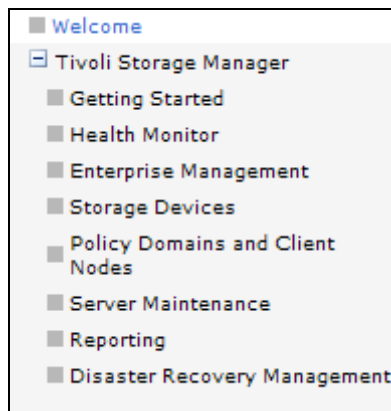

Figure 2. Tivoli Storage Manager Links

Another variable that influences the Administration Center session memory requirements is the size in rows and columns of the tables displayed. Larger tables will require larger amounts of memory while the Administration Center is obtaining the data from the TSM server and formatting the data for display to the browser, and while the table is displayed at the browser until the portlet is closed. In these tests, the some of the tables displayed contained the following number of rows:

- Server connections - 4 rows
- Activity log - 0 to 300 rows
- Administrators - 200 to 500 rows
- Client nodes - 200 to 500 rows
- Volume history - 1000 rows

It is recommended that filtering options be used where available to reduce the number of rows displayed for large tables, as this reduces the amount of memory required to complete the task, as well as reduces the elapsed time of the task in cases when the Administration Center server is heavily loaded.

Results

Administration Center Server General Performance

This section describes the performance of a Tivoli Storage Manager Administration Center server in general terms in order to identify the important hardware resources required for optimal performance. All of the data in this section refers to a single specific performance test. However, the conclusions made based on this data apply in general to all Administration Center servers. Understanding these general principles allows the reader to grasp the important considerations to pay attention to when planning and configuring an Administration Center server, and just as well, to put to rest concerns about some hardware resources that are unlikely to have an impact on performance.

The following data was captured during a 3 hour test with 4 automated administrators executing a subset of TSM administration tasks concurrently and continuously. The tasks executed are the same tasks as described in detail elsewhere in this document. The TSM Administration Center server was an IBM xSeries 360, 1-way 1.6 GHz processor with hyper-threading disabled, with 6GB memory, running Windows 2003 Server, Enterprise Edition SP1.

Because the system is Windows, the tool of choice for understanding application performance is the Windows Performance Monitor, which was used to collect the data and display the following figures.

Figure 3 displays the server CPU utilization during this test. As can be observed in the graph, the average CPU utilization is around 20%, indicating there is plenty of processing power available, even with this relatively slow CPU (currently shipping processors for server-class systems are about twice as fast). There are spikes in the CPU utilization in the graph below, partly because this data was captured on a 15-second interval. These do not appear to cause significant delays indicative of a processor bottleneck. Additional performance measurements, not presented here, have shown that the overall elapsed time for TSM administration tasks is not very dependent on the processor speed of the TSM Administration Center server. Additional processors may be used by the Administration Center server, but they won't necessarily have a material impact on the application performance.
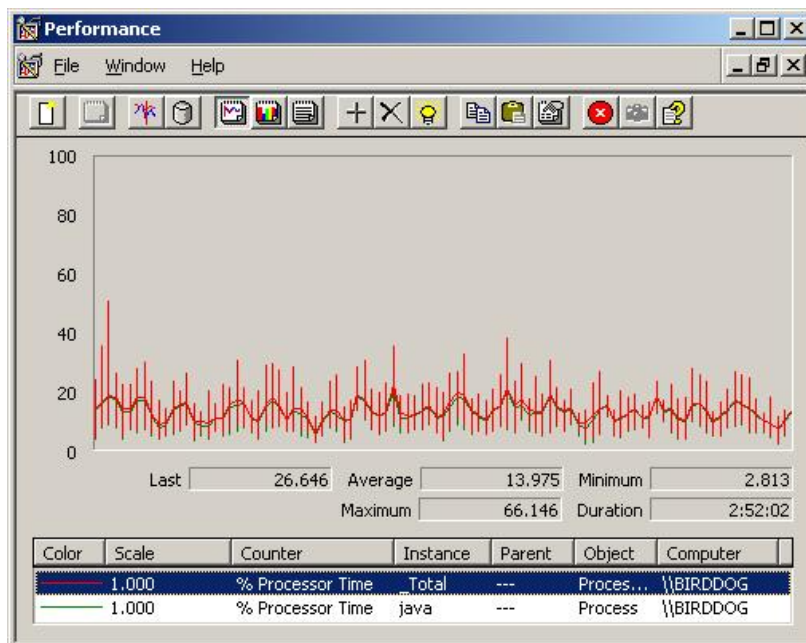

Figure 3. Administration Center Server % CPU Utilization

Figure 4 displays how busy the operating system disk was during the test. The Integrated Solutions Console and the TSM Administration Center server were installed using the default installation path on the system disk. Because this application contains a number of embedded components, including the Integrated Solutions Console, and a Java database, it might seem like there would be a need for a robust disk subsystem. In fact, once the server is operational, there is very little disk activity. The vertical scale on this chart was changed to include only from 0 to 10% busy, just to be able to show something on the chart. This is because once the server is operational, the executable code has mostly been loaded into memory, and the configuration files have been read. Note that in the case of a memory-constrained system, there may be less storage available for the system file cache, resulting in fewer files being cached in memory, and this might result in more disk activity.
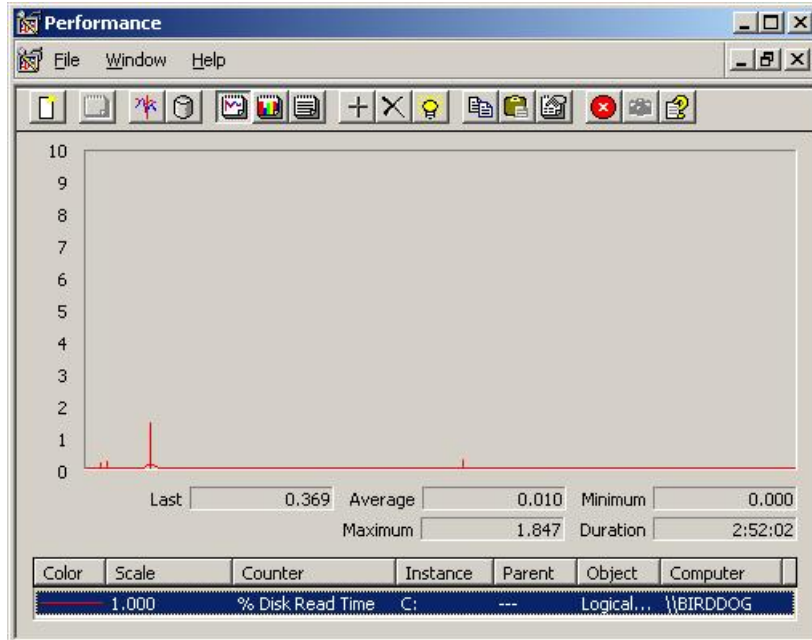

Figure 4. Administration Center Server System Disk Busy %

Most of the information processed by the Administration Center server is received or sent over the network, either between Administration Center and the TSM servers, or between Administration Center and the administrator browsers. **Figure 5** displays this data traffic. In this test, all of the TSM servers (4), and the TSM administrators (4), were on the same 100 Mb Ethernet network with only the single switch between all of the systems. The average network throughput over this network interface from the Administration Center server was only 65 KB/sec, which was further identified as consisting of a receive data rate of 24 KB/sec, and a send data rate of 41 KB/sec. For this test at least, the amount of data sent (mostly to the browsers) was about twice as much as the amount of data received (mostly from the TSM servers). Part of this is explained by the realization that formatting the data for display requires the inclusion of a significant number of HTML tags.

The maximum network data rate observed during this test on this network interface was only 278 KB/sec. Compared to the maximum theoretical rate of a 100 Mb Ethernet network, this is only about 2% of the capacity of this network. It is unlikely that a faster network (Gb Ethernet) would have any effect toward improving the performance of this application. However, networks that are poorly tuned, networks that are already saturated by other applications, or networks that have significantly higher latency (WANs) could impact Administration Center performance appreciably.
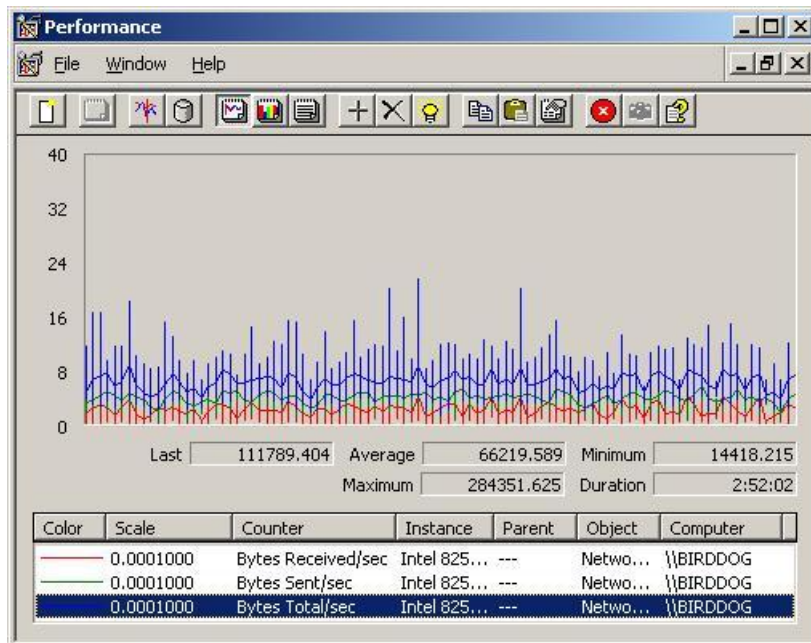

