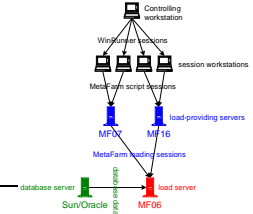


Communications Team

Memo



To SuperTeam, Communications Team, Ron Pedersen, Wells Fargo Project Team
From Leslie "Pete" Petersen
Date 13 September 2000
Subject MetaFarm simulated load tests



The first section of this document will provide a high-level Summary. The technical details, including Server Configurations, Study Details, Problem Report, and Resolution Recommendations follow.

Summary

The purpose of this test was to discover the type of stress that Loan Manager will put on the CrossLand Mortgage MetaFarm servers (including memory, CPU, network, and disk usage). This is a pre-conversion load test. The question file and custom CMC macros have not been included in these tests. Another test will be conducted to include these to determine the load they have on the MetaFarm servers.

There were four actual load tests completed while the scripts were honed to a point of functionality. During the 3rd test, 58 simultaneous virtual users were heavily actively using Loan Manager, GroupWise, Word, Excel, Desktop Underwriter, and GoldenGate, while 100 total users were logged in.

Although every effort was made to make this as real a test as possible, it should be noted that this test is only the result of technologists making assumptions about the actual load real-life users will put on the server. The estimated number of active users each server can hold as scripted below is **45-50 users**. At 80% concurrency and 50% activity rates, this means that to serve **1000 users, nine active MetaFarm servers** are needed. Actual usage will depend on user activity. Server memory, disk usage, and network usage were not significant factors in this test. However, it is to be noted that in previous tests, a hardware RAID card significantly reduced the CPU load of a MetaFarm server (CPU load was the heaviest loaded measurement of the tests).

Additional tests will be performed to discover the load that the Sun/Oracle servers can handle, and another test to discover the performance under load of a single Loan Detail File directory serving the entire enterprise.

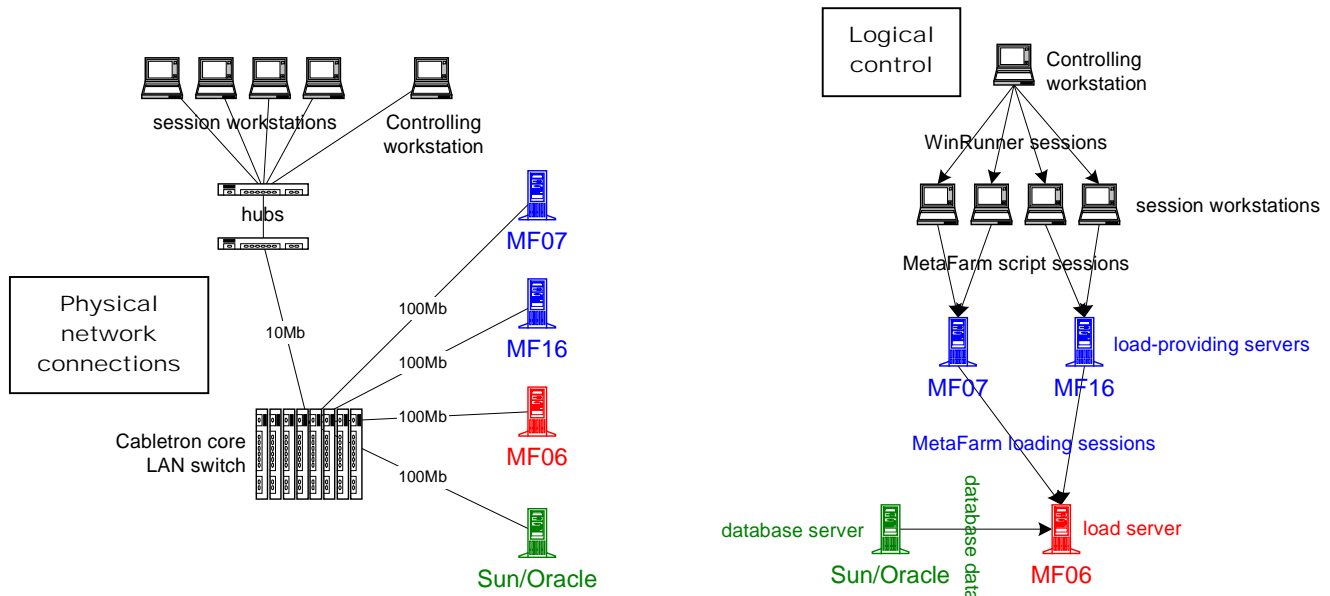
Load test configurations

Based on previous load tests (29 October 1999 and 21 July 2000), the server model and processor speed made no noticeable difference in the test. Therefore the load server is a Compaq ProLiant 6400 with 4 Xeon 550Mhz CPUs.

