

Windchill PDMLink & ProjectLink 8.0 Server Sizing Test Results on IBM POWER5/AIX 5.2/5.3

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Windchill R8 Server Sizing Benchmark Testing on IBM POWER5

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IBM on AIX Sizing Tool

(<http://www.ibm.com/servers/deepcomputing/wc8size.html>)

Test Goals

The purpose of these tests is to assist our hardware platform partners in developing Windchill server sizing guidelines

- ⦿ Develop platform specific formulas for number of concurrent users per CPU for the application tier and DB tier
- ⦿ Develop platform specific formulas for amount of physical memory per CPU for the application tier and the DB tier
- ⦿ Develop guidelines for converting concurrent users to named users

Concurrent User – A concurrent user is a simulated user that is actively logged in and using the system

Named User – A named user is someone who has the ability to log into the system and is a regular user of the PDMLink/ProjectLink functionality

Identify a set of High Concurrency Optimization parameters for Windchill R8 on AIX

Workload Definition

The PDMLink/ProjectLink workload and database definition have been defined by PTC Product Management

- ⦿ The database definition is defined to represent a medium sized implementation after approximately 3 months of use or a small implementation after 1 year of use
- ⦿ The workload is defined as a set of 50 simulated users equally divided between PDMLink and ProjectLink users
- ⦿ Each PDMLink and ProjectLink user commits a defined set of transactions over the course of the 1 hour test run
- ⦿ The test is defined such that the think time between transactions for each user is randomized
- ⦿ See the next several slides for additional details on the workload definition

It's important to note that the benchmark does not include transactions that use CAD data nor does the database contain any CAD data objects. These gaps will be addressed in Q1FY06

It's also important to note that the workload does not include any administrative functionality nor any significant workflow processing nor does the test include the use of IBAs

Workload Definition (Database Definition)

The Database consists of 100 PDMLink Products, 2 Component libraries, 100 ProjectLink Projects, and 1000 named users

Total database size is approximately 20 Gbytes

Each Product contains a multi level product structure with multiple subassemblies each containing multiple parts with a total of 600K parts and 27K part masters, 45K document masters and 165K document, as well as various object links and reference links

Each Project contains a multi level folder structure with each subfolder containing documents

Workload Definition (Database Definition)

The characteristics of the database are described below

Data Type	Quantity	
Number of Users	1000	
Number of Groups	~3500	
Number of Teams	~400	
Number of Products	100	
Number of Projects	100	
Number of Parts	~606K	
Number of PartMasters	~27K	
Number of Documents	~165K	
Number of Document Masters	~45K	
Number of Libraries	2	
Number of part usage links	~606K	
Number of part reference links	605K	
Number of part describe by links	605K	
Number of ACL Entries	~450K	
Number of ProductView Images	~24K	