Figure 5. Administration Center Server Network Throughput

Figure 6 displays the Administration Center process Working Set memory during the test. This is the amount of real memory in use by the application. It can be seen from the graph that this memory utilization increases from the start of the test to reach a maximum level of about 696 MB, and then stays there for the remainder of the test. The Integrated Solutions Console was configured for using a 512 MB Java heap (the default) for this test. The process working set memory includes this Java heap memory and additional memory outside the heap for use by the Java Virtual Machine (JVM). More than any other resource, the TSM Administration Center needs a significant amount of memory, in order to perform well.
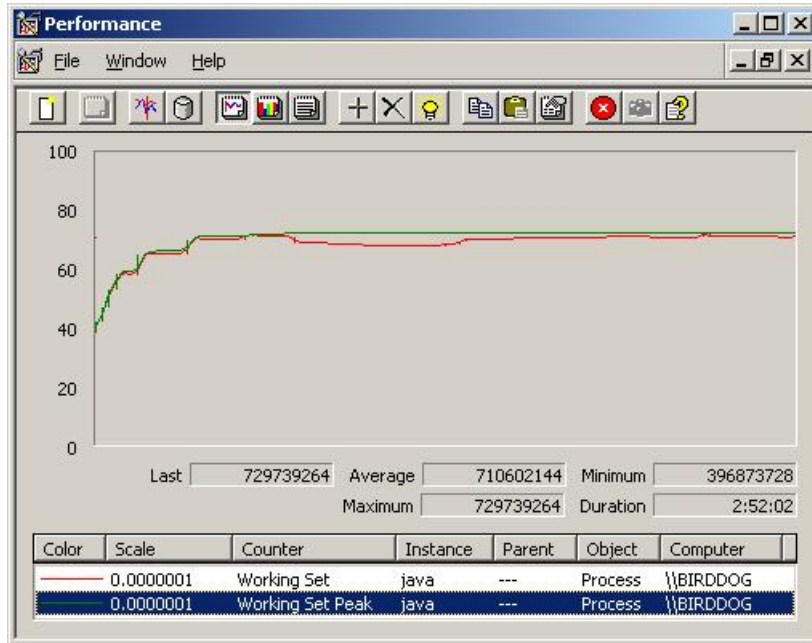

Figure 6. Administration Center Server Working Set Memory

In summary, the TSM Administration Center server requires:

    moderate processing power
    minimal system disk throughput
    minimal network throughput
    significant amount of real memory

In describing the remaining performance results in this report, disk and network throughput data will not be included since they are of minor importance in this environment. The overhead on the TSM servers during these tests was not measured as it was not a concern for this analysis.

As a reminder, the TSM Administration Center hardware requirements and product platform support may be found in the README.INSTALL document, or online at:

http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManagerVersionRelease.html

Administration Center Server on AIX Results

This section describes the performance measurement results for a Tivoli Storage Manager Administration Center server on AIX. These tests were designed to investigate the scalability and resource requirements for Administration Center installations where the number of concurrently active administrators was varied from 1 to 8. A small installation with only a single concurrently active administrator was measured with an ISC maximum Java heap size of 192 MB. A medium-sized installation with up to 4 concurrently active administrators was measured with an ISC maximum Java heap size of 512 MB (the default). A large installation with up to 8 concurrently active administrators was measured with an ISC maximum Java heap size of 2048 MB (the maximum). Concurrently active administrators are those that are logged in to the Administration Center server at the same time.

Table 2 and **Figure 7** show the mean task elapsed time for the measurements in these environments. The task elapsed time is not the response time of a single HTTP request, but rather the total elapsed time to perform the activity as noted in the task description in **Table 1**. The measurement was chosen because it indicates the amount of time taken for an administrator to get a real unit of work completed. The tasks included consist of some that are very simple, consisting of a single step, and some that are more complex, consisting of several steps and including sub-tasks. The mean task elapsed time is therefore representative of no particular specific activity but remains a good indicator of the performance impact of resource constraints or additional workload due to other administrators.

ISC Java Heap	Number of admins	Task elapsed time (sec)	Server CPU %
192 MB	1	22.4	5.9
512 MB (default)	1	22.1	5.0
	2	23.4	7.6
	4	25.4	12.3
2048 MB (max)	1	22.0	5.6
	2	23.4	7.8
	4	25.0	11.3
	8	25.7	17.5

Table 2. AdminCenter AIX Server Performance Data

These data show a moderate increase in mean task elapsed time as additional workload is added. The largest increase in mean task elapsed time was 3.7 seconds, resulting in an increase of 17%.

There is no significant difference in the mean task elapsed time for measurements with the same number of administrators due to the configured size of the ISC maximum Java heap. In other words, there is no advantage or penalty for making the Java heap bigger than it needs to be. However, there are significant functional and performance impacts if the Java heap is not large enough.

Table 2 and **Figure 8** show the Administration Center server CPU utilization increasing moderately as a function of the number of active administrators. These data, along with the number of tasks completed data from **Table 3**, were analyzed using linear regression to arrive at the best fit equation relating average CPU utilization and tasks completed per hour:

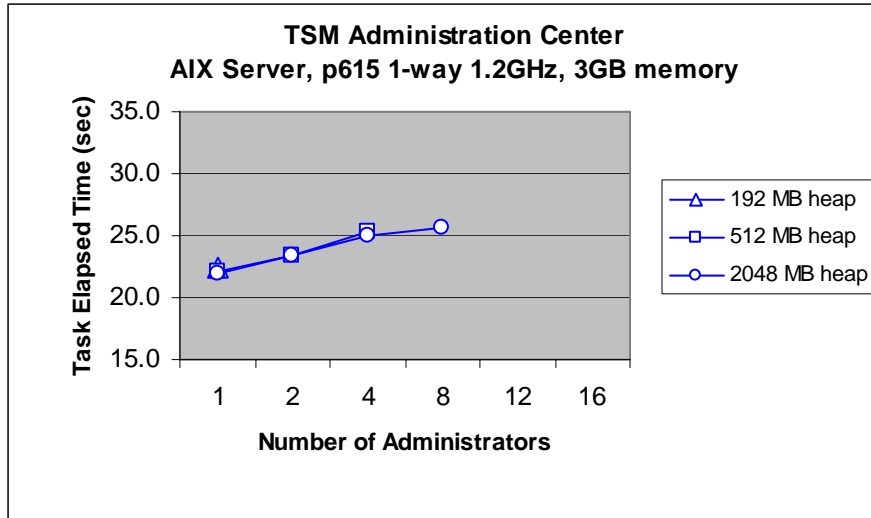**CpuUtilization (%) = 2.4 + TasksCompleted (per Hour) * 0.014**

TSM Administration Center
AIX Server, p615 1-way 1.2GHz, 3GB memory

Figure 7. AdminCenter AIX Server Task Elapsed Time

TSM Administration Center
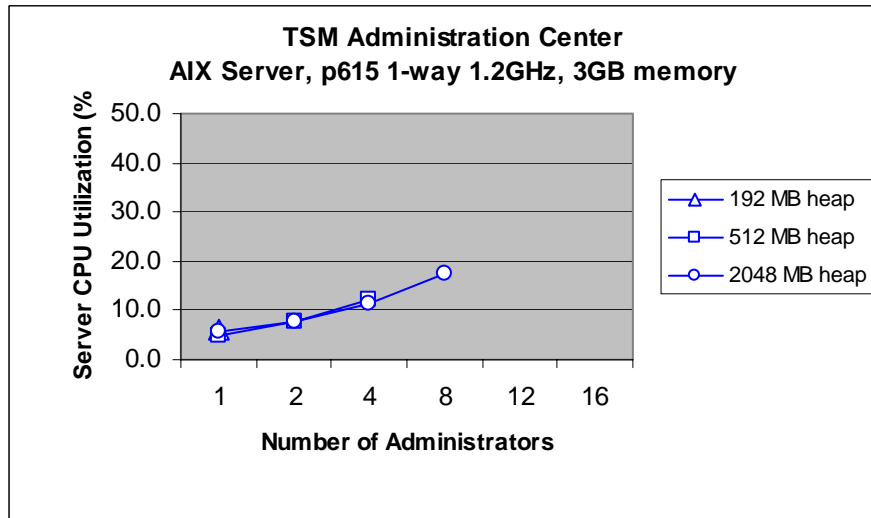**AIX Server, p615 1-way 1.2GHz, 3GB memory**

Figure 8. AdminCenter AIX Server CPU Utilization

The number of tasks completed represents the amount of work completed during the test. Each of these tests was conducted for 3 hours. A larger number of tasks completed means that the test was more productive, given that the same relative usefulness of tasks was completed in tests being compared. **Table 3** and **Figure 9** show that there is no significant difference in the number of tasks completed for measurements with the same number of administrators due to the configured size of the ISC maximum Java heap.

The task percent success rate is calculated from the number of tasks completed divided by the total number of tasks completed and failed. For the Administration Center server on AIX, tests with more than 8 administrators were conducted, however, they had less than a 98% task success rate, indicating the application was having difficulty accommodating this level of activity, and the data for these tests were therefore declared to be invalid and are not presented here. When a failure does occur, the desired action may or may not have been completed. In many cases, the administrator can click the refresh button on the browser and the application may be able to recover.

