

PERFORMANCE

Microsoft Dynamics CRM 3.0

Performance Report

White Paper

This report summarizes the performance test results of 2000 concurrent users of Microsoft CRM 3.0 executing a heavy load of sales and marketing transactions on a single 4-processor Intel® Xeon® CRM application server and a single 4-processor dual-core Intel Xeon database server. We are grateful to Intel Corporation for its support of these efforts.



Microsoft Dynamics™ CRM

Executive Summary

Microsoft Dynamics CRM 3.0 provides the functionality and performance scalability to serve the needs of companies ranging from small business to the global enterprise. This report summarizes the performance test results of 2000 concurrent users of Microsoft CRM 3.0 executing a heavy load of sales and marketing transactions on a single 4-processor Intel® Xeon® CRM application server and a single 4-processor dual-core Intel Xeon database server.

The goal of the report is to:

- Publish quantitative benchmark performance data illustrating the enterprise-level scalability of CRM 3.0.
- Provide customer and partner guidance on enterprise-class system and database configuration requirements.
- Introduce the Microsoft Performance Testing Toolkit and encourage its use. Great care must be taken when extrapolating these benchmark results. The Testing Toolkit should be used to simulate specific customer workloads and accurately determine system requirements.

The measured results clearly demonstrate the ability of a single server MS CRM 3.0 system to meet the needs of 2000 concurrent users executing a heavy workload against a large and complex database.

Capsule Results

Key Parameters	
Concurrent users tested	2000
CRM business transaction rate	15,000/hour
Database size	80 Gb; 8.3 million rows
CRM Application Server	Single 4-processor Intel Xeon server
Database Server	Single 4-processor dual-core Intel Xeon server

Key Measurements	
Atomic CRM command response time	319 millisecond average
CPU Utilization – CRM Server	20% average
CPU Utilization – DB Server	41% average

Introduction

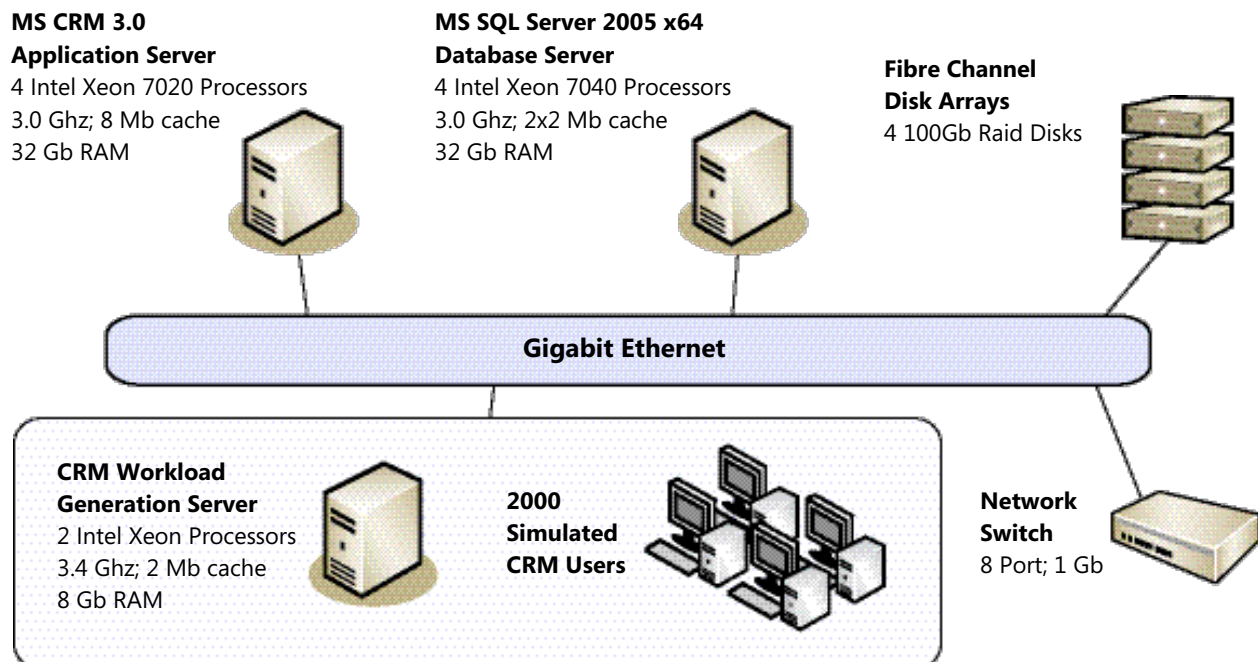
The purpose of this document is to detail and quantify the performance of a system running Microsoft Dynamics CRM 3.0 on current generation Intel Xeon server platforms. The workload presented to the system under test is designed to mimic that of a 2000 concurrent user population interacting with the system to carry out a number of simulated business operations. Details of the exact workload are presented later in this document.

