



ODIN™ Performance Assessment Report

at Cisco Center

*Cessna Business Park
Kadubeesanahali, Varthur Hobli
Sarjapur Marathalli Outer Ring Road
Bangalore 560087*

For



Creating Markets. Unlocking Value.™

FINANCIAL TECHNOLOGIES (INDIA) LTD.

FT Fower, CTS No. 256 & 257, Suren Road,
Chakala, Andheri (East), Mumbai -400093
Tel: +91-22-66868010 Fax: +91-22-66868050

Contents

Executive Summary

Abbreviations

Introduction to ODIN™

Importance of Load and Performance Testing

Performance Testing Methodology

Why Cisco?

Objectives and Goals

Test Configuration

Test Cases and Results

Deployment Diagram

Conclusion

Executive Summary

Financial Technologies (India) Limited (FTIL) approached Cisco for conducting a third party assessment of ODIN™ software with the latest configuration of servers. The purpose of the testing was to identify the peak sustainable load in terms of concurrent users, message handling and broadcast tick information dissemination capacity. A summary of the results is tabulated below -

ODIN™ Integrated

ODIN™, an FTIL flagship product, has been the 'Trading Platform of Choice' for several years, powering many brokerage houses. It is a complete front-office solution suite offering built-in order routing, risk management and display engine with real-time connectivity to the back-office system.

ODIN™ is a multi-Exchange, multi-asset, multi-currency trading and risk management system that enables trading on multiple markets seamlessly through the use of a single application. It incorporates appealing features and works on advanced technology that facilitates higher accessibility and ensures speedy performance.

ODIN™, a scalable solution that ensures high performance standards, can be easily deployed across varied locations with relative ease. It provides real-time connectivity to multiple Exchanges with the highest order execution speed and operational stability. It has extensive search and filtering option and that, too, with minimal investment and ease of manageability.

A test was conducted for determining the baseline performance of ODIN™ on following Cisco servers:

- Rack Server C210 M
- Blade Server B200 M2
- Blade Server B230 M2
- Rack Server C260 M2

The testing was done with a basic set of test cases with the ODIN™ application configured in Cisco lab. The system was loaded with over 25,000 users and a series of other transactions messages. Concurrent user testing began with a small number of users and gradually increased to support more users.

This process also helped to debug the test environment itself, and fine tune server to handle the specified load mentioned in the test cases.

As a result,

- System can handle 25,000 concurrent users can perform with 80,000 MPS for 15 minutes.
- System can also sustain stability of 6 hrs with the three peak of 80,000 messages for a minute and flat 4,000 MPS for rest of the time.
- Market information server can also handle 24 MBPS of traffic of high frequency of market data.
- Broadcast Server, also, sustained with the 4,000 concurrent connections with the 100 token loaded in each connection and generating the network traffic of 250+ MBPS.

We have successfully tested ODIN™ integrated at Cisco lab. The test results and analysis documented in this report meet the desired values in terms of concurrent connection and message handling capacities.

We would like to take this opportunity to thank FTIL management for choosing Cisco to test their flagship product - ODIN™. We also appreciate all the support received in terms of functional and business understanding of the product.

Abbreviations

| | | |
|-----------|---|----------------------------|
| BC | : | Buffer Count |
| Broadcast | : | Market Data |
| BSE | : | Bombay Stock Exchange |
| DB | : | Database |
| EQ | : | Equities |
| F&O | : | Future & Options |
| HPC | : | High Performance Computing |
| HT | : | Hyper Threading |
| MIS | : | Market Information Server |
| NSE | : | National Stock Exchange |
| OPS | : | Orders Per Second |
| OS | : | Operating System |
| PAL | : | Performance Analyzer |
| SBS | : | Secondary Broadcast Server |
| TCP | : | TCP / IP Protocol |
| TG | : | Transaction Generator |

Introduction to ODIN™

ODIN™, which is an FTIL flagship product, has been the 'Trading platform of Choice' for several years powering many brokerage houses. It is a complete front-office solution suite offering built-in order routing, risk management and display engine with real-time connectivity to the back office system.

ODIN™ is a multi-Exchange, multi-asset, front office trading and risk management system that enables trading on multiple markets easier through the use of a single application. It incorporates appealing features and works on advance technology that facilitates higher accessibility, ensure speedy performance and advance risk management.

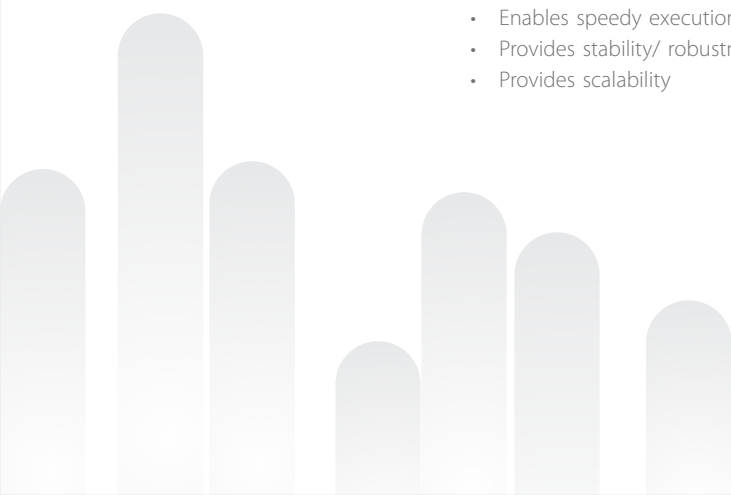
ODIN™ is a scalable solution that ensures high performance standards and which can be easily deployed across varied locations with relative ease. It provides real-time connectivity to multiple Exchanges offering highest highest order execution speed and operational stability. It provides extensive search and filtering options, offers easy manageability with minimal investment.

Benefits

- **Business Expansion**
 - Extends trading across the country by using heterogeneous network.
 - Provides common dealing desk for multiple exchange segments with minimal investment and easy manageability.
 - Facilitates operational ease with extensive search and filtering options.
- **Risk Management**
 - Enables comprehensive multi tier risk management across multi-Exchange segments with user-defined periodicity.
 - Enables easy monitoring of Real-time Risk position.
 - Facilitates complete trade and system audit trail.
- **Performance**
 - Enables speedy execution of orders
 - Provides stability/ robustness
 - Provides scalability

Value Proposition

- Multi-Exchange, multi-segment front office securities trading platform for equities, derivatives, and commodities markets - in a single application.
- Offers real-time connectivity between the exchange and back office system with faster intersegment trading.
- Offers a complete trade and system audit trail, real-time price and position information, and real-time risk monitoring at all levels.
- Fully customizable views at all levels besides extensive search and filtering options.



Importance of Load & Performance Testing

The elements contained in load, stress, endurance and performance testing are critical to the successful sustainability of the client/server and web-based applications.

Almost every application suffers from some performance problems. Neglecting these problems can lead not only to poor end-user experience, but even application outages. Many defects are discovered only when the system is placed under load. These defects do not surface in low load conditions. This is why load and performance testing is as important as functional testing. This enables risks under high load condition are identified and minimized.

Load testing is done by creating a set of virtual users that simulate various loads and scenarios for the application. This helps in understanding the response time, performance reliability and scalability of the solution. Without load and performance testing, it is difficult and virtually impossible to know these numbers / values.

Load and performance testing at FTIL primarily focused at identifying the number of users, messages, total transaction as well as other bottlenecks that are present in the application.

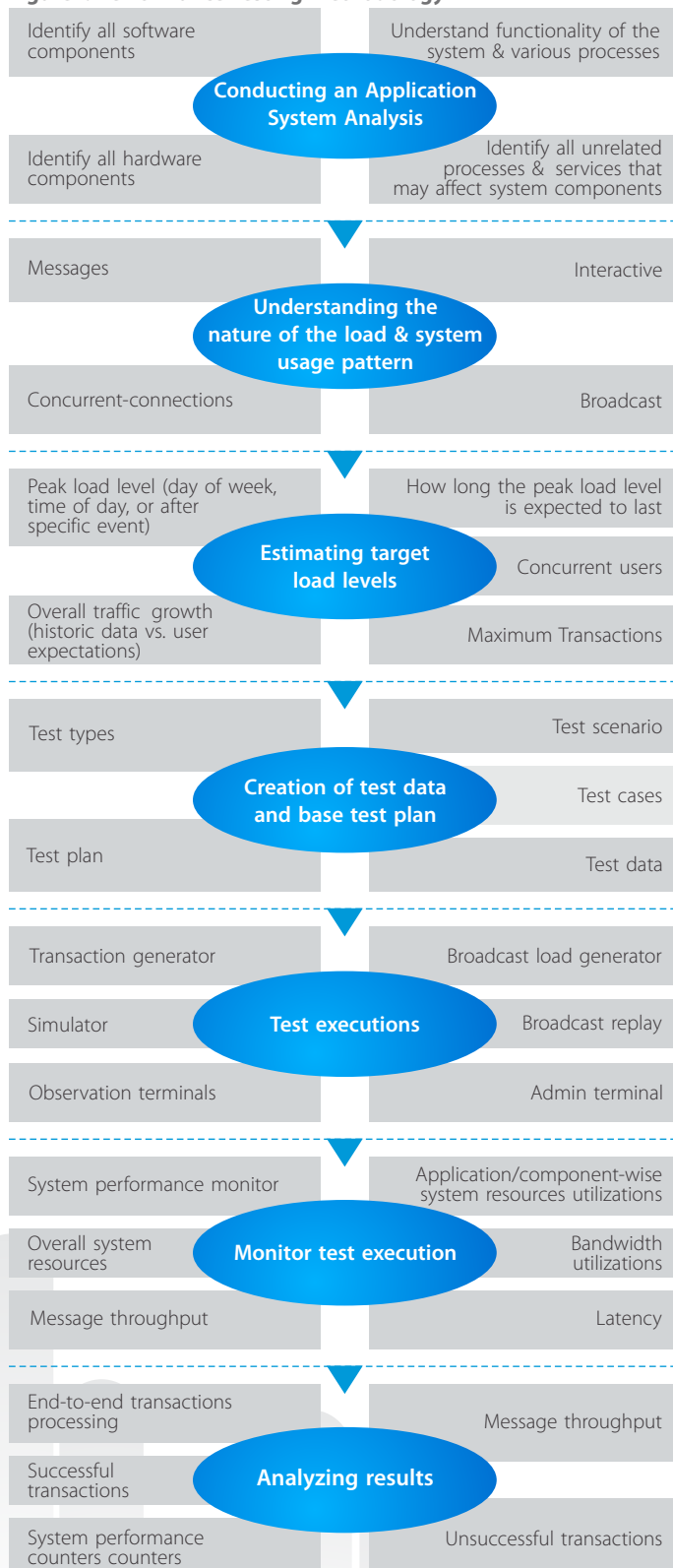
The goal of this test is to understand how the application will react to different user and transaction load, and determine whether it can handle the necessary load with acceptable response time or not.

ODIN™ Performance Testing Exercise

Performance Testing Methodology

As given below, figure 1, provides an overview of the performance testing methodology that FTIL used.

Figure1: Performance Testing Methodology



A. Conducting a Application System Analysis

In this phase, the entire system is analyzed and broken down into specific components. Any one component can have a dramatic effect on the performance of the system. This step is critical for simulating and understanding the load and potential problem areas. Furthermore, it can later aid in making suggestions on how to resolve bottlenecks and improve performance.

B. Understanding the Nature of the Load and system usage pattern

Understanding where and when the load comes from is necessary to correctly simulate the load. Along with nature of the load, it is also necessary to understand the system usage pattern. With this information, minimum, maximum, and average loads can be determined, as well as the distribution of the load.

C. Estimating Target Load Levels

With respect to the analysis in the previous steps target load levels, and goals, were established.

D. Creation of Test Plan

On the basis of available domain expertise and the information gathered a detailed test plan was drawn up which has also been documented in the later sections of the report. The frequency of the test case execution was also defined.

E. Test Execution

In this phase the application is deployed with the pre defined standard configurations. The required load is then generated to help execute the defined scenarios and test cases.

F. Monitor Test Execution

During execution, systems are logged and monitored. The Data gathered in this phase is used to generate the system utilization report as well as the system component performance reports.

G. Analyzing Results

The last but the most important step in load testing is to collect and process the data to identify performance bottlenecks. The generated reports represent the details covered

H. Reports and Suggestions

The following reports details the findings of the performance tests with respect to the metrics above,

Why Cisco ?

Cisco is the worldwide leader in networking that transforms how people connect, communicate and collaborate. At Cisco (NASDAQ: CSCO) customers come first and an integral part of our DNA is creating long-lasting customer partnerships and working with them to identify their needs and provide solutions that support their success.

Cisco Unified Computing System™ (Cisco UCS) is the first truly unified data center platform that combines x86-architecture blade and rack servers with networking and storage access into a single system. The system is an intelligent infrastructure that uses integrated, model-based management to simplify and expedite deployment of enterprise-class applications and services running in bare-metal, virtualized, and cloud-computing environments. The system's unified Input-Output (I/O) infrastructure uses a unified fabric to support IP, storage, and management traffic, while the Cisco Fabric Extender Architecture (FEA) extends the fabric directly to servers and virtual machines for increased performance, security, and manageability.

Servers Powered with Cisco Innovations

The system's x86-architecture rack and blade servers are powered exclusively by Intel® Xeon® processors and enhanced with Cisco innovations. These industry-standard servers deliver world-class performance to power mission-critical workloads. Cisco servers, combined with a simplified, unified architecture, drive better IT productivity and superior price/performance for lower total cost of ownership (TCO).

Simplifying Three Networks Into One

Building on Cisco's strength in enterprise networking, Cisco Unified Computing System is integrated with a standards-based, high-bandwidth, low-latency, virtualization-aware 10-GBPS unified fabric. The system is wired once to support the desired bandwidth and carries all Internet protocol, storage, management, and virtual machine traffic with security isolation, visibility, and control equivalent to physical networks. The system meets the bandwidth demands of today's multicore processors, eliminates the cost of separate networks for each type of traffic while increasing workload agility, reliability, and performance.

Bringing Automation to Information Technology

Cisco UCS is an intelligent infrastructure that is self-aware and self integrating. The system is built

from the ground to up, so that every aspect of server identity, personality, and connectivity is abstracted and can be applied through software. With Cisco UCS, servers are configured automatically, eliminating the manual, time-consuming, error-prone assembly of components into systems. With Cisco virtual interface cards, even the number and type of I/O interfaces is programmed dynamically, making every server ready to power any workload at any time.

Aligning Configurations to Workloads Through Policies

With integrated, model-based management, administrators manipulate a model of a desired system configuration, associate a model's service profile with hardware resources, and the system configures itself to match the model. This automation speeds provisioning and workload migration with accurate and rapid scalability. For the first time, IT organizations have an automated, policy-based mechanism for aligning server configuration with workload. The result has enhanced IT staff productivity, improved compliance, and reduced risk of failures due to inconsistent configurations.

Directly Connecting Servers and Virtual Machines to the Network

While the unified fabric reduces the number of networks in a system, the Cisco FEA reduces the number of network layers by directly connecting physical and virtual servers to the system's fabric interconnects. It eliminates both blade server and hypervisor-based switches by connecting fabric interconnect ports directly to individual blade servers and virtual machines. Virtual networks are now managed exactly as physical networks, but with massive scalability. This represents a radical simplification over traditional systems, reducing capital and operating costs while increasing business agility, simplifying and speeding deployment, and improving performance.

Beyond Efficiency

Making it more productive Cisco UCS helps organizations go beyond efficiency. It helps them become more effective through technologies that breed simplicity rather than complexity. The result is flexible, agile, high-performance, self-integrating information technology, reduced staff costs with increased uptime through automation, and more rapid return on investment.

ODIN™ Performance Testing Exercise

Objectives and Goals

Strategic Objectives

- Conduct load and performance testing to identify the capacity of ODIN™ in terms of concurrent users and transactional processing capabilities on various type of Cisco servers and various type of server platform.
- ODIN™ Integrated (with blade and rack servers and different type of CPUs)
- Market information server
- Secondary broadcast server

Project Objectives

- Identify the bottlenecks in the application
- To understand throughput and messages processing capabilities of the blade / rack systems with 6 Core and 10 Core CPUs.
- Test the stability of the product
- Identify the maximum concurrent users with maximum throughput that the system can support.

Goal

- ODIN™ Integrated ver. 10 x: 80,000 messages per second with 25,000 concurrent users on with various types of hardware and platform.
- MIS: Maximum messages processing capacity
- SBS: Maximum concurrent with maximum tokens handling capacity.

Attributes considered for Performance Testing

Following are some of the attributes out of many that were considered during performance testing.

- CPU usages
- Memory usages (memory leaks, thread leakage)
- Queues and I/O waits
- Bottlenecks (Memory, cache, process, processor, disk and network)
- Network usages
- Identification of the database usages in terms of settings and configurations read per second, write per second, etc.
- Throughput and response time
- Performance measurement with various combinations of concurrent users

Scope (Load Test, Stress Test & Stability Test)

- ODIN™ Manager Stress Test
 - Maximum throughput 80,000 MPS
 - Maximum concurrent-connections 25,000
- Broadcast test (MIS / SBS)
 - Maximum packets processing capacity MIS with UDP processing of 5,000 tokens subscriptions
 - Maximum concurrent-connection handling capacity
SBS, 4,000 concurrent-connections with 100 scrips subscriptions
- Stability Test
 - Duration = 14 hrs
 - Concurrent-connections = 10,000.
 - Peak = 80,000 MPS for 10 Mins and constant 4,000 MPS
 - SBS = 4,000 concurrent-connections and 100 tokens subscription.
- Exit Criteria:
 - Stability for 14 hrs.
 - Data verification on offline admin and online writing on database
 - No delay on the observation terminal
 - No delay on TCP connection on SBS (compare to MIS- UDP broadcast)

Test Configurations

Recorded broadcast feeds used during the testing were

- NSE EQ (Recorded high frequency broadcast)
- NSE FAO (Recorded high frequency broadcast)

Interactive simulators used where

- NSE EQ (simulator)
- NSE F&O (simulator)

Order Trade Ratio

- 1 order : 1 trade

Total messages

- 1 transaction = 8 messages

Server Platform

- Blade Server B200 M2
- Blade Server B230 M2
- Rack Server C210 M2
- Rack Server C260 M2

Server Configuration

Blade B200 M2

Memory - 12 DIMM x 8192 MB -1333 MHz

Network adapter -Cisco UCS M81KR

Blade B230 M2

Memory - 32 DIMM x 4192 MB @ 1333 Mhz

Network adapter -Cisco UCS M81KR

Rack server C210 M2

Memory -16 DIMM x 8192 MB @ 1333 Mhz

Network Adapter -Cisco UCS VIC P81E 10 Gbps

Rack server C260 M2

Memory -16 DIMM x 8192 MB 1333 Mhz

Network Adapter -Cisco UCS VIC P81E 10 Gbps

Test Configuration



| B200 M2 | |
|---------------------------------|--|
| OS Name | Microsoft Windows Server 2008 R2 Enterprise |
| Version | 6.1.7600 Build 7600 |
| Other OS Description | Not Available |
| OS Manufacturer | Microsoft Corporation |
| System Name | WIN-7HJI2DS6E1K |
| System Manufacturer | Cisco Systems Inc |
| System Model | N20-B6625-1 |
| System Type | x64-based PC |
| Processor | Intel® Xeon® CPU X5690 @ 3.47GHz, 3459 Mhz, 6 Core(s), 12 Logical Processor(s) |
| Processor | Intel® Xeon® CPU X5690 @ 3.47GHz, 3459 Mhz, 6 Core(s), 12 Logical Processor(s) |
| BIOS Version/Date | Cisco Systems, Inc. S5500.1.3.1h.0.030120111342, 3/1/2011 |
| SMBIOS Version | 2.5 |
| Windows Directory | C:\Windows |
| System Directory | C:\Windows\system32 |
| Boot Device | \Device\HarddiskVolume1 |
| Locale | United States |
| Hardware Abstraction Layer | Version = "6.1.7600.16385" |
| User Name | Not Available |
| Time Zone | India Standard Time |
| Installed Physical Memory (RAM) | 96.0 GB |
| Total Physical Memory | 95.9 GB |
| Page File | C:\pagefile.sys |

Test Configuration



| C210 M2 | |
|---------------------------------|--|
| OS Name | Microsoft Windows Server 2008 R2 Enterprise |
| Version | 6.1.7601 Service Pack 1 Build 7601 |
| Other OS Description | Not Available |
| OS Manufacturer | Microsoft Corporation |
| System Name | WIN-73C04695V4K |
| System Manufacturer | Cisco Systems Inc |
| System Model | R210-2121605W |
| System Type | x64-based PC |
| Processor | Intel® Xeon® CPU X5675 @ 3.07GHz, 3060 Mhz, 6 Core(s), 12 Logical Processor(s) |
| Processor | Intel® Xeon® CPU X5675 @ 3.07GHz, 3060 Mhz, 6 Core(s), 12 Logical Processor(s) |
| BIOS Version/Date | Cisco Systems, Inc. C200.1.3.2.0.032720112248, 3/27/2011 |
| SMBIOS Version | 2.5 |
| Windows Directory | C:\Windows |
| System Directory | C:\Windows\system32 |
| Boot Device | \Device\HarddiskVolume1 |
| Locale | United States |
| Hardware Abstraction Layer | Version = "6.1.7601.17514" |
| User Name | Not Available |
| Time Zone | India Standard Time |
| Installed Physical Memory (RAM) | 96.0 GB |
| Total Physical Memory | 95.9 GB |
| Available Physical Memory | 91.2 GB |
| Total Virtual Memory | 192 GB |
| Available Virtual Memory | 187 GB |
| Page File Space | 95.9 GB |
| Page File | C:\pagefile.sys |

Test Configuration



| B230 M2 | |
|---------------------------------|--|
| OS Name | Microsoft Windows Server 2008 R2 Enterprise |
| Version | 6.1.7601 Service Pack 1 Build 7601 |
| Other OS Description | Not Available |
| OS Manufacturer | Microsoft Corporation |
| System Name | WIN-HO78RAEADSK |
| System Manufacturer | Cisco Systems Inc |
| System Model | N20-B6730-1 |
| System Type | x64-based PC |
| Processor | Intel® Xeon® CPU E7- 2870 @ 2.40GHz, 2395 Mhz, 10 Core(s), 20 Logical Processor(s) |
| Processor | Intel® Xeon® CPU E7- 2870 @ 2.40GHz, 2395 Mhz, 10 Core(s), 20 Logical Processor(s) |
| BIOS Version/Date | Cisco Systems, Inc. B230M2.1.4.3b.0.052420111644, 5/24/2011 |
| SMBIOS Version | 2.5 |
| Windows Directory | C:\Windows |
| System Directory | C:\Windows\system32 |
| Boot Device | \Device\HarddiskVolume1 |
| Locale | United States |
| Hardware Abstraction Layer | Version = "6.1.7601.17514" |
| User Name | Not Available |
| Time Zone | India Standard Time |
| Installed Physical Memory (RAM) | 128 GB |
| Total Physical Memory | 128 GB |
| Available Physical Memory | 124 GB |
| Total Virtual Memory | 142 GB |
| Available Virtual Memory | 138 GB |
| Page File Space | 14.0 GB |
| Page File | C:\pagefile.sys |

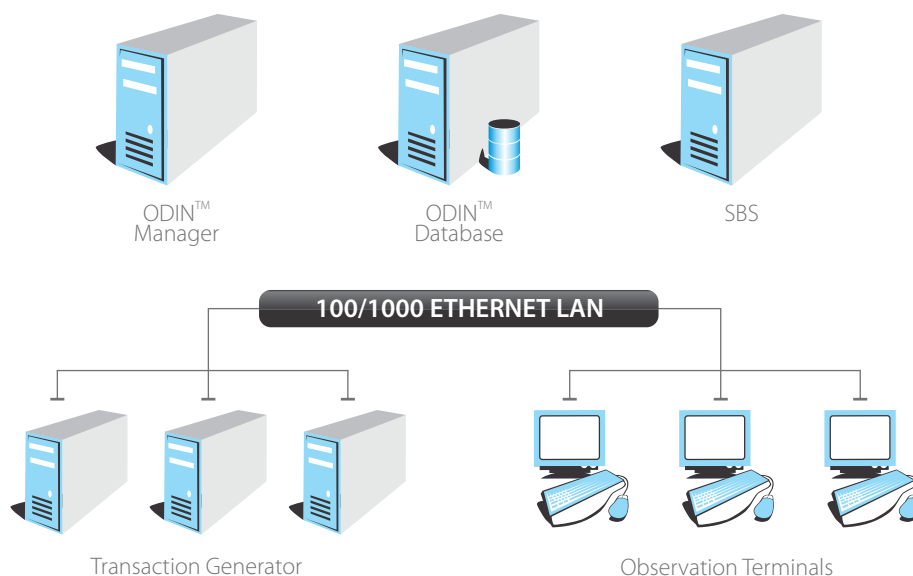
Test Configuration



| C260 M2 | |
|---------------------------------|--|
| OS Name | Microsoft Windows Server 2008 R2 Enterprise |
| Version | 6.1.7600 Build 7600 |
| Other OS Description | Not Available |
| OS Manufacturer | Microsoft Corporation |
| System Name | WIN-2THRLKSLT3 |
| System Manufacturer | Cisco Systems Inc |
| System Model | C260-BASE-2646 |
| System Type | x64-based PC |
| Processor | Intel® Xeon® CPU E7- 2870 @ 2.40GHz, 2395 Mhz, 10 Core(s), 20 Logical Processor(s) |
| Processor | Intel® Xeon® CPU E7- 2870 @ 2.40GHz, 2395 Mhz, 10 Core(s), 20 Logical Processor(s) |
| BIOS Version/Date | Cisco Systems, Inc. C260.1.3.3a.0.082520111345, 8/25/2011 |
| SMBIOS Version | 2.5 |
| Windows Directory | C:\Windows |
| System Directory | C:\Windows\system32 |
| Boot Device | \Device\HarddiskVolume1 |
| Locale | United States |
| Hardware Abstraction Layer | Version = "6.1.7600.16385" |
| User Name | Not Available |
| Time Zone | India Standard Time |
| Installed Physical Memory (RAM) | 128 GB |
| Total Physical Memory | 128 GB |
| Available Physical Memory | 58.4 GB |
| Total Virtual Memory | 256 GB |
| Available Virtual Memory | 182 GB |
| Page File Space | 128 GB |
| Page File | D:\pagefile.sys |

Test Configuration

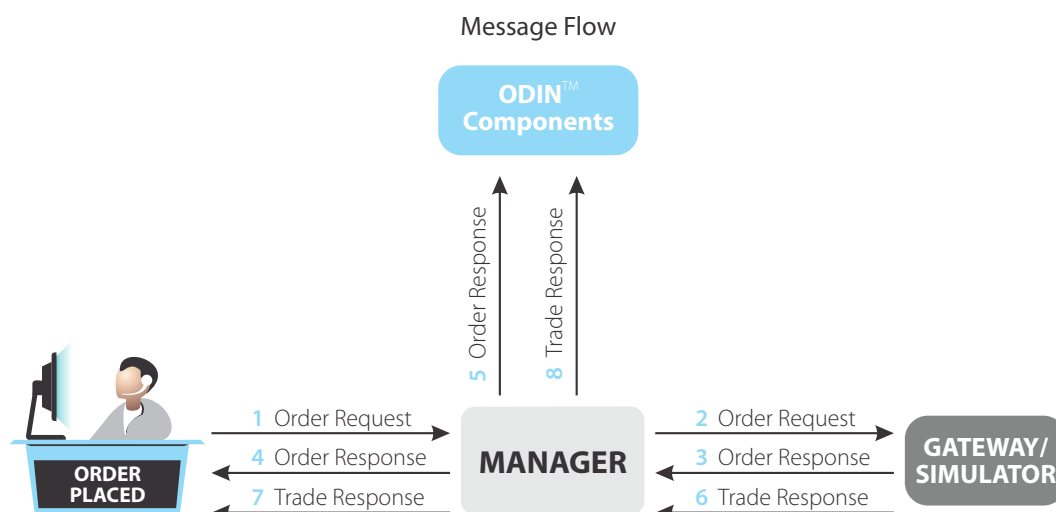
Deployment Diagram



Software / tools used

- Windows Performance Counters: Recording the system resources utilization.
- PAL: That helps to analyze performance counters
- Interactive Transaction Generator: Used to generate transaction and virtual user connection.
- Broadcast Transaction Generator: Used for connection virtual clients on MIS/SBS with defined tokens subscription.
- Wire shark: Network packet sniffing tool, for packet and latency analysis.