ISC Java Heap	Number of admins	Tasks completed	Tasks failed	% Success rate
192 MB	1	632	0	100.0
512 MB (default)	1	616	1	99.8
	2	1136	4	99.6
	4	2065	12	99.4
2048 MB (max)	1	639	0	100.0
	2	1152	1	99.9
	4	2026	15	99.3
	8	3128	65	98.0

Table 3. AdminCenter AIX Server Task Completion Data
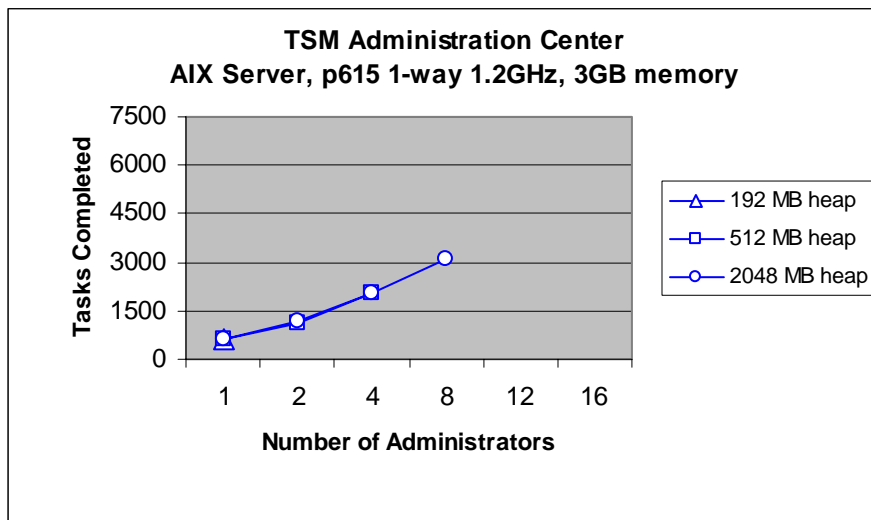

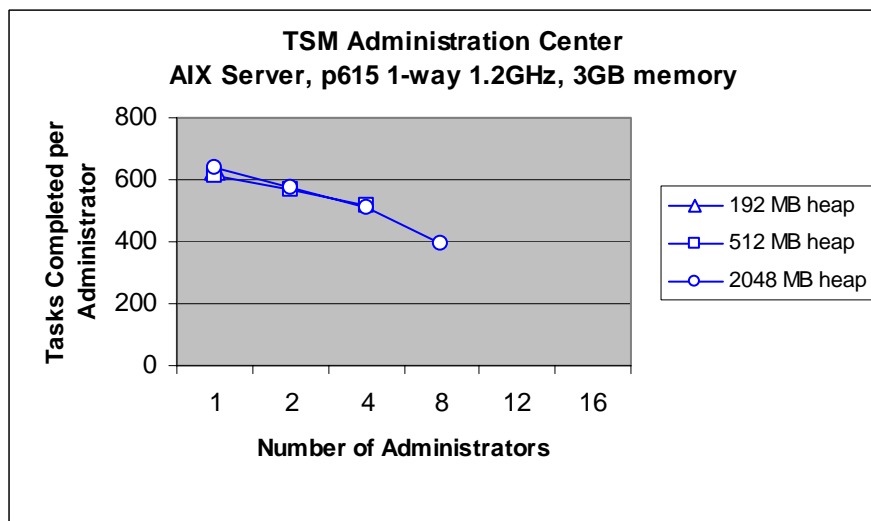**Figure 9. AdminCenter AIX Server Tasks Completed**

Figure 10. AdminCenter AIX Server Tasks Completed per Administrator

The impact of additional administrators on the number of tasks completed per administrator is shown in **Figure 10**. The 8-administrator test completed about 400 tasks, or 130 tasks per hour per administrator. This is likely to be more than what a real administrator would accomplish. In addition, the interface includes many possibilities where the administrator can execute multiple operations in a single "task", effectively getting much more work done. One such example would be in selecting and associating multiple nodes at a time with a new client schedule, rather than doing this one node at a time.

Figure 11 shows the task elapsed time by task for the tests using a 2048 MB Java heap and 1, 4, and 8 administrators. The tasks are enumerated in the chart from left to right in the order they are performed in the testcase. Many tasks do not experience a significant increase in task elapsed time with an increasing workload of multiple administrators. There are some tasks that do show significant increases, usually the longer tasks, such as `createClientNode`, `searchForClientNode`, `openClientNode`, and `deleteClientNode`.
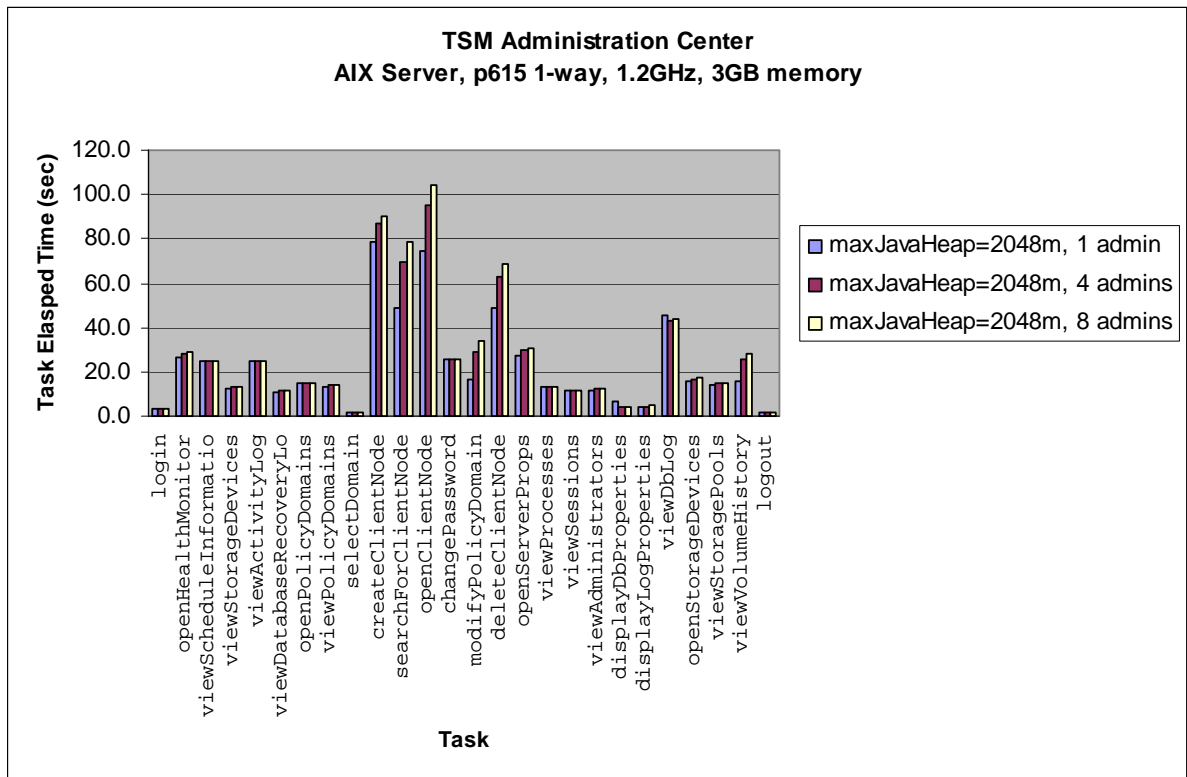

Figure 11. AdminCenter AIX Server Task Elapsed Time by Task

Table 4 shows the Administration Center server on AIX memory utilization by Java heap size configuration and number of active administrators. The Java heap allocated measurement is the maximum size of the Java heap that contains allocated data structures directly after garbage collection has run. This is an indication of the amount of Java heap memory that is required to hold the application object data for all the administrator sessions and tasks in progress. These data were analyzed using linear regression to arrive at the best fit equation relating the maximum Java heap allocated and the number of active administrators:

JavaHeapAllocated (MB) = 102 + ActiveAdministrators * 33

ISC Java Heap	Number of admins	Java heap allocated (MB)	Java heap maximum (MB)	ISC process memory (MB)
192 MB	1	118	191	358
512 MB (default)	1	124	256	423
	2	171	332	495
	4	260	511	695
2048 MB (max)	1	124	225	387 [1]
	2	177	360	538 [1]
	4	260	545	721 [1]
	8	345	732	942 [1]

Table 4. AdminCenter AIX Server Memory Utilization

Table 4 also includes the maximum Java heap size and the maximum ISC process working set memory size observed during these tests. Note that the observed maximum Java heap size contains both allocated data structures and free space, and can be less than but never greater than the configured maximum Java heap size. The process working set memory includes this Java heap memory and additional memory outside the heap for use by the Java Virtual Machine (JVM). A linear regression analysis indicates that the best fit equation relating the ISC process working set memory and the observed maximum Java heap size is the following:

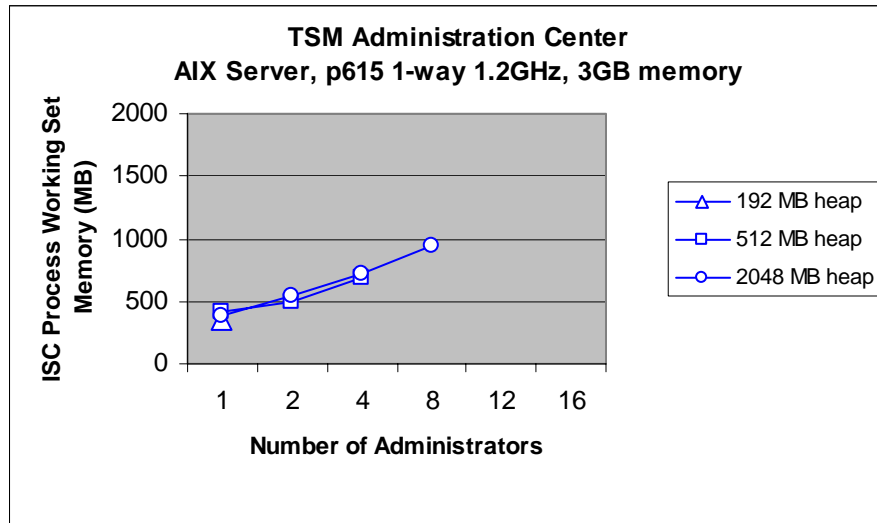**IscProcessMemory (MB) = 146 + JavaHeapMaximum (MB) * 1.08**

Figure 12. AdminCenter AIX Server ISC Process Memory

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[1] The AIX **ps** command returned inconsistent data for the process working set memory (RSS) when the ISC Java heap was set to 2048 MB, so this data is estimated using the differences between the working set and maximum observed Java heap size for the Windows server.

Administration Center Server on Windows Results

This section describes the performance measurement results for a Tivoli Storage Manager
Administration Center server on Windows. These tests were designed to investigate the scalability
and resource requirements for Administration Center installations where the number of concurrently
active administrators was varied from 1 to 16. A small installation with only a single concurrently
active administrator was measured with an ISC maximum Java heap size of 192 MB. A medium-
sized installation with up to 4 concurrently active administrators was measured with an ISC maximum
Java heap size of 512 MB (the default). A large installation with up to 16 concurrently active
administrators was measured with an ISC maximum Java heap size of 1536 MB (the maximum).
Concurrently active administrators are those that are logged in to the Administration Center server at
the same time.

