HP Business Availability Center

Software Version: 8.x

Performance Benchmark on VMware

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1. Executive Summary

This benchmarking study was performed in our HP performance labs. The results demonstrate that Business Availability Center (BAC) 8.x can be deployed on VMware ESX Server 4.0 in a favorable server consolidation ratio to meet corporate IT business requirements.

The performance degradation, according to our results, can vary from 11.07% to 19.07%, depending on the VMware configuration.

2. Introduction

In the last published VMware vSphere 4.0 results, VMware expects application performance degradation of 5% to 10%.

The results of our performance tests using updated hardware are presented in this document. We also included other technical consulting resources used in the tuning process.

The purpose of this document is to provide a direct comparison between HP Business Availability Center (BAC) 8.04 servers running on a physical environment and BAC 8.04 running on a virtual environment. While we tested a specific version (8.04), we expect the same results for all 8.x versions of BAC.

Between the physical and virtual tests, all other environmental variables are the same (BAC version, database parameters, performance system test, etc.).

The measured performance differences give an indication of the resource demand required to operate under the virtual machine hypervisor and management systems.

The same performance test was executed against physical and virtual environments.

3. Background

3.1. Benchmark Goals

The goal of this study is to provide meaningful data relevant to end users, giving them enough confidence to consider deploying BAC 8.04 in an ESX Server environment. The detailed goals are as follows:

- Use BAC 8.x deployed by end users on virtual environments as deployed on dedicated physical platforms.
- Demonstrate that BAC 8.x can run virtualized with minimal risk.
- Present BAC 8.x consolidation ratio, meeting corporate IT business requirements.
- Highlight the probable bottleneck areas of a virtual implementation.
- Simulate as much as possible a typical IT environment including resources, knowledge and infrastructure.
- Apply no application optimization that might skew results. For example: we used a guest operating system and ESX server with out-of-the-box configuration, with further optimization thoroughly documented.
- Create a set of best practices that can apply to BAC 8.x virtual deployments.
- Limit the benchmark to a specific workload type with clearly defined performance criteria.
- Perform benchmark testing that can be duplicated using the same environment.

3.2. Methodology

This benchmark uses a pre-defined performance test called **system test**. This test includes certain uses cases which cover different parts of the most representative BAC usage. Following are details of this test:

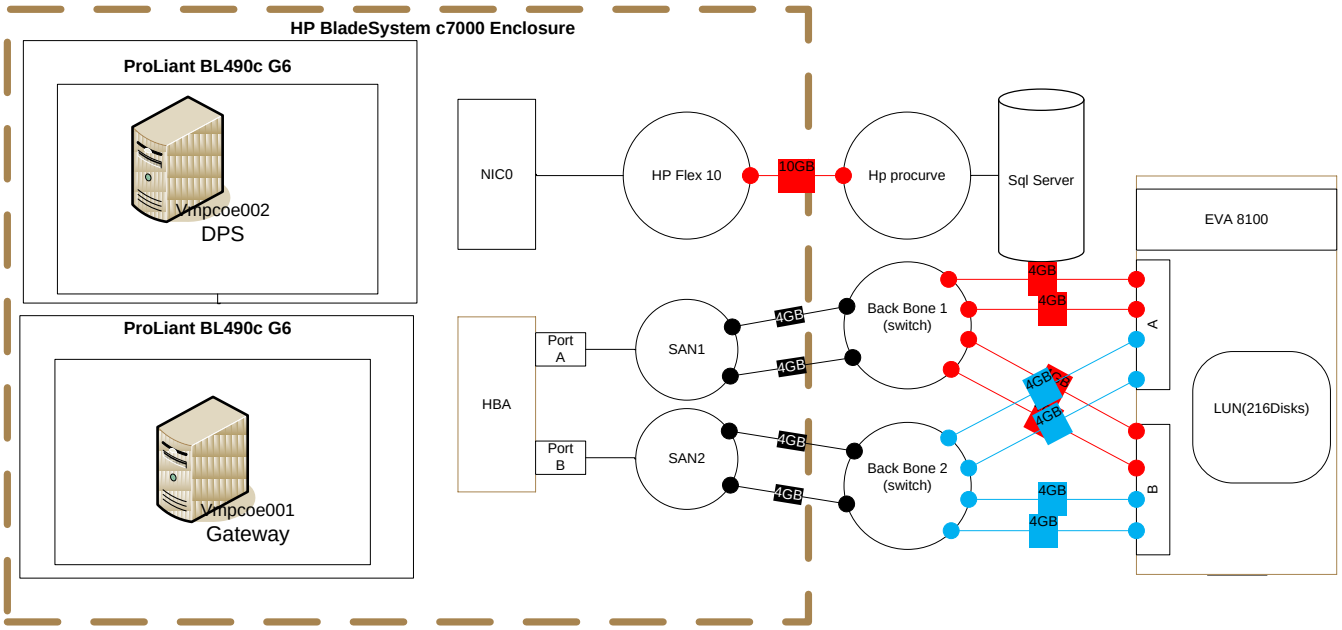
- BAC is deployed in a distributed environment across two basic servers, one called Data Processing Server (DPS), and the other called Gateway. Both servers interact often during normal operations.
- The BAC 8.04 system test was run on two separate physical hosts to establish a 'bare metal' baseline.