ODIN™ Message Flow Diagram



Test Cases & Result Analysis

ODIN™ Integrated 10x

Load Test

- ODIN™ Integrated ver 10x can handle 80,000 MPS for continuous till system resources available
- This version also handle 25,000 concurrent-connections

Stress test

- ODIN™ can also handle peaks of 80,000 MPS for duration of 15 mins
- This version also handles 25,000 concurrent-connections

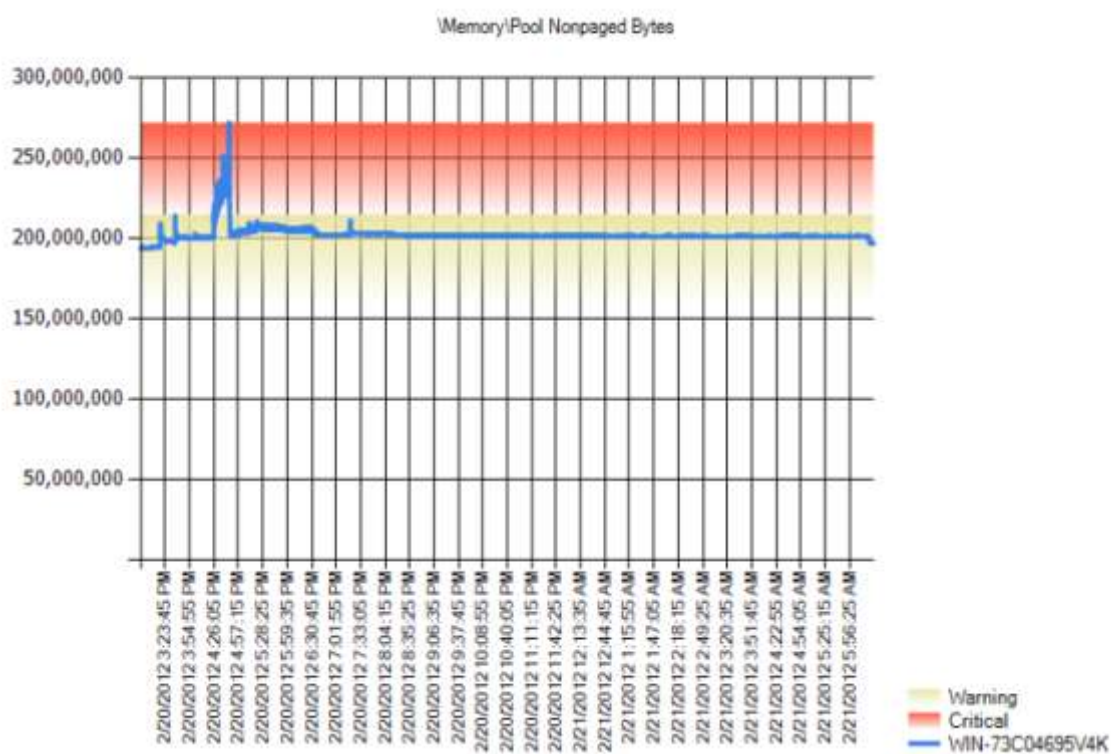
Stability test

- Run Date : 20th Febuary 2012
- Test Run Time : 2.25 PM to 6.26 AM
- Test Run Duration : 14 hrs +
- Server Hardware : CISCO C210 M2 Blade Server with (2 x 6 Core CPUs)
- Peak MPS : 80,000 MPS for 10 mins
- Peak MPS time : 4.25 PM to 4.35 PM
- Concurrent Users : 10,000+
- Flat MPS : 4,000 MPS

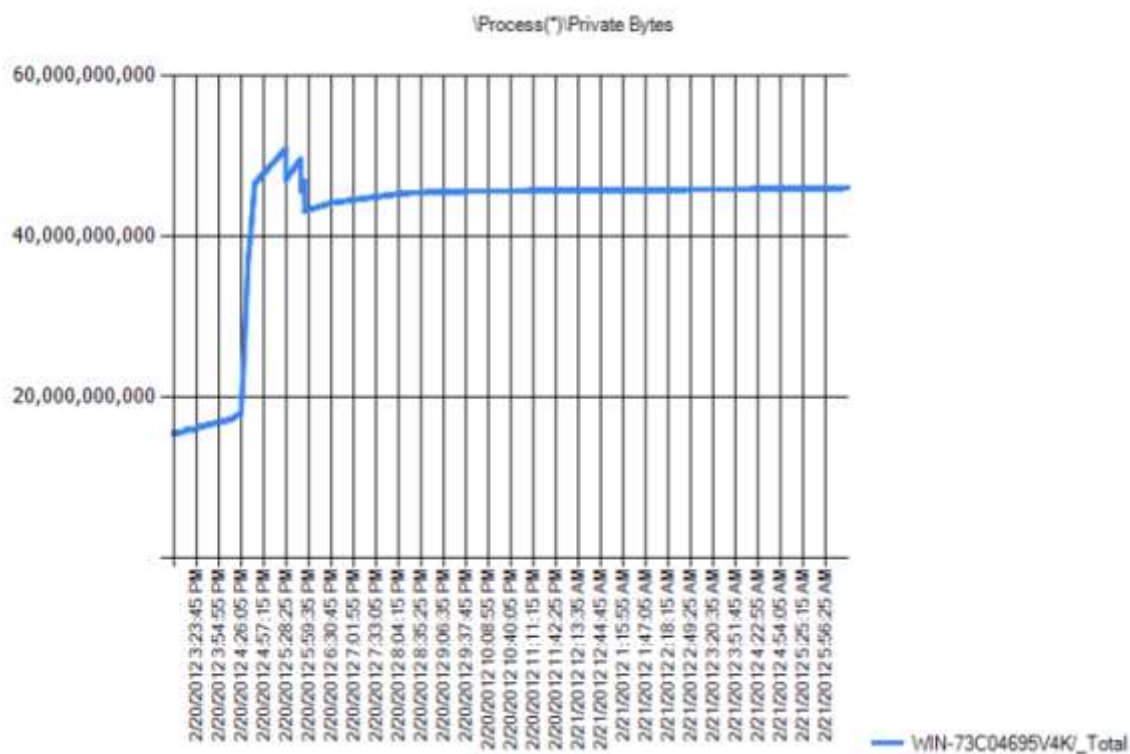
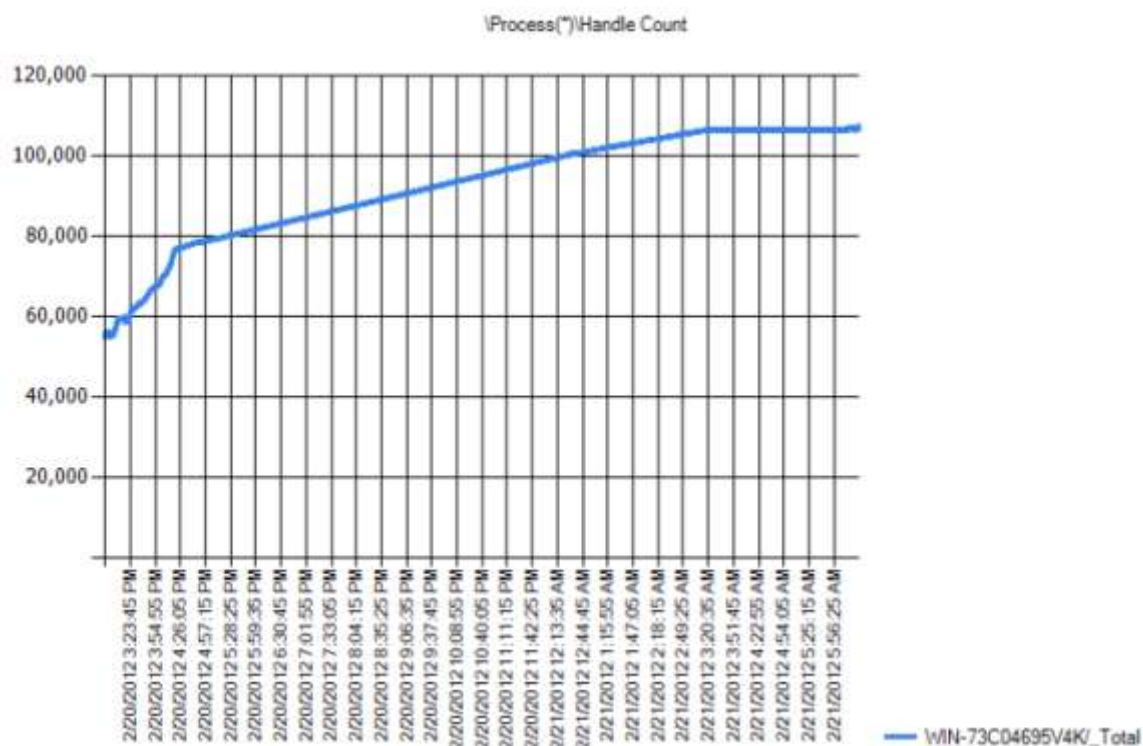
Observations & Analysis

- Test run on 20th Febuary 2012, 2.52 PM to 6.26 AM (for reference to performance graphs)
- 80,000 MPS of peak also successfully executed between 4.25 PM to 4.35 PM
- No delay was observed during the test
- CPU utilization observed less than 50% during the flat 4,000 MPS
- No advance settings at BIOS level implemented for the above test
- Total 10,000+ concurrent users connected during the test
- Total transactions processed during the test was 4,76,77,719
- Total messages processed during the test was 38,14,21,752
- No disconnection was observed during the test duration

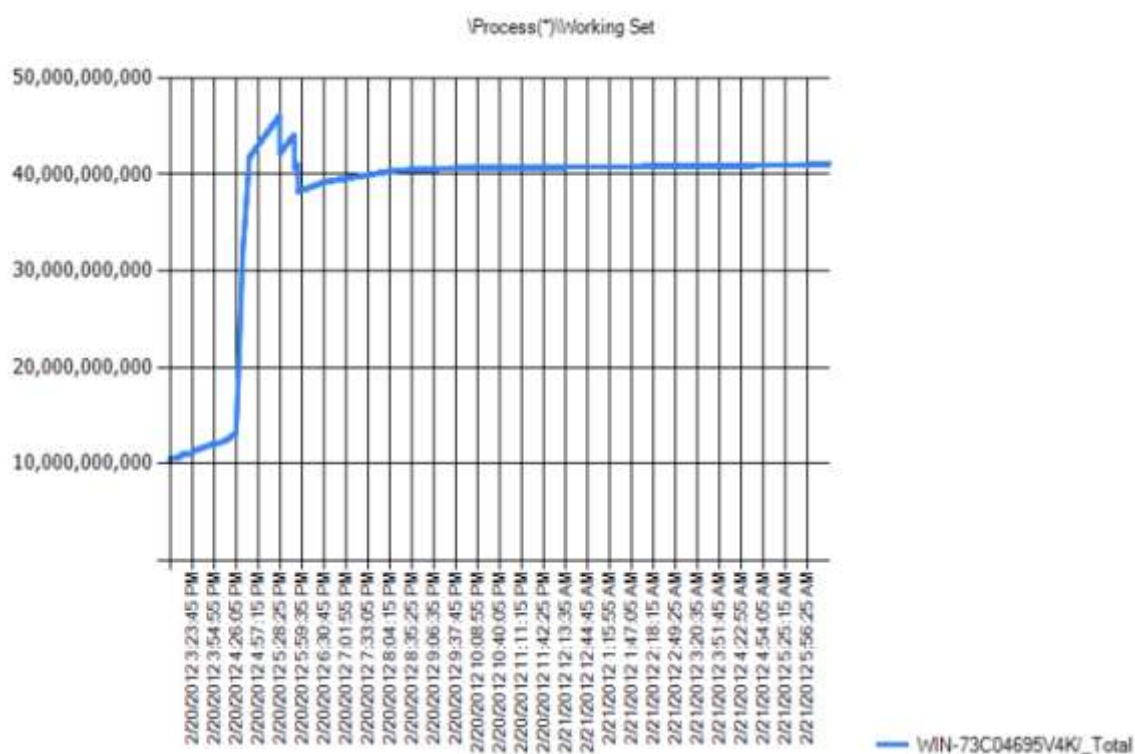
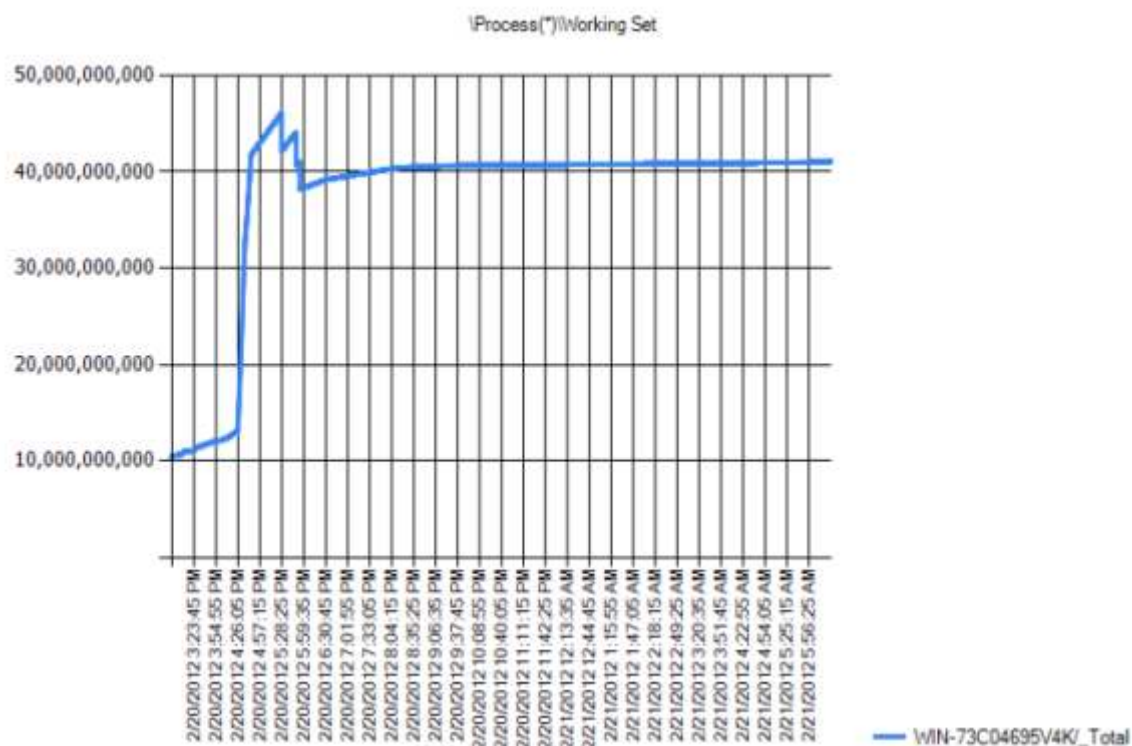
ODIN™ Performance Testing Exercise



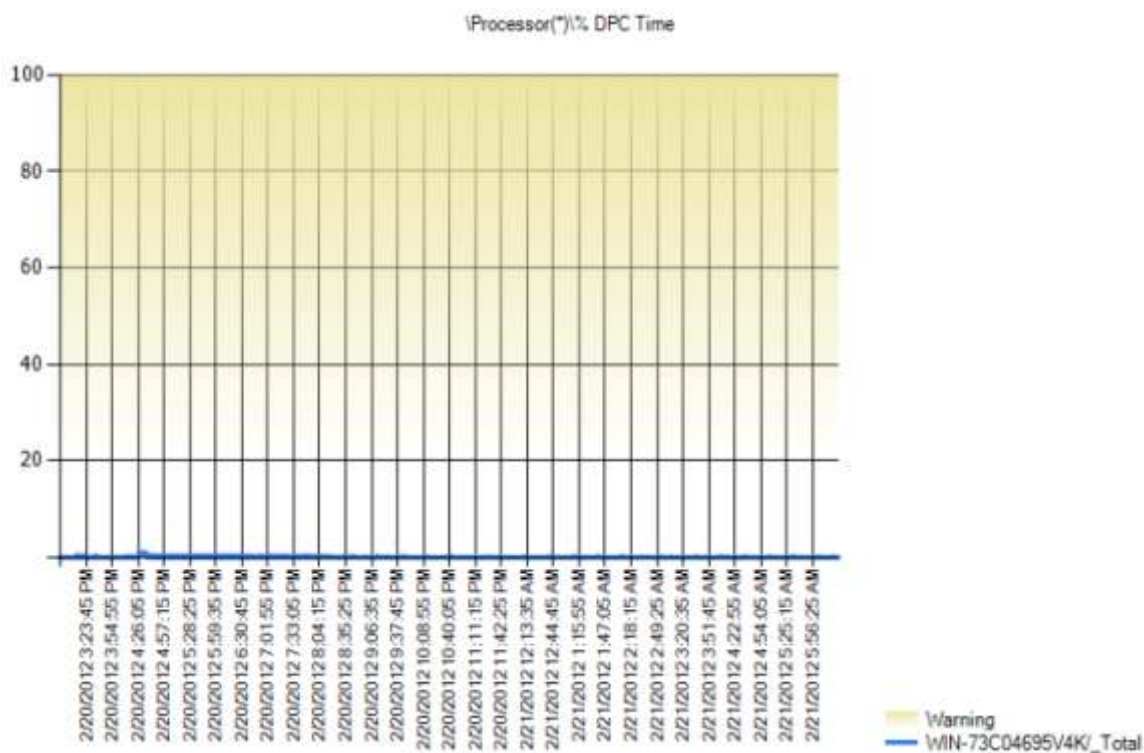
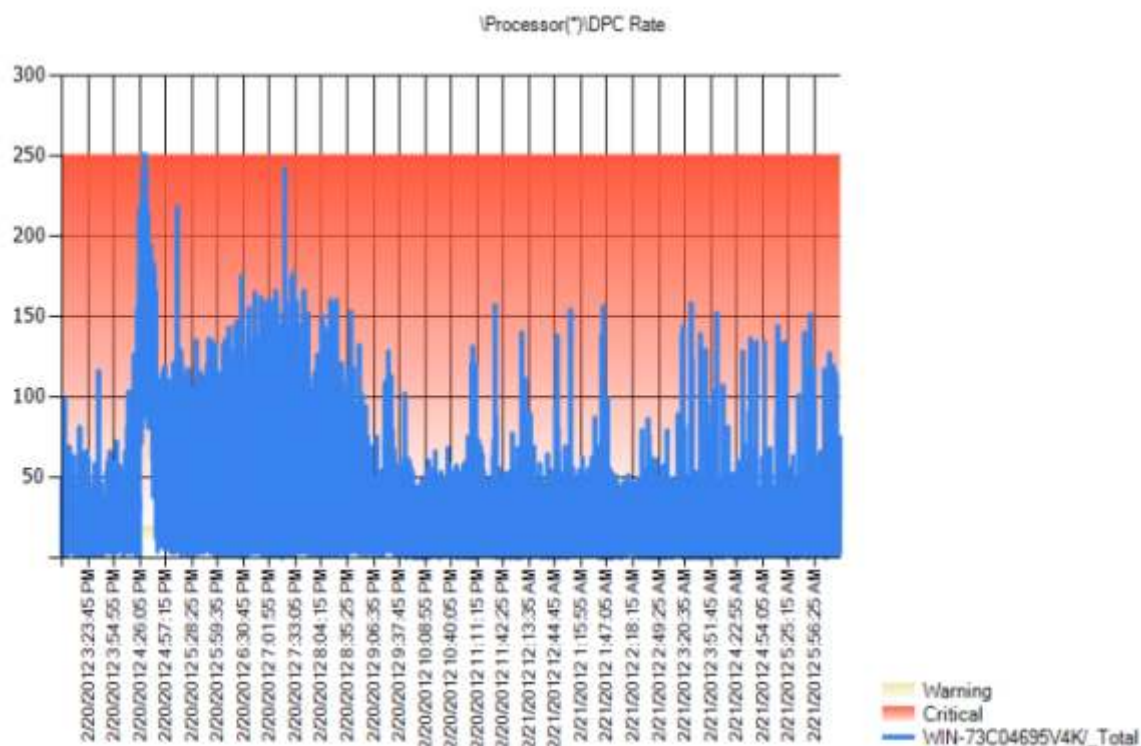
ODIN™ Performance Testing Exercise



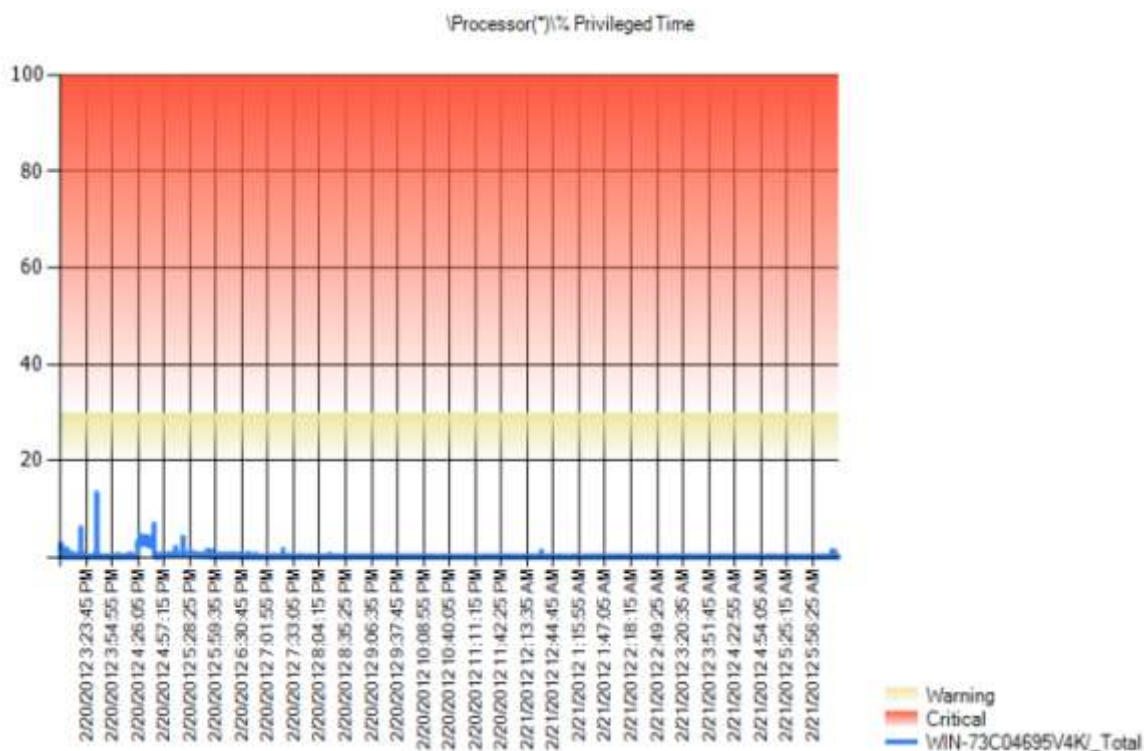
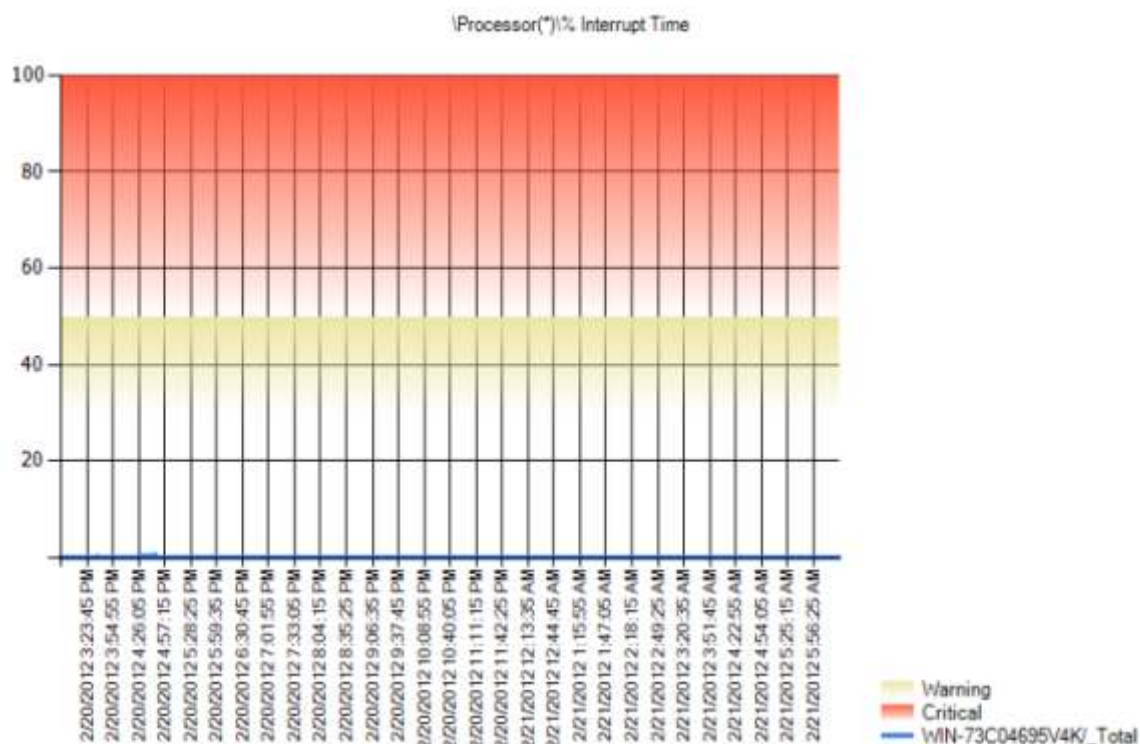
ODIN™ Performance Testing Exercise