It was determined during previous tests that the servers with 100 Mb/s network connection out-performed those with 10 Mb/s network connections. Therefore all MetaFarm servers were moved to 100 Mb/s network connections, and that connection speed was used the load server during this load test.

It was also determined during previous load tests that the servers with a hardware RAID SCSI controller far out-performed those with software RAID, resulting in significantly less CPU usage. However, no action has been taken to satisfy that recommendation. Therefore, the SCSI no RAID (software RAID) configuration was used for this test. More details on the previous study and the current load test study of the RAID configurations are included below.

Two additional MetaFarm servers were used to provide the virtual users for the load server. Controller workstations were used to run the scripts. From the controller workstations, virtual users were logged onto either MF07 or MF16 (the load-providing servers). They, in turn, logged onto MF06 (the load server). Please refer to the drawing and server configuration details below.



Physical network connections

All servers (mf07, mf16, mf06, Sun) were connected to the core Ethernet switch at 100Mb/s. The controlling workstation and session workstations all shared a single 10Mb/s connection to the core switch.

Logical control

The server being measured (the load server) was mf06. It retrieves its database data from the Sun/Oracle database server, and the Loan Detail Files from local disk storage. The server was configured with Windows NT Terminal Server Edition with Citrix MetaFrame 1.8 with Terminal Server service pack 5 and MetaFrame service pack 1 (which is the current user environment).

The servers that contained the virtual users and ran the scripts (load-providing servers) were mf07 and mf16. These machines provided the actual keystrokes and mouseclicks for the apps running on mf06. They were configured with Windows NT Terminal Server Edition with Citrix MetaFrame. These machines ran WinRunner (the scripting program), and received their scripts from the session workstations.

The workstations that housed the scripts (session workstations) were configured with Windows NT 4. Each could supply an average of 25 MetaFrame sessions for scripting.

The workstation that controlled which scripts to run when (controlling workstation) was configured with Windows NT 4. This workstation held all statistics and monitored the results of the tests.

Server configurations

- MF06
 - Hardware: ProLiant 6400
 - Processor: Quad Xeon 550Mhz
 - Memory: 3 GB (24 Gb)
 - Network: 100 Mb/s (12.5 MB/s)
 - SCSI: no RAID (software)
- MF16 and MF07
 - Hardware: ProLiant 6400
 - Processor: Quad Xeon 550Mhz
 - Memory: 3 GB (24 Gb)
 - Network: 100 Mb/s (12.5 MB/s)
 - SCSI: no RAID (software)