- Using the same server type and OS parameters, we ran the same BAC 8.04 system test as we ran to establish the 'bare metal' baseline on BAC 8.04 installed on two virtual machines.
- In both cases, the relational database management system (RDBMS) uses the same MS SQL server database, which was isolated from any other workload and was running in a physical configuration.
- We tested 7 different ESX and VM configurations, as detailed and presented in this document.

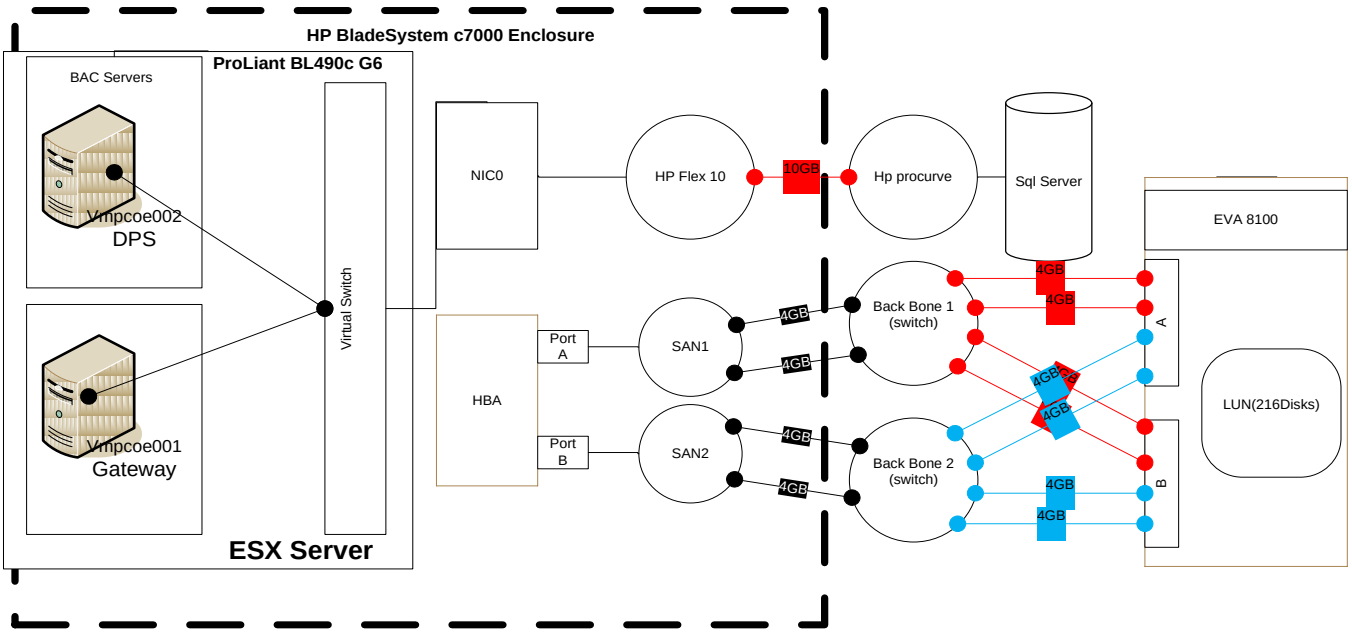
3.3. Physical Infrastructure

- The 'bare metal' baseline ran two hosts using HP ProLiant BL490c G6 servers running native Windows 2003 Enterprise Edition 64-bit version, with 4 CPUs, 8 GB RAM each.
- The ESX Server used the same HP ProLiant BL490c G6 type machine using 8 CPUs and 64 GB RAM.
- In the virtual environment, BAC 8.04 was installed on two virtual machines (VM), configured with 8 GB RAM and 4 virtual CPU each, and the same Windows 2003 Enterprise Edition 64-bit version operating system.
- The RDBMS uses the same MS SQL server database, installed on a ProLiant BL460c G1 physical machine, with 8 CPUs and 32 GB RAM.
- SAN external storage was used as storage for both BAC servers, as a boot image, and for internal storage.
- The ESX server has one HBA card with two ports, connected to a SAN switch in High Availability configuration, and to an EVA 8100 SAN server, using a 4-GB Fibre Channel connection. Both LUNs use 30 GB of storage, which is configured in a 216-disk array.
- The SAN provides redundant paths to the storage, but only one side is actually active at a time, which means that all the traffic to and from the storage array flows through the same switch. In case of a failure in any Fibre Channel components in the path, it is possible to fail over to the alternative switch and continue operation. This normally occurs without interruption to BAC.

3.3.1. Physical Chart (Baseline)



3.3.2. VMware Test Chart



3.4. Deployment Findings and Best Practices

- BAC 8.04 was tested in a straightforward ESX server configuration with good results, which could be further improved with more tuning.
