

Performance

Microsoft Dynamics CRM 2011

Microsoft Dynamics CRM Performance and Scalability on Intel Xeon Processor-based Dell Servers with Solid-State Drives

White Paper

Date: March 2011



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Feedback

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Overview

Microsoft Dynamics® CRM 2011 is designed to help enterprise organizations attain a 360-degree view of customers, achieve reliable user adoption, adapt quickly to business change, and accelerate project delivery and returns – all on a platform that provides enterprise levels of scalability and performance. This white paper focuses on user scalability.

Microsoft, working with Intel® Corporation, completed benchmark testing of Microsoft Dynamics CRM 2011 running on Intel® Xeon® 7500 series processor-based Dell R910 servers with Pliant Technology solid state drives (SSDs). Standard optimizations were applied per guidelines published in the white papers *Optimizing and Maintaining Microsoft Dynamics CRM* and *Improving Microsoft Dynamics CRM Performance and Securing Data with Microsoft SQL Server 2008*.

Intel's Xeon 7500 series processors, Microsoft Windows Server 2008 R2, Microsoft SQL Server 2008 R2, and Microsoft Dynamics CRM are revolutionizing how enterprises deploy mission critical applications, offering a new standard of performance, reliability, and manageability with the added benefits of virtualization, all at a dramatically lower total cost of ownership (TCO).

Results Summary

Benchmark testing was performed on a Microsoft Dynamics CRM 2011 implementation that included the latest versions of Microsoft® Windows Server® and Microsoft SQL Server®, as well as Intel® Xeon® Processor 7500 series processor-based servers with SSDs. In this test environment, Dynamics CRM 2011 demonstrated the following performance characteristics:

Concurrent Users*	Average Response Time	Web Requests	Business Transactions	Average SQL Server Utilization	Average CRM Server Utilization
150,000	.4 seconds	5.5 M/hr	703,080/hr	39.6%	42%

* 150,000 users, each performing a business transaction with the system every 8 minutes

Benchmark results demonstrate that a single Microsoft Dynamics CRM 2011 instance can achieve sub-second response times with 150,000 concurrent users executing a heavy workload against a large, complex database. Large enterprises often deploy multiple parallel CRM instances to meet the diverse needs of different business units or geographies. Distributed across multiple instances, a Microsoft Dynamics CRM deployment can scale to meet the needs of the largest enterprises.

This white paper details the results of benchmark testing conducted on Microsoft Dynamics CRM 2011 running on Intel Xeon 7500 series processor-based servers with SSDs, providing:

- A description of the CRM implementation and the methods used to obtain the benchmark
- Details of the hardware configuration used in testing
- A summary of the key test parameters and results achieved

Important: These results reflect the scalability and performance of a specific Microsoft Dynamics CRM 2011 implementation running in a particular test environment. Factors ranging from industry vertical to geographic span can affect how enterprise organizations use their CRM system, so results will vary for each implementation. Customers may be able to achieve higher levels of performance and scalability via customization and a finer level of optimization.

While the CRM Online service is a multi-tenant environment in which resources for each organization are assigned dynamically based on demand, because the online service leverages the same code as does the on-premises version of the product, the benchmark results provided in this paper are applicable across platforms.

Also note that this benchmark focuses on server-side performance and metrics. Dynamics CRM 2011 clients provide richness that requires multiple requests to the server. As a result, response times here are in no way indicative of client responsiveness, for example in loading a form or performing a complete transaction.

Testing Methodology

Microsoft, working with Intel Corporation, conducted testing to demonstrate the performance and scalability characteristics of a Microsoft Dynamics CRM 2011 implementation running with:

- Microsoft® Windows Server® 2008 R2
- Microsoft SQL Server® 2008 R2
- Intel® Xeon® 7500 series processor-based Dell R910 servers with Pliant Technology SSDs

Test Scenarios

Based on extensive customer research, an enterprise-class deployment of Microsoft Dynamics CRM was modeled, including an extensive structure of over 100 business units and teams and with 150,000 users. To represent the variety and distribution of users and activities across an enterprise, nine specific user roles were selected, and each role was assigned one or more of the 100 unique business transactions included in the design. In addition, to model usage by an enterprise organization, the Dynamics CRM implementation was configured with specific features, such as field-level security, and various customizations that are in common use in the enterprise.

Test cases were created by using the Microsoft Dynamics CRM 2011 Performance and Stress Testing Toolkit (the "Performance Toolkit"), which is designed to help formalize performance testing of Microsoft Dynamics CRM by facilitating load testing of simulated customer environments. Available as a free download, the Performance Toolkit allows organizations to evaluate the potential viability of Dynamics CRM for their own environments.

Note: The Performance Toolkit includes all of the test cases that were used in this benchmark, which customers can use as a basis in their own benchmarking efforts. For additional information about or to download the Performance Toolkit, see the *Microsoft Dynamics CRM Performance and Scalability Toolkit** at:

<http://go.microsoft.com/fwlink/?LinkId=213092>

* Microsoft Dynamics CRM 2011 version available after commercial release of the product

Important: The test cases, metrics, and usage patterns contained in this document were defined by the CRM Product Team during the discovery phase of the testing process. Only the test scenarios and processes that are defined in this document were provided for testing and evaluated for performance. Scenarios or processes that are not defined in this document have not been tested with regard to performance. Microsoft cannot predict or guarantee how additional scenarios or processes may affect system performance.