The document is divided into several sections, each detailing a different aspect of the experiment:

1. The hardware comprising the system under test.
2. The workload represented by the test (dataset and activity mix), as well as the characteristics of the system under test while servicing the workload (response times, utilizations, etc.).
3. Tunings required to achieve the characteristics revealed in section three (indexing strategies, IIS/ASP configurations, etc.).

Hardware Environment

The system under test was constructed from current generation Intel Xeon hardware. The hardware features Intel's Extended Memory 64 Technology (EM64T) technology, which supports both 32- and 64-bit applications, helping to ensure the smooth migration of businesses to 64-bit computing. The data tier was configured with a 64-bit Windows operating system running Microsoft SQL Server 2005 x64 edition and 32 Gb of memory.



The hardware environment which comprised the system under test is detailed in the following tables:

Client System (workload generator)	
Manufacturer	Dell
Model	PowerEdge 1850
Operating System	Microsoft Windows® Server 2003
Processor	(2) Intel Xeon Processors 3.4Ghz 2MB cache 800Mhz FSB
Network Adapter	(2) Gigabit Ethernet Adapter
RAM	8 Gb DDR2
Software	Microsoft Visual Studio Team Suite 2005 Microsoft Dynamics CRM 3.0 Performance Testing Toolkit

Database Server	
Manufacturer	Dell
Model	PowerEdge 6850
Operating System	Windows Server 2003 Enterprise x64
Processor	(4) Dual-Core Xeon (7040) 3.0Ghz 2x2Mb cache 667 Mhz FSB HT Enabled
Network Adapter	(2) Gigabit Ethernet Adapter
RAM	32 Gb DDR2 400Mhz
Software	Microsoft SQL Server 2005 x64

Fiber Channel Raid Array	
Manufacturer	Adaptec
Model	SANBloc 2Gb RAID
Disk Configuration	(4) 100Gb RAID 0 striped partitions (2) Hot Spares

Application Server	
Manufacturer	Dell
Model	PowerEdge 6850
Operating System	Windows Server 2003 Enterprise Ed.
Processor	(4) Xeon (7020) 3.0Ghz 8Mb cache 667 Mhz FSB HT Enabled
RAM	32 Gb DDR2
Software	Internet Information Services (IIS) 6.0 Microsoft Dynamics CRM 3.0
Network Adapter	(2) Gigabit Ethernet Adapter

Domain controller	
Manufacturer	Dell
Model	E510n
Operating System	Windows® 2003 Advanced Server
Processor	(1) P4 2.8Ghz 800Mhz FSB HT Enabled
RAM	512 MB
Software	Active Directory
Network Adapter	(2) Gigabit Ethernet Adapter

Network Switch	
Manufacturer	Linksys
Model	(8) Port 1GB Switch

Workload Description and Test Results

The workload used for this benchmark stems from extensive Microsoft research on the installed base of CRM customers. It is meant to simulate a realistic heavy usage of the product across sales and marketing functions. The CRM database tested is extremely large and complex, reflecting a sophisticated enterprise-level customer profile.

Simulated users execute a series of real-world *business transactions*. Each business transaction is composed of a set of discrete user interactions with the CRM system. For example, the business transaction "AccountActivityRollup" consists of the following discrete CRM interactions:

1. Start at Sales homepage
2. Select Accounts
3. Insert name criteria in 'Find' box and Select "Find" button
4. Open Account (double click)
5. Select Activities

Each discrete interaction is itself comprised of one or more atomic CRM commands. On average each business transaction represents 5-10 atomic CRM commands and takes anywhere from 1 to 41 seconds to realistically execute.

Simulated users execute business transactions at an average rate of 7.5 per hour, yielding an overall CRM system interaction rate of approximately 15,000 business transactions per hour.

The Microsoft CRM 3.0 Performance Testing Toolkit was used as the basis for generating the dataset and simulated user actions. The Performance Testing Toolkit, as well as all relevant scripts and configurations are available from a Microsoft representative.

Test Results	
Number of named CRM Users	2000
Number of concurrent CRM Users	2000
Business Transaction Rate	480 seconds / 7.5 per hour per user Equivalent to approximately 15,000 Business Transactions per hour
Size of CRM database	Approximately 80 GB
CPU Utilization %, Application Tier	20%
CPU Utilization %, Data Tier	41%
Atomic CRM Command Response Time	319 milliseconds average
Execution Time per Business Transaction	3.63 seconds average
Run Duration	1 hour 35 minutes

The following table lists the business transactions executed during the test along with the number of executions during the run and the average execution time.