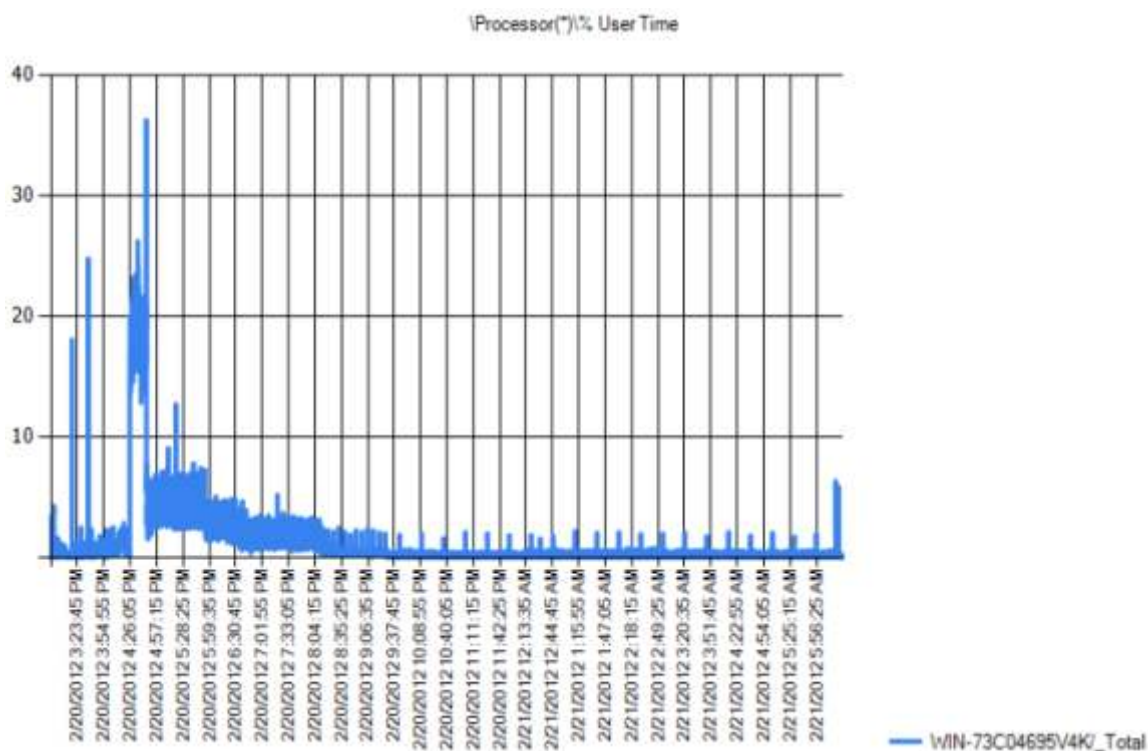
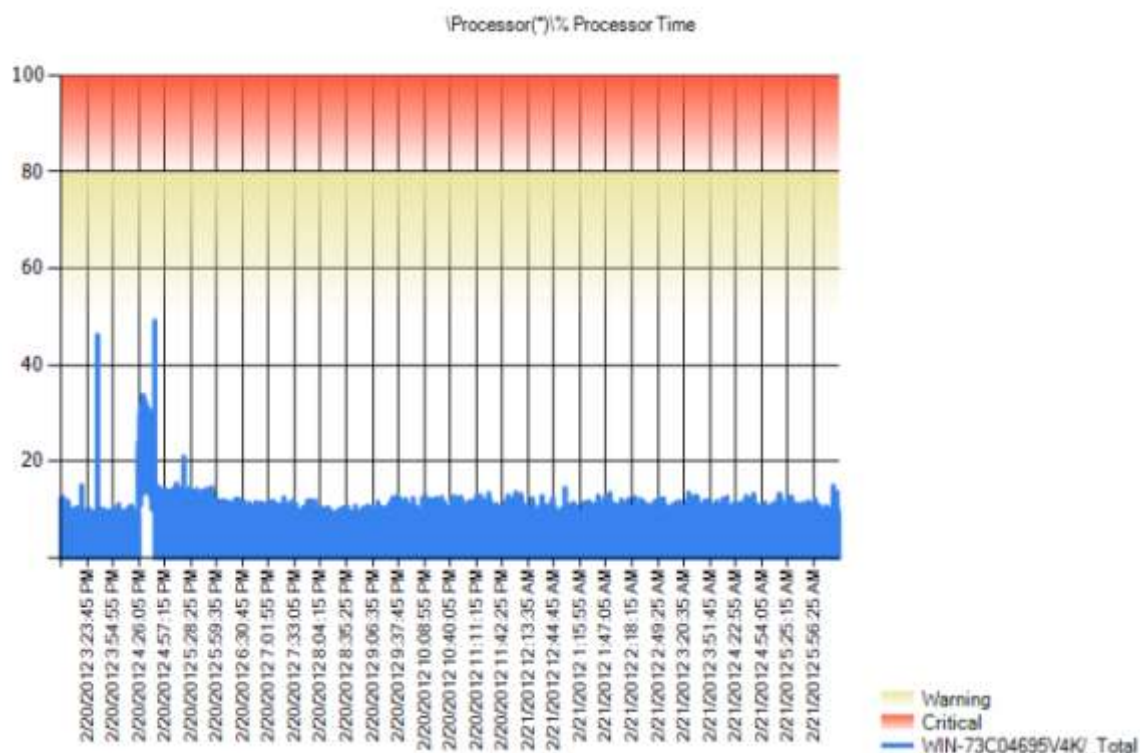
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise

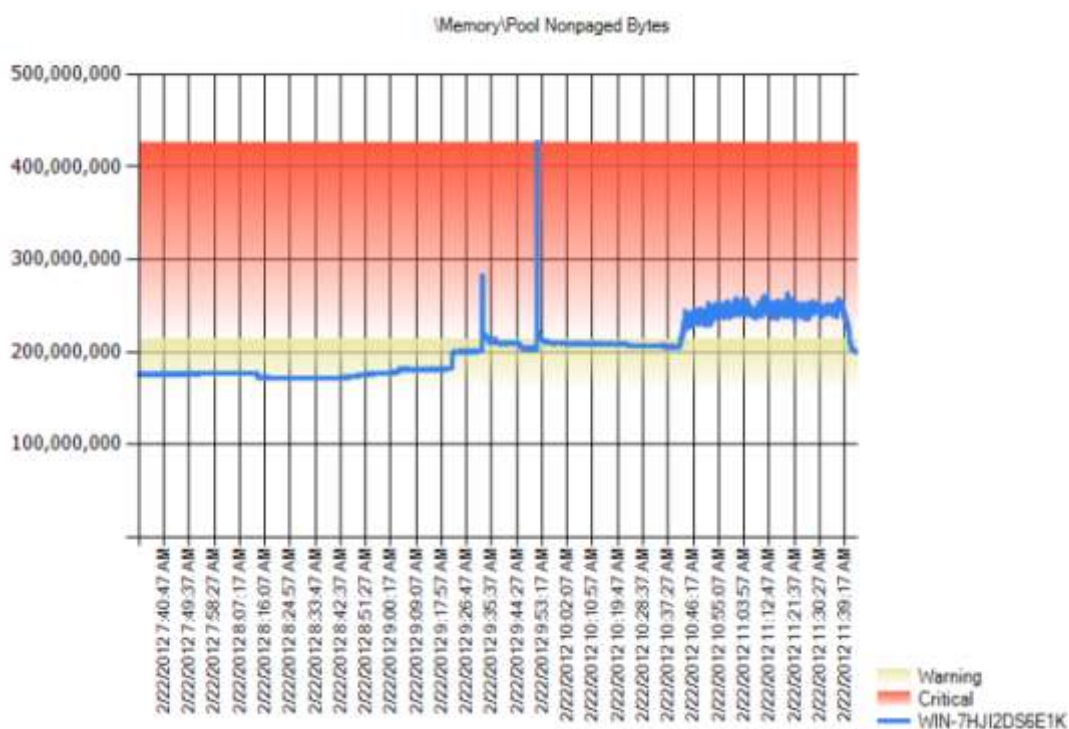
Stress test 1

- Run Date : 22nd February 2012
- Test Run Time : Between 7.32 AM to 11.47 AM
- Test Run Duration : 15 min +
- Server Hardware : Cisco B200 M2 Blade Server with (2 x 6 Core CPUs)
- Peak MPS : 80,000 MPS
- Concurrent Users : 25,000
- Expected Transactions: 90,00,000

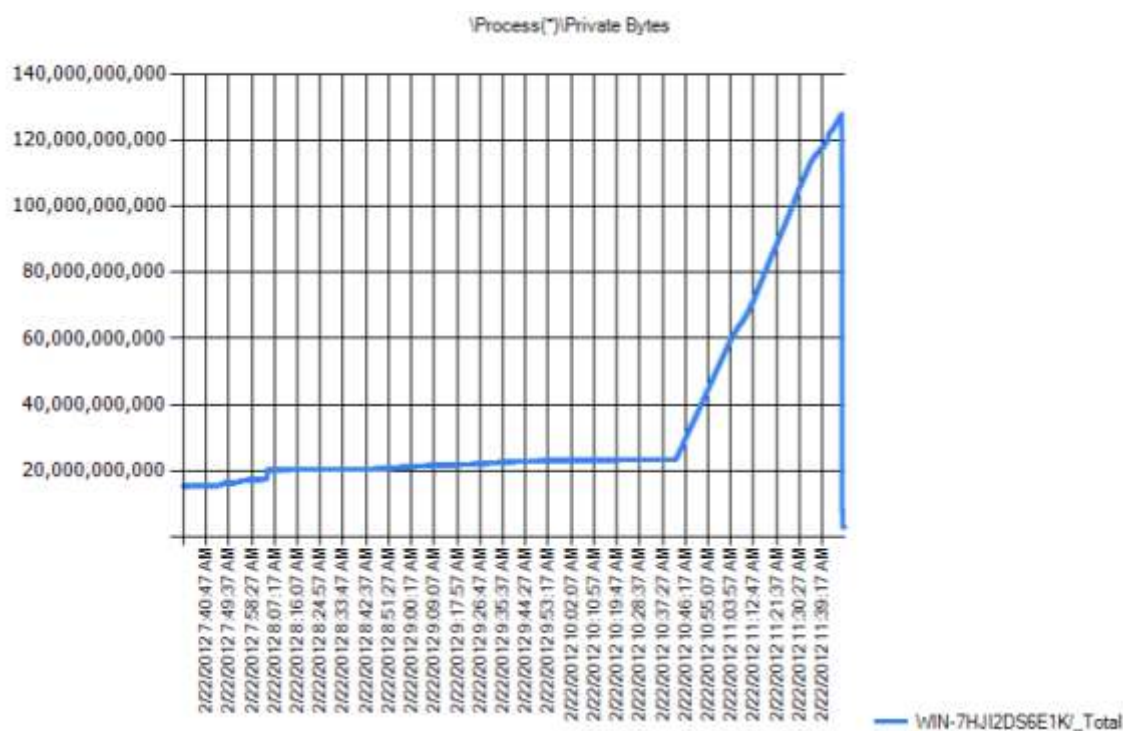
Observations & Analysis

- Test run on 22nd February 2012, (for reference to performance graphs)
- Test successfully ran for 15+ mins with the desired throughput and concurrent-connections
- CPU utilization observed between 20-30% during the stress test

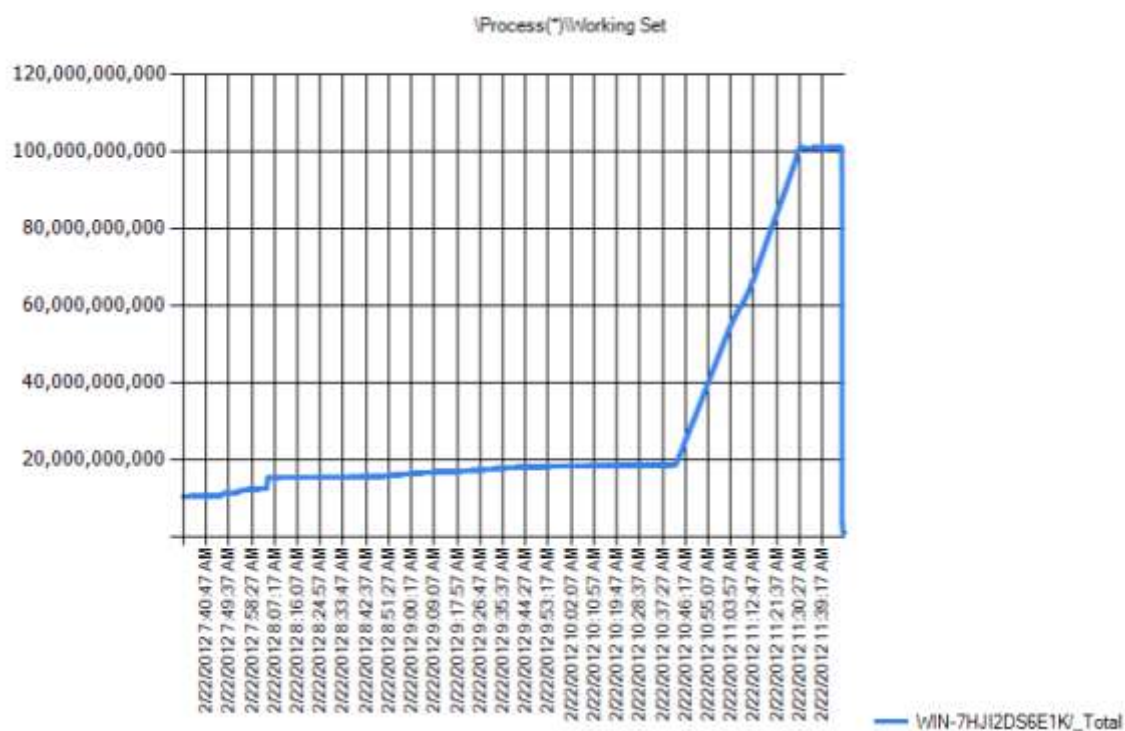
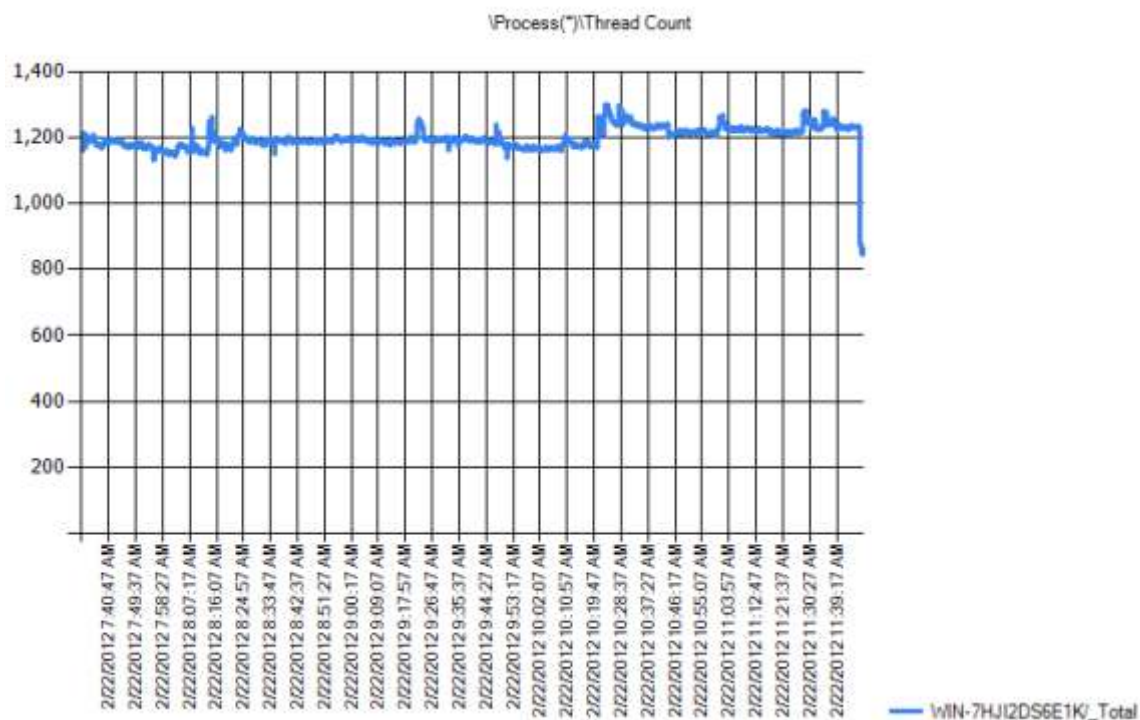
ODIN™ Performance Testing Exercise



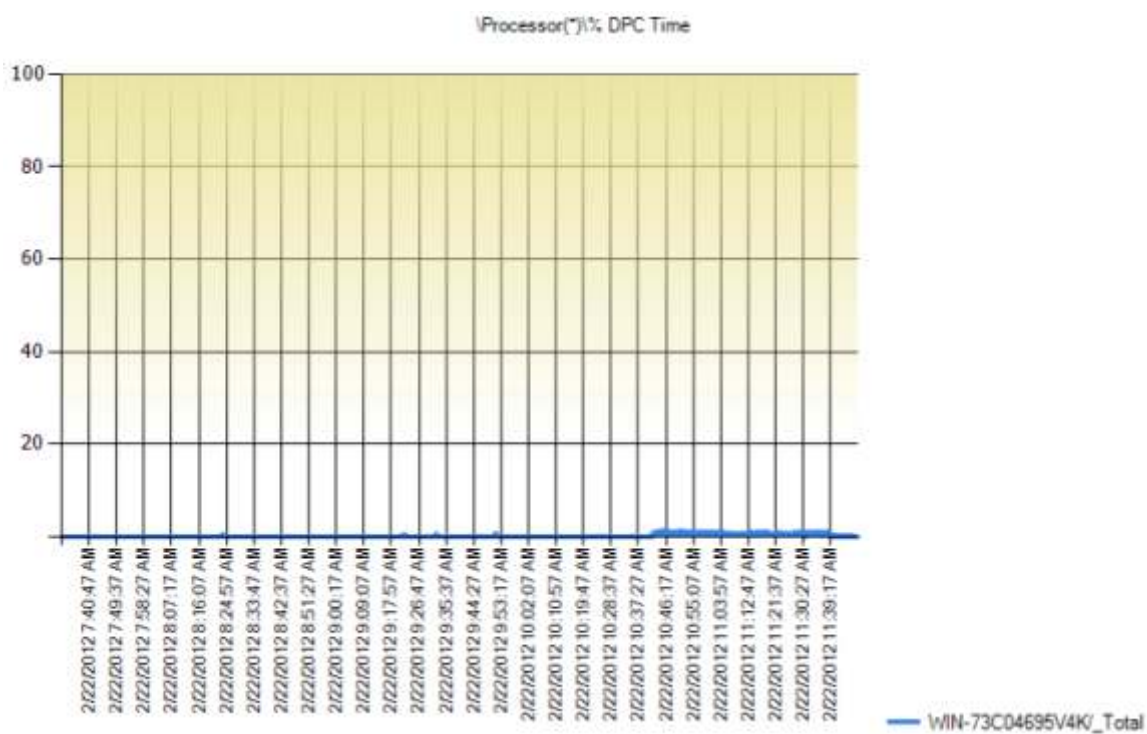
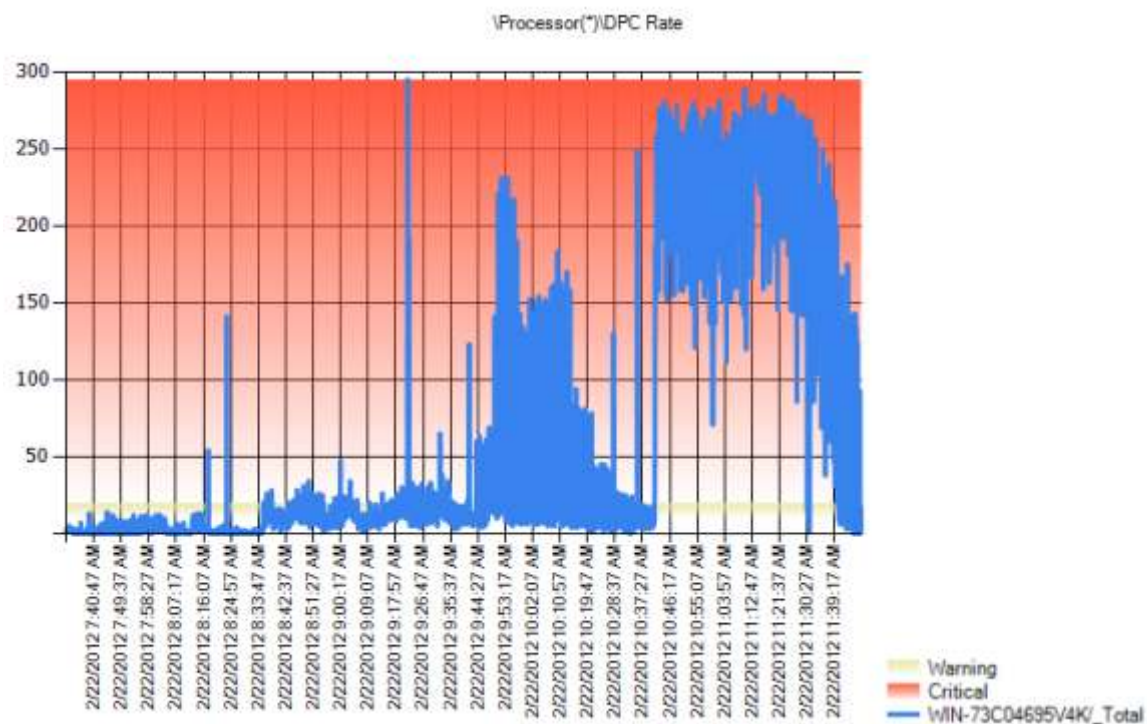
ODIN™ Performance Testing Exercise



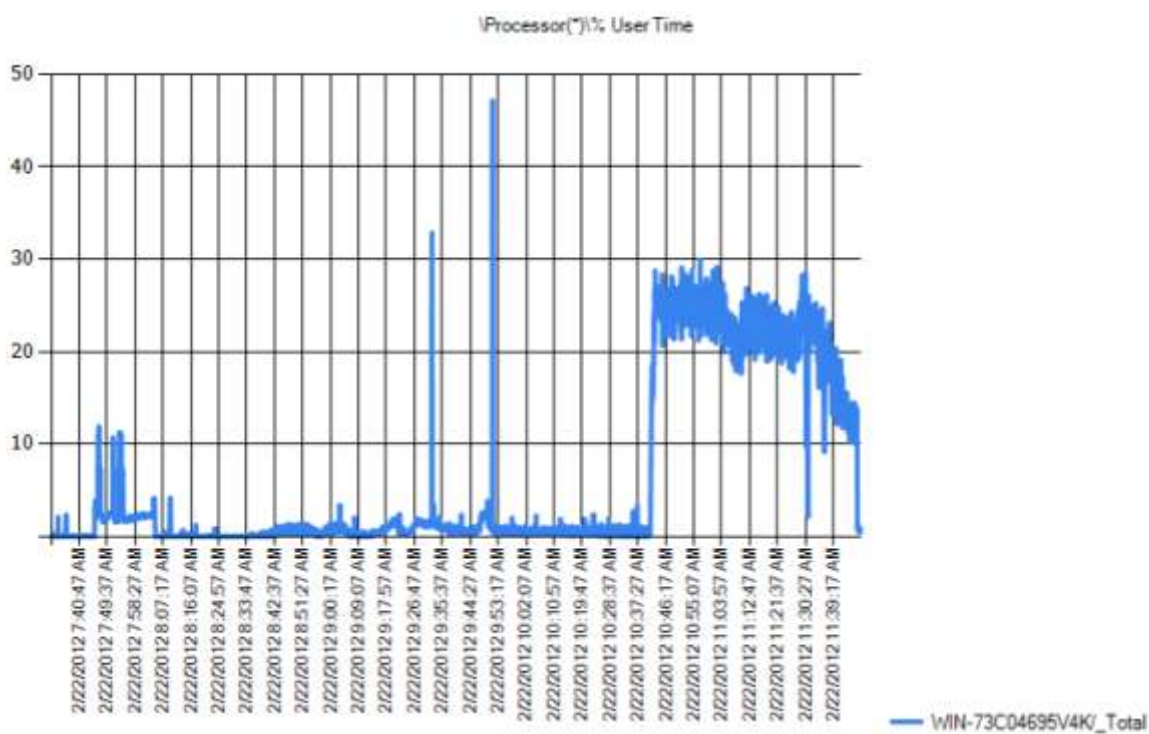
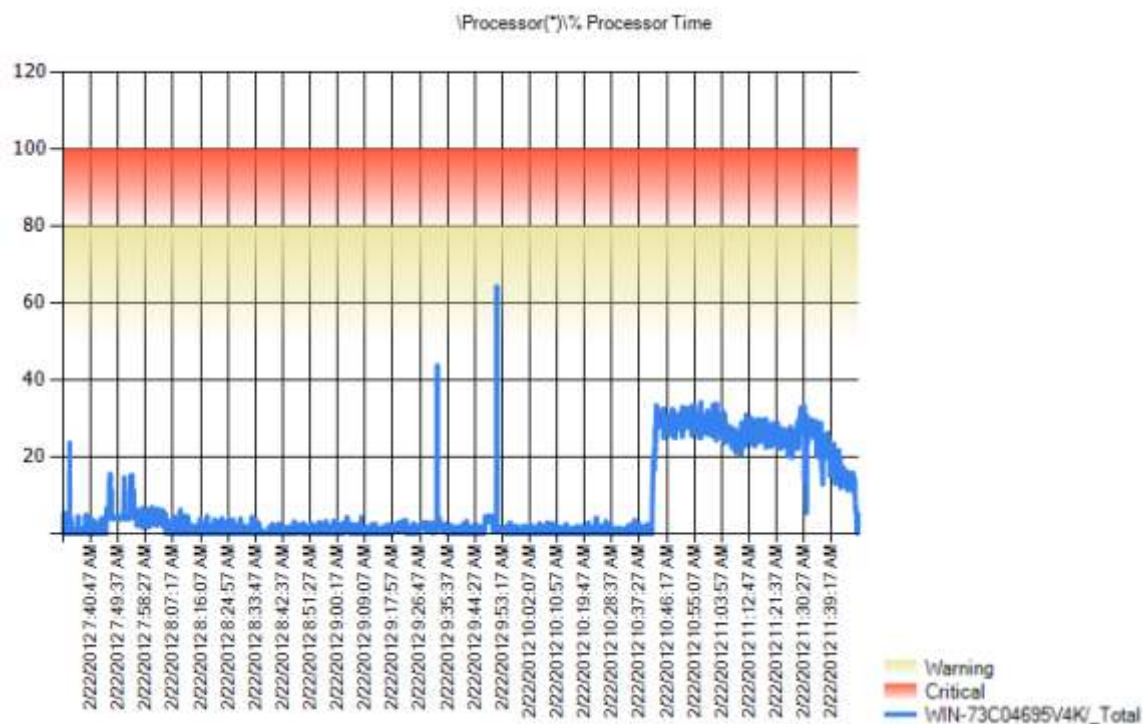
ODIN™ Performance Testing Exercise