Business Transactions

To accurately model heavy usage of a real-world Microsoft Dynamics CRM implementation, simulated users in this benchmark executed real business transactions, touching capabilities across Microsoft Dynamics CRM functionality. Each business transaction in the testing consists of several discrete atomic interactions between the user and the system.

For example, the *Create e-mail* business transaction consists of the following Microsoft Dynamics CRM atomic interactions:

1. Open the **Workplace** homepage.
2. Under **Activities**, select **New** to create a new e-mail message.
3. Use the Find feature to select the recipient from the user list.
4. Enter a subject and description.
5. In the **Regarding** field, select an account from the list.
6. Click **Save**.
7. Close the form.

In this test, each business transaction represents multiple commands, with each command taking approximately .4 seconds to execute. This translates into a rate of up to 5.5 million commands per hour.

Transaction Workload

One hundred unique business transactions were tested to simulate a variety of enterprise roles and activities. The workload was created to simulate a high transaction CRM deployment exercising a broad range of CRM functionality. The entire group of 150,000 users was logged on rapidly (within eight minutes) to assess the impact of a large number of CRM users logging on to the system in a brief time period.

The workload executed resulted in over 703,080 complex business transactions, or over 5.5 million Web requests, per hour for the 150,000 active concurrent users test. In a follow-the-sun global deployment, this translates to a projected 24-hour average of over 16.87 million business transactions, representing over 132 million Web requests.

There were multiple workflows active during the benchmark runs and workflow activities were being executed at a rate of 11.5 activities per second.

Note: For a list of the business transactions included in the testing, in *Appendix B: Benchmark Testing Detail*, see Table 4.

Database Server

The benchmark transactions were performed against a database with size and complexity comparable to a real-world implementation of Microsoft Dynamics CRM 2011. The test database included over 220 million business records with a total size of 720 GB.

Note: For a list of row counts for all tables with more than 10,000 rows, in *Appendix B: Benchmark Testing Detail*, see Table 3.

Tuning and Optimization

Standard optimization techniques were applied per guidelines contained in the white papers *Optimizing and Maintaining Microsoft Dynamics CRM* and *Improving Microsoft Dynamics CRM Performance and Securing Data with Microsoft SQL Server 2008*. Depending on the specific business processes involved, higher levels of performance and scalability may be possible through customization to meet specific business and performance requirements, and through deeper optimization.

Standard SQL scripts were used to ensure that table indexes on the database were not fragmented and that the statistics were up to date, helping to ensure efficient database operation. Early test runs of the scripts identified several areas in which new or modified indexes could improve query performance. SQL Profiler was used to identify long running queries that were executed frequently, and this information was used to carry out additional tuning of the database server.

Note: For additional information, see the following white papers:

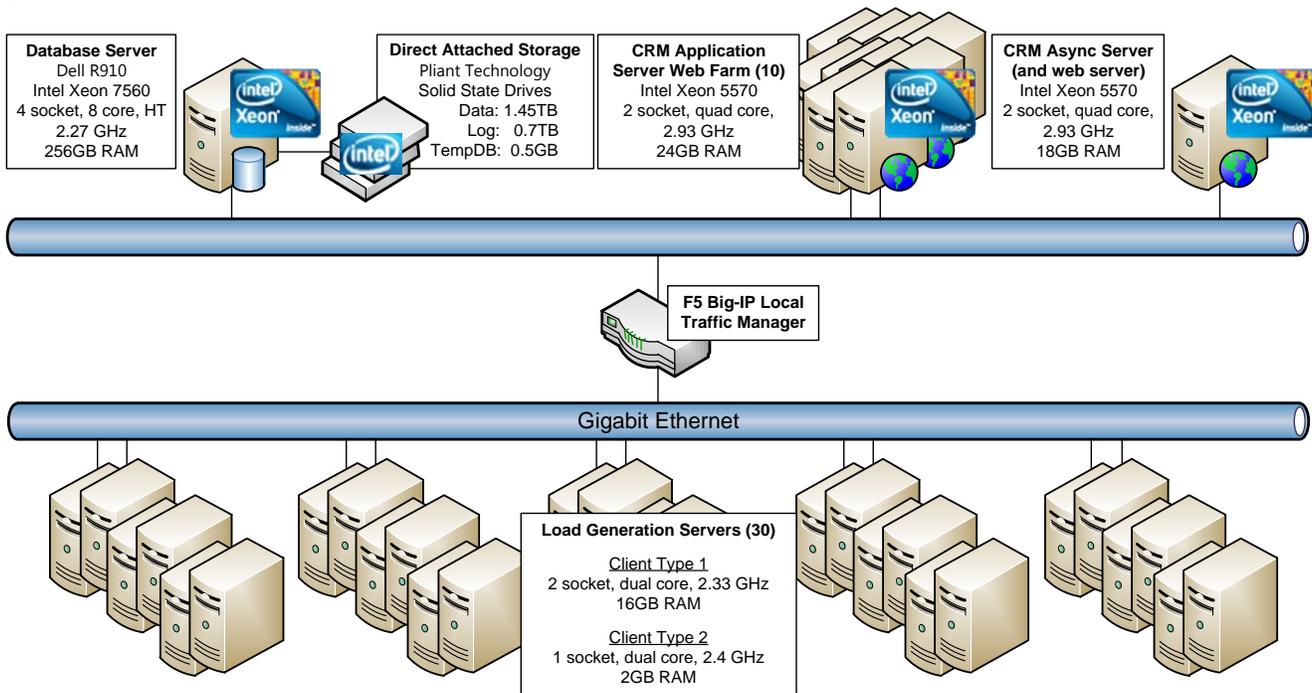
- *Optimizing and Maintaining Microsoft Dynamics CRM**
<http://go.microsoft.com/fwlink/?LinkId=213093>
* Microsoft Dynamics CRM 2011 version available after commercial release of the product
- *Improving Microsoft Dynamics CRM Performance and Securing Data with Microsoft SQL Server 2008*
<http://www.microsoft.com/downloads/details.aspx?FamilyID=b5bb47a4-5ece-4a2a-a9b5-5435264f627d&DisplayLang=en>