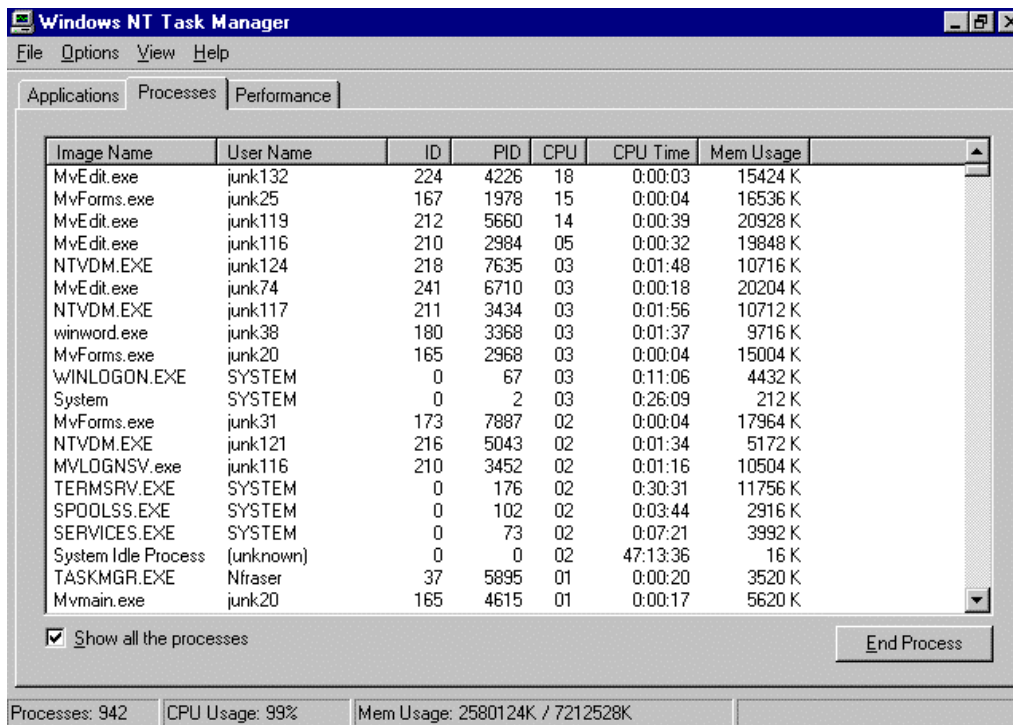
The RAID card on mf05 does software RAID. RAID was turned off, so the differences were not as pronounced as they could have been, but as seen from the studies below, the differences in the SCSI cards is very significant.

Scripts

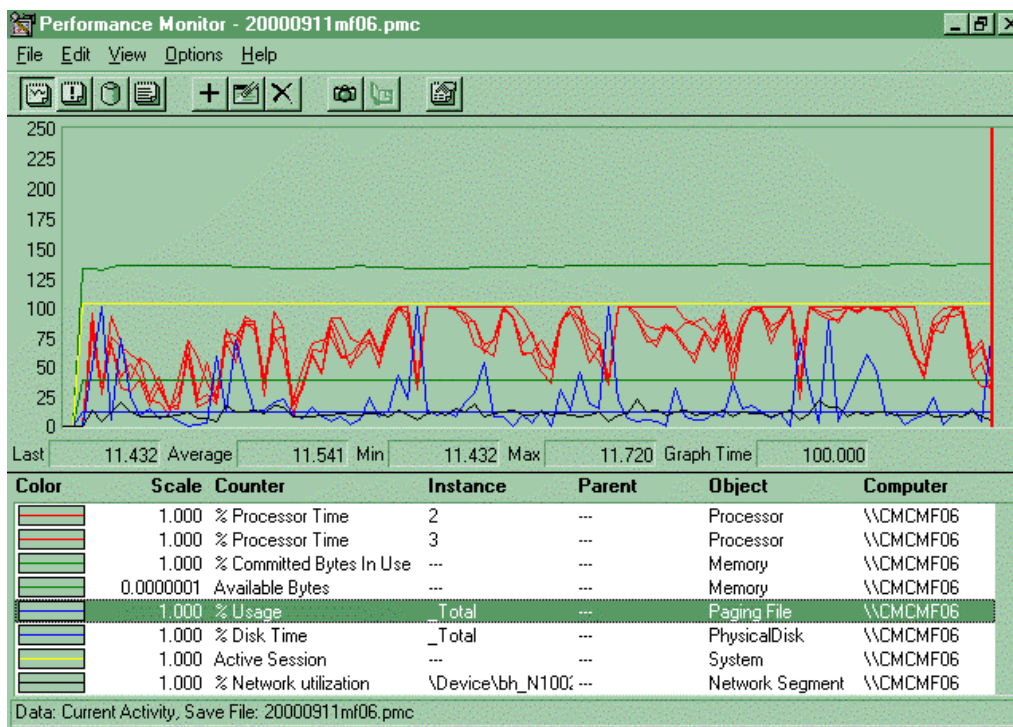
Please refer to the Further Inspection load test study document for script details.