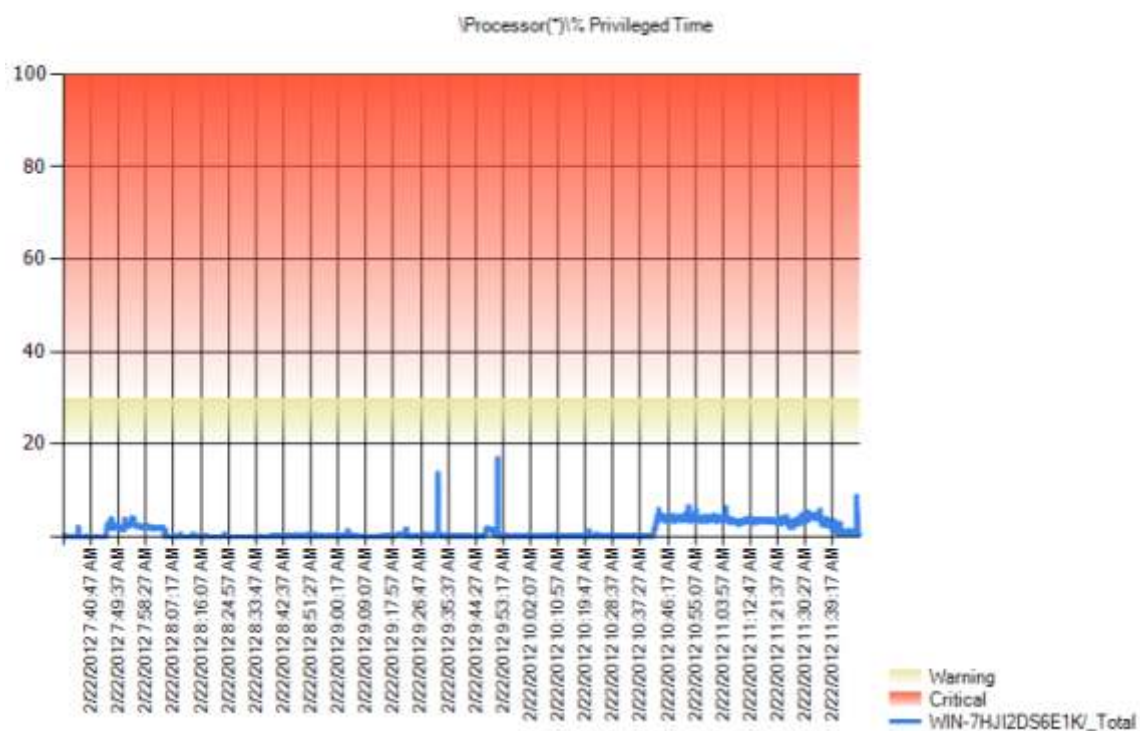
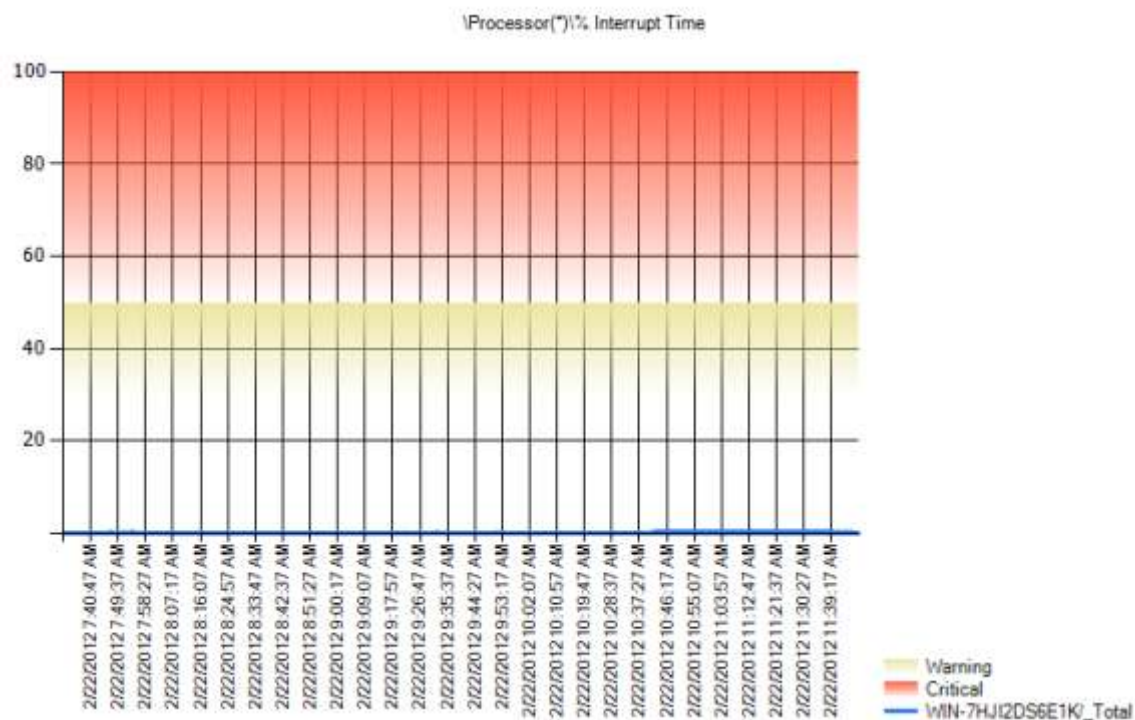
ODIN™ Performance Testing Exercise



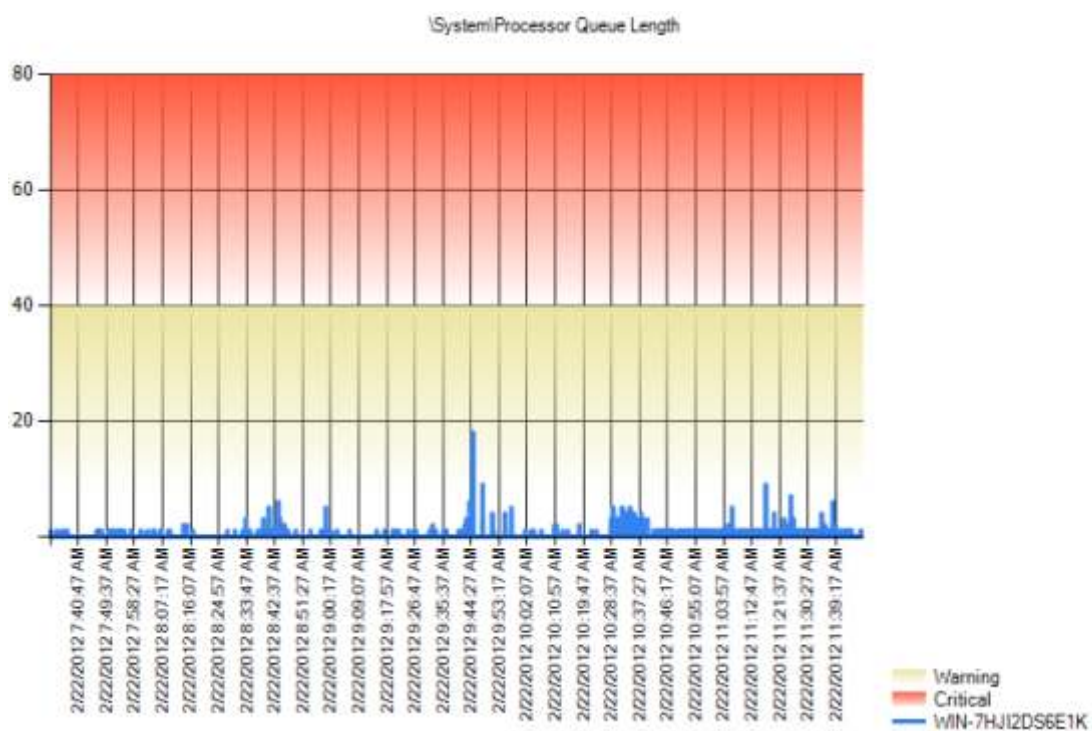
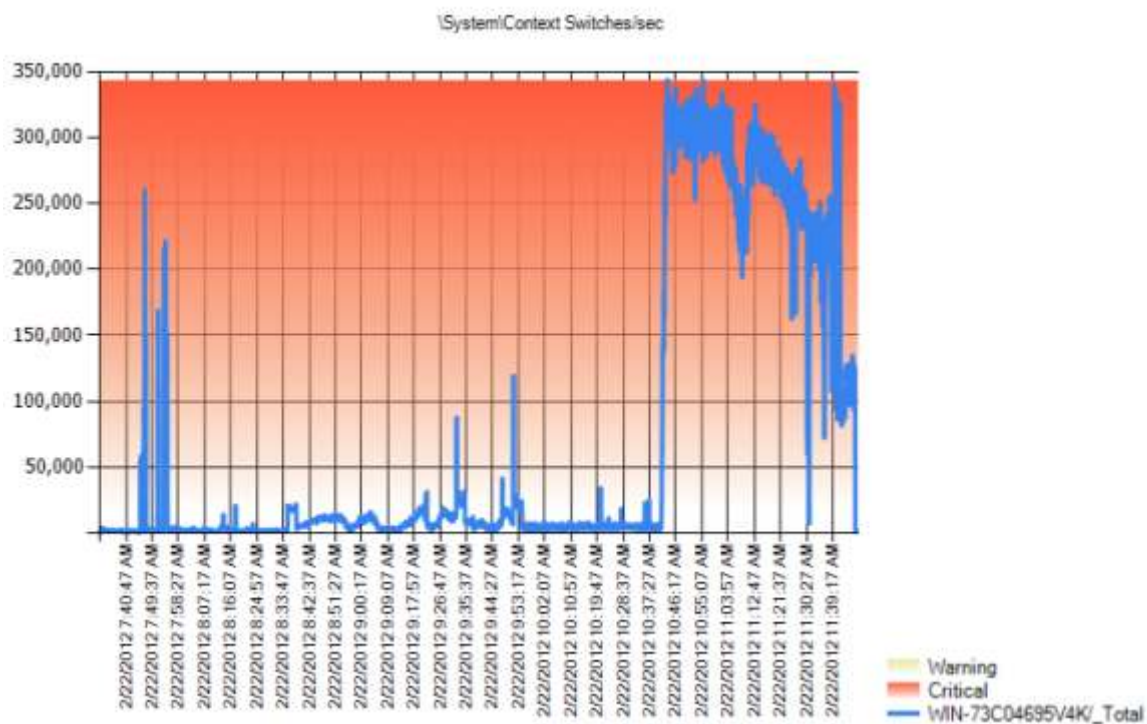
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise

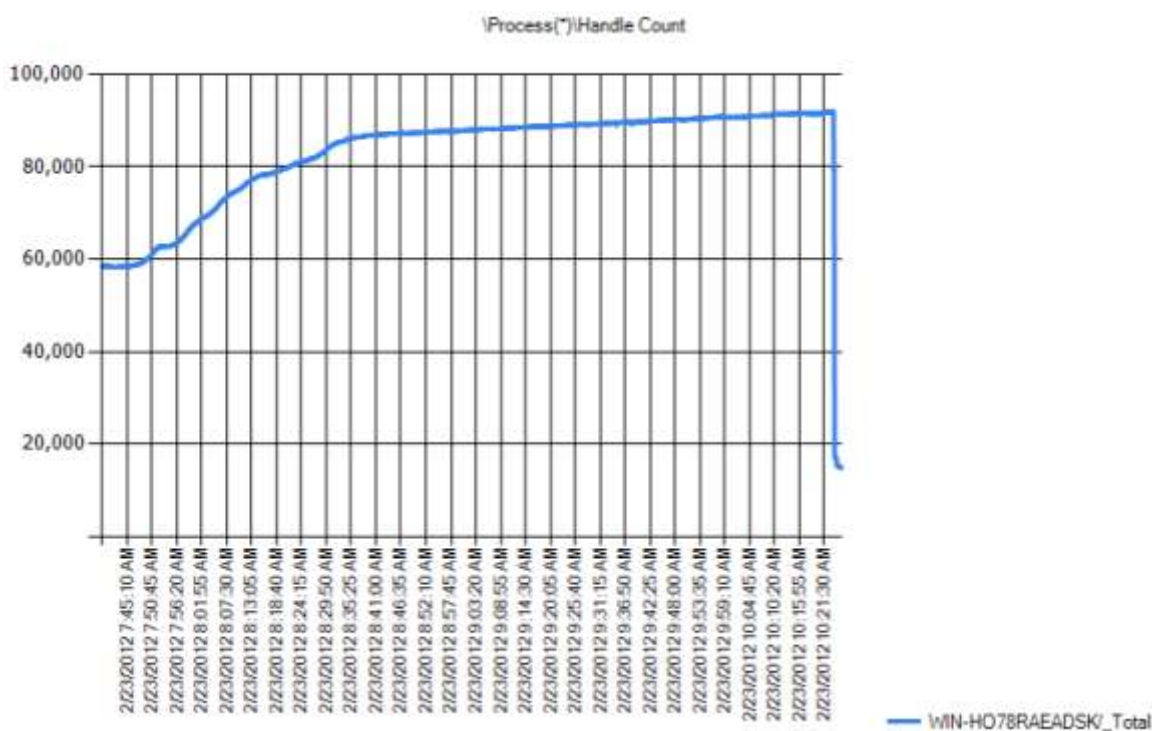
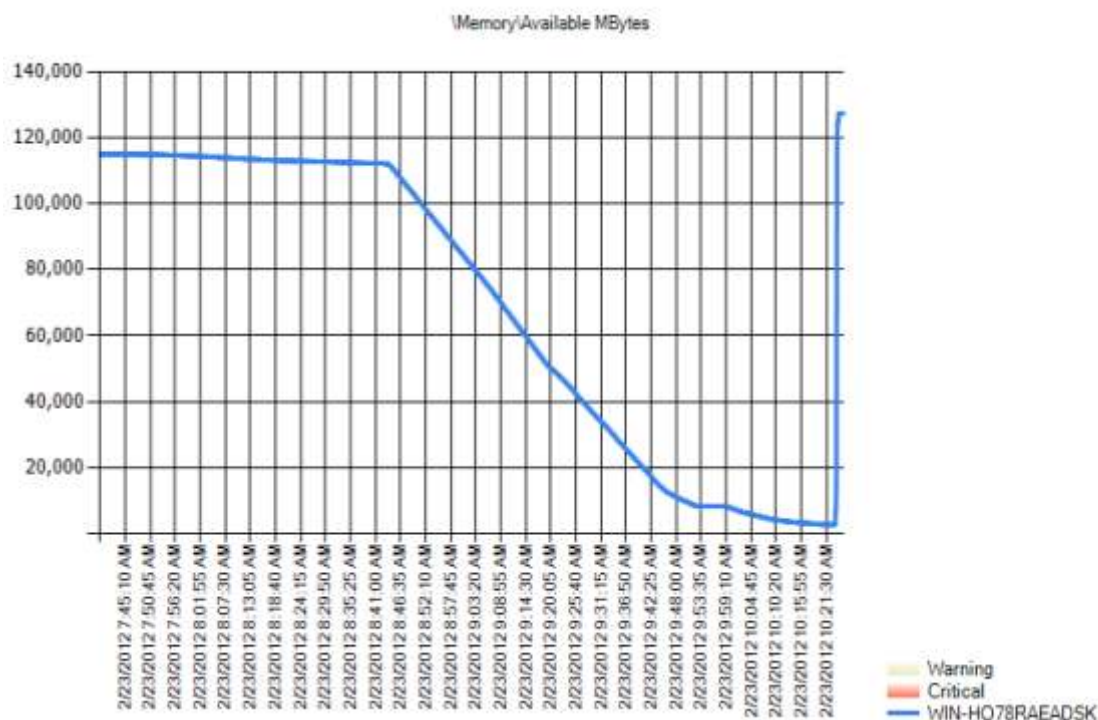
Stress test 2

- Run Date : 23rd February 2012
- Test Run Time : Between 7.39 AM to 10.25 AM
- Test Run Duration : 15 min +
- Server Hardware : Cisco B230 M2 Blade Server with (2x 10 Core CPUs)
- Peak MPS : 80,000 MPS
- Concurrent Users : 25,000
- Expected Transactions: 90,00,000

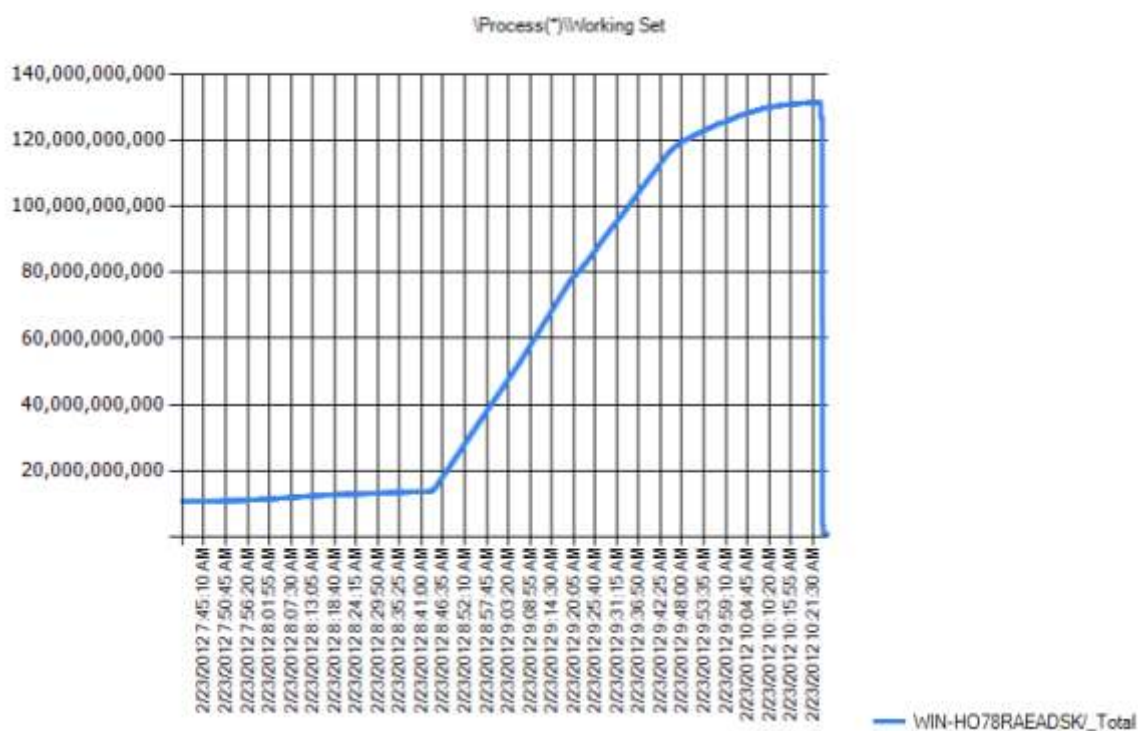
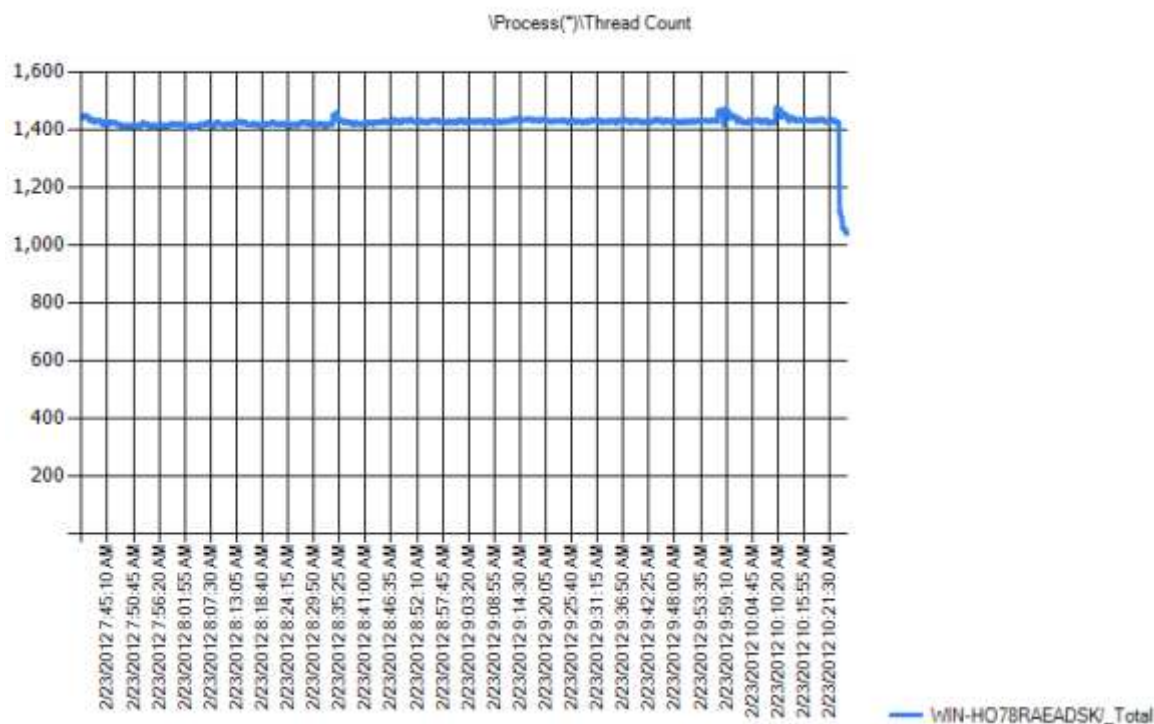
Observations & Analysis

- Test run on 23rd February 2012, 07.45 AM to 10.21 AM (for reference to performance graphs)
- Test successfully ran for 15+ mins with the desired throughput and concurrent-connections
- CPU utilization observed between 16-25 % during the stress test

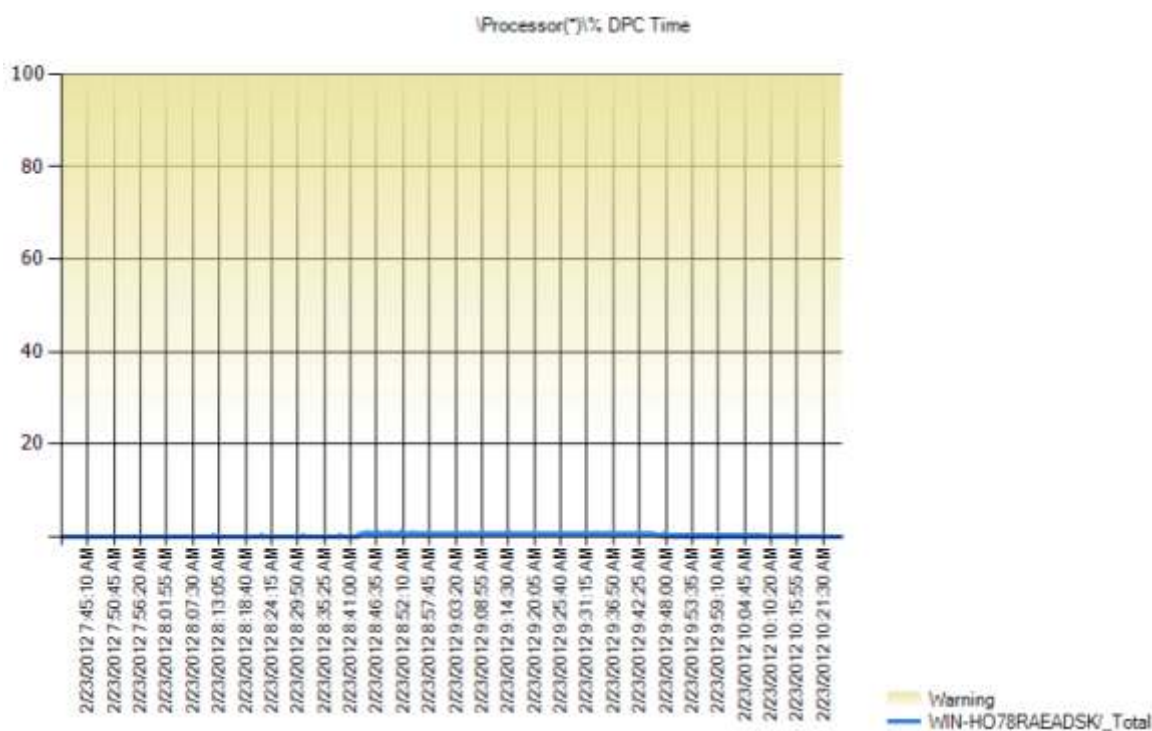
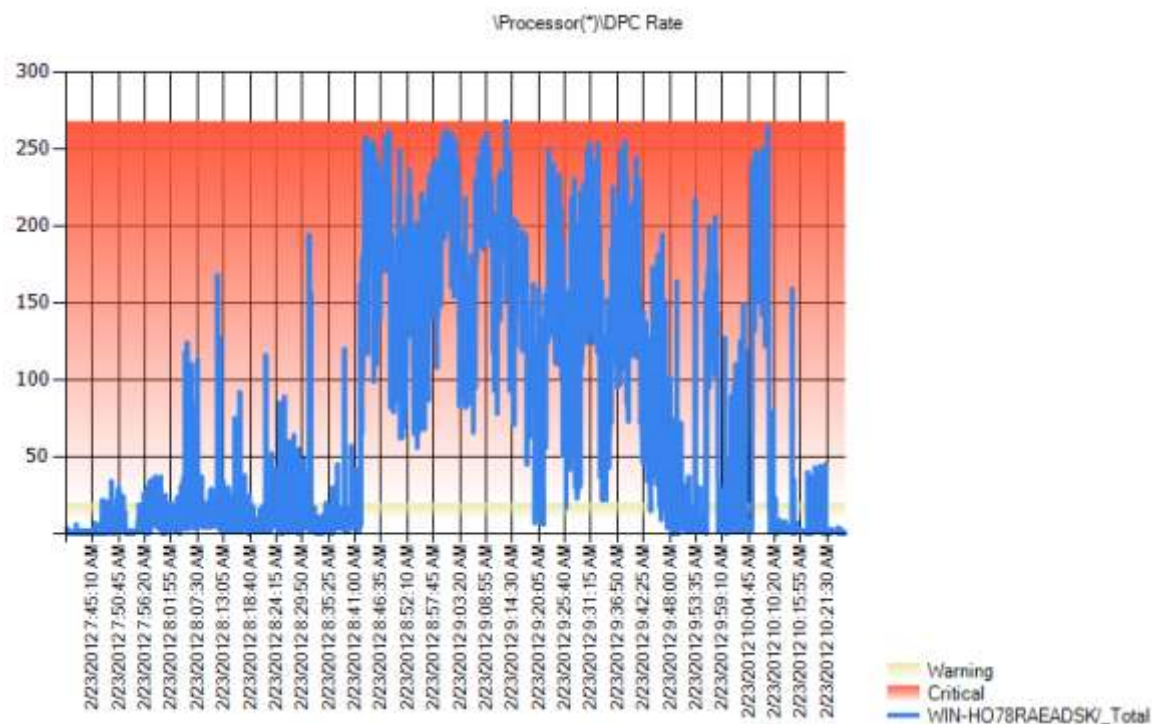
ODIN™ Performance Testing Exercise



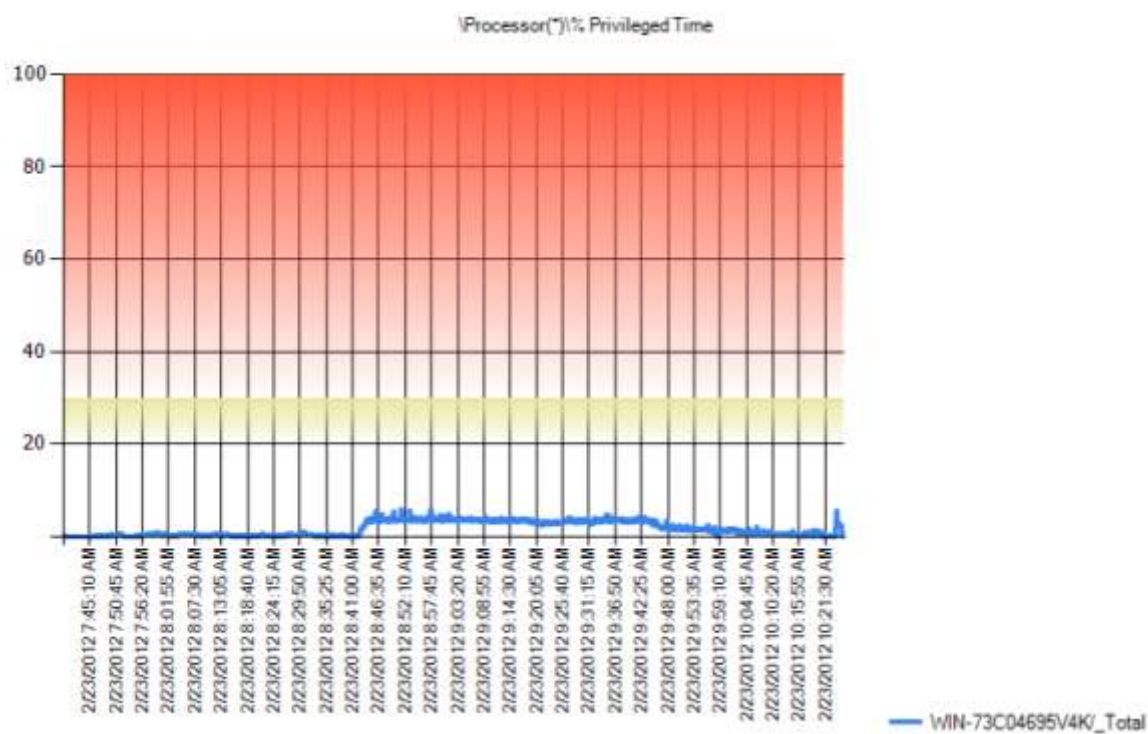
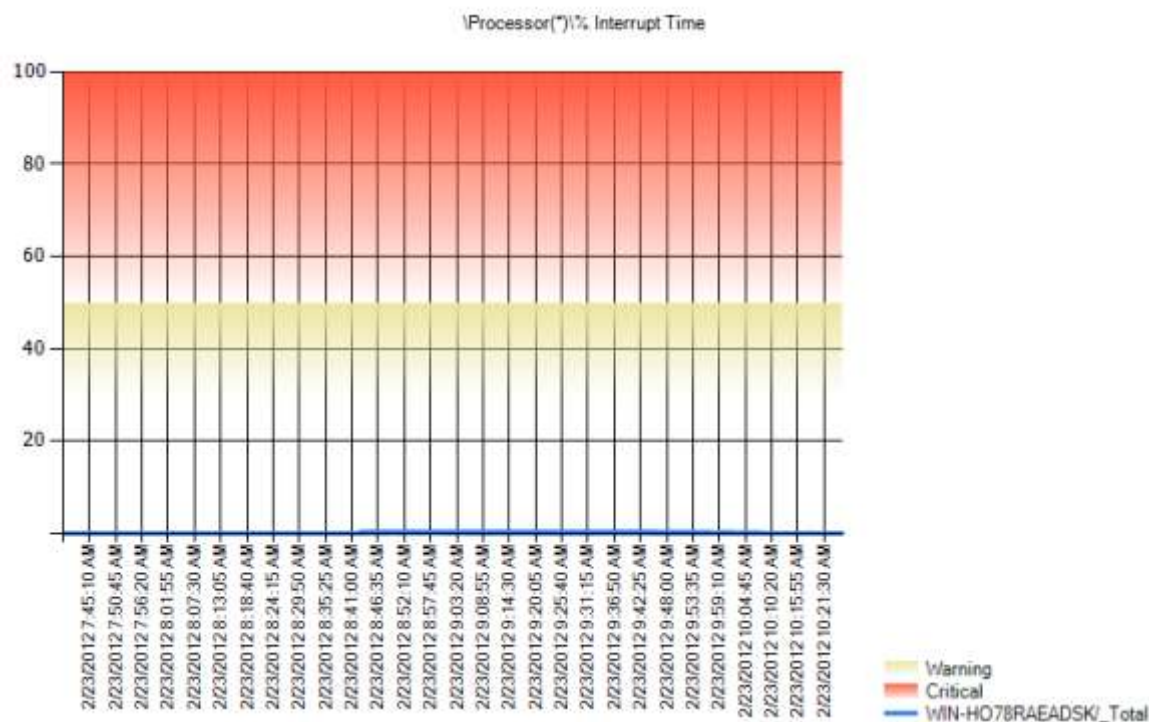
ODIN™ Performance Testing Exercise