Hardware Environment

The application tier was deployed in a Web farm with 11 application servers, one of which had the Async role in addition to the Web server role. The application Web farm used an F5 Big-IP Local Traffic Manager configured for round-robin load balancing to ensure that each server received a similar level of utilization.

The database tier was deployed on a single Dell R910 server with a four (4) socket, eight (8) core Intel® Xeon® 7560 processor with HyperThreading technology running with Pliant Technology SSDs. Thirty load generation servers running Microsoft Visual Studio® 2010 Ultimate were used to reliably generate the simulated 150,000 concurrent user workload.

The hardware environment used for this benchmark testing effort is illustrated in the following graphic:



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Note: For additional information about the hardware used in this test, see *Appendix B: Benchmark Testing Detail* and *Appendix C: Key Benchmark Component Details*.

Test Results

The results of the benchmark study validate that a Microsoft Dynamics CRM 2011 implementation that includes Microsoft Windows Server 2008, Microsoft SQL Server 2008 R2 Enterprise Edition running on Intel® Xeon® Processor 7500 series processor-based Dell R910 servers with Pliant Technology solid state drives can scale to support 150,000 concurrent users in a single instance while averaging sub-second response times to web requests.

With 150,000 concurrent users, the application executed at a projected rate of 16,873,920 business transactions per day.

Note: The test results were achieved with minimal tuning and optimization. Advanced tuning and optimization may deliver better user scalability.

Important: This benchmark focuses on server-side performance and metrics. Dynamics CRM 2011 clients provide richness that requires multiple requests to the server. As a result, response times in this document are in no way indicative of client responsiveness, for example in loading a form or performing a complete transaction.

Conclusion

This benchmark demonstrates that a single instance of Microsoft Dynamics CRM 2011 on Intel® processor-based servers with solid state drive hardware can scale to support an enterprise implementation of 150,000 concurrent users, achieving discrete atomic response times under one second. Enterprises often deploy multiple CRM instances to serve the diverse needs of different business units and geographies.

Based on these results, an organization with a similar data and transaction volume can expect similar results. No two enterprise implementations of Microsoft Dynamics CRM are the same. Multiple factors can affect performance, including the following:

- Number of records in the database
- Number, type, and frequency of transactions
- Processing power dedicated to workflows or plug-ins

While this benchmark demonstrates scalability under high transaction rates, customers should evaluate the requirements of their own environments before undertaking a large-scale deployment. The Microsoft Dynamics CRM 2011 Performance and Stress Testing Toolkit provides tools to assist companies in this effort.

Important: The test cases, metrics, and usage patterns contained in this document were defined by the CRM Product Team during the discovery phase of the testing process. Only the test scenarios and processes that are defined in this document were provided for testing and evaluated for performance. Scenarios or processes that are not defined in this document have not been tested with regard to performance. Microsoft cannot predict or guarantee how additional scenarios or processes may affect system performance.

Appendix A: Additional Resources

Microsoft

- Microsoft Dynamics CRM Web Site
<http://www.microsoft.com/dynamics/crm/default.aspx>
- Microsoft Dynamics CRM Performance and Scalability Toolkit*
<http://go.microsoft.com/fwlink/?LinkId=213092>
** Microsoft Dynamics CRM 2011 version available after commercial release of the product*
- *Optimizing and Maintaining Microsoft Dynamics CRM***
<http://go.microsoft.com/fwlink/?LinkId=213093>
*** Microsoft Dynamics CRM 2011 version available after commercial release of the product*
- *Improving Microsoft Dynamics CRM Performance and Securing Data with Microsoft SQL Server 2008*
<http://www.microsoft.com/downloads/details.aspx?FamilyID=b5bb47a4-5ece-4a2a-a9b5-5435264f627d&DisplayLang=en>
- *Investigating Microsoft Dynamics CRM 4.0 Performance*
<http://blogs.gotdotnet.com/crm/archive/2008/03/04/investigating-crm-v4-performance.aspx>
- *Microsoft Dynamics CRM 2011 Implementation Guide*
<http://www.microsoft.com/downloads/en/details.aspx?FamilyID=9886ab96-3571-420f-83ad-246899482fb4>

Intel

- *Intel® Microarchitecture, Codenamed Nehalem*
<http://www.intel.com/technology/architecture-silicon/next-gen/?iid=SEARCH>
- *Server Performance Summary - Intel® Xeon® Processor 7500 Series*
http://www.intel.com/performance/server/xeon_mp/summary.htm?iid=perf_server_lhn+mp_sum
- *The New Economics of Mission-Critical Computing*
http://www.intel.com/Assets/en_US/PDF/whitepaper/323911.pdf
- *Benefits of Intel Xeon Processors and Windows Server 2008 R2 for Business-Critical Applications*
<http://intelalliance.com/microsoft/assets/Benefits-of-Intel-Xeon-Processors-and-Windows-Server-2008-R2-for-Business-Critical-Applications-EB.pdf>
- *Planning Guide for Migrating to Microsoft SQL Server 2008 R2 and Intel Xeon Processor-based Servers*
<http://intelalliance.com/microsoft/assets/Planning-Guide-for-Migrating-to-Microsoft-SQL-Server-2008-R2-and-Intel-Xeon.pdf>