Load test study

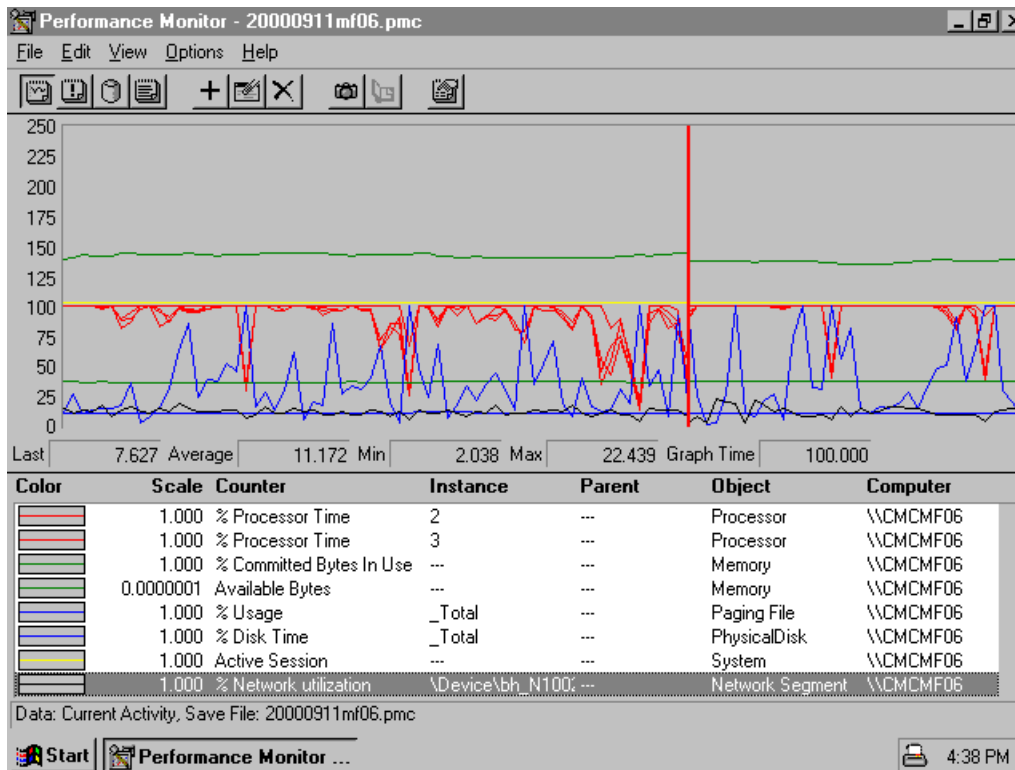
The purpose of the test was to see how many active Loan Manager users a single, currently-configured MetaFarm server can handle. This section will cover the study of MetaFarm server under load. Included below are detailed charts taken during the load test. Since server monitoring is given a lower priority by the servers, you will noticed there are times of no data polling during the testing period. All charts are detailed to 15-second increments. Before each test, 100 virtual users were logged in to the load server. The user counts that will be discussed below are actively running scripts.