- ESX affinity CPU groups were tested to separate the workloads of both BAC 8.x servers (DPS and Gateway). In the test described, we used 4 CPUs for each CPU group affinity. The first affinity group was defined for the CPUs 4 to 7 and the second affinity group for the CPUs 8 to 11.
- The influence of the VMCI (Virtual Machine Communications Interface) feature was tested. This feature, combined with the affinity feature described above, gives us the best results. However, with VMCI enabled, there are some limitations using HA and other VMware features, such as Vmotion. Consult VMware documentation for further information.
- When hyper-threading sharing was disabled, the test results were negatively impacted.
- Use the same ESX server for both DPS and Gateway when possible, since both servers interact heavily through the network. Using the same ESX server will assure that network traffic between DPS and Gateway occurs internally at the ESX level.

3.5. Benchmark Conclusions

- There is degradation in the average transaction response time (TRT) compared with the physical environment using VMware ESX server and VM for the BSM servers (DPS and Gateway).
- The average degradation can vary, depending on the VM environment configuration.
    - Best performance: DPS and Gateway machines running with CPU affinity and VMCI enabled for both VMs.
    - Overall average TRT increased by factors of 11.07% to 19.07% for the best performing transactions.
- No intensive I/O operation was observed during the test on the VM machine.
- There was no unusual behavior from either I/O or context-switch perspectives.

3.6. Important Remarks

- The ESX server was dedicated for this test; there were no other activities on the ESX server.

4. Test Results

4.1. Load Test

Description	Number
Concurrent users	133
Events per second (average)	350

For additional details about the virtual users and the different group types, see *Appendix A*.

4.2. Load Test Stability

The results of the benchmark study in the described workload demonstrate the stability achieved running BAC 8.x on virtualized ESX server vSphere 4.0 environment.

4.3. Average Transaction Response Time

The following table summarizes the average transaction response time (TRT) for each of the configurations tested.