Appendix B: Benchmark Testing Detail

Table 1: Key Benchmark Test Parameters

Test Parameter	
Concurrent Users Tested	150,000
CRM Business Transaction Rate	703,080/hour
CRM Web Request Rate	5.5 million/hour
Database Size	720 GB
CRM Database Server	4 socket, 8 core, HT Intel Xeon 7560, 2.27 GHz*; 256GB RAM (Dell R910)
CRM (10) Web Servers	2 socket, quad-core Intel Xeon 5570, 2.93 GHz; 24GB RAM
Additional CRM Server (Web server + Async server roles)	2 socket, quad-core Intel Xeon 5570, 2.93 GHz; 18GB RAM (18x1GB)

**4 socket, 8 core Intel Xeon 7560 with HyperThreading technology, 64 processor threads, 2.27 GHz*

Table 2: Key Benchmark Results

Metric	Result*
Atomic Web Request response time	.4 seconds
CPU Utilization – CRM Servers	42%
CPU Utilization – SQL Server	39.6%

**Average value over the duration of the testing process*

Table 3: Row counts for tables with 10,000+ rows

Table	Total Rows
ActivityPartyBase	77984427
ActivityPointerBase	27531110
AnnotationBase	14010354
LeadAddressBase	11755238
TaskBase	10534474
EmailSearchBase	9330583
CustomerAddressBase	8180034
LeadBase	5877619
LeadExtensionBase	5877619
PrincipalObjectAccess	4107233
IncidentBase	2870096
ConnectionBase	2810038
OpportunityBase	2666111
OpportunityExtensionBase	2666111
OpportunityProductBase	2498437
SystemUserBusinessUnitEntityMap	2340727
PrincipalAttributeAccessMap	2291960

Table 3: Row counts for tables with 10,000+ rows (cont.)

Table	Total Rows
ContactBase	2268402
ContactExtensionBase	2268402
PrincipalEntityMap	2082166
SyncEntry_73ad273da02de011a84500219ba2c0ef	1879934
AccountBase	1821615
AccountExtensionBase	1821615
QuoteBase	1324553
UserEntityUISettingsBase	1292104
SalesOrderBase	1054413
QuoteDetailBase	1048732
SalesOrderDetailBase	942581
InvoiceBase	937746
InvoiceDetailBase	929163
ResourceGroupExpansionBase	829772
SystemUserPrincipals	717622
ListMemberBase	653893
new_imBase	375060
CalendarBase	300323
CalendarRuleBase	300322
InternalAddressBase	300210
ListBase	269309
TeamMembership	267619
QueueBase	262260
OwnerBase	180409
ResourceBase	150165
SystemUserBase	150003
UserSettingsBase	150001
SystemUserRoles	149995
CampaignBase	64620
QueueItemBase	63754
SystemUserProfiles	57299
DependencyBase	50737
CampaignItemBase	50325
CampaignActivityItemBase	43382
DependencyNodeBase	42282
ResourceGroupBase	30410
TeamBase	30406
LocalizedLabel	19801
ImportDataBase	12000

Table 4: Business Scenarios Tested (by User Role)

Business Transactions	
Customer Service Representative Manager	
<ul style="list-style-type: none"> ▪ AccountActivityRollup ▪ CRMOverviewDashboard 	<ul style="list-style-type: none"> ▪ ReleaseQueueItem ▪ ResolvedCaseSatisfactionChart
Customer Service Representative	
<ul style="list-style-type: none"> ▪ AddActivityToAccount ▪ AdvancedFindAccount ▪ AdvancedFindContact ▪ AdvancedFindContract ▪ AssignServiceCase ▪ CreateAppointment ▪ CreateEmail ▪ CreateFax ▪ CreateLetter ▪ CreateNewNoteForTask ▪ CreatePhonecall ▪ CreateServiceCaseAccount ▪ CreateTask ▪ CreateTaskWithCustomAttributes ▪ FindAccounts ▪ FindContacts 	<ul style="list-style-type: none"> ▪ MyCalendar ▪ OpenAppointment ▪ OpenEmail ▪ OpenFax ▪ OpenLetter ▪ OpenPhonecall ▪ UpdateAppointment ▪ UpdateContact ▪ UpdateContactWithCustomAttributes ▪ UpdateEmail ▪ UpdateFax ▪ UpdateLetter ▪ UpdatePhonecall ▪ UpdateTask ▪ UpdateTaskWithCustomAttributes
Marketing Manager	
<ul style="list-style-type: none"> ▪ AccountConnectionRollup ▪ AccountHelpVisor ▪ AccountOppRollup ▪ ActivityByMonthDueChart ▪ AddConnectionToAccount ▪ AddMembersToList ▪ AdvancedFindAccount ▪ AdvancedFindContact ▪ CRMOverviewDashboard ▪ ContactHelpVisor ▪ CreateCampaignActivity ▪ CreateNewAccountWithCustomAttributes ▪ CreateNewLead ▪ CreateNewNoteForLead ▪ CreateNewNoteForOpp 	<ul style="list-style-type: none"> ▪ CreateServiceCaseAccount ▪ CustomerServiceRepresentativeDashboard ▪ EmailQuote ▪ GridFilterAccounts ▪ GridFilterLeads ▪ GridFilterOpportunities ▪ LeadWithChart ▪ MarketingDashboard ▪ MyCalendar ▪ OpportunityGridWithTop10Opportunity ▪ SalesActivityDashboard ▪ UpdateAccount ▪ UpdateLead ▪ me_Homepage
Marketing Professional	
<ul style="list-style-type: none"> ▪ AccountHelpVisor ▪ ActivityHelpVisor ▪ AddActivityToAccount ▪ AddActivityToLead ▪ AddConnectionToAccount ▪ AddMembersToList ▪ AddMembersToTeam ▪ AdvancedFindAccount ▪ AdvancedFindContact 	<ul style="list-style-type: none"> ▪ CreateNewOpportunity ▪ CreatePhonecall ▪ CreateQuote ▪ CreateSalesOrder ▪ CreateTask ▪ CreateTaskWithCustomAttributes ▪ DisplayListMembers ▪ FindAccounts ▪ FindContacts