Table 5 and **Figure 13** show the mean task elapsed time for the measurements in these
environments. The task elapsed time is not the response time of a single HTTP request, but rather
the total elapsed time to perform the activity as noted in the task description in **Table 1**. The
measurement was chosen because it indicates the amount of time taken for an administrator to get a
real unit of work completed. The tasks included consist of some that are very simple, consisting of a
single step, and some that are more complex, consisting of several steps and including sub-tasks.
The mean task elapsed time is therefore representative of no particular specific activity but remains a
good indicator of the performance impact of resource constraints or additional workload due to other
administrators.

ISC Java heap	Number of admins	Task elapsed time (sec)	Server CPU %
192 MB	1	22.4	6.7
512 MB (default)	1	22.0	5.9
	2	21.9	8.9
	4	24.1	14.4
1536 MB (max)	1	22.3	5.9
	2	22.1	9.3
	4	24.1	13.4
	8	25.2	24.1
	12	25.5	31.2
	16	25.0	38.8

Table 5. AdminCenter Windows Server Performance Data

These data show a moderate increase in mean task elapsed time as additional workload is added.
The largest increase in mean task elapsed time was 3.4 seconds, resulting in an increase of 15%.

There is no significant difference in the mean task elapsed time for measurements with the same
number of administrators due to the configured size of the ISC maximum Java heap. In other words,
there is no advantage or penalty for making the Java heap bigger than it needs to be. However, there
are significant functional and performance impacts if the Java heap is not large enough.

Table 5 and **Figure 14** show the Administration Center server CPU utilization increasing moderately as a function of the number of active administrators. These data, along with the number of tasks completed data from **Table 6**, were analyzed using linear regression to arrive at the best fit equation relating average CPU utilization and tasks completed per hour:

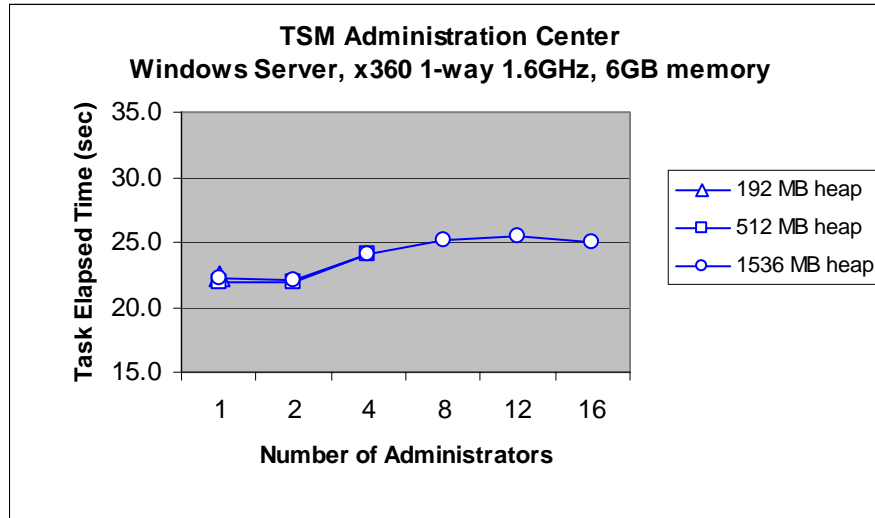$$\text{CpuUtilization (\%)} = 2.1 + \text{TasksCompleted (per Hour)} * 0.017$$

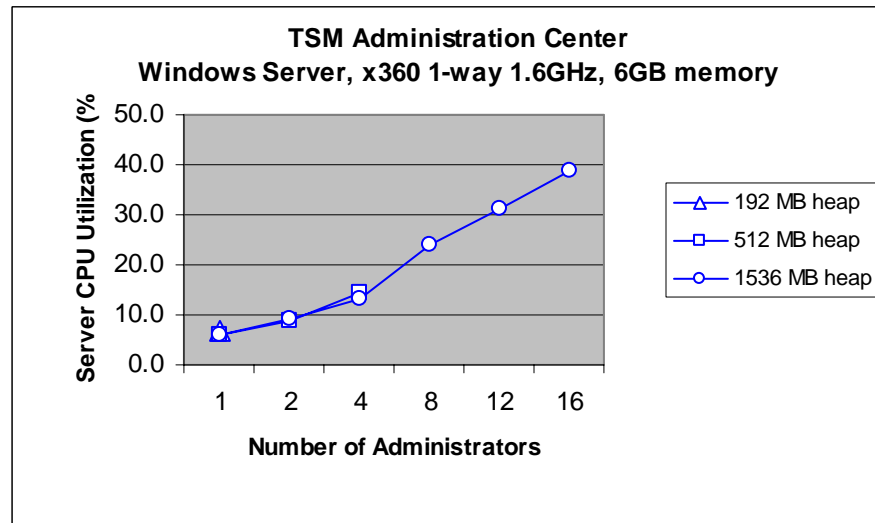**Figure 13. AdminCenter Windows Server Task Elapsed Time**

Figure 14. AdminCenter Windows Server CPU Utilization

The number of tasks completed represents the amount of work completed during the test. Each of these tests was conducted for 3 hours. A larger number of tasks completed means that the test was more productive, given that the same relative usefulness of tasks was completed in tests being compared. **Table 6** and **Figure 15** show that there is no significant difference in the number of tasks completed for measurements with the same number of administrators due to the configured size of the ISC maximum Java heap.

The task percent success rate is calculated from the number of tasks completed divided by the total number of tasks completed and failed. For the Administration Center server on Windows, no tests had less than a 98% task success rate, indicating the application is capable of accommodating this level of activity. When a failure does occur, the desired action may or may not have been completed. In many cases, the administrator can click the refresh button on the browser and the application may be able to recover. These results show that the Administration Center on Windows, as configured in these tests, is more scalable than the Administration Center on AIX, despite the larger memory used for the Java heap on the AIX system.

ISC Java heap	Number of admins	Tasks completed	Tasks failed	% Success rate
192 MB	1	632	0	100.0
512 MB (default)	1	638	0	100.0
	2	1284	0	100.0
	4	2268	6	99.7
1536 MB (max)	1	634	0	100.0
	2	1275	0	100.0
	4	2103	12	99.4
	8	3687	36	99.0
	12	5103	87	98.3
	16	6419	129	98.0

Table 6. AdminCenter Windows Server Task Completion Data
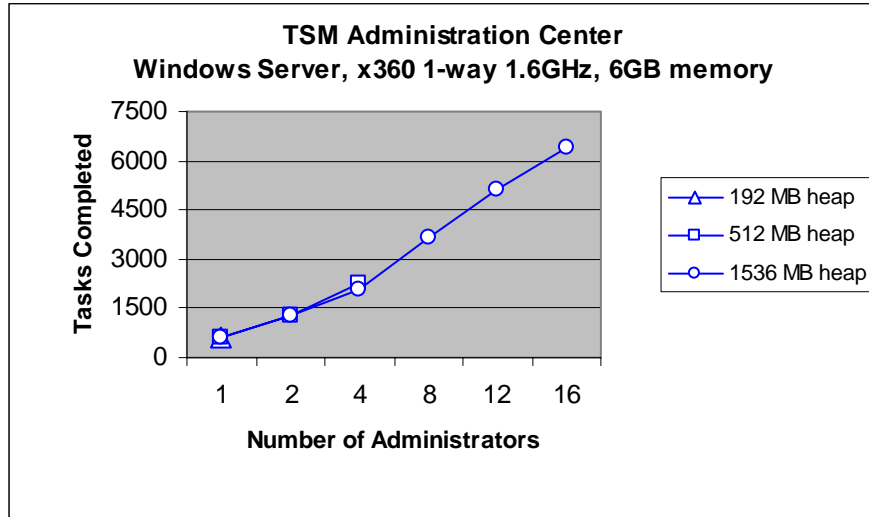

Figure 15. AdminCenter Windows Server Tasks Completed

The impact of additional administrators on the number of tasks completed per administrator is shown in **Figure 16**. The 16-administrator test completed over 400 tasks, or about 130 tasks per hour per administrator. This is likely to be more than what a real administrator would accomplish. In addition, the interface includes many possibilities where the administrator can execute multiple operations in a single "task", effectively getting much more work done. One such example would be in selecting and associating multiple nodes at a time with a new client schedule, rather than doing this one node at a time.

Figure 17 shows the task elapsed time by task for the tests using a 1536 MB Java heap and 1, 4, and 16 administrators. The tasks are enumerated in the chart from left to right in the order they are performed in the testcase. Many tasks do not experience a significant increase in task elapsed time with an increasing workload of multiple administrators. There are some tasks that do show significant increases, usually the longer tasks, such as `createClientNode`, `searchForClientNode`, `openClientNode`, and `deleteClientNode`.
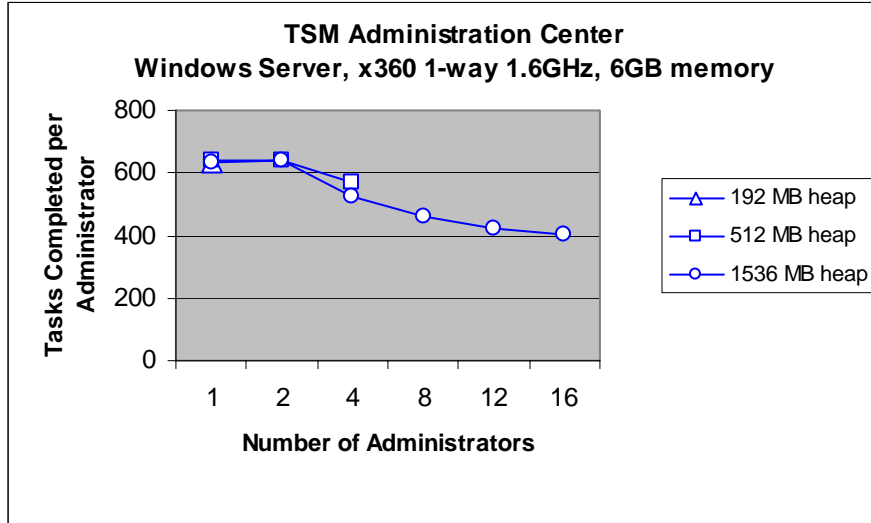