Configuration	Average TRT (seconds)
Physical HW	1.44
VMware 64-bit default configuration	1.67
VMware 64-bit with Affinity	1.72
VMware 64-bit with Affinity and VMCI	1.60
VMware 64-bit with 2 CPU Affinity	1.71
VMware 64-bit with 2 CPU Affinity VMCI	1.69
VMware 64-bit with Affinity, VMCI and no HT sharing	1.82
VMware 64-bit with VMCI only	1.72

4.4. Average TRT Comparison

The following table shows the difference in average TRT, compared with the physical environment, for each of the configurations tested, in seconds and as a percentage.

Configuration	Average TRT difference (seconds)	Average TRT difference (%)
Physical HW	0.00	0.00
VMware 64-bit default configuration	0.23	16.30
VMware 64-bit with Affinity	0.28	19.78
VMware 64-bit with Affinity and VMCI	0.16	11.07
VMware 64-bit with 2 CPU Affinity	0.28	19.12
VMware 64-bit with 2 CPU Affinity VMCI	0.25	17.46
VMware 64-bit with Affinity, VMCI and no HT sharing	0.38	26.63
VMware 64-bit with VMCI only	0.28	19.47

4.5. Results for Transactions with Greatest Degradation

The table below shows the three transactions that had the greatest degradation, on average, between the physical and VMware environments. Please note: Few transactions increased more than 1.5 seconds. To see the full TRT result, please refer to *Full TRT result xls file*.

Configuration	TRT (seconds)		
	Go_To_Top_View	Over_Time_ClickGenerate	Go_To_Dashboard
Physical HW	3.34	2.13	3.08
VMware 64-bit default configuration	5.21	4.01	3.71
VMware 64-bit with Affinity	6.37	4.39	4.30
VMware 64-bit with Affinity and VMCI	5.93	1.91	4.09
VMware 64-bit with 2 CPU Affinity	6.93	5.36	4.30

Configuration	TRT (seconds)		
	Go_To_Top_View	Over_Time_ClickGenerate	Go_To_Dashboard
VMware 64-bit with 2 CPU Affinity VMCI	6.17	4.48	4.00
VMware 64-bit with Affinity, VMCI and no HT sharing	6.82	5.13	4.55
VMware 64-bit with VMCI only	5.45	2.07	3.93

4.6. Average CPU Utilization

The following table summarizes the average VM CPU utilization (as a percentage) in a concurrent environment running both Gateway and DPS for each of the configurations tested. The average VM CPU utilization was obtained using the VMware counters added to the virtualized OS (perfmon), available using the VMware VM tools installed in the guest OS.

Configuration	Gateway (%)	DPS (%)
Physical HW	34.37	22.21
VMware 64-bit default configuration	31.43	21.90
VMware 64-bit with Affinity	35.13	28.04
VMware 64-bit and VMCI	35.15	23.98
VMware 64-bit with 2 CPU Affinity	51.56	38.38
VMware 64-bit with 2 CPU Affinity VMCI	50.84	39.90
VMware 64-bit with Affinity, VMCI and no HT sharing	37.66	30.13
VMware 64-bit with VMCI only	31.05	20.50

Note that the VM CPU utilization clearly increases when limiting the number of CPUs to 2 available for each DPS and Gateway BAC servers, ~50% and ~40% respectively, compared with the other configurations.

5. Configurations

5.1. Application under Test

Application Version	Build
HP Business Availability Center 8.0.4	2148

5.2. Lab Hardware

Role	System Model	CPU (Cores x MHz)	RAM (GB)	Operating System	VMware	Comment
Physical Environment						
HP Business Availability Center Gateway	ProLiant BL490c G6	4x2.933	8	Microsoft Windows 2003 EE (64 bit)	N	
HP Business Availability Center Data Processing	ProLiant BL490c G6	4x2.933	8	Win2003 EE (64 bit)	N	
VMware Environment						
ESX Server	ProLiant BL490c G6	16x2.933	64	ESX 4.0	N	
HP Business Availability Center Gateway	N/A	4x2.933	8	Win2003 EE (64 bit)	Y	vmpcoe001
HP Business Availability Center Data Processing	N/A	4x2.933	8	Win2003 EE (64 bit)	Y	vmpcoe002
Database						
Database	ProLiant BL460c G1	8x3.0	32	Win2003 EE (64 bit)	N	

Appendix A – Scripts and Scenarios

The load test consisted of 10 test groups. Each group contained a separate test script and a different number of virtual users executing different business processes.