Business Transactions

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ AdvancedFindContract ▪ AdvancedFindProduct ▪ AssignAccount ▪ ContactAuditTrail ▪ ContactHelpVisor ▪ CopyListMembers ▪ CreateCampaignActivity ▪ CreateCampaignResponse ▪ CreateEmail ▪ CreateInvoice ▪ CreateLetter ▪ CreateNewAccount ▪ CreateNewAccountWithCustomAttributes ▪ CreateNewCompetitor ▪ CreateNewContact ▪ CreateNewContactWithCustomAttributes ▪ CreateNewLead ▪ CreateNewList ▪ CreateNewNoteForAccount ▪ CreateNewNoteForContact ▪ CreateNewNoteForLead ▪ CreateNewNoteForOpp ▪ CreateNewNoteForTask | <ul style="list-style-type: none"> ▪ GridFilterAccounts ▪ GridFilterContacts ▪ GridFilterLeads ▪ GridFilterOpportunities ▪ LeadWithChart ▪ MyCalendar ▪ OpenPhonecall ▪ OpportunityGridWithSalesPipeline ▪ QuickCreateNewAccount ▪ RemoveFromList ▪ SubGridChartOnAccount ▪ UpdateAccount ▪ UpdateAccountWithCustomAttributes ▪ UpdateContact ▪ UpdateContactWithCustomAttributes ▪ UpdateEmail ▪ UpdateFax ▪ UpdateLead ▪ UpdatePhonecall ▪ UpdateTask ▪ UpdateTaskWithCustomAttributes ▪ me_Homepage |
|--|--|

Sales Associate *(custom role)*

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ ActivityByMonthDueChart ▪ ActivityHelpVisor ▪ AddActivityToAccount ▪ AddActivityToLead ▪ AddConnectionToAccount ▪ AddMembersToList ▪ AddMembersToTeam ▪ AdvancedFindAccount ▪ AdvancedFindContact ▪ AdvancedFindContract ▪ AdvancedFindProduct ▪ AssignAccount ▪ AssignAccounts ▪ AssignContact ▪ AssignLead ▪ AssignOpportunity ▪ ContactAuditTrail ▪ ContactHelpVisor ▪ ConvertleadToOppWithAccount ▪ CopyListMembers ▪ CreateAppointment ▪ CreateCampaignActivity ▪ CreateCampaignResponse ▪ CreateEmail | <ul style="list-style-type: none"> ▪ CreatePhonecall ▪ CreatePlanningTask ▪ CreateQuote ▪ CreateSalesOrder ▪ CreateServiceCaseAccount ▪ CreateTask ▪ CreateTaskWithCustomAttributes ▪ DisplayListMembers ▪ EmailQuote ▪ FindAccounts ▪ FindContacts ▪ GridFilterAccounts ▪ GridFilterContacts ▪ GridFilterLeads ▪ GridFilterOpportunities ▪ LeadWithChart ▪ MyCalendar ▪ OpenAppointment ▪ OpenEmail ▪ OpenFax ▪ OpenLetter ▪ OpenPhonecall ▪ OpenTask ▪ OpportunityGridWithSalesPipeline |
|--|---|

Business Transactions

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ CreateFax ▪ CreateInvoice ▪ CreateNewAccount ▪ CreateNewAccountWithCustomAttributes ▪ CreateNewCompetitor ▪ CreateNewContact ▪ CreateNewContactWithCustomAttributes ▪ CreateNewLead ▪ CreateNewNoteForAccount ▪ CreateNewNoteForContact ▪ CreateNewNoteForLead ▪ CreateNewNoteForOpp ▪ CreateNewNoteForTask ▪ CreateNewOpportunity ▪ CreateNewQueue ▪ CreateNewTeam | <ul style="list-style-type: none"> ▪ OpportunityGridWithTop10Opportunity ▪ QuickCreateNewAccount ▪ SubGridChartOnTask ▪ UpdateAccount ▪ UpdateAccountWithCustomAttributes ▪ UpdateAppointment ▪ UpdateContact ▪ UpdateContactWithCustomAttributes ▪ UpdateFax ▪ UpdateLead ▪ UpdateLetter ▪ UpdateOpportunity ▪ UpdatePhonecall ▪ UpdateTask ▪ UpdateTaskWithCustomAttributes ▪ me_Homepage |
|--|---|