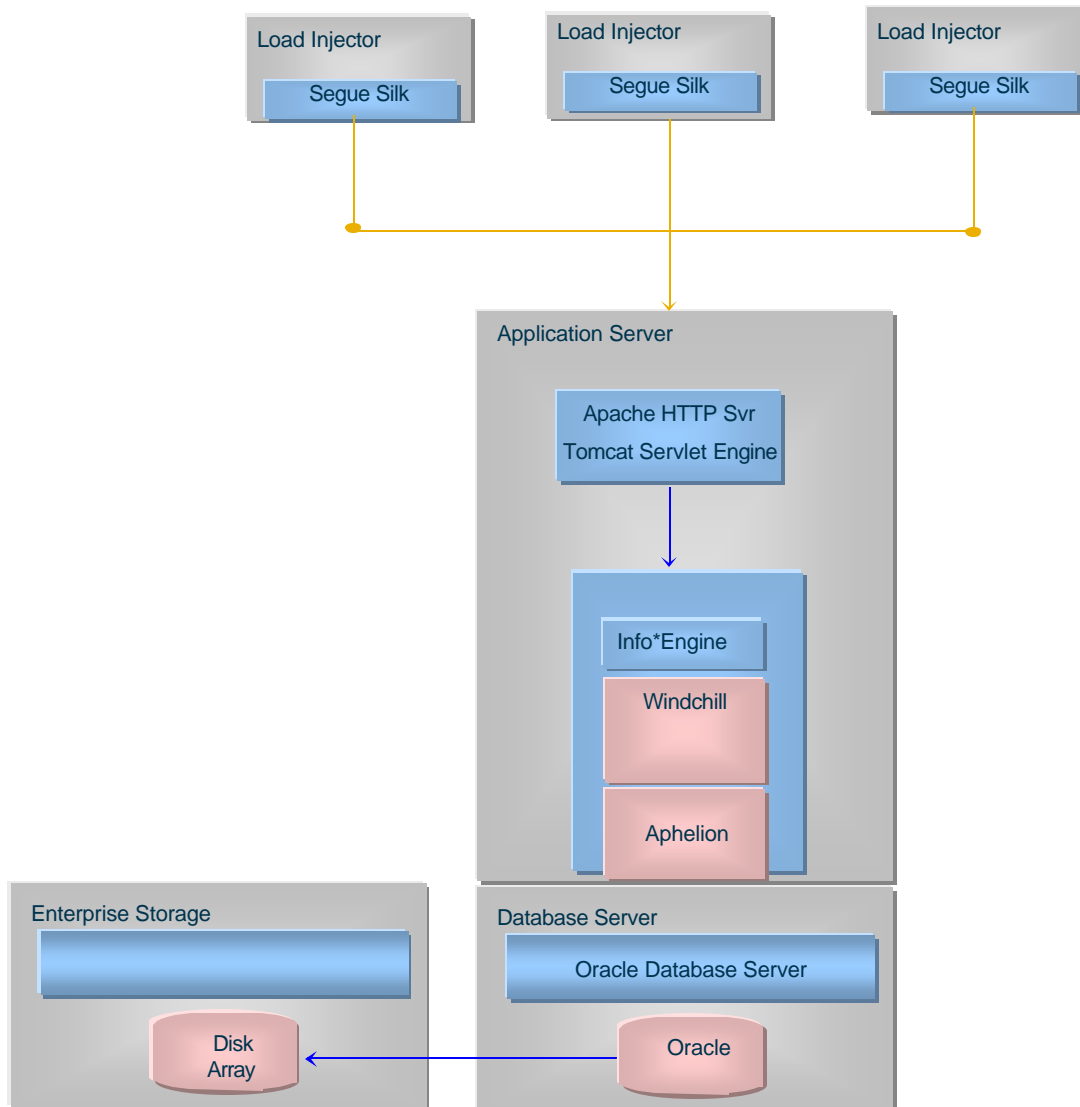
Workload Definition (Transaction Types)

PDMLink	ProjectLink
CreateDocument	PJL_CreateProjectDocument500kb
CheckoutDocument	PJL_Checkout500kb
CheckinDocument	PJL_Checkin500kb
ViewExpandedFolder	PJL_CreateProjectDocument1mb
WildcardSearch	PJL_Checkout1mb
SearchPartByNumberExact	PJL_Checkin1mb
SearchDocumentByNumberExact	PJL_CreateProjectDocument10mb
SearchPartByNameWildcard	PJL_Checkout10mb
ViewProductFoldersPage	PJL_Checkin_10mb
ViewProductsPage	PJL_ViewFilesListPage
ViewHome	PJL_ViewHomePage
ViewAssignment	PJL_ViewAssignments
SearchDocumentByNameWildcard	PJL_ViewProjects
ViewProductDetailsPage	PJL_SearchWithinAProject

Workload Definition (Transaction Types)

PDMLink	ProjectLink
ViewProductStructure	PJL_ViewProjectDetailsPage
ViewProductStructureWithDocuments	PJL_CreateProject
ViewChangeMonitorPage	PJL_ViewPlanPage
ViewChangeMonitorForSpecificProduct	PJL_ViewPostingList
ViewPostings	PJL_CreateMilestone
CreateProblemReport	PJL_CreateActivity
CreateECR	PJL_CreateDeliverable
CreateECN	PJL_ViewFullyExpandTeam
ViewProductTeam	PJL_SearchTeamMember
SearchForTeamMember	PJL_ViewActionItems
ViewDocumentContent	PJL_ViewNotebook
ViewPartDocumentRelations	PJL_ViewDocDetails
ViewPartIterations	PJL_SaveProjTemplate
HTTPCheckoutPart	PJL_AddUserToMemberGroup
HTTPCreatePart	PJL_CreateActionItem