Business Transaction Distribution and Execution Times		
Test Case	Actual Executions during 1h35m run	Average Test Case Execution Time
AccountActivityRollup	276	3.88
AccountOppRollup	288	3.91
AccountSCRollup	288	3.98
AddActivityToAccount	580	3.12
AddActivityToLead	595	3.89
AddMembersToList	129	3.4
AdvancedFindAccount	209	5.24
AdvancedFindAccountNotes	174	4.07
AdvancedFindContact	218	6.23
AdvancedFindContract	159	1.07
AdvancedFindProduct	153	1.01
AssignAccounts	88	41.6
AssignLead	462	4.52
AssignOpportunity	214	3
ConvertleadToOppWithAccount	146	5.81
CreateCampaignActivity	158	2.87
CreateCampaignResponse	300	2.86
CreateEmail	805	6.54
CreateNewAccount	744	1.19
CreateNewCampaign	123	1.12
CreateNewContact	854	1.2
CreateNewLead	604	1.18
CreateNewList	79	1.16
CreateNewNoteForAccount	820	2.53
CreateNewNoteForContact	892	2.65
CreateNewNoteForLead	785	3.16

Test Case	Actual Executions during 1h35m run	Average Test Case Execution Time
CreateNewNoteForOpp	792	1.82
CreateNewNoteForTask	840	5.68
CreateNewOpportunity	334	1.47
CreatePlanningTask	141	2.51
CreateQuote	167	4.2
CreateTask	813	6.54
DeleteAccountNC	103	5.54
DeleteContactNC	111	5.64
DeleteLead	139	6.66
DeleteNoteOnAccount	115	6.12
DeleteNoteOnContact	152	7.32
DeleteNoteOnLead	127	4.83
DeleteNoteOnOpportunityNE	146	4.07
DeleteNoteOnTask	123	5.78
DeleteOpportunity	84	4.28
DeleteTaskNC	129	6.32
EmailQuote	184	4.1
FindAccounts	1,286	1.95
FindContacts	1,323	1.91
QuickCreateNewAccount	630	0.7
RemoveFromList	111	3.95
ShareAccounts	91	41.2
UpdateAccount	485	3.71
UpdateContact	651	3.77
UpdateLead	491	4.93
UpdateOpportunity	307	1.34
UpdateTask	399	4.14
	Total: 20417	Average (weighted): 3.63s

Database Description

The amount of data present in the system during testing is critical to performance. This benchmark uses a large and complex 80 Gb database with 8.3 M rows. It includes:

- 115,000 accounts
- 175,000 contacts
- 100,000 leads
- 1.4 million opportunities
- 8 million tracked activities

The following table lists the row counts for tables with greater than 10,000 rows. Tables with less than 10,000 rows are omitted for brevity.

Database Row Counts		
Table	Row count	Approximate per user data
ActivityParty	18278160	9139
ActivityPointer	8288180	4144
Annotation	5785836	2893
Quote	3603600	1802
QueueItem	3408305	1704
QuoteClose	2702700	1351
QuoteDetail	2462460	1231
Task	1901800	951
Opportunity	1401400	701
OpportunityProduct	1401399	701
CampaignActivity	1001000	501
CampaignActivityItem	1001000	501
CampaignResponse	1001000	501
CampaignItem	963969	482
Email	900900	450
OpportunityClose	720720	360
CustomerAddress	580180	290
PrincipalObjectAccess	501968	251
ListMember	250218	125
Incident	225225	113

Table	Row count	Approximate per user data
LeadAddress	200256	100
Contact	175075	88
Account	115015	58
Lead	100128	50
Invoice	75075	38
InvoiceDetail	75075	38
SalesOrder	75075	38
OrderClose	60060	30
Campaign	50050	25
List	50050	25
UserQuery	44044	22
SalesOrderDetail	30030	15
DocumentIndex	15015	8
KbArticle	15015	8
SystemUserRoles	12001	6