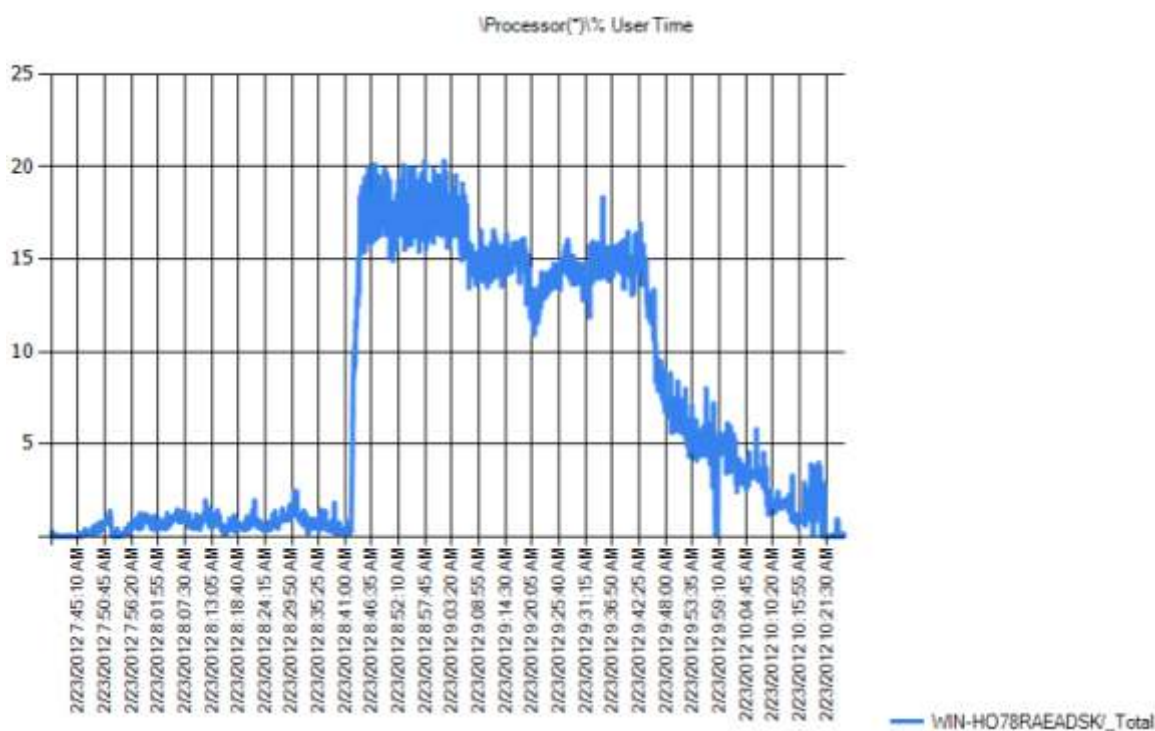
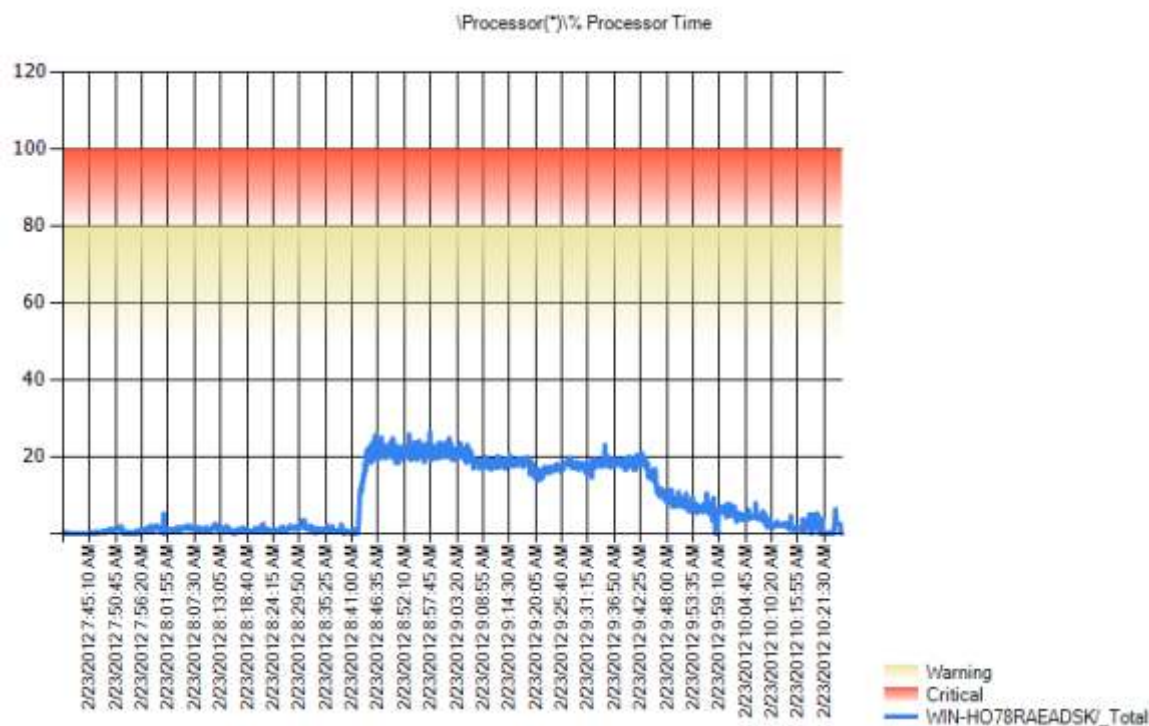
ODIN™ Performance Testing Exercise



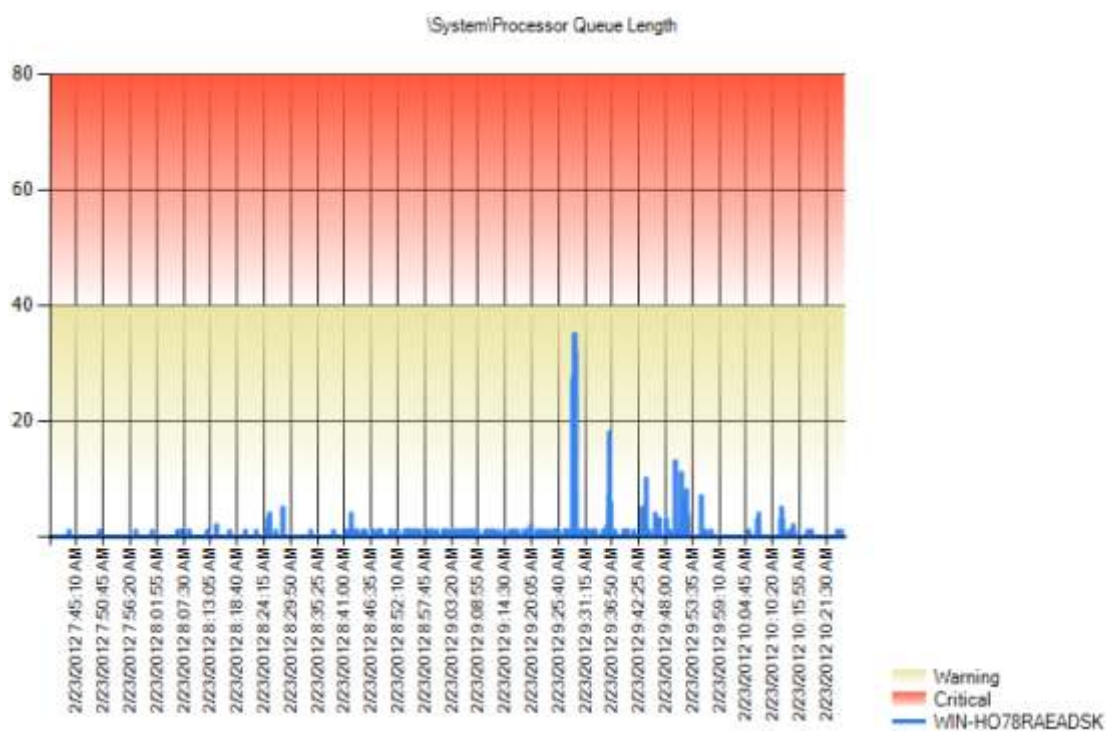
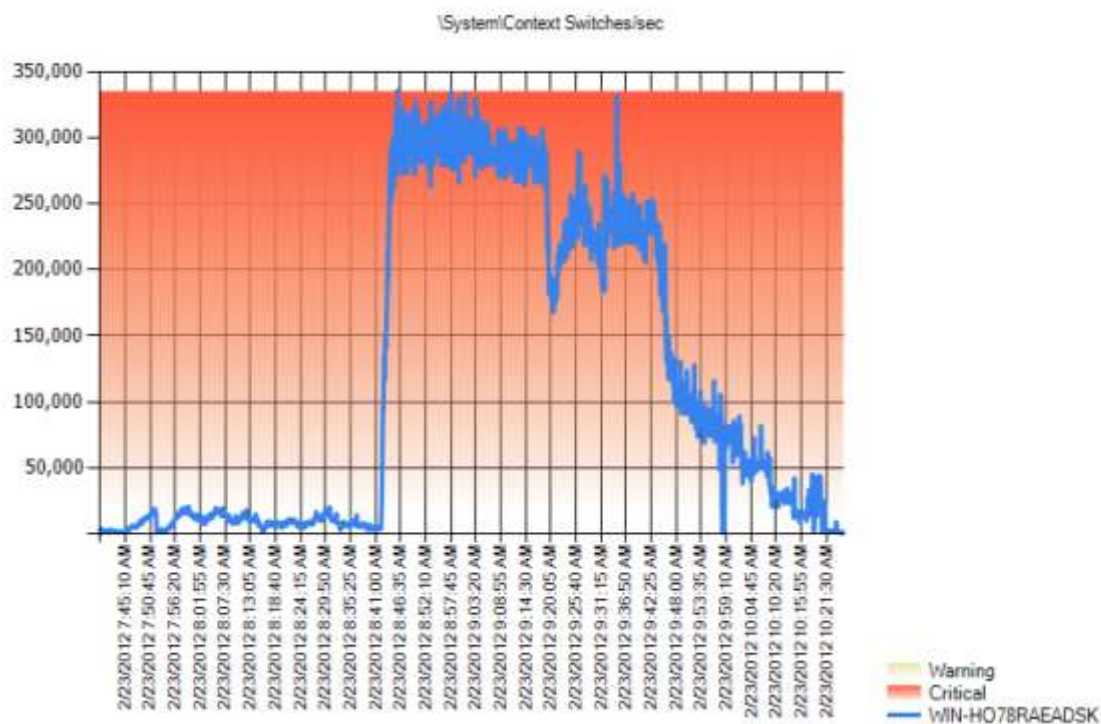
ODIN™ Performance Testing Exercise



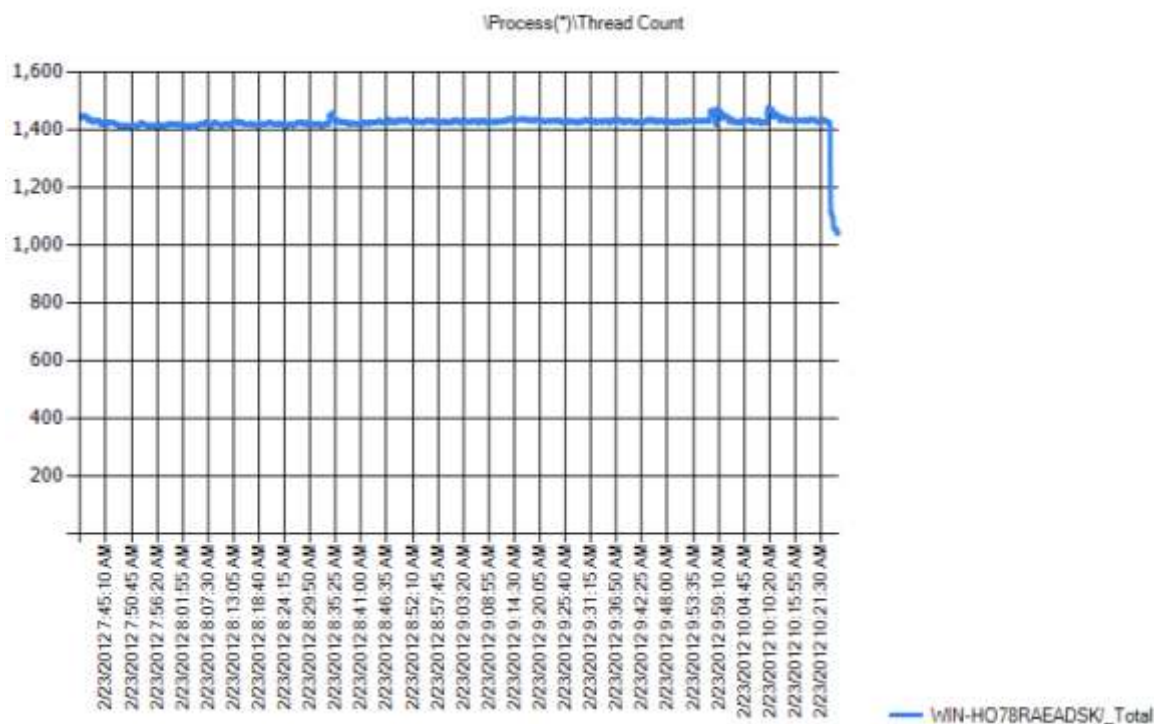
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise

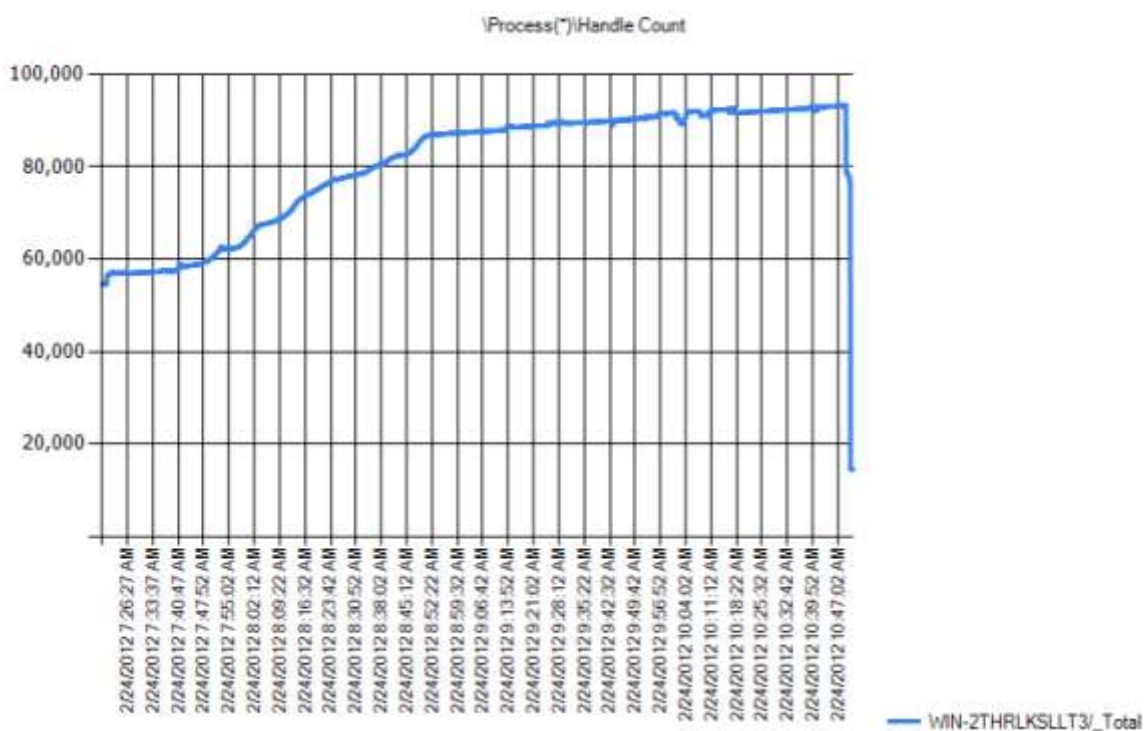
Stress test 3

- Run Date : 24th February 2012
- Test Run Time : Between 7.19 AM to 10.51 AM
- Test Run Duration : 15 min +
- Server Hardware : Cisco C260 M2 Blade Server with (2 x 10 Core CPUs)
- Peak MPS : 80,000 MPS
- Concurrent Users : 25,000
- Expected Transactions: 90,00,000

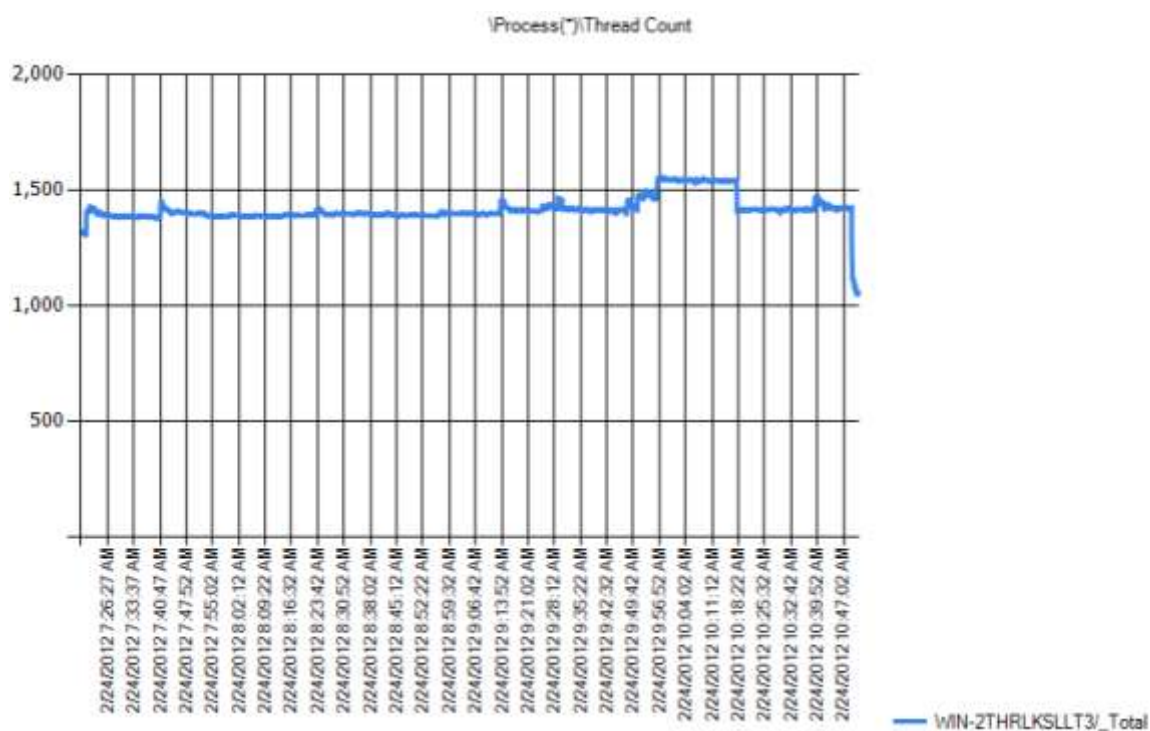
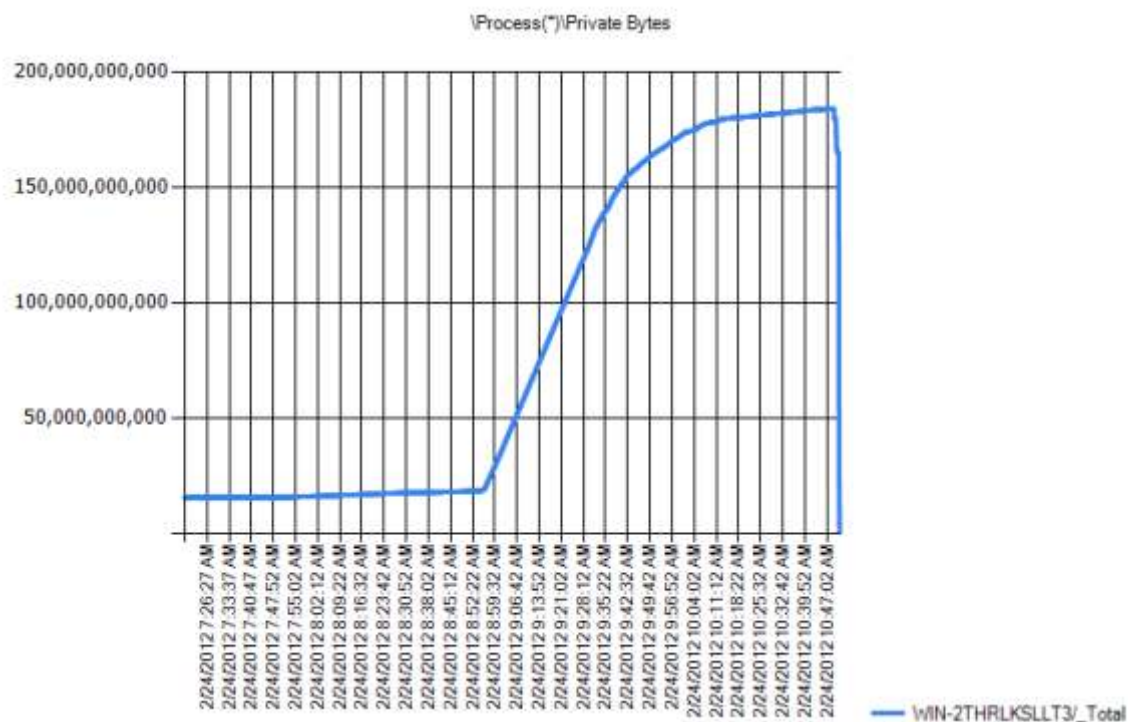
Observations & Analysis

- Test run on 24th February 2012, 07.26 AM to 10.47 AM (for reference to performance graphs)
- Test successfully ran for 15+ mins with the desired throughput and concurrent-connections
- CPU utilization observed between 20-29 % during the stress test

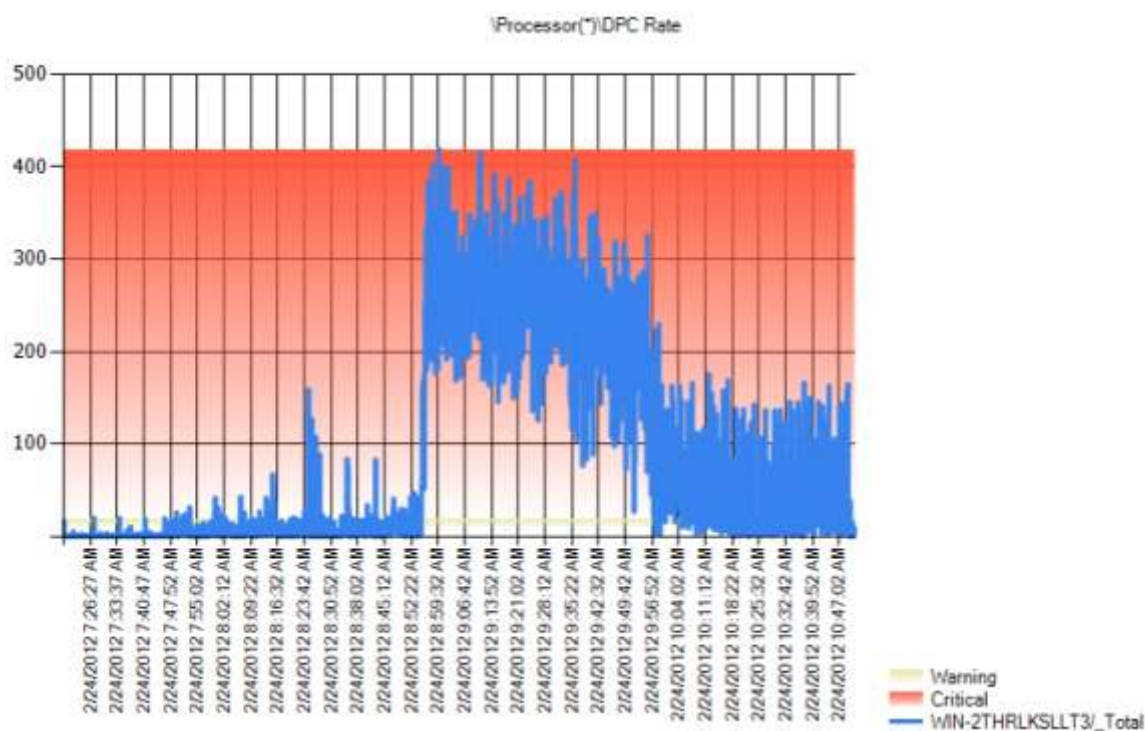
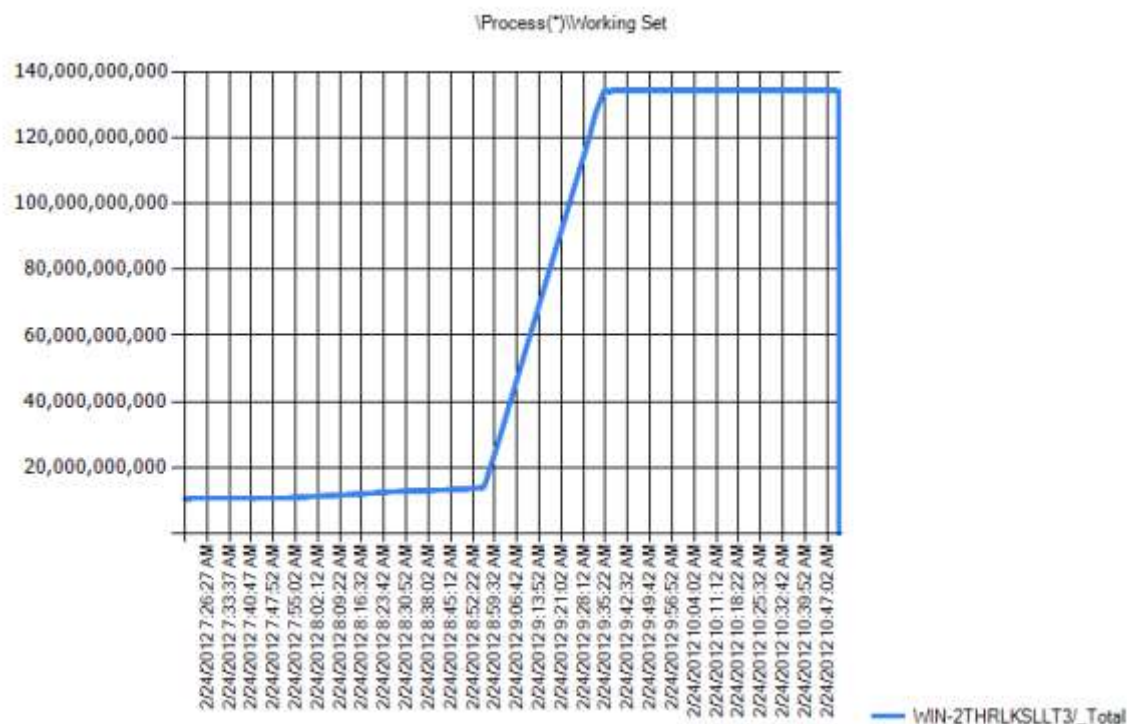
ODIN™ Performance Testing Exercise