Architecture Definition



Architecture Definition

IBM Server Specifications

- ⦿ Each of the 2 servers was a P570 with 8 X 1.9 GHz POWER5 CPUs and 32 Gbytes of RAM running the 64 bit version of AIX 5.2/5.3
- ⦿ AIX 5.3 was used for most of the testing as there were no functional differences observed with Windchill or the other software components and AIX 5.3 performs up to 30% better than AIX 5.2 with the use of SMT (Simultaneous Multi-Threading)
- ⦿ AIX 5.2 is currently supported for Windchill 8.0. AIX 5.3 is being tested and will be supported in a future maintenance release for Windchill 8.0.
- ⦿ These servers are dynamically configurable to change the number of CPUs and or Memory available to the application
- ⦿ Software component versions were:
 - Windchill PDMLink R8 FCS*
 - Windchill ProjectLink R8 FCS*
 - JDK 1.4.2*
 - Apache 2.0.52*
 - Tomcat 5.0.30*
 - Oracle 9.2.0.5*
 - Aphelion 2003.2*

Test Results

Test runs were completed with various numbers of CPUs and memory settings in order to determine the optimal configuration settings

Baseline test runs were all normalized to 4 CPUs

The methodology used to determine the number of concurrent users per CPU was to use a baseline test run of 50 simulated users with a fully optimized configuration and compare the average response time of each run to this baseline performance

- ⦿ The maximum number of concurrent users per CPU was considered exceeded if the average response time of an optimized test run exceeded two times the average response time of the baseline 50 user run

This generally corresponded with very high CPU utilization (on a normalized CPU basis) of the application server

Test Results

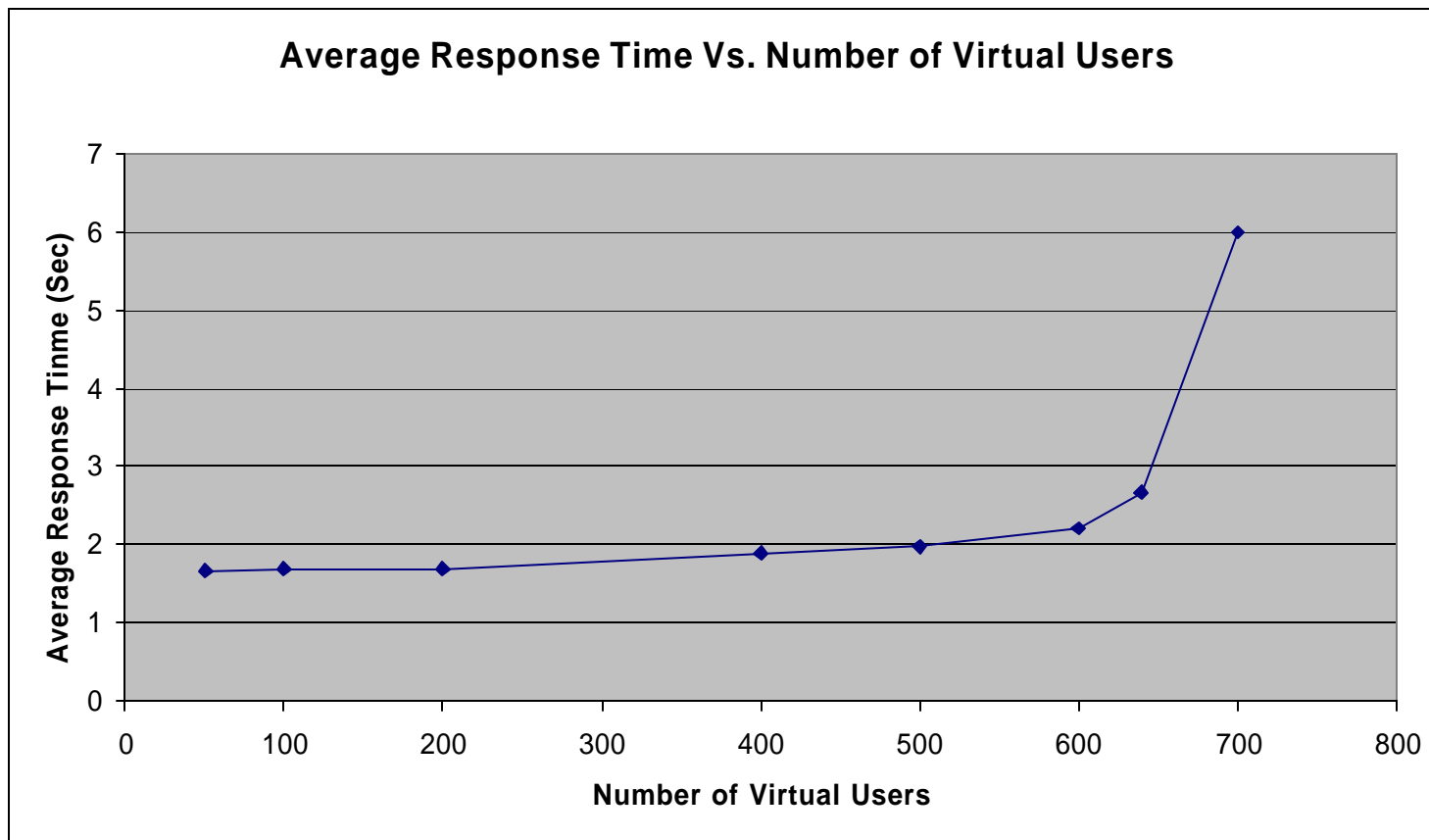
The next slides show a series of example graphs that demonstrate the sizing methodology