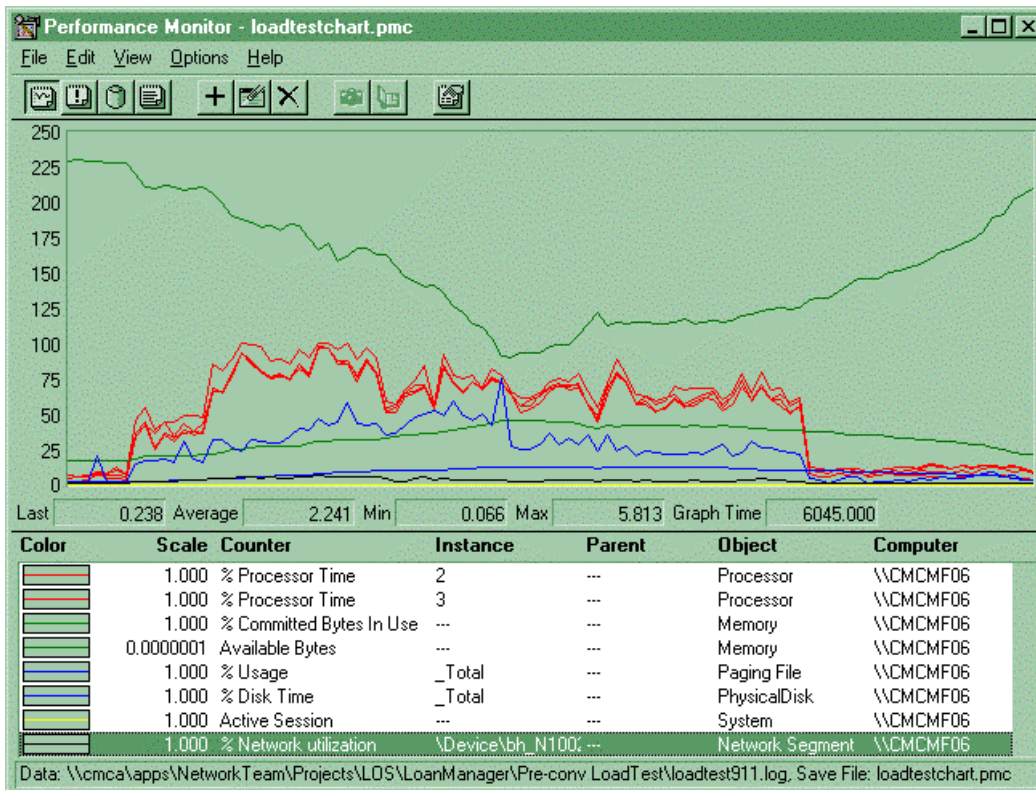
This image was taken on 11 September 2000 at 4:34pm with 45 virtual users actively running scripts. It shows a typical CPU load of the applications. It is sorted by the CPU (usage) column. Notice that at the point of this snapshot, CPU utilization was at 98% (System Idle Process at 2%). Also note that MvEdit and MvForms are the highest utilizing applications. This was typical throughout the test.



This snapshot was taken on 11 September 2000 at 3:49pm with 38 virtual users running scripts. These scripts were among the heaviest run. After this point, the scripts were modified to simulate a more realistic user. This chart uses one-second poll intervals (during a 90-second time period). Notice that CPU usage during these heavy scripts is high but usable and stable. Network utilization is negligible, and disk time is steady. In previous load tests, it was proven that in this configuration, disk time adversely affects CPU utilization (see 29 October 1999 and 21 July 2000 load test studies). Both CPU utilization and disk time can be reduced with a SCSI hardware RAID card. Memory also scaled acceptably throughout all tests.