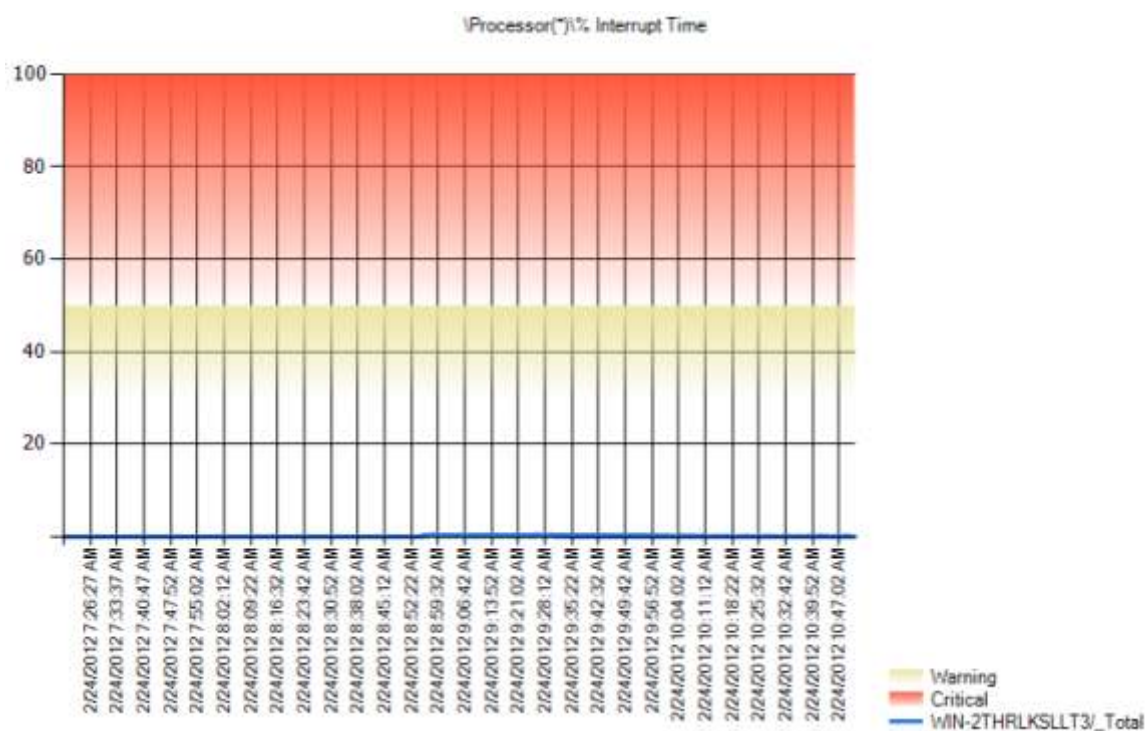
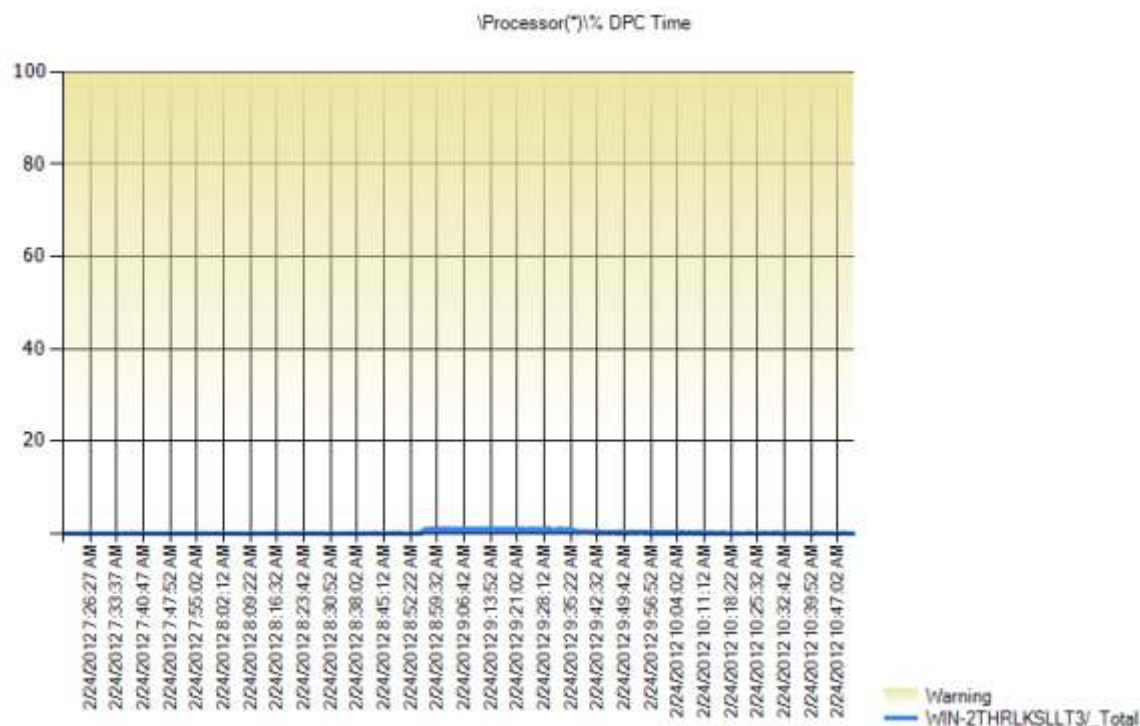
ODIN™ Performance Testing Exercise



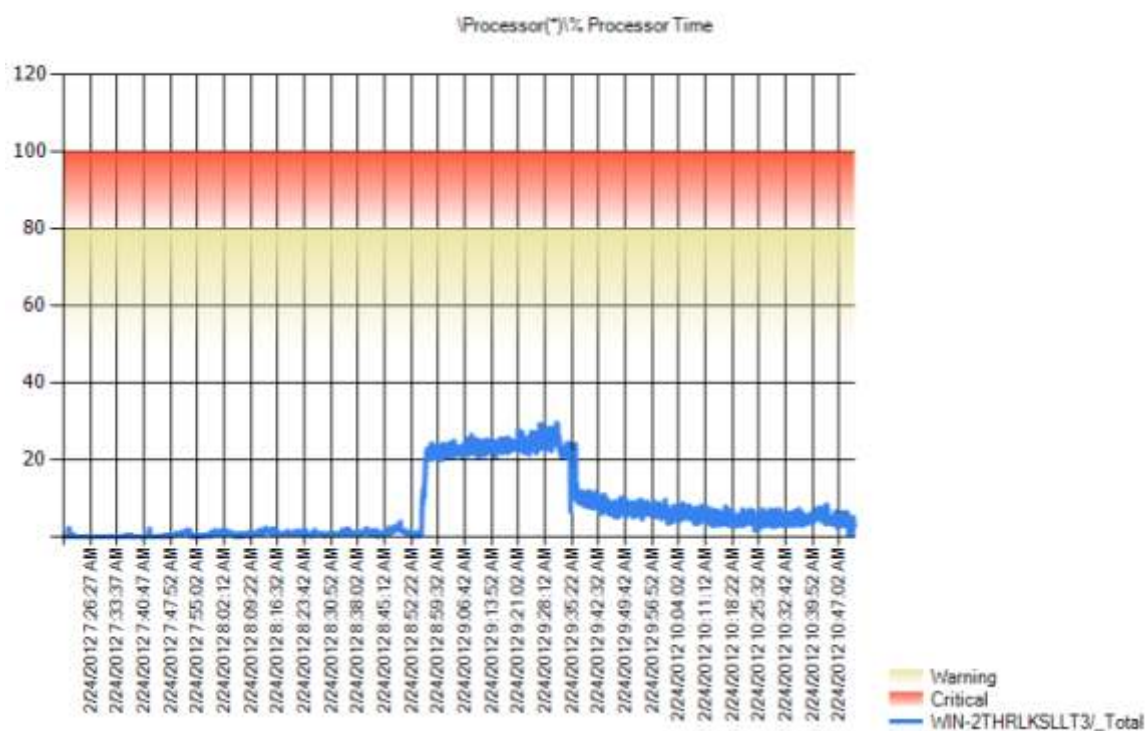
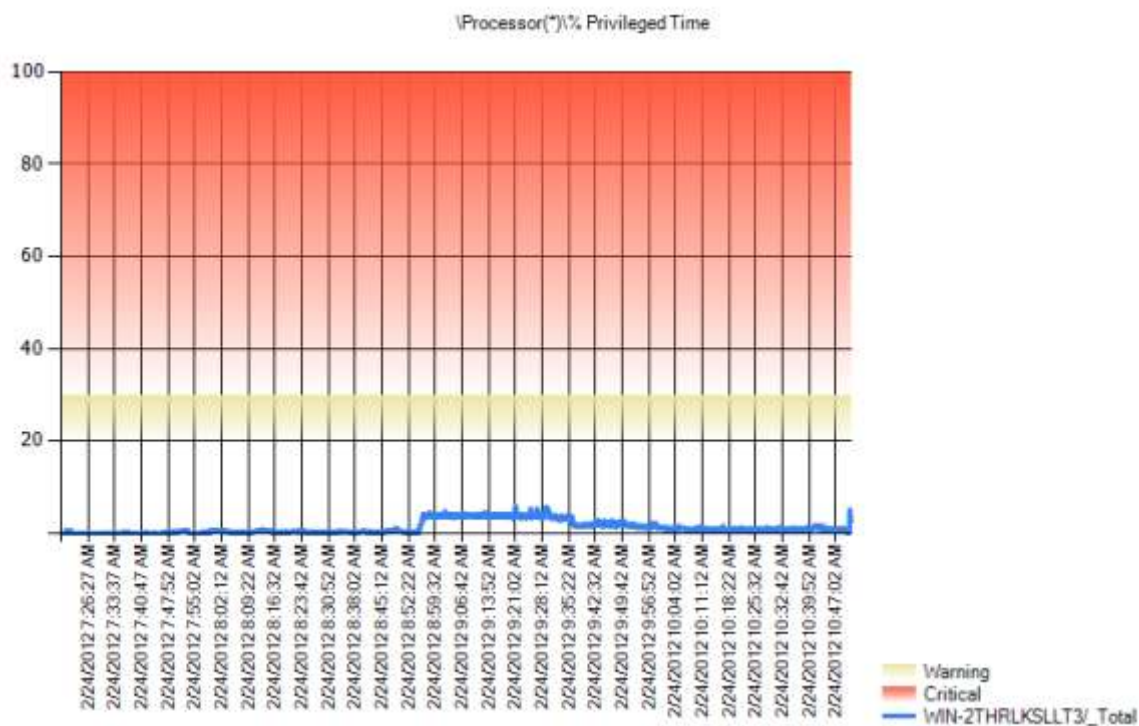
ODIN™ Performance Testing Exercise



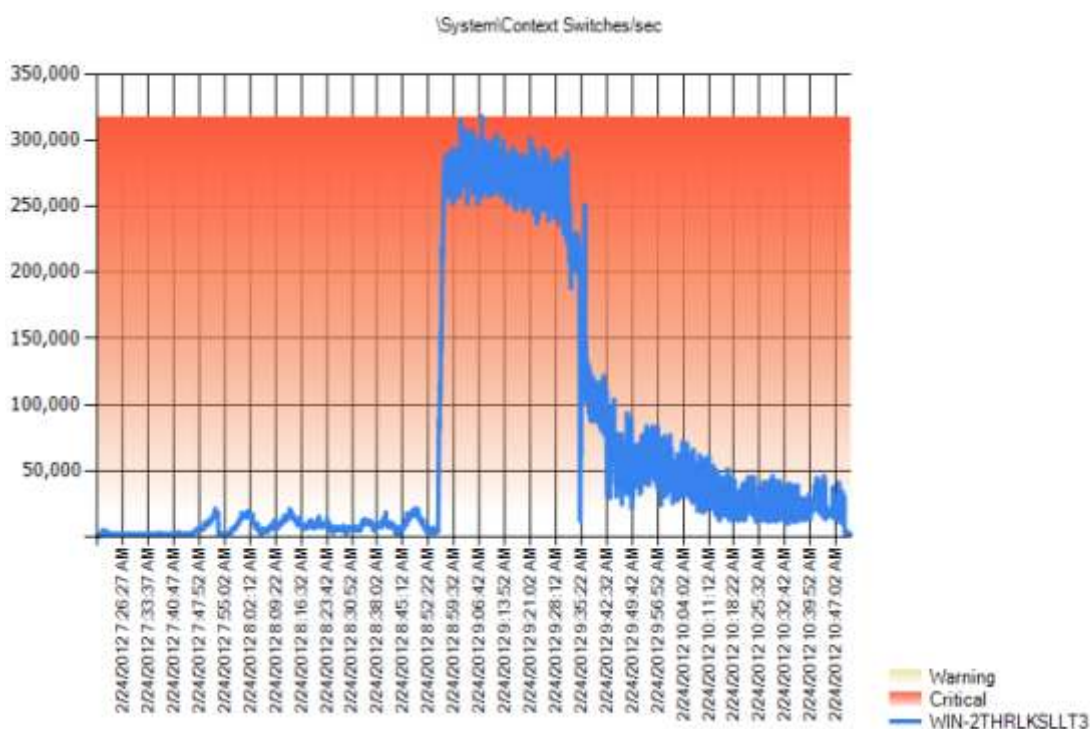
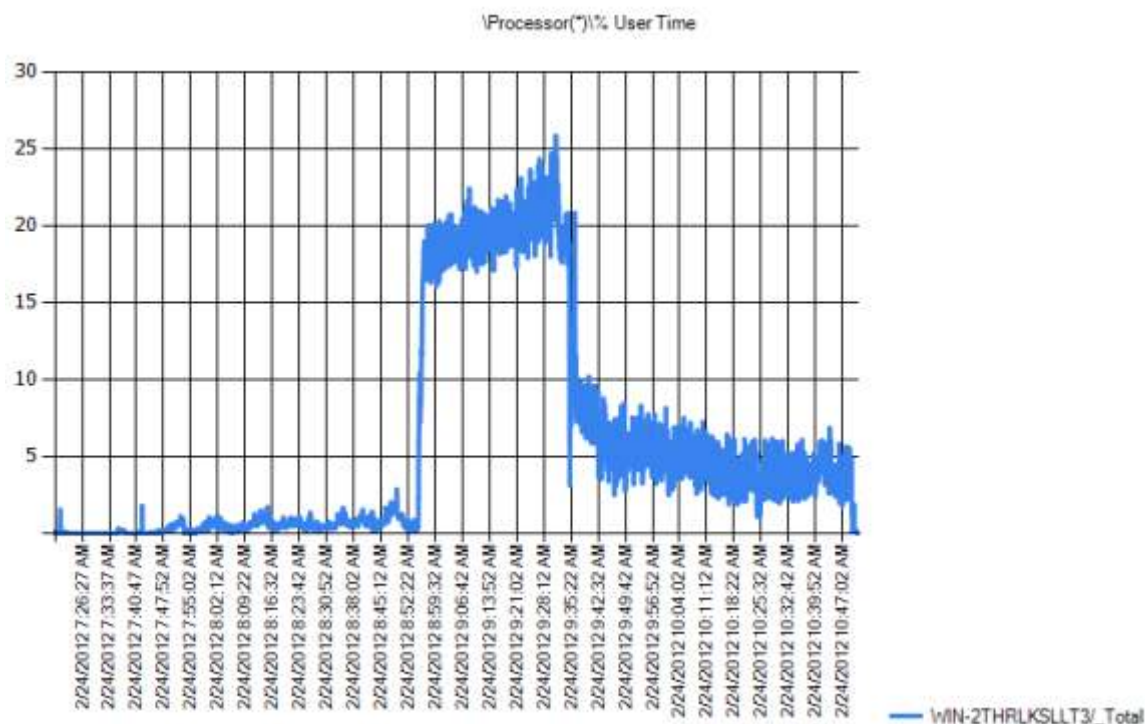
ODIN™ Performance Testing Exercise



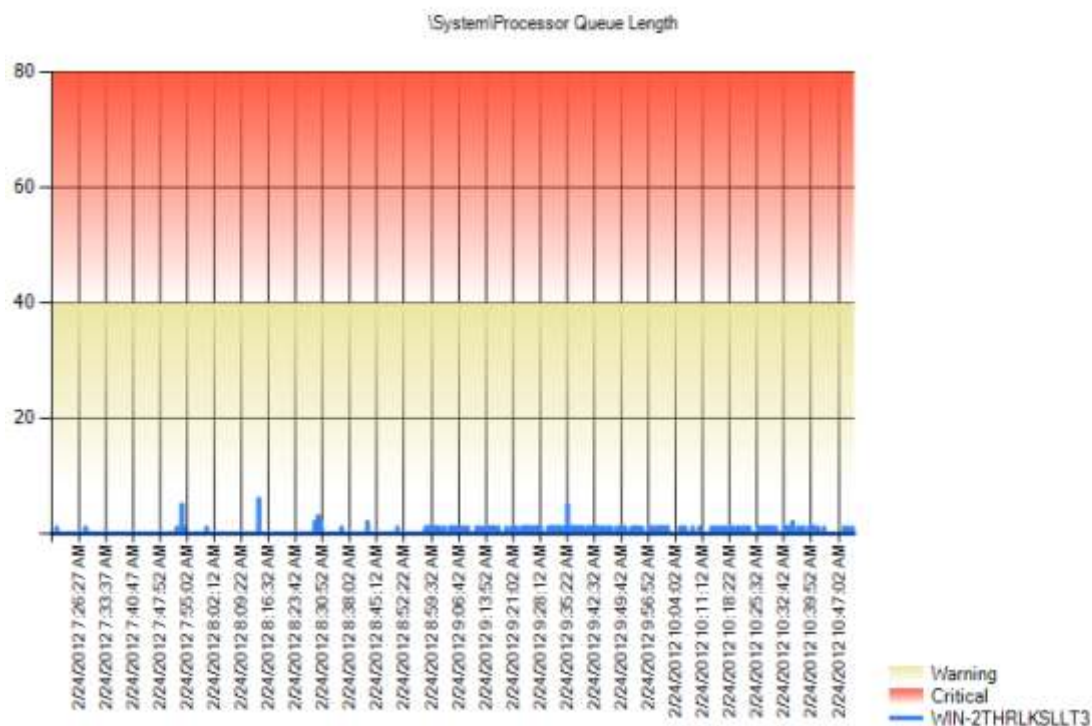
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise

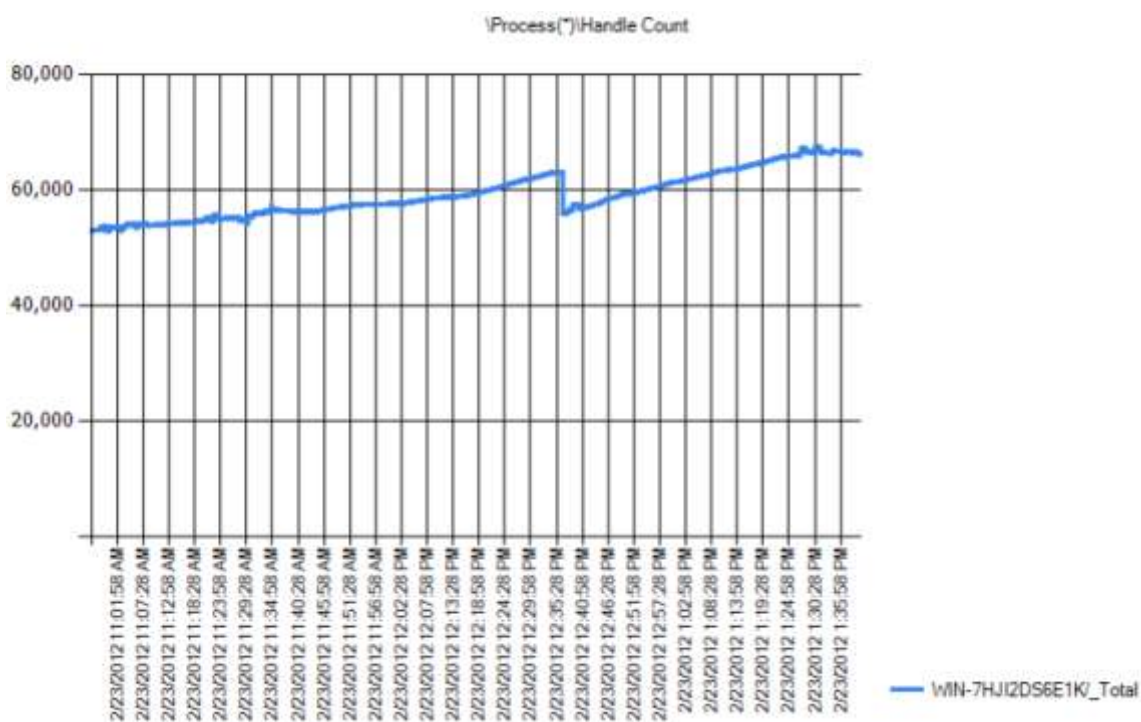
Stress test 4

- Run Date : 24th February 2012
- Test Run Time : Between 11.38 AM to 13.34 PM
- Test Run Duration : 15 min +
- Server Hardware : Cisco C210 M2 Blade Server with (2 x 6 Core CPUs)
- Peak MPS : 80,000 MPS
- Concurrent Users : 25,000
- Expected Transactions: 90,00,000

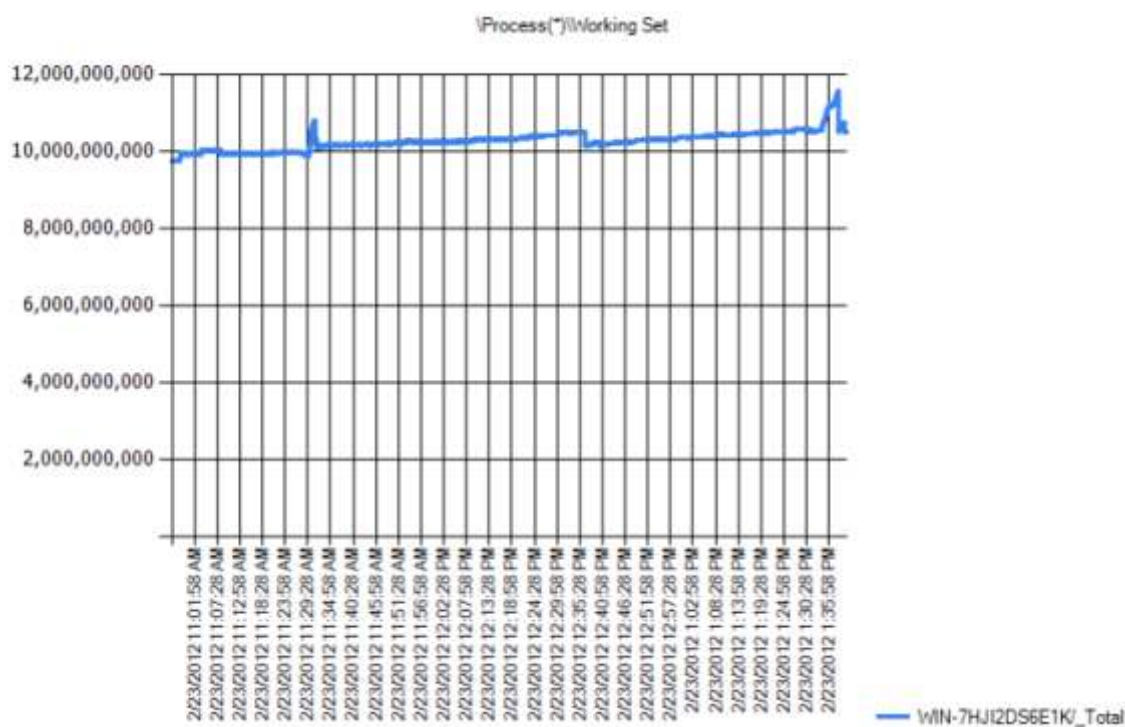
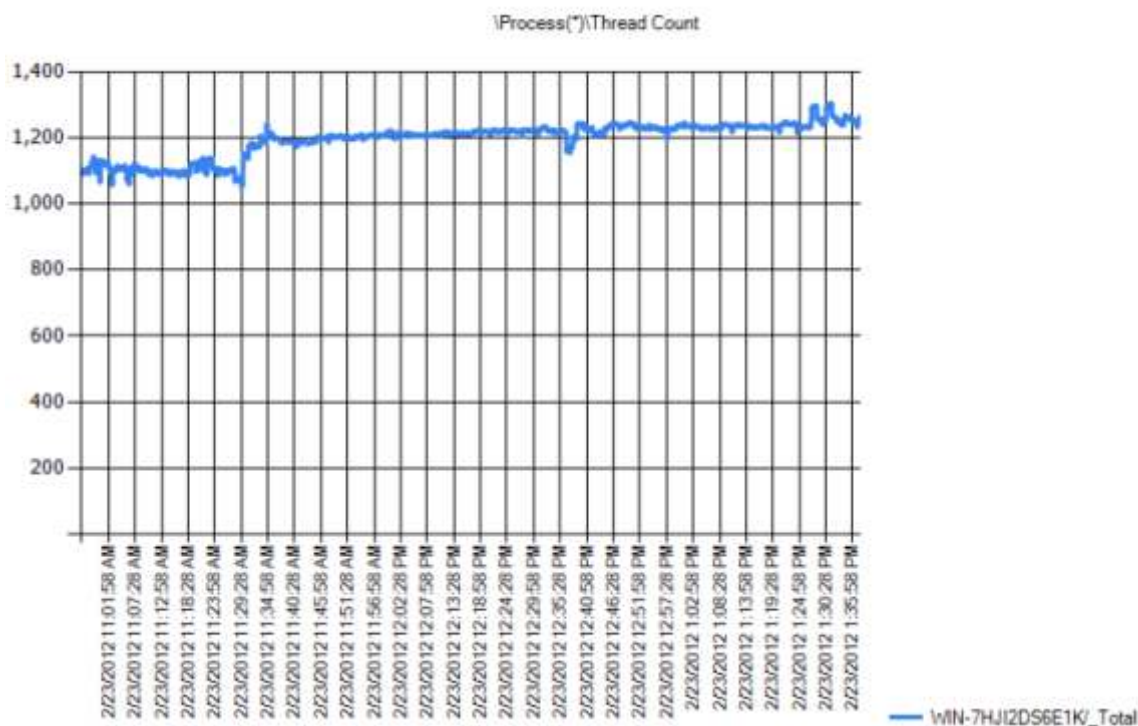
Observations & Analysis