- ⦿ The first slide shows a graph of average response time plotted against number of simulated users

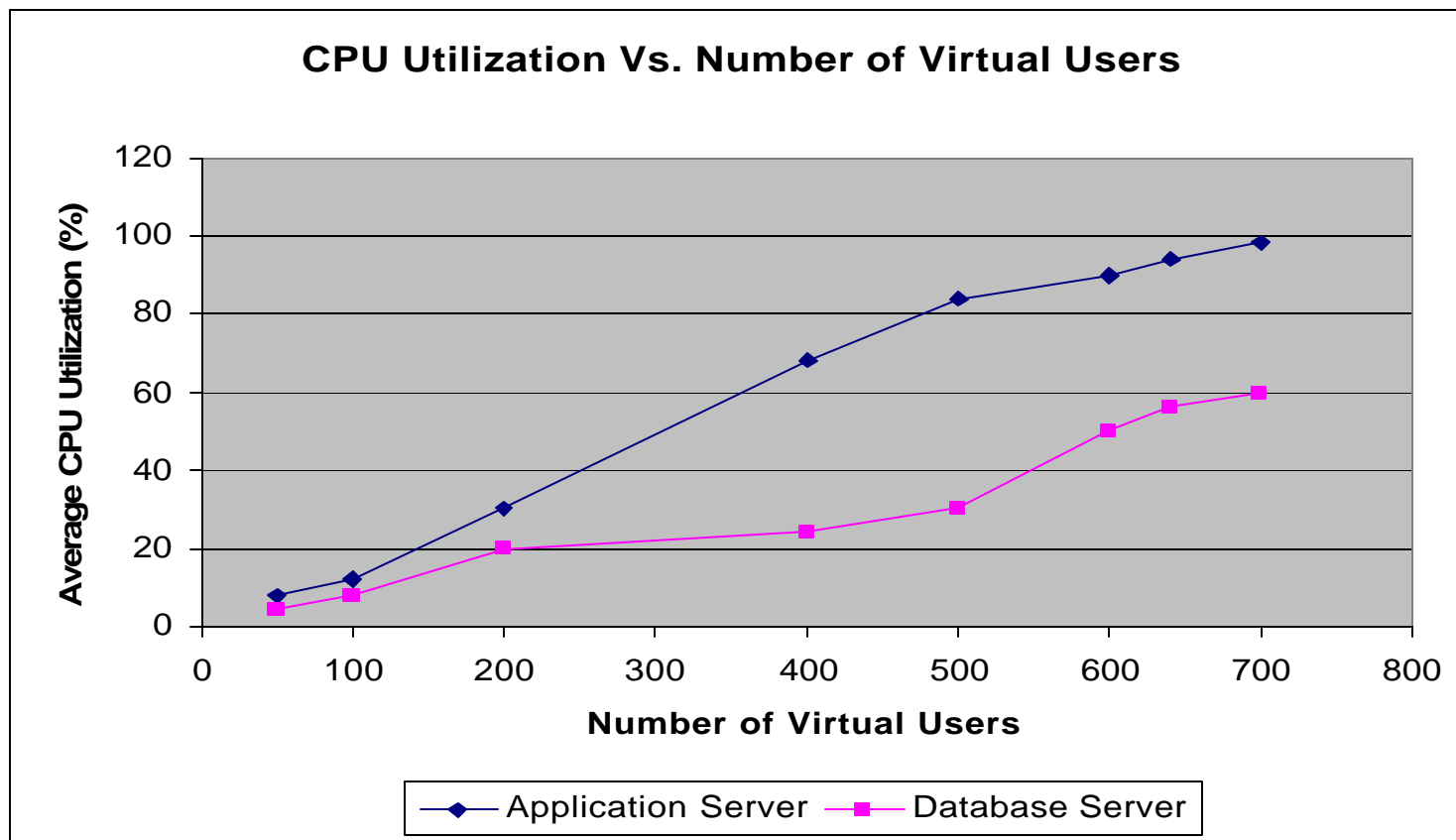
It is quite easy to see that response times begin to increase exponentially once the maximum number of simulated users exceeds a certain threshold