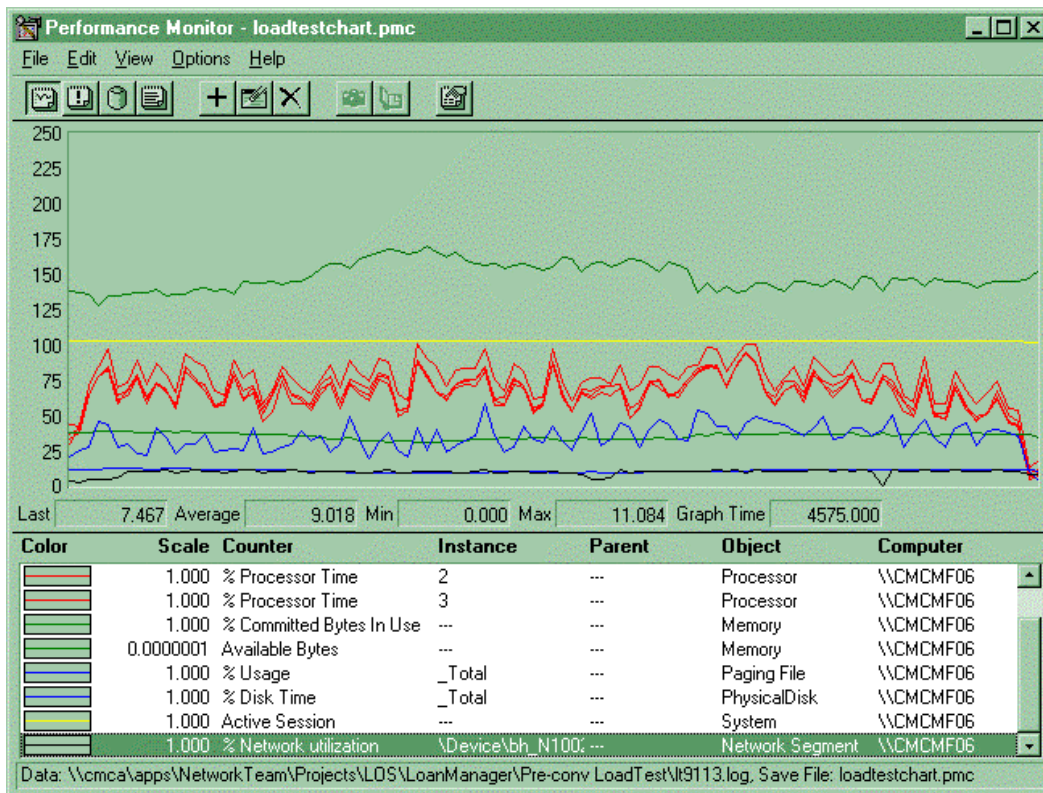


This snapshot was taken during the 2nd load test when 47 active scripts were running. This chart uses 15-second poll intervals (during a 90-second period). Processing was held close to 100% much of the time, and disk usage was comparatively high. Available memory didn't drop below 1 GB free during the entire test (see next load test chart below). Network utilization was steady and relatively low throughout all tests.



This chart is from the log from 10:25am to 12:06pm on 11 September 2000. This chart uses 15-second poll intervals. This was the first load test. Notice that memory dropped to 1 GB available during the peak of the test. Also note that processing was very high in the beginning (hovering close to 100%), but then after the users had gone into MvEdit and MvForms the

first time, processing wasn't as heavy. Processing decreased sharply as scripts were stopped, and available memory increased as users were logged out.



This chart is from the log from 3:44pm to 5:00pm on 13 September 2000. This chart uses 15-second poll intervals. There were some problems logging into Desktop Underwriter, and so it was removed from this last load test. The Loan Manager scripts at this point were as user-realistic as possible. The processor did not hover as close to 100%, and memory was more stable. Memory stability can be attributed to the lack of DU in the test. Note, however, that DU is in full production today and is not a memory issue.

Loading and printing loans

As noted above, CPU utilization was the most-taxed resource on the load server. During screen-by-screen tests, it was noted that after logging in, the first time MvEdit (editing an existing or new loan) and MvForms (printing screen), one user can require 20% of the server's CPU time for up to six seconds. The subsequent times these programs are loaded, there is no significant processor load.

Problem report

- The first scripts that were written were unrealistic. An entire loan was entered in six seconds. It is not possible for a human to type that quickly.
- It must be noted that the entire load tests were based on many assumptions, including how well the technologists could simulate how they thought users would load the server. Using the applications above, scripts could be written to only allow 4 users per server, or other scripts could be written to allow 100 users per server. Educated guesswork was used to arrive at the scripts used above.
- The scripts were written with time-out delays, but the average script still entered data faster than a real user could. Due to these speed increases, intermittent connection errors occurred within Loan Manager. These errors could not be recreated by a live user or slower scripts.

Resolution recommendations

- In order to solve disk time problems and related CPU loading, the hardware RAID card is necessary. The card is a Compaq SmartRAID 3200 at a cost of \$1858 each. [For the 15 servers that do not have the card, the total fix costs \\$27,870.](#) Any new MetaFarm server should be purchased with this card.
- As noted in the Further Inspection load test study document, as scripted 45-50 users can comfortably use Loan Manager and the other applications (Word, Excel, GroupWise, GoldenGate, Desktop Undwriter) on a single MetaFarm server.
- If we assume 1000 users at time of release, the number of servers to serve the 1000-user base is eight as calculated below.
 - 1000 users at time of release
 - 800 concurrent (80% concurrency peak)
 - 400 active (50% peak active based on current usage and assumed usage of Loan Manager)
 - 45 active users per server (as above)
 - $400 / 45 = 9$ servers needed for the MetaFarm
 - 5 servers (50% overage) needed for standby/rollout
 - 14 total servers needed for MetaFarm to serve 1000 users