The following table displays the business process and number of virtual users for each of the different groups.

The load distribution defined here represents the workload analysis obtained from several large customers using BAC. The outcome of this workload analysis was the following specific distribution.

Business Process	**Details**	**Number of Virtual Users**
Create New Trend Report	Open_Report_Manager , Open_Trend_Report_Wizard , TRWizard_SetTrendProperties, Open_Add_Measurements_Page, SelectBP_Profile, Add__Measurements, ShowHeaderFooter D8_ReportPreview, SaveReport, DeleteReport	1
View Dashboard Tabs	Go_To_Dashboard, Choose_View, Go_To_Top_View, Go_To_Filters Go_To_Custom_Map	25
Generate End User Management Legacy Reports	Availability_over_Time_AutoGenerate, Availability_over_Time_PastHour, Response_Time_over_Time_AutoGenerate, Response_Time_over_Time_PastDay, Transaction_Analysis_AutoGenerate, Transaction_Analysis_PastHour, Error_Summary_AutoGenerate, Error_Summary_PastDay, Location_Analysis_AutoGenerate, Location_Analysis_PastHour, Breakdown_over_Time_AutoGenerate, Breakdown_over_Time_PastDay, Breakdown_Summary_AutoGenerate, Breakdown_Summary_PastHour, MinMax_Response_Time_AutoGenerate, MinMax_Response_Time_PastDay	32
Generate End User Management User-defined Reports	Reports_List_From_SiteMap, Reports_List_From_GeneratedReport, Generate_Custom_Report, Generate_Custom_Report_PastHour	9
Generate New End User Management Reports	Go_To_Status_Snapshot, Go_To_Triage_Report, Triage_Report_Select_Profile, Triage_Report_Generate_Past_Day, Triage_Report_Export_To_Repository_Preview, Triage_Report_Export_To_Repository_Submit, Go_To_Report_Repository, Triage_Report_Delete_From_Repository	18

Generate Triage Raw Data Report	Go_To_Triage_Raw_Data_Report, TRD_Report_Select_Profile, TRD_Report_Generate_PastDay, TRD_Report_Export_Preview, TRD_Report_Export_Submit, Go_To_Report_Repository, Report_Delete_From_Repository	19
View Monitors Tabs	Go_To_Administration_Tab, Go_To_Monitors, Select_Monitor, Go_To_Views_Tab, Go_To_Reports_Tab, Transaction_Ordering, Transaction_Coloring, Report_Filters	2
Platform Administration	Go_To_Administration_Page, DataCollectorMaintenance_SiteScope, DataCollectorMaintenance_BPM, DataCollectorMaintenance_RUM, DowntimeEvent_Schedule, Profile_Entity_Maintenance, PMeasurementFilters	1
Generate Service Level Management Overtime Reports	CIs_Over_Time_ClickGenerate, Choose_Item_Apply, CIs_Over_Time_WeekToDate, CI_Over_Time_vs_Target_ClickGenerate, CI_Over_TimevsTarget_WeekToDate	24
Service Level Agreement Status Snapshot	ViewSLAsStatusSnapshotPageFromSiteMapLink, RefreshSLAsStatusSnapshotPage	1
Total concurrent users:		**133**

Appendix B – Acronyms

Acronym	Explanation
BAC	Business Availability Center
BP	Business process
DB	Database
DPS	Data Processing Server
EPS	Events per second
ESX	VMware Hypervisor server
FC	Fibre Channel
LR	Load Runner
RDBMS	Relational database management system
SAN	Storage Area Network
TRT	Transaction Response Time
VM	Virtual machine

Appendix C – Testing Tools

Product	Purpose
HP LoadRunner	Scripts creation, results analysis, drive loads, resources monitoring
Sample simulator	Sample simulator, event simulator