- ⦿ Slide two shows that the relationship between the number of simulated users and the CPU utilization is fairly linear which demonstrates a high degree of scalability in the Windchill Architecture

Test Results



Test Results



Test Results

Several other key metrics or points of information were noted during the benchmark

- ⦿ Average bandwidth consumption per active user was ~23 kbps

This is approximately a 20% decrease from R7 bandwidth consumption. Most of this decrease is due to a reduction in html page size which is the result of pagination of several commonly used pages as well as the use of Apache web server compression

WAN bandwidth can be reduced to approximately 5 kbps by using content cache/replication servers since much of the bandwidth is consumed by uploading/downloading of file content

Please note these tests are conducted with virtually no network latency so no information is available about the affects of latency on transaction times

- ⦿ Average number of “transactions” per active user is 20 over the course of the one hour simulation

For a simulation of 500 active users this would translate into 10,000 transactions over the course of one hour

Each “transaction” includes multiple page views

An example would be a user going to their Product or Project list and selecting a product or project, then searching within that specific product or project and performing some action on an object resulting from the search

- ⦿ Average number of http hits at peak load is 60/sec

This translates into over 300,000 http hits over the course of a one hour run for 500 active users

- ⦿ Disk I/O can be a serious impediment to scaling the system to a large number of users so it is important to optimize disk throughput by striping the Oracle database and Retrievalware indexes across multiple disks in a RAID 0+1 configuration or using some type of Enterprise storage system that caches disk I/O for high concurrency applications

Application Server Sizing Guidelines

Based upon the analysis of these test results, we make the following recommendations for sizing guidelines for a combined PDMLink/ProjectLink Server (without Wildfire integration)

- ⦿ For the IBM AIX platform use 125 concurrent users per POWER5 CPU for the application tier
- ⦿ We recommend 1.5 Gbytes of RAM for each CPU in the application tier. This recommendation would hold true up to 8 CPUs at which point 1 Gbyte of RAM per CPU would be more appropriate

Prior examination of customer production environments has shown that a ratio of 5:1 between named users and concurrent users is a good relationship to use in sizing servers

- ⦿ This means that a single POWER5 CPU can support approximately 625 named users
- ⦿ It is important to note that we would almost always recommend a minimum of 2 CPUs in the application tier to provide the necessary scalability to run multiple software components simultaneously (I.e. ServerManger, MethodServer, BackGround MethodServer, Tomcat, Retrievalware, Aphelion, Apache, etc.)