System Tuning and Optimization

When working with large user and data populations, it is often necessary to optimize database and application settings to make best use of the available resources for the given workload. For this particular test, the following indexes were added to the database tier to improve query performance and response times:

```
CREATE NONCLUSTERED INDEX [ATC_DSC_Sub_activitypointerbase] ON
[dbo].[ActivityPointerBase]
(
    [ActivityTypeCode] ASC,
    [DeletionStateCode] ASC,
    [Subject] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF) ON [PRIMARY]
```

```
CREATE NONCLUSTERED INDEX [Subj_Activitypointerbase] ON
[dbo].[ActivityPointerBase]
(
    [Subject] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF) ON [PRIMARY]
```

```
CREATE NONCLUSTERED INDEX [DSC_SC_FN_MN_LN_FNM_EM1_contactbase] ON
[dbo].[ContactBase]
(
    [DeletionStateCode] ASC,
    [StateCode] ASC,
    [FirstName] ASC,
    [MiddleName] ASC,
    [LastName] ASC,
    [FullName] ASC,
    [EmailAddress1] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF) ON [PRIMARY]
```

```
CREATE NONCLUSTERED INDEX [LstMemId_EntId_listmemberbase] ON
[dbo].[ListMemberBase]
(
    [EntityId] ASC,
    [ListMemberId] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF) ON [PRIMARY]
```

```
CREATE NONCLUSTERED INDEX [DSC_SC_Nm_opportunitybase] ON
[dbo].[OpportunityBase]
(
    [DeletionStateCode] ASC,
    [StateCode] ASC,
    [Name] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF, MAXDOP = 2) ON [PRIMARY]
```

```
CREATE NONCLUSTERED INDEX [StCD_ActivityPointerBase] ON
[dbo].[ActivityPointerBase]
(
    [StateCode] ASC
)WITH (SORT_IN_TEMPDB = OFF, DROP_EXISTING = OFF, IGNORE_DUP_KEY = OFF,
ONLINE = OFF) ON [PRIMARY]
```

Additionally it was found that the PrincipalObjectAccess table benefited from periodic index reorganization. In a production environment this could be accomplished via a job scheduling mechanism. The following SQL statements rebuild the PrincipalObjectAccess table and ensure it's statistics are up to date:

```
UPDATE STATISTICS PrincipalObjectAccess with FULLSCAN
alter index all on PrincipalObjectAccess rebuild with (ONLINE=off,
maxdop=4)
```

Note that all the above SQL statements apply to Microsoft SQL Server 2005. The syntax and usefulness of these statements may differ for other versions of Microsoft SQL Server.

The following table lists the Microsoft SQL Server 2005 configuration options in effect for the test:

Ad Hoc Distributed Queries	0	max worker threads	0
affinity I/O mask	0	media retention	0
affinity mask	65535	min memory per query (KB)	1024
affinity64 I/O mask	0	min server memory (MB)	0
affinity64 mask	0	nested triggers	1
Agent XPs	1	network packet size (B)	4096
allow updates	0	Ole Automation Procedures	0
awe enabled	0	open objects	0
blocked process threshold	0	PH timeout (s)	60
c2 audit mode	0	precompute rank	0
clr enabled	0	priority boost	0
cost threshold for parallelism	5	query governor cost limit	0
cross db ownership chaining	0	query wait (s)	-1
cursor threshold	-1	recovery interval (min)	0
Database Mail XPs	0	remote access	1
default full-text language	1033	remote admin connections	0
default language	0	remote login timeout (s)	20
default trace enabled	1	remote proc trans	0
disallow results from triggers	0	remote query timeout (s)	600
fill factor (%)	0	Replication XPs	0
ft crawl bandwidth (max)	100	scan for startup procs	0
ft crawl bandwidth (min)	0	server trigger recursion	1
ft notify bandwidth (max)	100	set working set size	0
ft notify bandwidth (min)	0	show advanced options	1
index create memory (KB)	0	SMO and DMO XPs	1
in-doubt xact resolution	0	SQL Mail XPs	0
lightweight pooling	0	transform noise words	0
locks	0	two digit year cutoff	2049
max degree of parallelism	1	user connections	0

max full-text crawl range	4
max server memory (MB)	24000
max text repl size (B)	65536

user options	0
Web Assistant Procedures	0
xp_cmdshell	0

Conclusions

The results outlined in this document illustrate certain aspects of the performance available to users of Microsoft Dynamics CRM 3.0 running on the latest Intel Xeon processor server platforms. The combination of improved architecture and design in Microsoft Dynamics CRM 3.0 along with the processing power and additional native memory available to the x64 data tier allow new levels of scalability and performance.

As with any benchmark, it is important to take care and study the results carefully when attempting to estimate performance of a particular system based on the results contained in this document. Here are a few considerations to keep in mind when making such extrapolations:

1. The notion of a user in the context of a performance test represents a given amount of data and a given amount of interaction with the server. For example, the parameters of this test dictate that a user owns roughly 50 accounts, 950 tasks, and so on, and each user performs a series of interactions with the server approximately every eight minutes to carry out one of the specified business transactions. Any differences in the amount of data per user, the frequency of operations per user, or the specific operations per user can dramatically affect performance.
2. The absolute amount of data in the system has the largest impact on overall system performance.
3. There were no workflows in the system, all users belonged to a single organization, and all users were interacting via the web browser interface.

While this document does not prove that *any* 2000 user CRM deployment is viable on this configuration, it does illustrate that CRM, along with Intel's latest hardware offerings, is capable of dealing with large datasets and high transaction rates. For those wishing to test the performance of different hardware configurations, datasets, or workloads, the Microsoft CRM 3.0 Performance Toolkit provides a complete simulation environment.

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