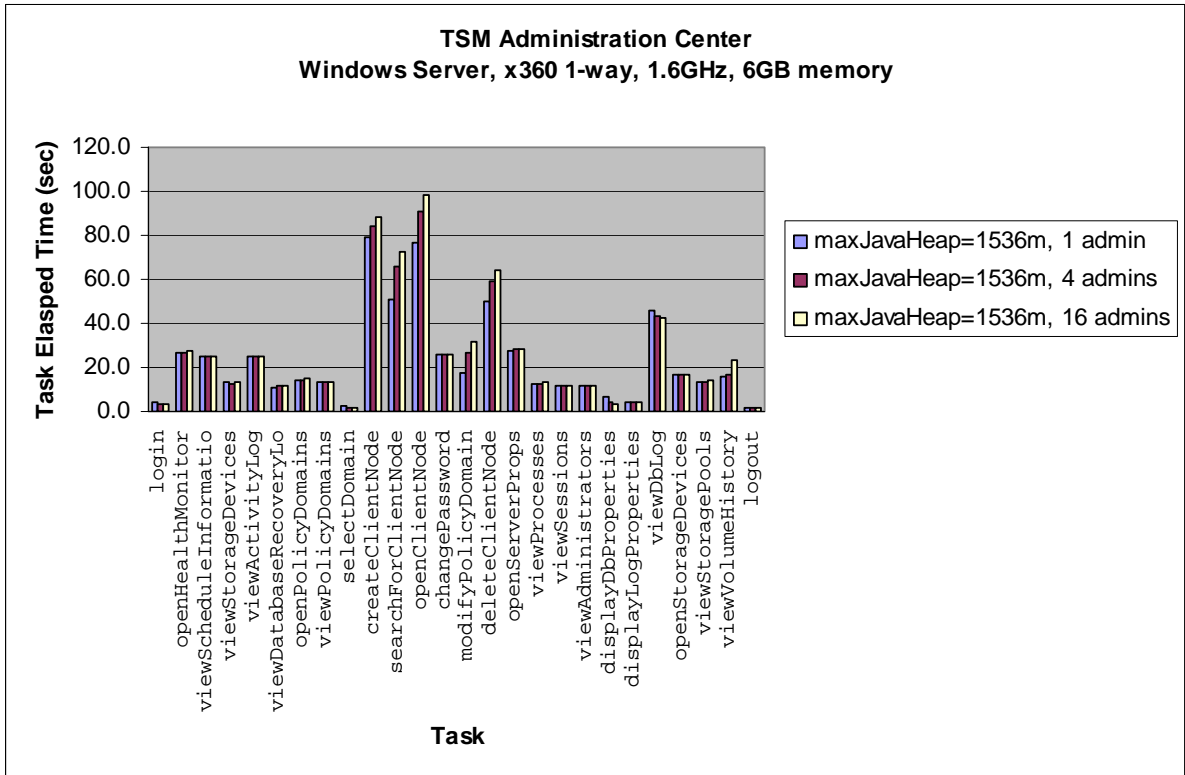**Figure 16. AdminCenter Windows Server Tasks Completed per Administrator**

Figure 17. AdminCenter Windows Server Task Elapsed Time by Task

Table 7 shows the Administration Center server on Windows memory utilization by Java heap size configuration and number of active administrators. The Java heap allocated measurement is the maximum size of the Java heap that contains allocated data structures directly after garbage collection has run. This is an indication of the amount of Java heap memory that is required to hold the application object data for all the administrator sessions and tasks in progress. These data were analyzed using linear regression to arrive at the best fit equation relating the maximum Java heap allocated and the number of active administrators:

$$\textbf{JavaHeapAllocated (MB) = 89 + ActiveAdministrators * 40}$$

ISC Java heap	Number of admins	Java heap allocated (MB)	Java heap maximum (MB)	ISC process memory (MB)
192 MB	1	127	191	355
512 MB (default)	1	118	219	382
	2	182	367	548
	4	245	511	696
1536 MB (max)	1	127	245	407
	2	180	381	559
	4	241	563	739
	8	400	882	1092
	12	595	1319	1556
	16	714	1535	1785

Table 7. AdminCenter Windows Server Memory Utilization
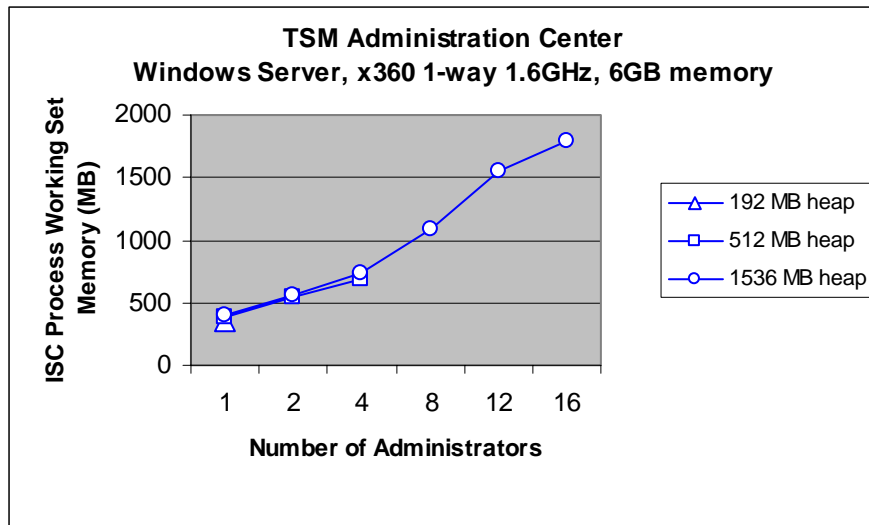
Figure 18. AdminCenter Windows Server Process Memory

Table 7 also includes the maximum Java heap size and the maximum ISC process working set memory size observed during these tests. Note that the observed maximum Java heap size contains both allocated data structures and free space, and can be less than but never greater than the configured maximum Java heap size. The process working set memory includes this Java heap memory and additional memory outside the heap for use by the Java Virtual Machine (JVM). A linear regression analysis indicates that the best fit equation relating the ISC process working set memory and the observed maximum Java heap size is the following:

$$\textbf{IscProcessMemory (MB) = 150 + JavaHeapMaximum (MB) * 1.07}$$

Coresident Administration Center / TSM Server on Windows Results

This section describes the performance measurement results for a Tivoli Storage Manager Administration Center server running on the same Windows system as a Tivoli Storage Manager server. This is a frequent requirement that occurs in small TSM environments where the number of servers is limited, and a dedicated Administration Center system would be too costly. Furthermore, the hardware resources of the available systems are likely to be limited. This test was designed to measure the feasibility and resource requirements for an Administration Center installation on such a system. Only a single active administrator was measured with an ISC maximum Java heap size of 192 MB and a system with 1GB real memory. This data was then compared to results presented earlier for a dedicated Administration Center server with a single active administrator and an ISC maximum Java heap size of 192 MB.

The measurement configuration for this test was different than for the dedicated Administration Center tests, and this configuration is described in **Figure 19** and below. The Integrated Solutions Console (ISC), the Tivoli Storage Manager (TSM) Administration Center, and a TSM 5.3.2 server were installed on a single Windows system. This system was configured with 2 processors compared to a single processor in the dedicated Administration Center server, to better handle the additional TSM server backup load. Hyper-threading was available on these processors, but was disabled. The amount of real memory was reduced to 1GB on this system to provide a memory-constrained system. The /3gb and /pae Windows boot flags were not used in this configuration.

The administration tasks were initiated using a web browser on a PC running Windows XP. This PC and the Administration Center were connected via a single 100 Mb Ethernet switch. In addition, 16 additional PCs were configured to perform file system incremental backups to the TSM server continually during the test cycle. Five percent of the files in these file systems were modified between backups so that each incremental backup sent backup file data. These backup clients were connected to the TSM server system via a 1Gb Ethernet switch.
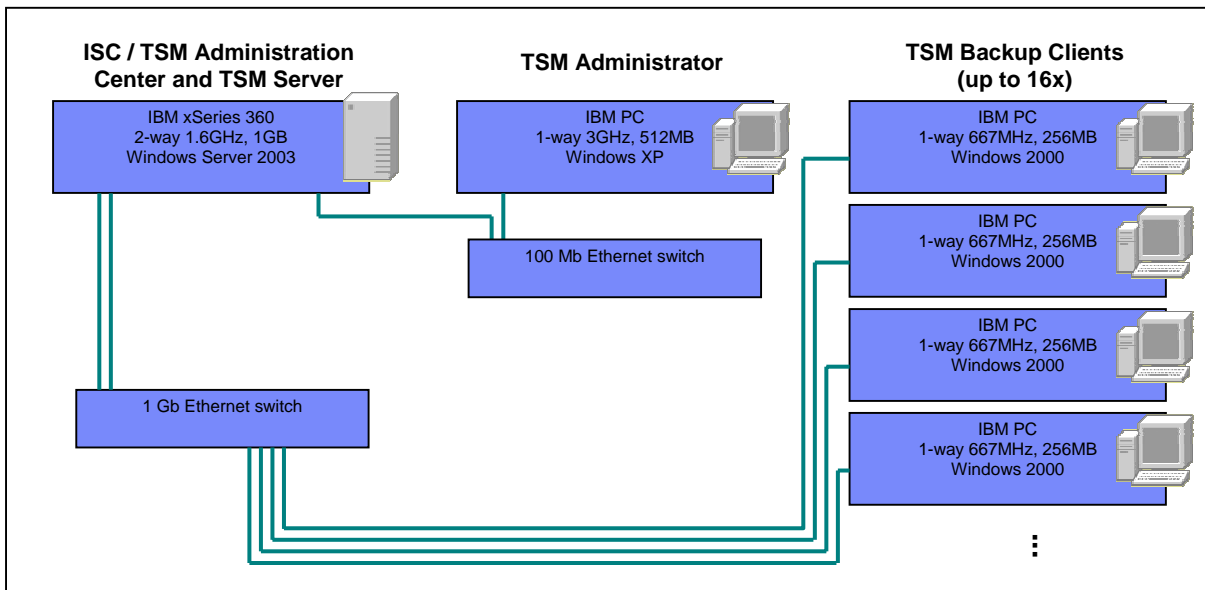

Figure 19. Coresident AdminCenter / TSM Server measurement configuration

The Integrated Solutions Console was configured with 17 TSM Administration Center users defined. Each of these administrators had from 1 to 4 TSM server connections defined, for a total of 5 unique TSM servers defined to the Administration Center. All administration tasks were executed using a

single administrator and the single TSM server installed on the same Windows system as the Administration Center. Each test was conducted for a 3 hour period.