- Test run on 24th February 2012, 11.38 AM to 13.34 PM (for reference to performance graphs)
- Test successfully ran for 15 mins with the desired throughput and concurrent-connections
- CPU utilization observed between 30 to 45% during the stress test

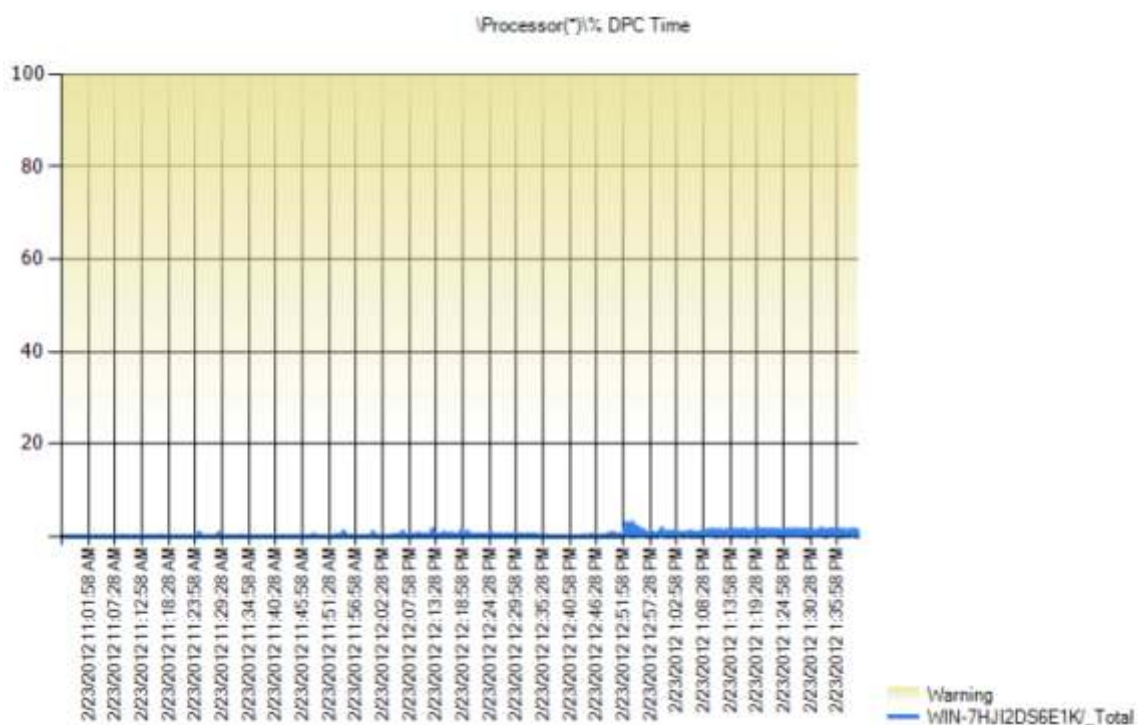
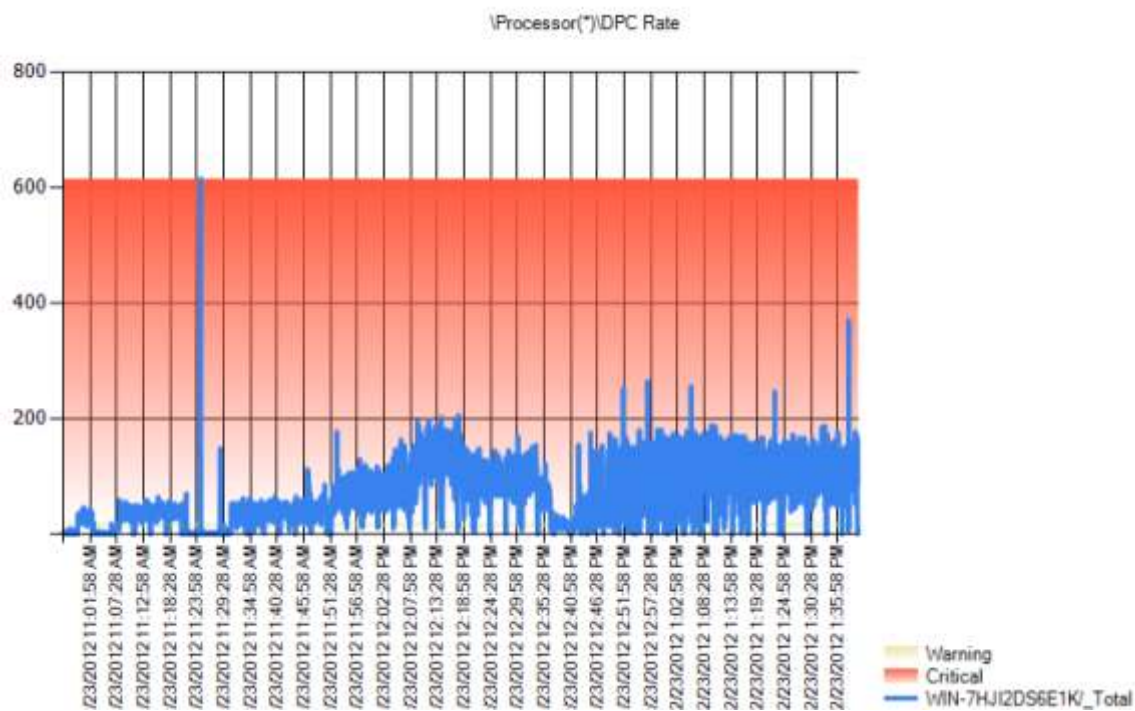
ODIN™ Performance Testing Exercise



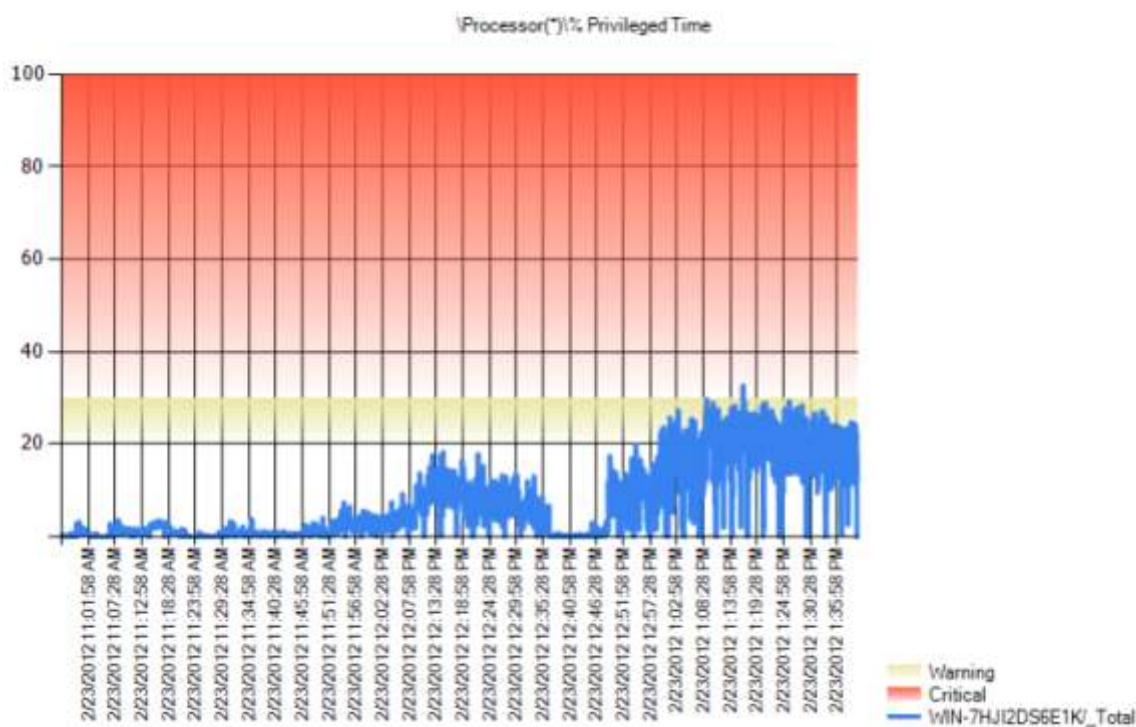
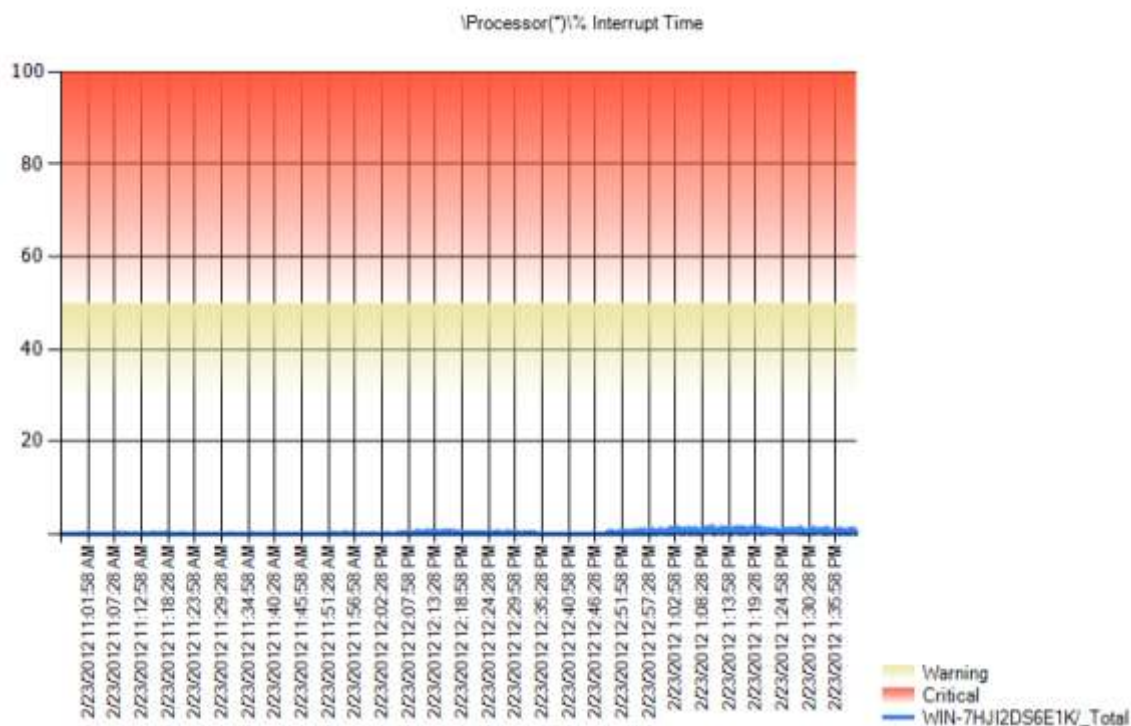
ODIN™ Performance Testing Exercise



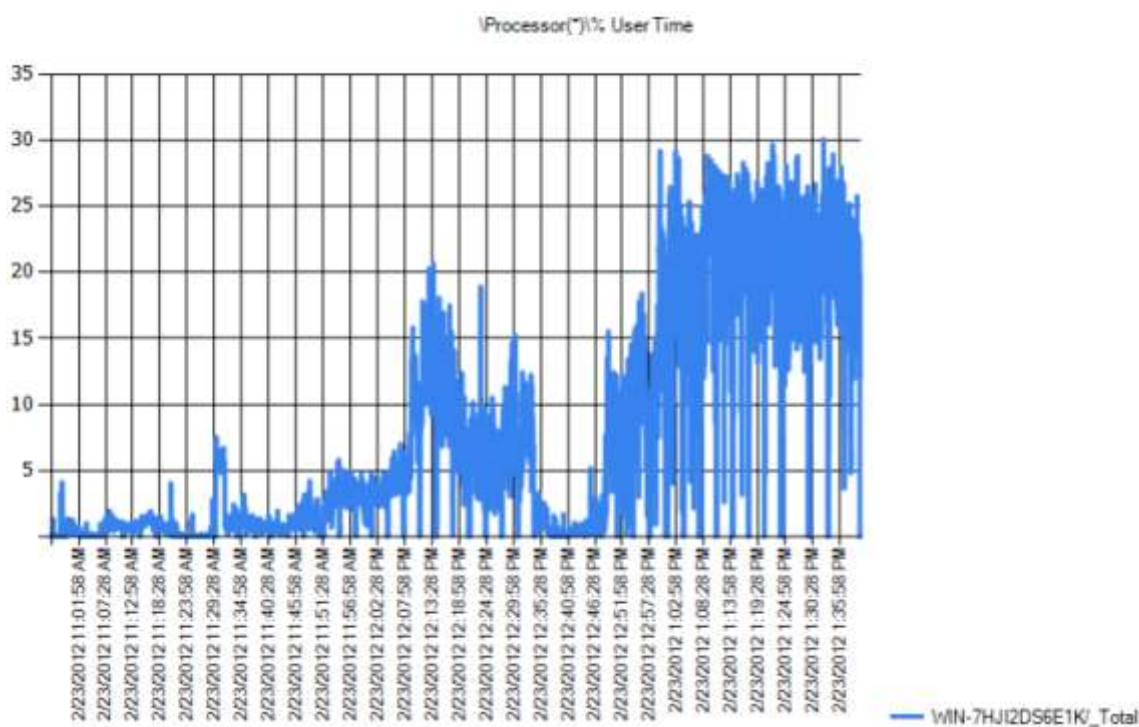
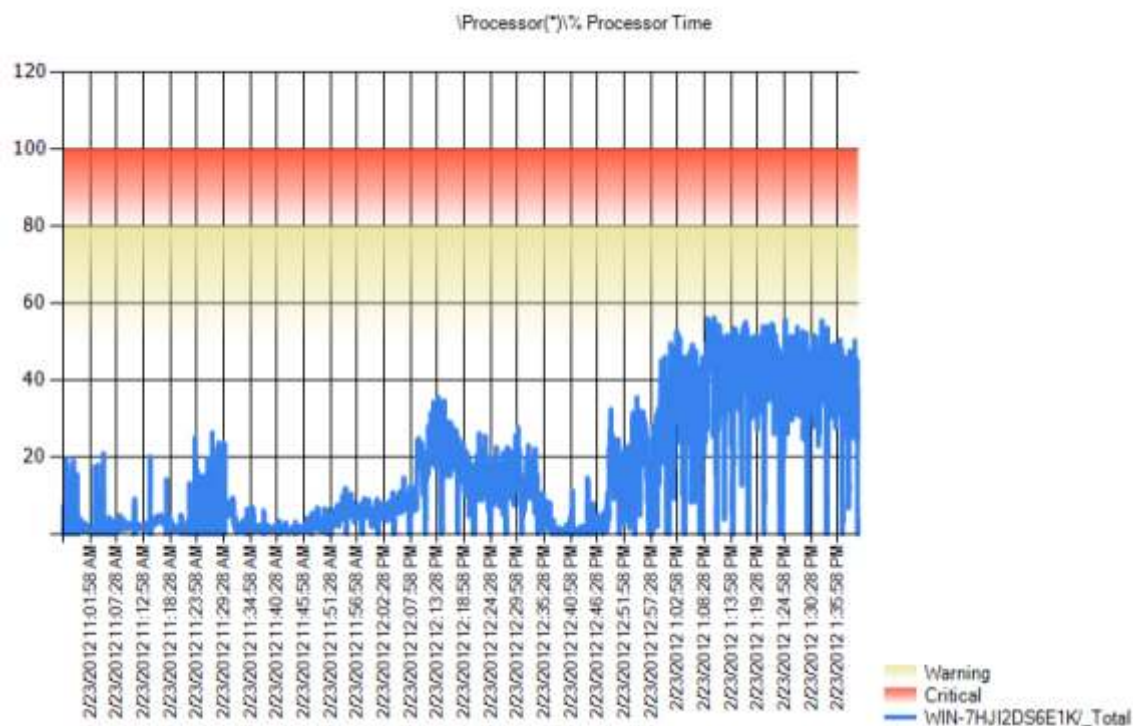
ODIN™ Performance Testing Exercise



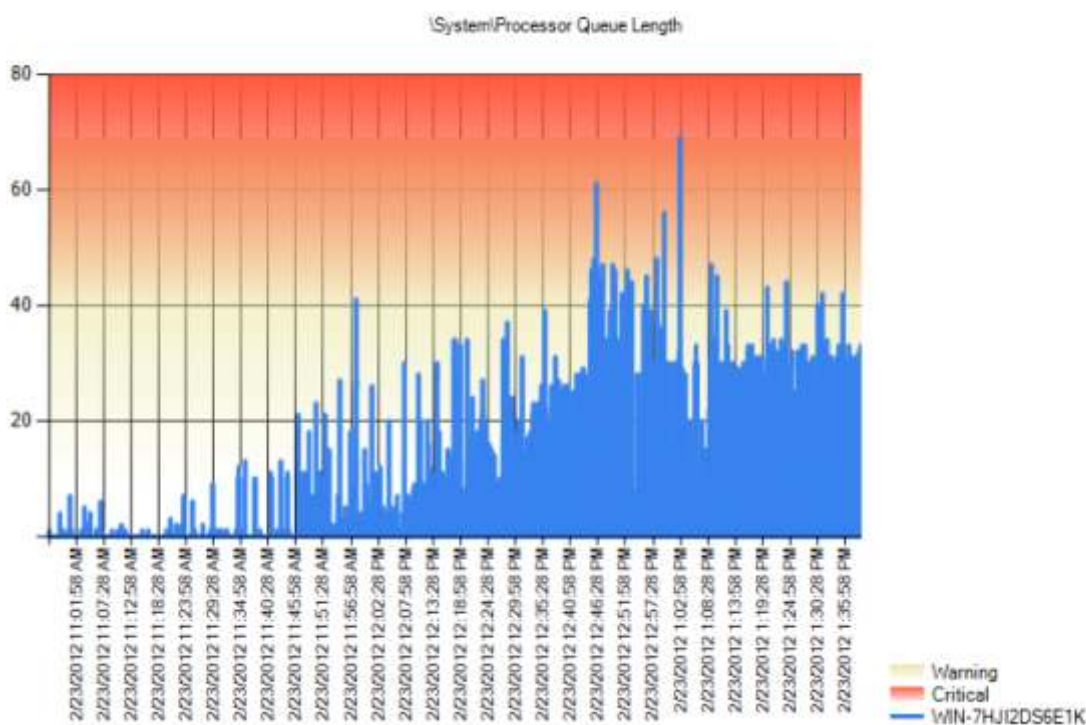
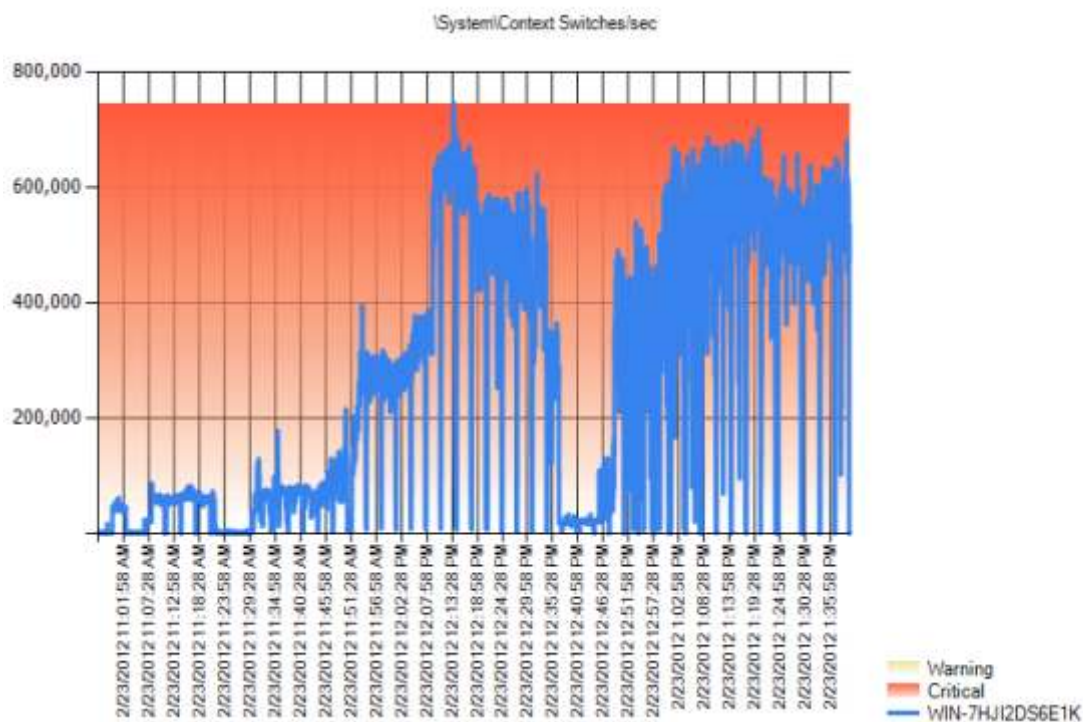
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



Load Test

Component : Market Information Server

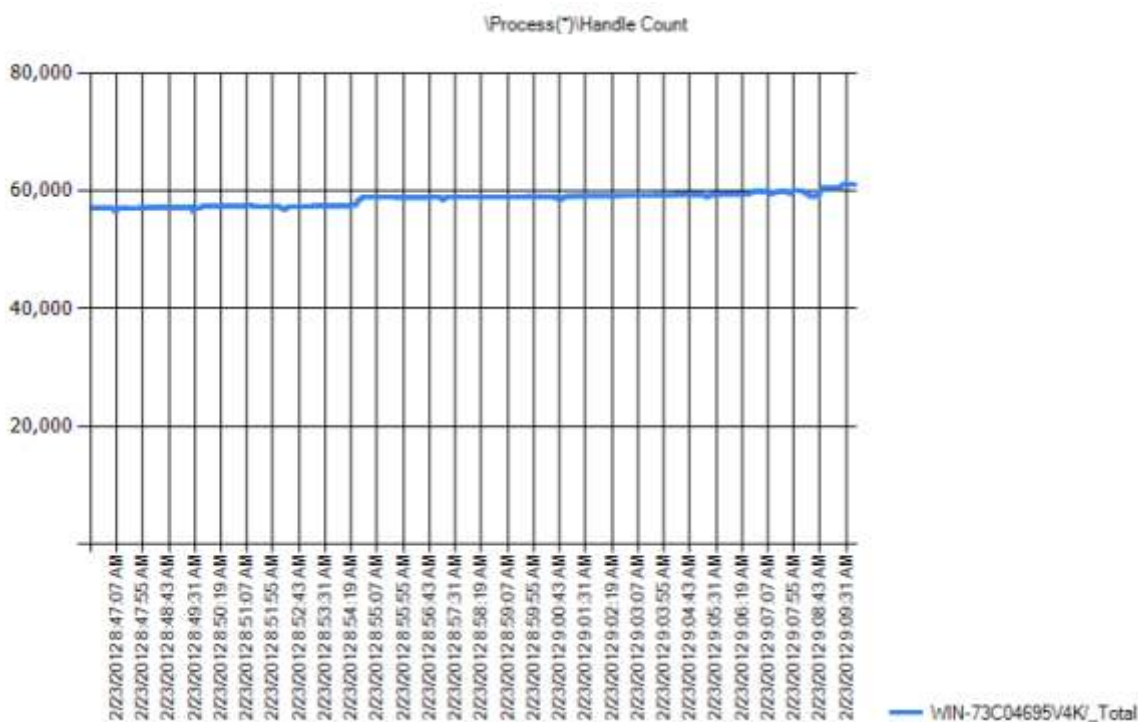
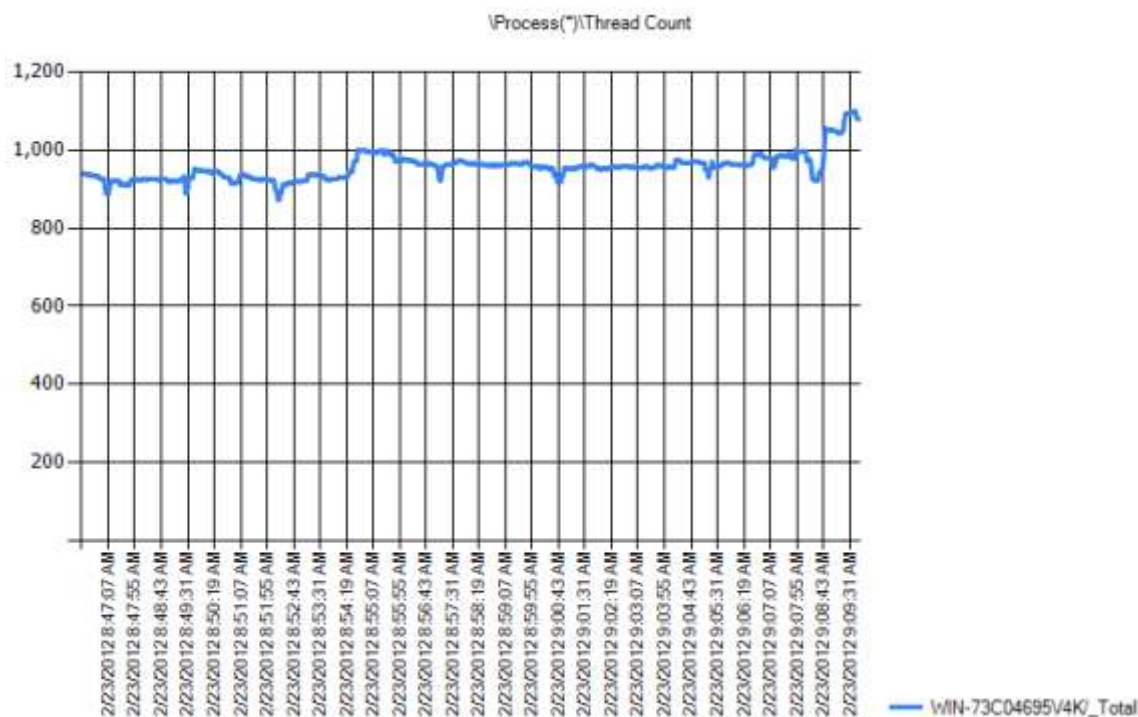
Type : Max Data processing capacity

- Run Date : 23rd February 2012
- Test Run Time : Between 08.47 AM to 09.09 PM
- Test Run Duration : 38 seconds
- Server Hardware : Cisco C210 M2 Blade Server with (2 x 6 Core CPUs)
- Packets loaded : 10,00,000 packets in MSMQ