Database Server Sizing Guidelines

Based upon the analysis of these test results, we make the following recommendations for sizing guidelines for a combined PDMLink/ProjectLink Database Server (without Wildfire integration)

- ⦿ For the IBM AIX platform use 1 CPU in the Database tier for every 2 CPUs in the application tier
- ⦿ It is important to note that we would always recommend a minimum of 2 CPUs in the database tier for all but the smallest production (i.e. < 200 named users) systems
- ⦿ This rule of thumb would hold true for the first 4 CPUs but for larger implementations we would strongly recommend using PTC for an architecture definition engagement

We recommend 1.5 Gbytes of RAM for each CPU in the database tier. This recommendation would hold true up to 4 CPUs at which point 1 Gbyte of RAM per CPU would be more appropriate

Configuration Parameters

Changes to db.properties

- ⦿ *wt.pom.cachedStatementReuseLimit=32000*
- ⦿ *wt.pom.cachedStatementRSLimit=256*
- ⦿ *wt.pom.maxDbConnections=40*
- ⦿ *wt.pom.maxIdleStatementCaches=0*
- ⦿ *wt.pom.statementCacheSize=100*
- ⦿ *wt.pom.paging.pagingSessionLimit=-1*

Configuration Parameters

Changes to init<SID>.ora

- ⦿ db_cache_size=2000000000 # 2GB
- ⦿ java_pool_size=1000000 # 1MB
- ⦿ large_pool_size=20000000 # 20MB
- ⦿ log_checkpoint_interval=10240
- ⦿ log_checkpoint_timeout=1800
- ⦿ pga_aggregate_target=200000000 # 200MB
- ⦿ sga_max_size=3000000000 # 3GB
- ⦿ shared_pool_size=200000000 # 200MB
- ⦿ sort_area_size=20000000 #20MB

Configuration Parameters

Changes to wttomcat_start

- ⦿ Please note that it was required to update the version of mod_jk.so that was shipped with FCS to build 14 (from the Apache website) to overcome a “wait to send” issue that significantly impacted performance. This issue is addressed in MOR010
- ⦿ `setenv JAVA_OPTS " -Xms2048M -Xmx2572M -Xgcpolicy:subpool"`

Configuration Parameters

Changes to wt.properties

- ⦿ wt.manager.monitor.start.MethodServer=3
- ⦿ wt.method.loadbalance.maxRedirects=2
- ⦿ wt.method.loadbalance.activeContext=5
- ⦿ wt.cache.size.AclCache=2000
- ⦿ wt.cache.size.NotificationListCache=5000
- ⦿ wt.cache.size.PagingSessionCache=1000
- ⦿ wt.cache.size.PrefEntryCache=10000
- ⦿ wt.cache.size.ReferenceCache=5000
- ⦿ wt.cache.size.SessionCache=500

Configuration Parameters

Changes to wt.properties (Continued)

- ⦿ wt.cache.size.WTCalendarCache=10000
- ⦿ wt.cache.size.WTPrincipalCache=10000
- ⦿ com.ptc.netmarkets.projmgmt.serverCacheLimit=100
- ⦿ com.ptc.netmarkets.serverCacheLimit=300
- ⦿ com.ptc.netmarkets.serverCacheEnabled=true
- ⦿ com.ptc.netmarkets.projmgmt.serverCacheEnabled=true
- ⦿ com.ptc.core.ca.co.common.prefs.session.cache=true

Configuration Parameters

Changes to wt.properties (Continued)

- ⦿ Additions to Method Server Startup Command-
-Xms2048m -Xmx2048m
- ⦿ Additions to BG Method Server Startup Command-
-Xms512m -Xmx512m
- ⦿ Additions to Server Manager Startup Command-
-Xms128m -Xmx512m