Table 9 shows the mean task elapsed time for the measurements on the dedicated Administration Center server and on the coresident Administration Center / TSM server with a 16 client incremental backup load.

Administration Center server type	Task elapsed time (sec)	Server CPU %
x360 1-way, 6GB, dedicated, no backup load	22.4	6.7
x360 2-way, 1GB, coresident with TSM server, 16 client incremental backup load	21.6	86.4

Table 9. Single Administrator Test Performance Data Comparison

It is in fact interesting to note that the mean task elapsed time is actually reduced in the case of the Administration Center running on the same system as the TSM server, even though the system is much busier due to the TSM backup load. There are a few possible explanations for this, as follows:

- In the coresident Administration Center / TSM server test, the data transferred between the TSM server and Administration Center is done locally (using localhost), rather than over a network. This local data transfer is more efficient and faster.
- In the coresident Administration Center / TSM server test, the TSM server is at version 5.3.2, while in the dedicated Administration Center test, the TSM server is at version 5.3.0. There is an improvement in administration data transfer performance with TSM 5.3.2 servers.
- In the coresident Administration Center / TSM server test, the TSM server is running on a faster system than in the dedicated Administration Center tests, though it is also executing a heavy amount of backups. The faster processor may make some difference in task elapsed time, however, this has not been observed in other measurements.
- In the coresident Administration Center / TSM server test, the administrator had only 1 server connection defined which was always pre-selected. In the dedicated Administration Center test, the administrator had 4 server connections defined. Because TSM Administration Center 5.3.2 now uses client-side selection when selecting rows from a table, there is no interaction with the Administration Center server for this action, and minimal elapsed time is involved. Pre-selection of the single row in a table makes much less difference, though it still eliminates one user mouse click.
- In the coresident Administration Center / TSM server test, the tables displayed by the tasks executed generally contained fewer rows than in the dedicated Administration Center test. The average number of client nodes was 35 (coresident), and 441 (dedicated). The average number of volume history table entries was 693 (coresident) and 1000 (dedicated). However, the average number of sessions was 43 (coresident) and 13 (dedicated).

Looking at the mean task elapsed time by task executed shows that we can identify a few tasks that are clearly faster for the coresident Administration Center / TSM server test. This data is shown in **Figure 20**. The `createClientNode`, `searchForClientNode`, `openClientNode`, `deleteClientNode`, and `viewDbLog` tasks all stand out as contributing most of the difference in elapsed time between the two configurations. Even though there are elapsed time differences between these two configurations, those differences are relatively small, and not likely to be noticeable to an administrator.
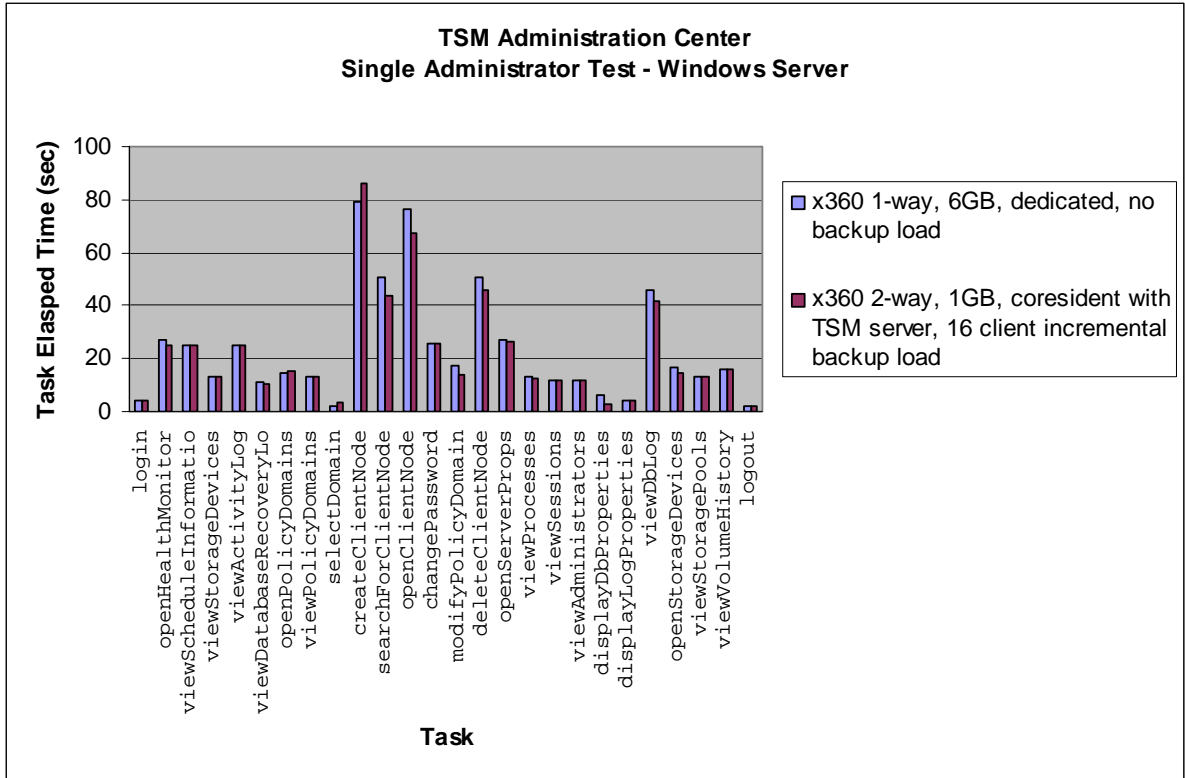
TSM Administration Center
Single Administrator Test - Windows Server

Figure 20. Single Administrator Test Task Elapsed Time Comparison

Additional data comparing the dedicated Administration Center server and the coresident Administration Center / TSM server with a 16 client incremental backup load are included in **Table 10**, and **Table 11**. All of these tables show that there are only minor differences in the performance of the two configurations. When only a single administrator is using the Administration Center, the maximum Java heap size does not need to be larger than 192 MB.

Administration Center server type	Tasks completed	Tasks failed	% Success rate
x360 1-way, 6GB, dedicated, no backup load	632	0	100.0
x360 2-way, 1GB, coresident with TSM server, 16 client incremental backup load	652	0	100.0

Table 10. Single Administrator Test Task Completion Data Comparison

Would it be possible to run 2 administrators concurrently in either or both of these configurations? This question can be answered from the data in **Table 11**, and the knowledge that the Java Virtual Machine (JVM) by default tries to keep 30% of the Java heap free so that future object allocations have a low probability of having to wait for garbage collection to run before the allocation can be satisfied. One way to meet the 30% free target is to increase the size of the Java heap. However, this cannot be done if the heap is already at the maximum size. In these tests, that is the case, and furthermore, if 30% of the heap is to be left free after garbage collection, then the maximum amount of the heap that can contain allocated objects is 192 MB * 0.70 = 134 MB. As seen in **Table 11**, the maximum allocated Java heap after garbage collection runs for both tests is just below this value.

The maximum allocated Java heap for the coresident Administration Center / TSM Server test is smaller than that for the dedicated Administration Center test most likely due to the use of smaller tables in the former test, as detailed earlier. If a second concurrent administrator was executing in these environments, the additional heap memory required would most likely reduce the free heap to less than 30% on a continual basis. Garbage collection would run more frequently, and there would be a higher probability that some object allocations would fail. The results would be that the mean task elapsed time would increase, and the percent task completion success rate would decrease, perhaps significantly. It is therefore doubtful that running two concurrent administrators in these environments (i.e. with a 192 MB Java heap) would be a productive experience. For the same reasons, it is not recommended to run Administration Center with less than a 192 MB Java heap, even if only intending to run one administrator at a time.

Administration Center server type	Java heap allocated (MB)	Java heap maximum (MB)	ISC process memory (MB)
x360 1-way, 6GB, dedicated, no backup load	127	191	355
x360 2-way, 1GB, coresident with TSM server, 16 client incremental backup load	110	191	345

Table 11. Single Administrator Test Memory Utilization Comparison

Because real memory on the coresident Administration Center / TSM Server system is constrained, it is important to make a memory budget and identify the requirements of the system components and applications. Exceeding the amount of real memory will result in the operating system using the paging file on disk, with the likely result that application performance will degrade. Based on the data collected in these tests, such a budget for a Windows system might look like **Table 12**.

Component or Process	MB
OS Kernel	62
ISC / TSM Administration Center	355
ISC / TSM Administration Center help system (Eclipse)	35
TSM Server	292
File System Cache	240
Free	40
Total	1024

Table 12. Coresident AdminCenter / TSM Server Windows Memory Budget

Important TSM configuration parameters for this environment as tested were as follows:

- ISC / Administration Center maximum Java heap size of 192 MB
- TSM Server database bufferpool size set using **bufpoolsize 131072** and **selftunebufpoolsize no**
- TSM Server **maxsessions 100** to limit the maximum number of client and administrative sessions

In addition, TSM server processes such as storage pool migration, storage pool backup, reclamation, and expiration should be scheduled to avoid overlap, and problems with trying to run too many sessions and processes at the same time.