Sales Manager

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ CreateNewNoteForTask ▪ CustomerServicePerformanceDashboard ▪ CustomerServiceRepresentativeDashboard ▪ FindAccounts ▪ GridFilterAccounts ▪ GridFilterContacts ▪ GridFilterLeads | <ul style="list-style-type: none"> ▪ GridFilterOpportunities ▪ MyCalendar ▪ OpportunityGridWithSalesPipeline ▪ QuickCreateNewAccount ▪ UpdateLead ▪ me_Homepage |
|--|---|

Salesperson

- | | |
|---|--|
| <ul style="list-style-type: none"> ▪ AccountActivityRollup ▪ AccountCampaignRollup ▪ AccountConnectionRollup ▪ AccountHelpVisor ▪ AccountOppRollup ▪ ActivityByMonthDueChart ▪ ActivityHelpVisor ▪ AddActivityToAccount ▪ AddActivityToLead ▪ AddConnectionToAccount ▪ AddMembersToList ▪ AddMembersToTeam ▪ AdvancedFindAccount ▪ AdvancedFindContact ▪ AdvancedFindContract ▪ AssignAccounts ▪ AssignContact ▪ ContactAuditTrail ▪ ContactHelpVisor ▪ ConvertleadToOppWithAccount ▪ CopyListMembers ▪ CreateAppointment ▪ CreateCampaignActivity | <ul style="list-style-type: none"> ▪ CreateNewNoteForTask ▪ CreateNewQueue ▪ CreateNewTeam ▪ CreatePhonecall ▪ CreateQuote ▪ CreateSalesOrder ▪ CreateServiceCaseAccount ▪ CreateTask ▪ CreateTaskWithCustomAttributes ▪ CustomerServicePerformanceDashboard ▪ CustomerServiceRepresentativeDashboard ▪ DisplayListMembers ▪ FindAccounts ▪ FindContacts ▪ GridFilterAccounts ▪ GridFilterContacts ▪ GridFilterLeads ▪ GridFilterOpportunities ▪ LeadWithChart ▪ MyCalendar ▪ OpenEmail ▪ OpenLetter ▪ OpportunityGridWithSalesPipeline |
|---|--|

Business Transactions	
<ul style="list-style-type: none"> ▪ CreateEmail ▪ CreateInvoice ▪ CreateLetter ▪ CreateNewAccount ▪ CreateNewAccountWithCustomAttributes ▪ CreateNewContact ▪ CreateNewContactWithCustomAttributes ▪ CreateNewLead ▪ CreateNewList ▪ CreateNewNoteForAccount ▪ CreateNewNoteForContact ▪ CreateNewNoteForLead ▪ CreateNewNoteForOpp 	<ul style="list-style-type: none"> ▪ OpportunityGridWithTop10Opportunity ▪ QuickCreateNewAccount ▪ UpdateAccount ▪ UpdateAccountWithCustomAttributes ▪ UpdateContact ▪ UpdateContactWithCustomAttributes ▪ UpdateFax ▪ UpdateLead ▪ UpdateOpportunity ▪ UpdateTask ▪ UpdateTaskWithCustomAttributes ▪ me_Homepage
Scheduler	
<ul style="list-style-type: none"> ▪ CreateServiceCaseAccount ▪ CreateTaskWithCustomAttributes ▪ FindAccounts ▪ FindContacts ▪ GridFilterLeads ▪ LeadWithChart ▪ MyCalendar ▪ OpenFax 	<ul style="list-style-type: none"> ▪ OpenLetter ▪ OpenPhonecall ▪ OpenTask ▪ OpportunityGridWithTop10Opportunity ▪ UpdateAccountWithCustomAttributes ▪ UpdateContact ▪ UpdatePhonecall
System Administrator	
<ul style="list-style-type: none"> ▪ AccountHelpVisor ▪ ActivityHelpVisor ▪ AdvancedFindAccount 	<ul style="list-style-type: none"> ▪ ContactHelpVisor ▪ CreateNewTeam

Table 5: CRM Database Server Hardware

CRM Database Server	
Manufacturer	Dell
Model	R910
Operating System	Microsoft Windows Server® 2008 R2 Enterprise 64-bit
Processor	4 socket, 8 core, HT Intel Xeon 7560, 2.27 GHz*
Network Adapter	1 GB Dual Port NIC
RAM	256 GB
Software	Microsoft SQL Server 2008 R2 Enterprise Edition
Direct Attached Storage:	
Disk Array Enclosure	Dell PowerVault MD1220 storage array
I/O Controller	Dell PERC H800
RAID Level	0
Pliant Technology SSDs	17
▪ Data	8 x 200 GB (~1.6 TGB SQL Data)
▪ Log	5 x 150 (~.75 TB)
▪ TempDb	4 x 150 (~.6 TB)

*4 socket, 8 core Intel Xeon 7560 with HyperThreading technology, 64 processor threads, 2.27 GHz

Table 6: CRM Web Servers (11, one with Async Server) Hardware

CRM Web Servers	
Web Servers (10)	
Manufacturer	Intel
Operating System	Microsoft Windows Server® 2008 R2 Enterprise 64-bit
Processor	2 socket, quad-core Intel Xeon 5570, 2.93 GHz*
Network Adapter	1 GB NIC
RAM	24 GB
Software	Microsoft Dynamics CRM 2011
Web/Async Server (1)	
Manufacturer	Intel
Operating System	Microsoft Windows Server® 2008 R2 Enterprise 64-bit
Processor	2 socket, quad-core Intel Xeon 5570, 2.93 GHz
Network Adapter	1 GB NIC
RAM	18 GB (18x1GB)
Software	Microsoft Dynamics CRM 2011