For a memory-constrained Windows server, it may be useful to optimize the memory usage for programs by doing the following (for Windows Server 2003): Click **Start**, **Settings**, and **Control Panel**. In the **Control Panel**, double click **System**. In the **System Properties** panel, click the **Advanced** tab, and then click the Performance **Settings** button. In the **Performance Options** panel, click the **Advanced** tab, and in the **Memory Usage** section, click the **Adjust for best performance of: Programs** (the default is **System cache**). Then click **OK** and reboot the server.

If these simple steps are implemented, the above data show that it is entirely possible to run the Administration Center server on the same memory-constrained system as a TSM server.

Capacity Planning

This section conveys information useful in sizing the number of Tivoli Storage Manager Administration Center servers which may be required to support a given number of TSM administrators and/or TSM servers in a large enterprise, and sizing the server hardware required by those Administration Center servers. The purpose in making an appropriate sizing is to allocate sufficient resources to meet the peak application demands with minimal to no performance degradation and/or loss of function.

Where the Administration Center server is sharing a system with other applications, the processing and memory requirements of those additional applications should be added to the Administration Center requirements to determine the total system requirements.

NOTE: The equations and calculations in this section are valid only for the TSM 5.3.2 Administration Center using the Integrated Solutions Console version 6.0.1. Previous versions of these products may have different requirements.

Maximum Number of Active Administrators

The results in this document suggest that the maximum number of concurrently active administrators that can be supported on a single Administration Center server instance at any given time is 8 for an AIX server and 16 for a Windows server. Concurrently active administrators are those that are logged in and actively executing some administration task at that time. Exceeding this limit is likely to result in an unacceptable rate of task failures and lost administrator productivity. Many more administrators can be defined to a single Administration Center server without concern. More administrators can likely be logged in at any given time if it can be assumed that they will be executing relatively few tasks, such as a few per hour, and that those tasks would not be concurrent.

These limits do not appear to be related to processing power or memory constraints. If the required number of active administrators is greater than these limits then multiple Administration Center instances should be planned.

Processing Capacity

The results in this document show that Administration Center environments with high performance requirements can be met with a uni-processor system of 1 GHz, or faster, processor speed. Additional performance measurements, not presented here, have shown that the overall elapsed time for TSM administration tasks is not very dependent on the Administration Center server processor speed. Additional processors may be used by the Administration Center server, but they won't necessarily have a material impact on the application performance.

The Administration Center processor utilization may be estimated using the following equation, based on the equations derived in this document from experimental data on the AIX and Windows platforms.

$$\text{CpuUtilization (\%)} = 2 + \text{TasksCompleted (per Hour)} * 0.02$$

The tasks completed per hour rate is the highest total number of tasks per hour expected to be executed using this Administration Center server. It includes tasks executed by all administrators logged in at the time. A task is best thought of as the minimum amount of interaction within the administration interface that produces some useable information, or completes some desired operation. The number of tasks executed per hour by a single administrator would be expected to be between 20 and 100, but should not exceed the maximums reached in the tests documented in this report (2140 tasks/hour). The CPU utilization should be further adjusted by multiplying by the ratio of 1.6 GHz relative to the planned processor speed, and dividing by the number of processors.

I/O Throughput

Administration Center disk I/O and network I/O requirements are not particularly demanding and there is no need for sustained high I/O throughput, however, application response time will suffer if network delays or disk I/O delays occur. A low latency network will provide the best administrator response time. Networks that are poorly tuned, networks that are already saturated by other applications, or networks that have significantly higher latency (WANs) could impact Administration Center performance appreciably.

Process Memory

The most important resource requirement for the Administration Center is memory. Performance results presented in this document show that the Administration Center (Integrated Solutions Console) process working set memory may be estimated using the following equation, based on the equations derived in this document from experimental data on the AIX and Windows platforms.

$$\text{IscProcessMemory (MB)} = 150 + \text{JavaHeapMaximum (MB)} * 1.1$$

The maximum Java heap size is the value specified for the Administration Center server, which is by default 512 MB. The largest value that can be configured for the maximum Java heap size is 2048 MB for AIX and 1536 MB for all other platforms. Thus, the Administration Center process working set memory requirement is effectively determined by the amount of Java heap memory specified.

Additional memory required by the operating system and any other applications on the Administration Center server should be added together, and the server configured with at least this much real memory. It is very important that this required real memory be available or significant response time degradation may occur as the result of system memory paging.

For situations where the TSM server and TSM Administration Center share the same system, the TSM server memory may be estimated using the following equation:

$$\text{TsmServerMemory (MB)} = \text{BufPoolSize (MB)} * 1.25 + \text{MaxSessions} + 32$$

Thus, the TSM server process working set memory requirement is effectively determined by the amount of database bufferpool memory specified by the TSM server option **bufpoolsize**, and the amount of memory used by sessions on the TSM server as limited by the maximum number of sessions specified by the TSM server option **maxsessions**.

Java Heap Memory Sizing

The Administration Center maintains information for each active administrative session as a set of objects within the configured Java heap memory. The administrative session memory requirements depend on the activities executed by the administrator during the session. Each open work page requires memory, and each open table requires additional memory that depends on the number of rows and columns in the table. Performance results presented in this document show that the Administration Center Java heap size may be estimated using the following equation, based on the equations derived in this document from experimental data on the AIX and Windows platforms.

$$\text{JavaHeapMaximum (MB)} = (90 + \text{ActiveAdministrators} * 40) / 0.7$$

The number of active administrators is the maximum number of concurrently logged in administrators. Additional administrators may be defined in the Integrated Solutions Console and as long as they are not logged in, no additional memory is required. The number of TSM server connections defined by

an administrator within the Administration Center is not an important variable in determining the Java heap size requirements, except in the sense that more servers implies more actual work may be required. A larger maximum Java heap size will provide additional memory in the case of unexpected administration activity or workload growth. However, more real memory would be required.

Note that using a maximum Java heap size that is too small for the amount of work being executed in the Administration Center will cause the Java Virtual Machine (JVM) to execute garbage collection more frequently, causing higher processor utilization and slower application response time. In excessive conditions, memory allocation failures will result in the application being unable to perform the requested action, until memory is freed up by closing work pages or logging out sessions.

Tips for reducing administrator session memory requirements:

- Close work pages as soon as you are finished with them.
- Logout if you will not be using any administrative functions for more than 30 minutes.
- Do not configure the session timeout period for more than 30 minutes.

Both the Administration Center session timeout period and the maximum memory size (Java heap size) should be configured using the Administration Center Support Utility. This utility is located in the `Tivoli/dsm/bin` subdirectory below the Integrated Solutions Center installation directory. An example of its usage is shown in **Figure 21** below.

```
C:\Program Files\IBM\ISC\Tivoli\dsm\bin>supportUtil.bat

Administration Center Support Utility - Main Menu
==================================================

1.  Turn all tracing on
2.  Turn all tracing off
3.  Turn a single trace class on
4.  Update the maximum memory size Administration Center can use
5.  Update the Administration Center session timeout setting
6.  Collect trace files, logs and system information to send to support
7.  View the log file for this utility
9.  Exit

Enter Selection: 5
The session timeout setting determines how long a session can be idle before it times
out. After a timeout occurs the user must log in again. The default timeout setting is 30
minutes. The minimum timeout setting is 10 minutes. To cancel this operation, enter an
empty value.
Enter the new session timeout (minutes): 30
Updating the session timeout to 30 minutes....... Session timeout successfully updated.
Restart ISC for changes to take effect.

Administration Center Support Utility - Main Menu
==================================================

1.  Turn all tracing on
2.  Turn all tracing off
3.  Turn a single trace class on
4.  Update the maximum memory size Administration Center can use
5.  Update the Administration Center session timeout setting
6.  Collect trace files, logs and system information to send to support
7.  View the log file for this utility
9.  Exit

Enter Selection: 4
The maximum memory size determines the largest amount of memory that can be used by the
Administration Center. A minimum heap size of 512 MB is recommended. When used by 10 or
more users, the recommendation is at least 1024 MB. To cancel this operation, enter an
empty value.
Enter the new JVM max memory size (MB): 1536
Updating the maximum memory size to 1536 MB...... Maximum memory size successfully
updated.
```

Figure 21. Example of Administration Center Support Utility Usage

Remember: Do not configure the maximum memory size (Java heap size) to be greater than the available real system memory, or significant performance degradation may occur.