*2 socket, quad-core Intel Xeon 5570with HyperThreading technology, 16 processor threads, 2.93 GHz

Table 7: Load Balancer Hardware

Load Balancer	
Manufacturer & Model	F5 BIG-IP Local Traffic Manager
Balancing algorithm	Round Robin

Table 8: Load Generation Servers (30) Hardware

Load Generation Servers	
Client Type 1	
Manufacturer	HP
Operating System	Microsoft Windows Server® 2008 R2
Processor	2 socket, dual core, 2.33 GHz
Network Adapter	1 GB NIC
RAM	16 GB (4x4GB)
Software	Microsoft Visual Studio 2010 Ultimate
Client Type 2	
Manufacturer	HP
Operating System	Microsoft Windows Server® 2008 R2
Processor	1 socket, dual-core. 2.4 GHz
Network Adapter	1 GB NIC
RAM	2 GB
Software	Microsoft Visual Studio 2010 Ultimate

Appendix C: Key Benchmark Component Details

This benchmark testing effort leveraged a number of key hardware components, as well as Microsoft SQL Server 2008 R2 Enterprise Edition, which are detailed in the following sections.

Intel® Xeon® 7500 Series Processors

The Intel® Xeon® 7500 Series Processor Advantage

Intel Xeon 7500 series processor-based servers provide a dramatic performance increase – the highest amount of increase from a previous generation processor in Intel’s history. 7500-series processes provide nine times the memory bandwidth of Intel Xeon 7400 series processors and double the memory capacity, with up to 16 slots per processor socket. These processors are ideal for server consolidation or application virtualization, handling demanding mission-critical applications with ease.

Intel Xeon 7500 series processors are built on the same Intel® Core™ architecture as are Intel Xeon 5500 series processors, but they have greater scalability, from large-memory two-socket servers up to eight-socket servers, which can simultaneously handle a total of 128 threads. Greater socket counts will be possible with third party solutions.

Intel Xeon 7500 series processors have 24MB of shared L3 cache and 2.3 billion transistors, together with features such as high bandwidth QPI links and integrated memory controllers, which were in 5500 series processors. Advanced RAS capabilities in the 7500 series processors, such as Machine Check Architecture (MCA) recovery, were previously found only in the Intel® Itanium® processors.

Scalability, Reliability and Performance of Intel® Xeon® 7500 Series Processors with Windows Server 2008 R2

Pairing Intel Xeon 7500 series processors with Windows Server 2008 R2 provides for the scalability required to confidently run mission-critical applications. Intel Xeon 7500 series processors provide up to eight cores per processor and 24 megabytes (MB) of shared last level cache. So for example, a 7500 series server with four processor sockets provides 32 cores running 64 threads. This makes 7500 series-based servers capable of handling tremendous processing workloads. With the ability to scale up to 256 logical processors¹⁶ per operating system instance and support for up to 2 terabytes of RAM, Windows Server 2008 R2 takes advantage of the Intel Xeon 7500 series processors’ capabilities, forming the ideal choice for ultra-dense, large scale applications.

The improved Network Load Balancing feature allows you to combine two or more servers in a cluster and distribute the workload for even greater scalability. Compared to Intel Xeon 7400 series processors, Intel Xeon 7500 series processors provide 16 times the compute (socket) scaling and 2.5 times the I/O lanes, which support greatly expanded use in mission-critical workloads.

Pairing Intel Xeon 7500 series processors with Windows Server 2008 R2 provides numerous reliability advantages over previous Intel/Windows platforms and rivals the RISC/UNIX platform, which was long held to be the standard for reliability.

Intel Xeon 7500 series processors provide more than 20 additional RAS features, including:

- Dynamic reassignment of workloads across processors
- Memory RAS features such as replay on CRC error, lane failover, patrol scrub, demand scrub, memory migration, memory mirroring, memory hot plug, and more
- Intel QuickPath Interconnect (QPI) RAS features such as link recovery, self-healing, poison forwarding, hot plug socket, hot plug IOH and domain partitioning
- Socket RAS features, including Correct Machine Check Interrupt (CMCI) and recoverable Machine Check Architecture (MCA) with 22 MCA banks per socket (which allows the software to potentially address errors before data is consumed)

Protecting the integrity of your data is a number one priority. These advanced reliability features protect your data by reducing circuit-level errors, detecting data errors across the system and limiting the impact of errors. They also increase availability by healing failing data connections, migrating workloads from failing CPU and memory, and recovering from uncorrected errors, as well as helping to predict failures before they occur.

Windows Server 2008 R2 includes support for MCA error recovery, with the ability to isolate uncorrectable errors and contain them, detecting errors early so the software has a chance to recover before the error brings down the machine. The operating system can terminate or restart an application mapped to the address or terminate the guest operating system so that the system remains up and running other applications and other guest operating systems. Windows Server 2008 introduced Windows Hardware Error Architecture (WHEA) with better root cause analysis, better support for hardware error recovery, and error avoidance via health monitoring. Windows Server 2008 R2 adds WHEA enhancements such as support for MCA recoverable errors and CMCI error handling.