Capacity Planning Example

A TSM Administration Center Capacity Planner tool exists that can simplify using the equations in this document and provide recommendations for Administration Center hardware sizing. Check the same location where you found this document, or see your IBM representative to obtain this tool. An example of this tool is shown in **Figure 22**.
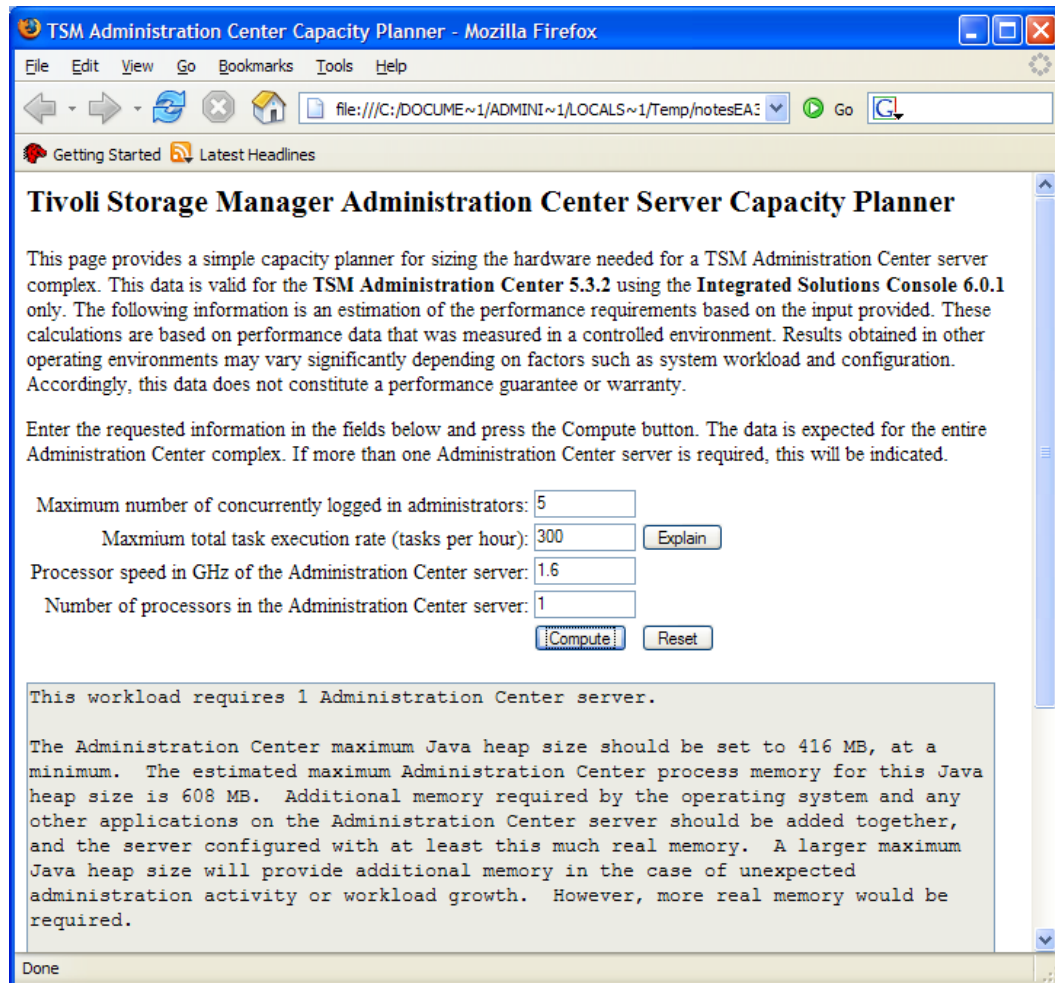

Figure 22. Example of Administration Center Capacity Planner Usage

Recommendations

The following recommendations may be useful in helping you to obtain optimal performance when using the Administration Center.

Administration Center installation requirements
The Administration Center installation should meet the minimum hardware requirements as found in the README.INSTALL document, or online at:

http://www.ibm.com/software/sysmgmt/products/support/IBMTivoliStorageManagerVersionRelease.html

If the Administration Center server is being installed in an environment where the workload is known to be light, i.e. a single administrator, then the memory requirements calculated using the Capacity Planning section in this document will indicate a smaller memory requirement than the minimums above. Administration Center server performance may be acceptable when using this smaller memory amount if the workload is indeed light. It should be noted that additional memory and processing power can provide significant performance benefits in the case of unexpected demand or workload growth.

In the case of an existing Tivoli Storage Manager server that is being upgraded to version 5.3, where the existing hardware cannot meet the additional Administration Center requirements, then upgraded hardware or an additional system should be proposed for the Administration Center function.

Administration Center installation location
A single Administration Center installation can be used for administration of many TSM servers. The Administration Center may be installed on the same machine as the TSM server if it meets the memory requirements described above and is being installed on one of the operating systems that the Administration Center supports. If additional applications are being deployed to the same Integrated Solutions Console (ISC) system, or if Administration Center will be used with multiple TSM servers and many administrators, it is recommended that Administration Center be installed on a system other than one with a TSM server. For availability reasons, you may wish to install multiple Administration Center images.

Because more of the network traffic during administration activities will occur between the Administration Center system and the administrator's browser than between the Administration Center system and a TSM server, the Administration Center should be installed close (in network topology) to the administrators, rather than close to the TSM servers. For example, you are in Chicago and must administer TSM servers in Los Angeles, Paris, and Tokyo. It is recommended that the Administration Center be installed in Chicago.

Use "localhost" for a TSM Server on the same system
For Administration Center installed on the same system as a TSM server, add a connection to that TSM server in Administration Center by using "localhost" as the TSM server TCP/IP address. Doing so will eliminate TCP/IP nameserver look-ups and may improve performance in some networks.

Minimize Administration Center memory usage
To keep the Administration Center server memory available for those users and tasks that really need it, use all of the following:

- Turn all Administration Center server tracing off, except as needed for problem determination.
- Do not increase the ISC session timeout above 30 minutes, as idle sessions could be holding on to large amounts of memory until the session is canceled due to the timeout.

- Instruct administrators to close portlet pages when finished using them, as closing the pages frees up any memory held by those pages.
- Use filtering options where provided when displaying data in large tables. The additional search criteria will reduce the amount of data that Administration Center receives from the TSM server, and/or reduce the amount of data sent to the browser, as well as reduce the amount of memory required.

Windows server memory optimization

For a memory-constrained Administration Center server on Windows, it may be useful to optimize the memory usage for programs by doing the following (for Windows Server 2003): Click **Start**, **Settings**, and **Control Panel**. In the **Control Panel**, double click **System**. In the **System Properties** panel, click the **Advanced** tab, and then click the Performance **Settings** button. In the **Performance Options** panel, click the **Advanced** tab, and in the **Memory Usage** section, click the **Adjust for best performance of: Programs** (the default is **System cache**), as shown in **Figure 23**. Then click **OK** and reboot the server.
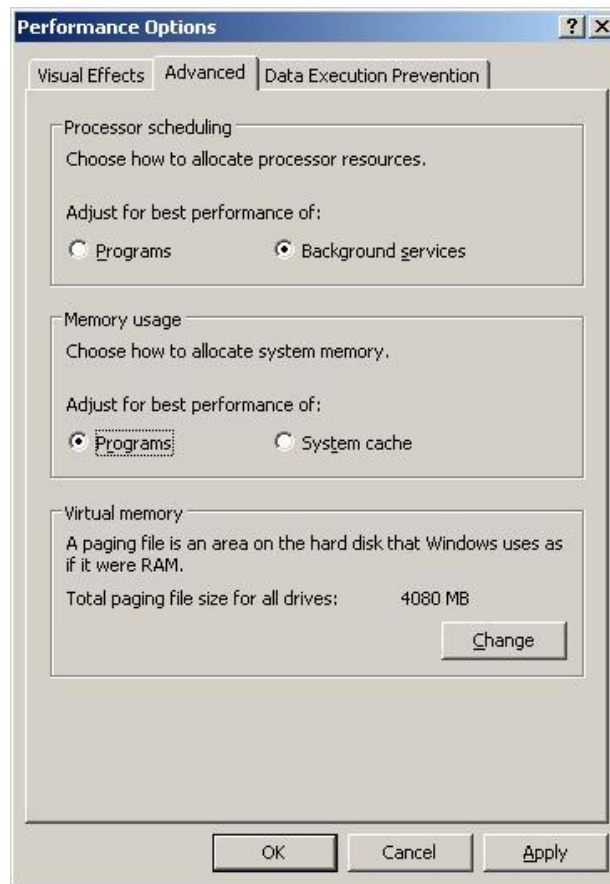

Figure 23. Windows Server 2003 Performance Options

Interface short-cut

A short-cut exists in the interface for selecting a storage object and executing the "default" action. From a list of selectable objects (servers, policy domains, etc.), the default action in the "Select action" drop-down box is executed when the underlined object is clicked. Most often, the default action is to display the properties for an object. Using the short-cut improves performance some by eliminating clicking the radio button next to the object, clicking the drop-down box, and selecting the requested action.

Performance Problem Determination

If you experience performance problems with the Administration Center, check the following:

Processor Problems

Any problem with excessive processor utilization on a system with Administration Center installed is likely due to other applications using too much of the processor(s). Use the available platform-specific performance tools on the Administration Center server to investigate this. If total processor utilization is over 90% for extended periods, either reduce the workload on the system, or add more processing capacity.

Network Problems

Check that network response time is acceptable. Use the **ping** command to determine the response time between the Administration Center server and the TSM server, and between the system used for the browser and the Administration Center server. Acceptable round-trip response times might be 10ms for a LAN, or 100ms for a WAN. If either network response time is consistently higher than expected, you should check with your network administrator.

Even if the **ping** network response time is good, bulk data transfer rates can be poor. Check the **ftp** data transfer rate of a 10MB file between the Administration Center server and the TSM server, and between the system used for the browser and the Administration Center server. An **ftp put** or **ftp get** for a 10 MB file should take no more than a few seconds in a properly configured network. For 100Mb Ethernet networks, the media speed setting can be a source of performance problems. This setting can be set to "100Mb full-duplex", "100Mb half-duplex", or "Auto". While newer hardware works fine with the "Auto" setting, some combinations of switches, hubs, and adapters exhibit very poor performance if incorrectly configured.

Memory Problems

Check that the maximum memory size that the Administration Center server can use (also known as the maximum Java heap) is correctly configured for the expected workload in terms of the number of concurrently logged in administrators and task execution rate. Use the Administration Center server capacity planning tool and section in this document. If the maximum Java heap is set too low, use the support utility to increase this setting, and stop and restart the Administration Center server. Note that stopping the server will free up any memory for idle sessions, without waiting for the session timeout to expire.

Check that the Administration Center server is not paging system memory. Use the available platform-specific performance tools on the Administration Center server to investigate this. For example, use the **vmstat** command on UNIX, or check the Windows Performance Monitor **Memory** object, **Pages Output/sec** counter. If the system is paging memory, then reduce the amount of memory in use by the active processes, or add more real memory.

To check the amount of real memory currently in use by the Administration Center server process, use the **ps** command on UNIX, or check the Windows Task Manager (**Processes** tab, **Mem Usage** column), or Windows Performance Monitor **Process** object, **java** instance, **Working Set** counter. The following commands can be used on AIX to find the Administration Center server process ID and then the resident set memory (RSS) for this process:

```
ps -ef | grep [I]SC_Portal | awk '{ print $2 }'
ps avxw PID
```

In addition, check the IBM support site for updates to the Integrated Solutions Console and Tivoli Storage Manager Administration Center, and for information that may describe your problem.