Intel Xeon 7500 series processors with Window Server 2008 R2 offer the ultimate in performance for your mission-critical applications. Benchmarks show that the Intel Xeon 7500 series processor provides best-of-class performance, whether running mission-critical databases or running virtual machines. The Intel Xeon 7500 series processor includes the intelligent performance feature that automatically optimizes performance to fit your business and application requirements, making it the world's most adaptable server platform.

The Intel Core microarchitecture replaces the front side bus with Intel® QuickPath Interconnect (QPI). The Intel® QuickPath Architecture maximizes data transfer performance for multiprocessor and/or multicore platforms with two-way interconnects between processors that can reach up to a blazing 25.6 GB per second. Intel QuickPath Technology and the integrated memory controller speed up traffic between processors and I/O controllers. Separate data paths for I/O and memory access make memory access faster because the CPU no longer has to communicate first with an external controller.

The Intel Xeon 7500 series processor also includes Intel® Turbo Boost Technology, which provides "performance on demand," allowing cores to run faster than base operating frequency when below specified power, current, and temperature thresholds. When a processor detects that it is below these limits, it increases its clock frequency to boost performance of the active cores. This gives you extra performance when and where it's needed, for a dynamically scalable solution to database demands. In addition, Intel® Hyper-Threading Technology (Intel HT Technology) delivers greater throughput and responsiveness

for multi-threaded applications. Intel's QPI technology increases the I/O and inter-processor performance with four advanced, high-bandwidth links that allow multiple processors to be directly connected to each other. Intel Turbo Boost Technology allows processor cores to run faster than the base operating frequency, so that the Intel 7500 series processor intelligently adapts processor frequency to optimize performance on SQL Server 2008 R2. This can increase performance of Intel Xeon 7500 series processor-based servers by more than 20 times when compared to older, 4S single-core servers.

Pliant Technology Solid State Drives

Using an innovative controller with MLC flash memory, Pliant Technology delivers industry-leading performance and reliability allowing enterprise data centers and cloud computing environments to leverage the speed capabilities within a SAS infrastructure while preserving valuable data. Pliant Technology drives can further scale performance by making use of a second SAS port. Based on an advanced parallel processing architecture, the Pliant Enterprise Flash Drive (EFD) provides high I/O performance with very low response times under peak conditions. Lightning EFDs 'just work better' to deliver the industry's highest sustained performance with the most predictable performance profile across a wide range of workloads, and have been specifically designed for demanding, mission-critical 24x7 applications.

Pliant Technology EFDs also deliver outstanding data integrity features for increased data reliability, which is essential for enterprise applications. Pliant Technology EFDs offer a cache-less design, strong error correction and data management checking, end-to-end data protection (including native T10 Data Integrity Field [DIF]), and advanced NAND management for extending life. Even if the host system does not provide the advanced data integrity features of T10 DIF, Pliant Technology EFDs automatically enable the feature.

Microsoft SQL Server 2008 R2 Enterprise Edition

Microsoft® SQL Server® 2008 R2 is a complete set of enterprise-ready technologies and tools that help people get the most value from information at the lowest TCO. Microsoft SQL Server 2008 R2 Enterprise Edition delivers several breakthrough capabilities that enable an organization to scale database operations with confidence and improve IT and developer efficiency, offering comprehensive security, reliability, manageability, and scalability for demanding transaction processing, business intelligence, and data-warehousing applications.

Key Features

- Greater than 64 logical processor support
- Database mirroring
- Up to 16-node failover cluster
- Hot-add memory and CPU support
- Transparent data encryption
- Backup compression
- Enterprise key management
- Central management of up to 25 instances
- PowerPivot for Microsoft SharePoint Server
- Master Data Services
- UCS-2 Unicode data compression
- No additional cost for multicore processors

Usage Scenarios

- Preventing and minimizing unplanned downtime
- Recovering data and resuming operations quickly in the event of disaster
- Helping to ensure high performance across workloads
- Decreasing storage up to 90 percent by using enhanced database compression
- Reducing hardware and licensing costs up to 50% with virtualization and consolidation

Note: For additional information, see the *Microsoft SQL Server 2008 R2* home page at: <http://www.microsoft.com/sqlserver/2008/en/us/R2.aspx>

F5 Big IP Local Traffic Manager

F5's BIG-IP Local Traffic Manager (LTM) is designed to allow customers to leverage the power of the network to provide high availability, scalability, and increased performance for applications and services such as Microsoft Dynamics. As part of F5's commitment to supporting Microsoft technologies, F5 regularly participates in joint test engagements like these in order to ensure continuing compatibility.

The BIG-IP LTM is a port dense network appliance with a custom architecture built specifically for consistent and accelerated network performance. The model used in this testing was the BIG-IP LTM 3600, which is capable of nearly 2 G/s of sustained traffic by using its dual core CPU architecture. With 8 tri-speed copper ports and 2 optional fiber ports, the LTM 3600 can attach to multiple networks, allowing separate access paths for internal and external users. The LTM 3600 is one of 5 different BIG-IP LTM platforms that allow customers to find the model that best suits their needs.

Note: For additional information about F5's BIG IP LTM, see the following resources:

- *Why do I need F5 for my Microsoft Dynamics CRM deployment?*
<http://www.f5.com/solutions/applications/microsoft/dynamics-crm/>
- *F5 Solutions for Microsoft Applications*
<http://www.f5.com/microsoft>