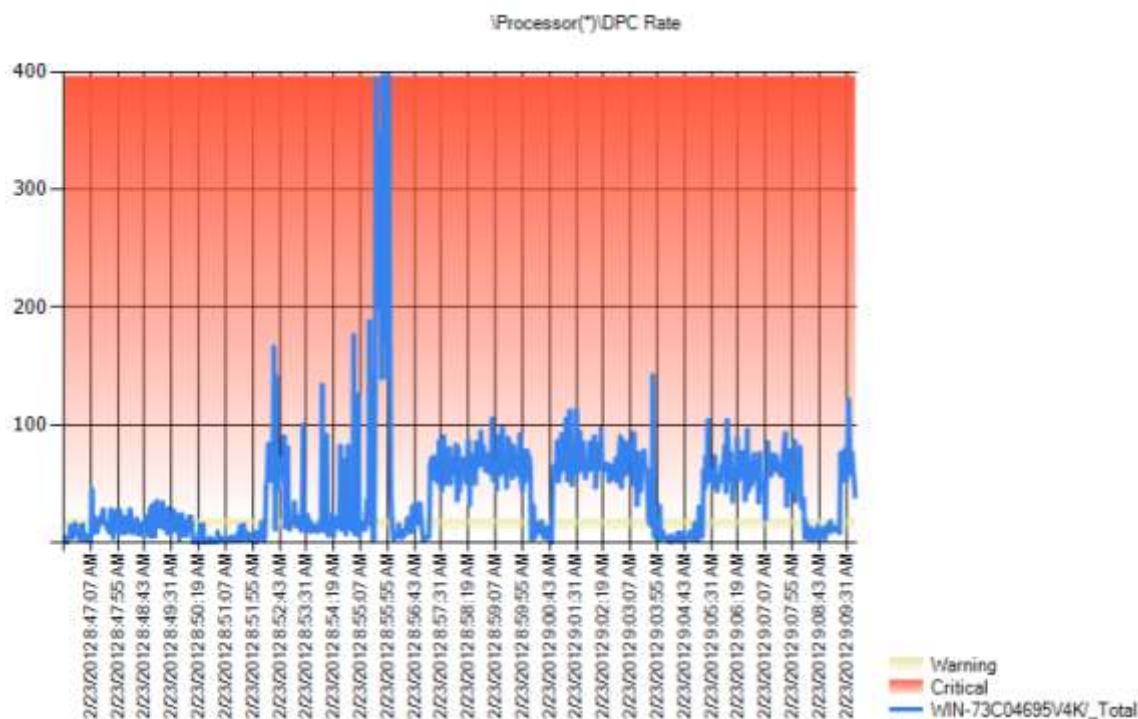
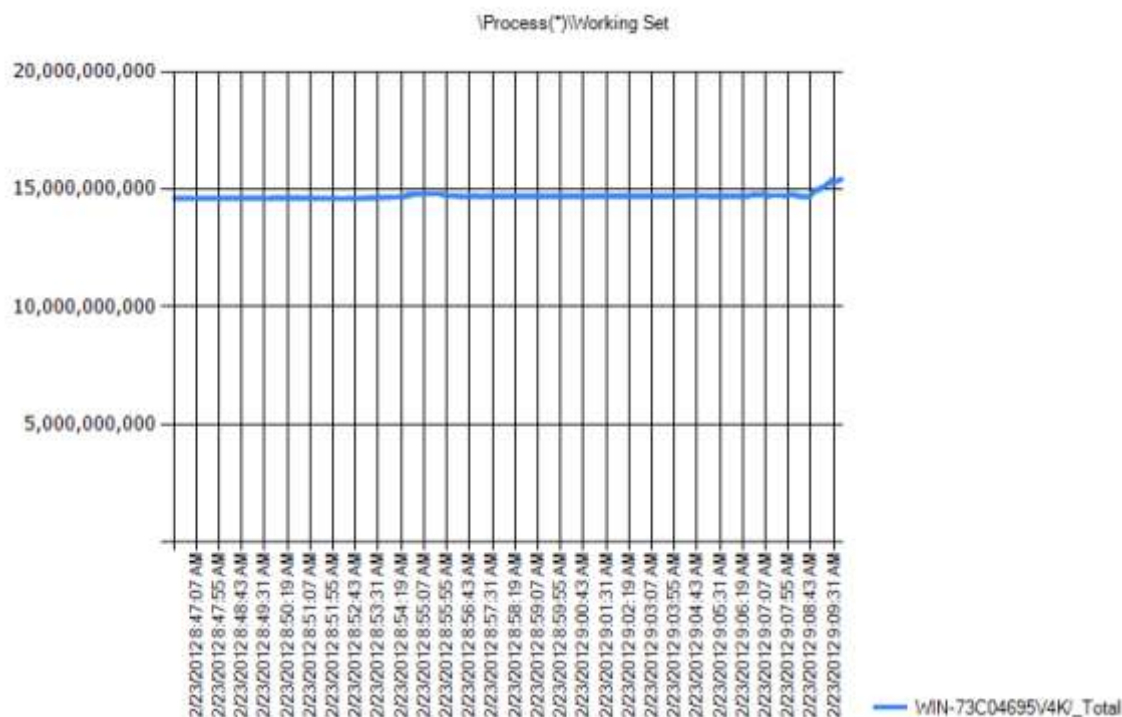
Observations & Analysis

- MSMQ clear within 38 seconds of application starts
- MIS can process 27,000 (approx.) packets of size 957 bytes in one second
- MIS also can process 24 MB of data in single second

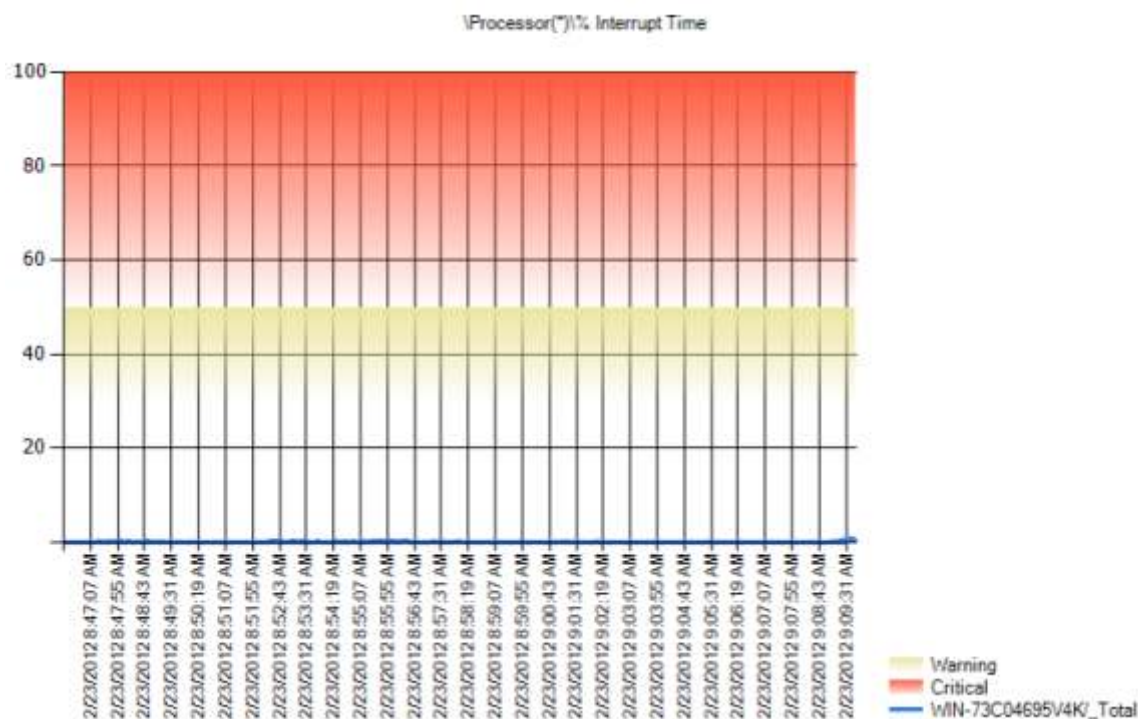
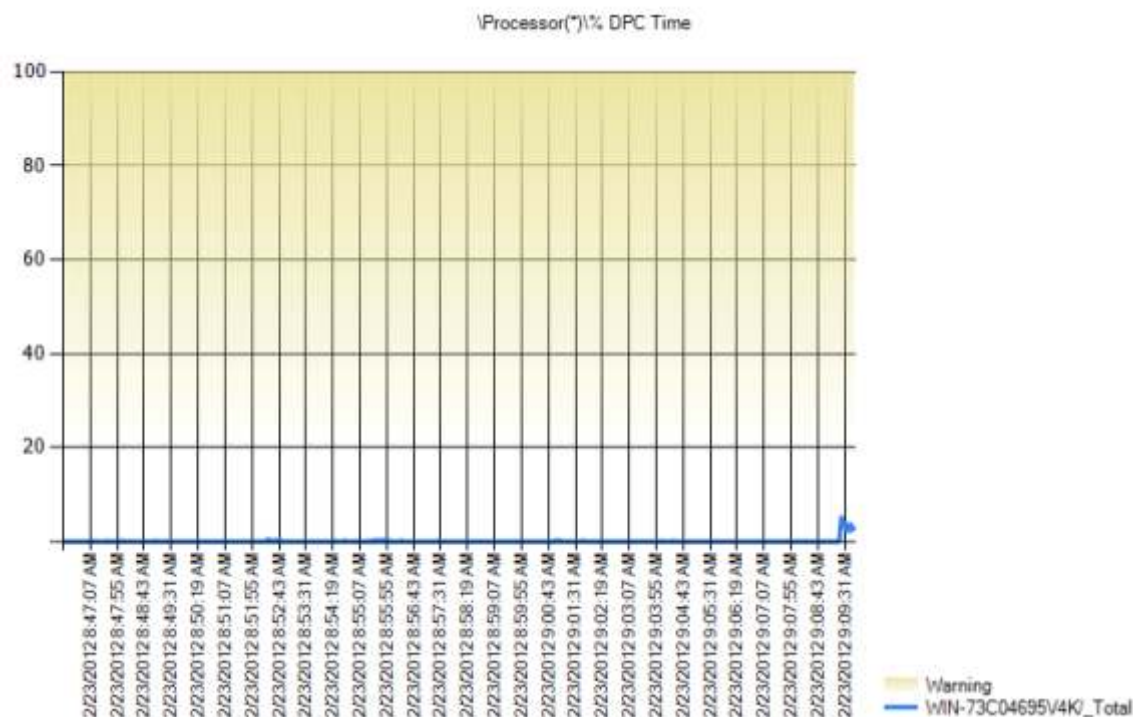
ODIN™ Performance Testing Exercise



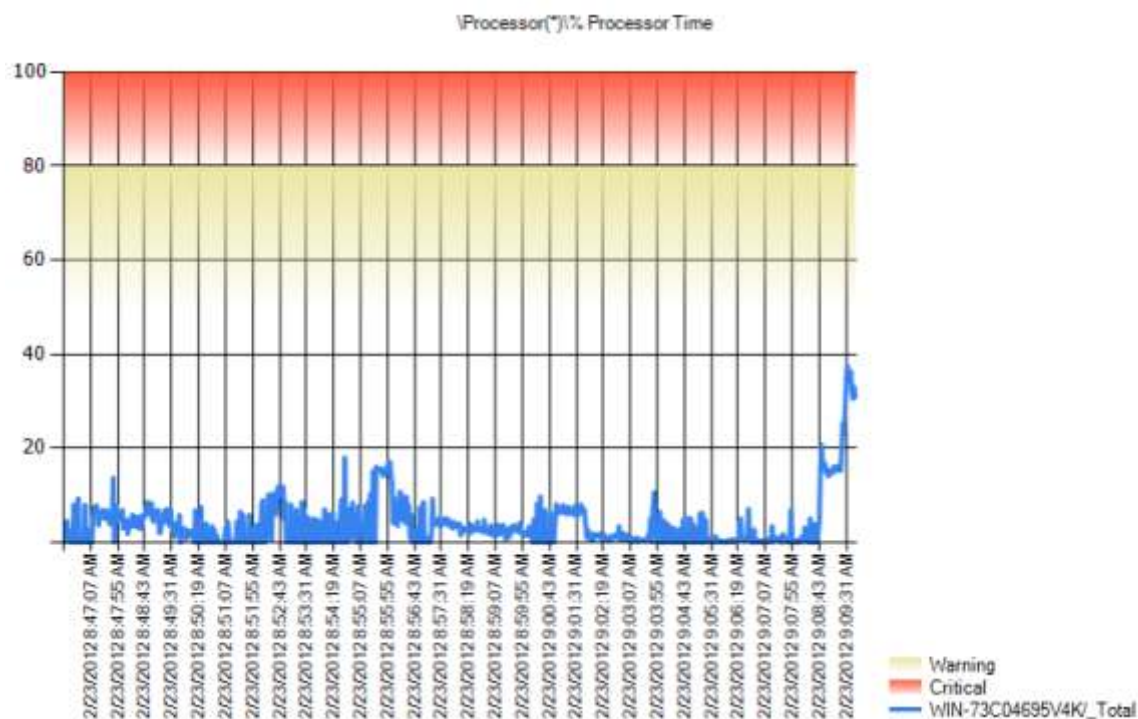
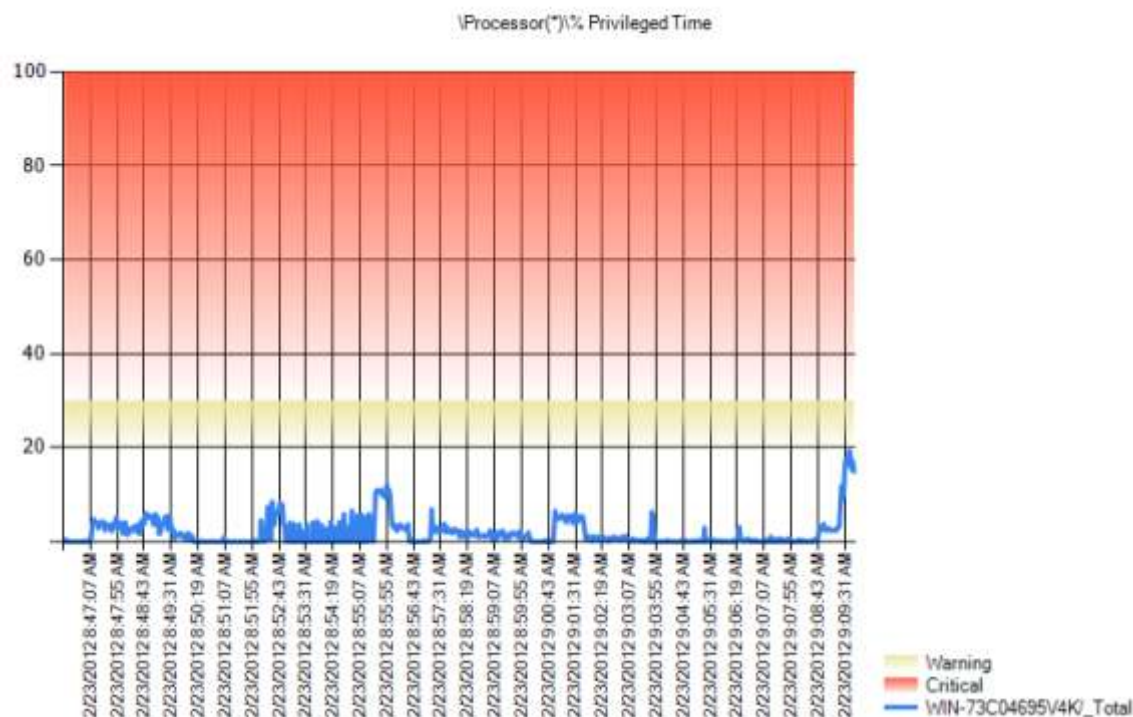
ODIN™ Performance Testing Exercise



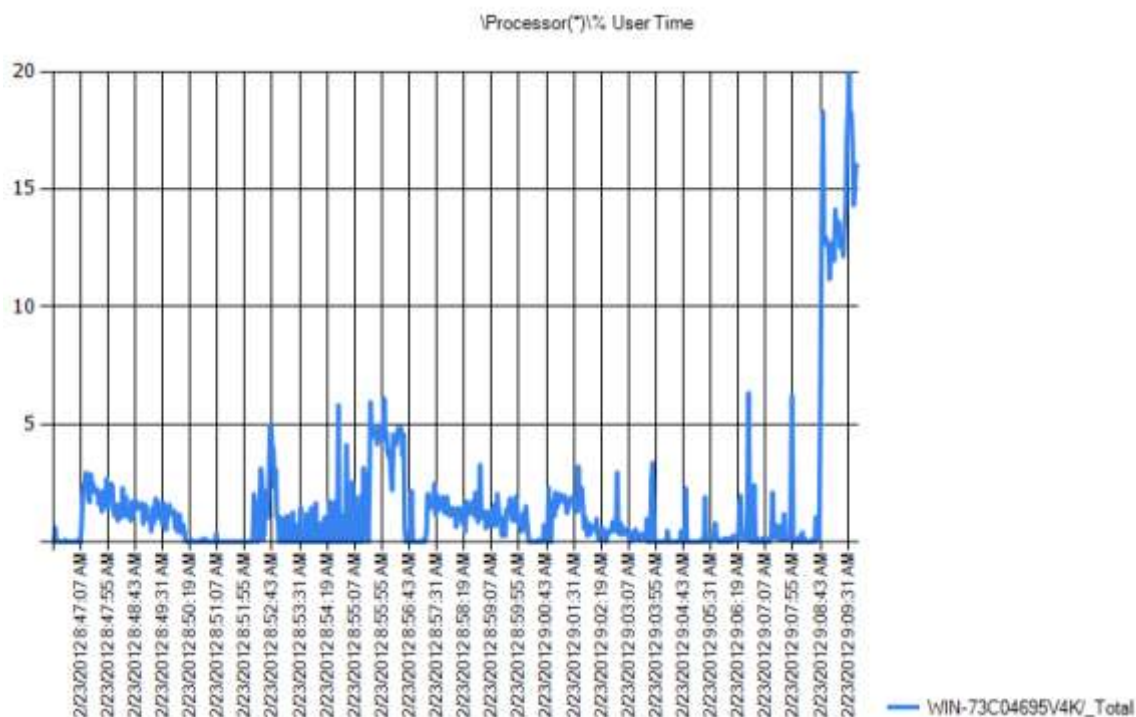
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise

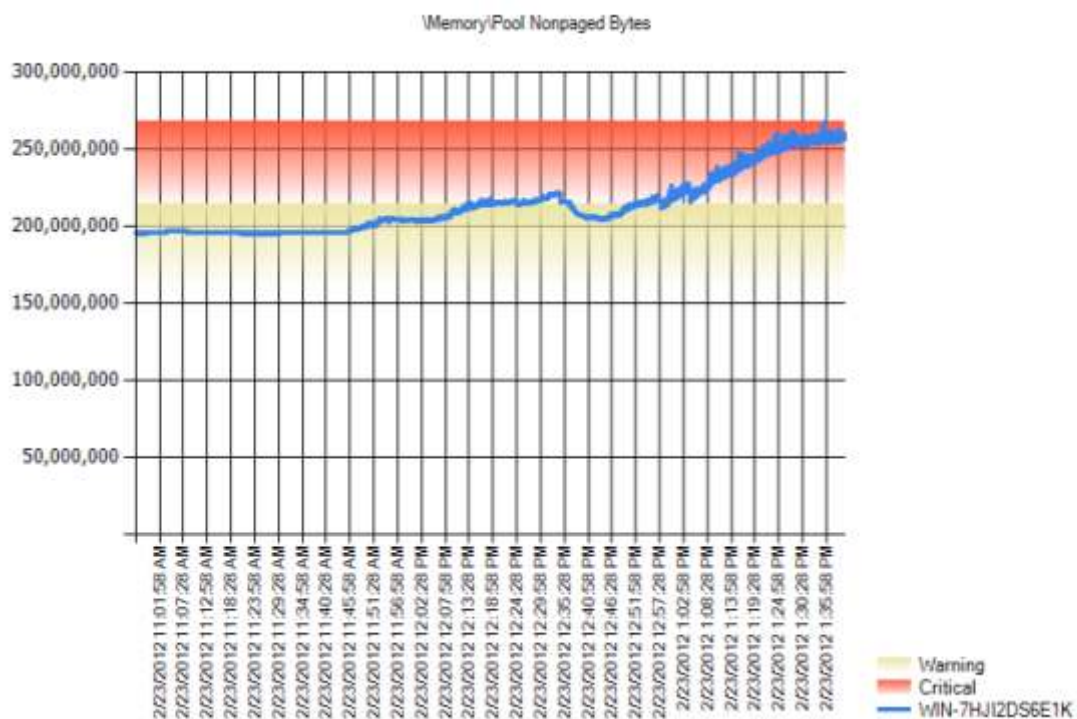
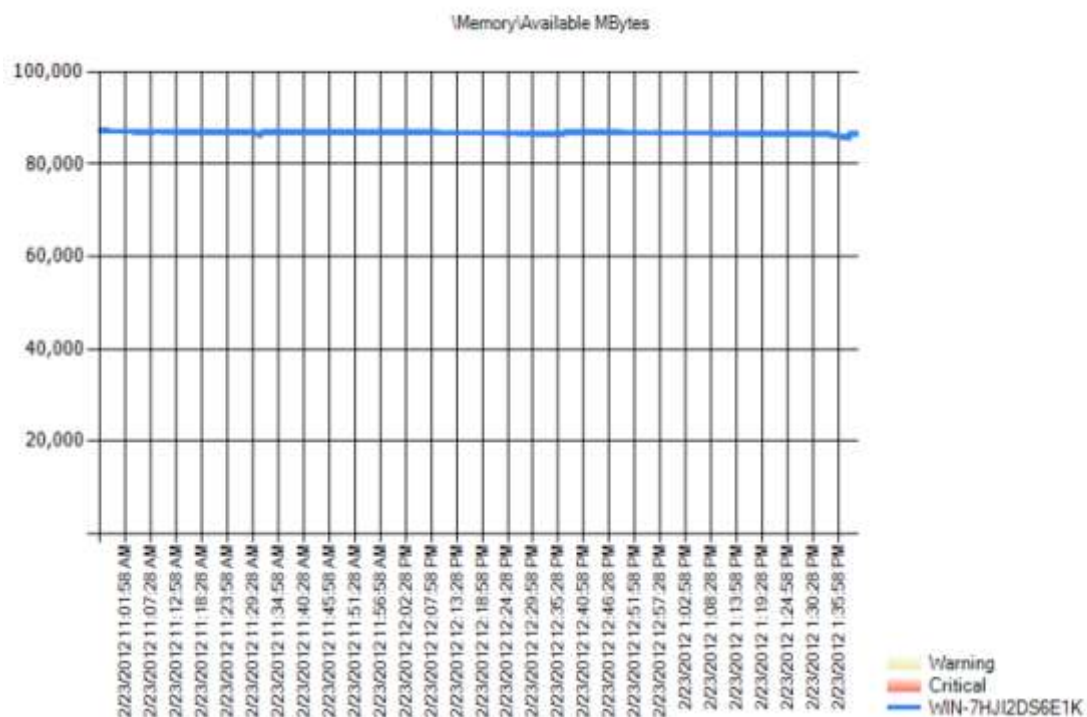
Component : Secondary Broadcast Server

- Run Date : 23rd February 2012
- Test Run Time : Between 11.01 AM to 01.35 PM
- Test Run Duration : 2 hrs 30 mins.
- Server Hardware : Cisco B200 M2 Blade Server with (2 x 6 Core CPUs)
- Con-connect users : 4,500 users
- Number of tokens : 100 tokens for each users
- Market Data feed : Two Segments with high frequency
- Type of data feed : Recorded

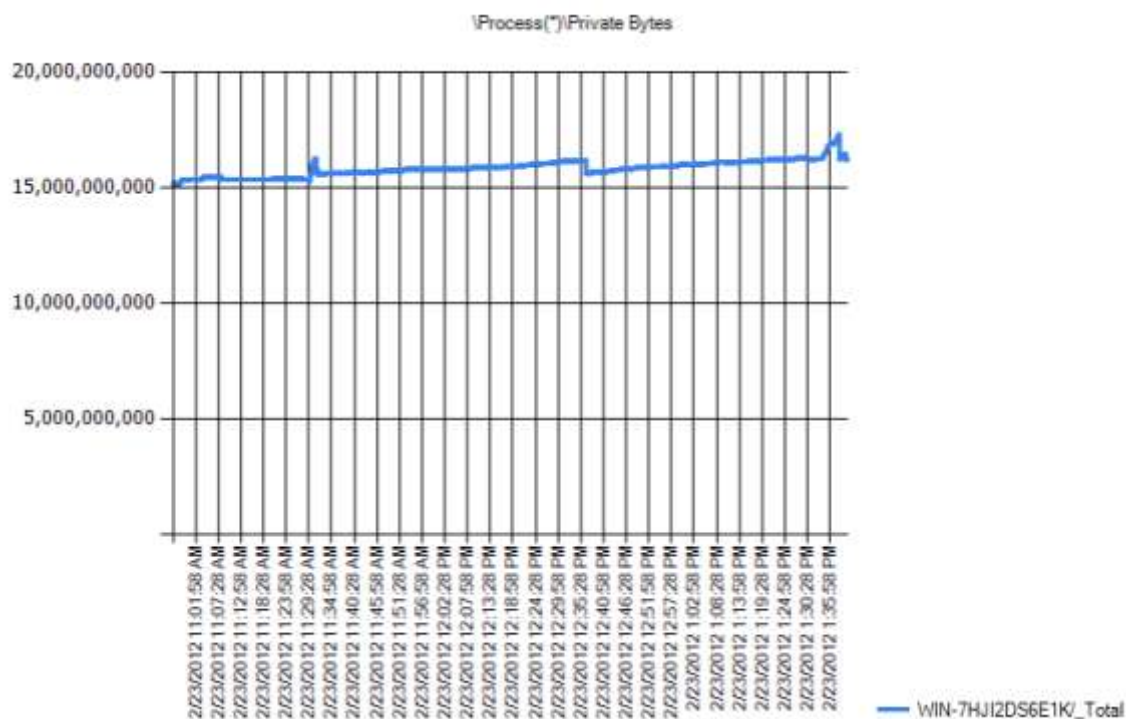
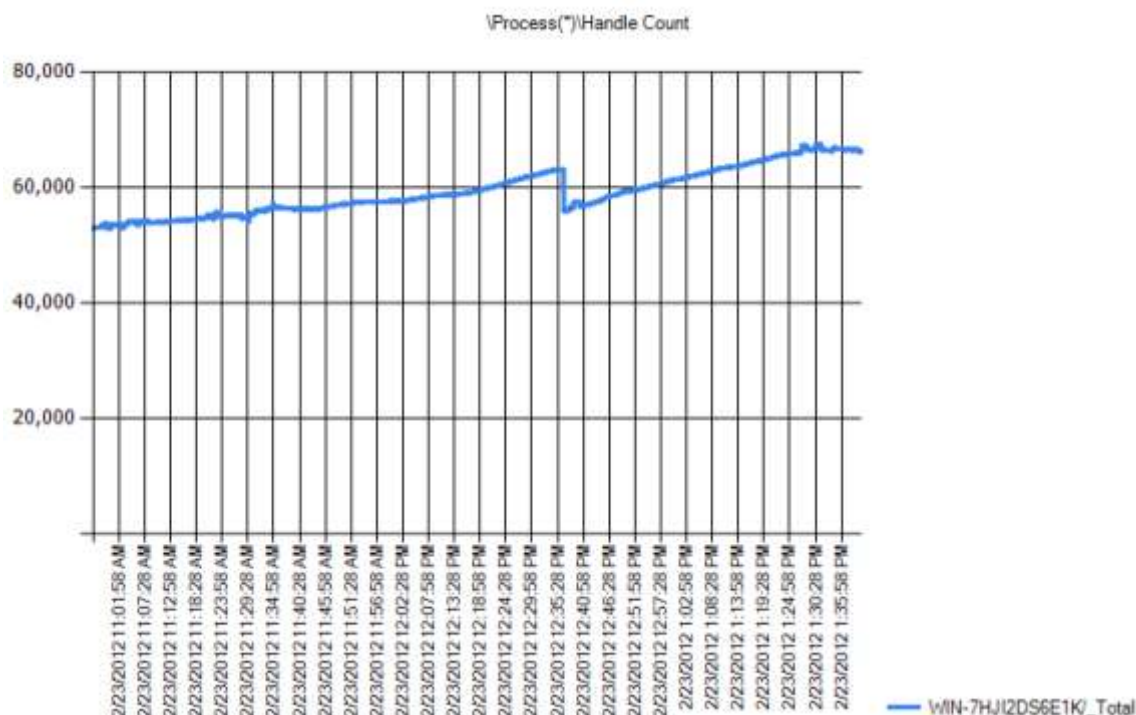
Observations & Analysis

- Test completed successfully with the desired expectations
- Secondary broadcast server can handle 4,500 concurrent-connections with the 100 tokens loaded on each connection
- During test 440 MBPS network traffic generated to server 4,500 users
- Other system resources utilization was also observed normal

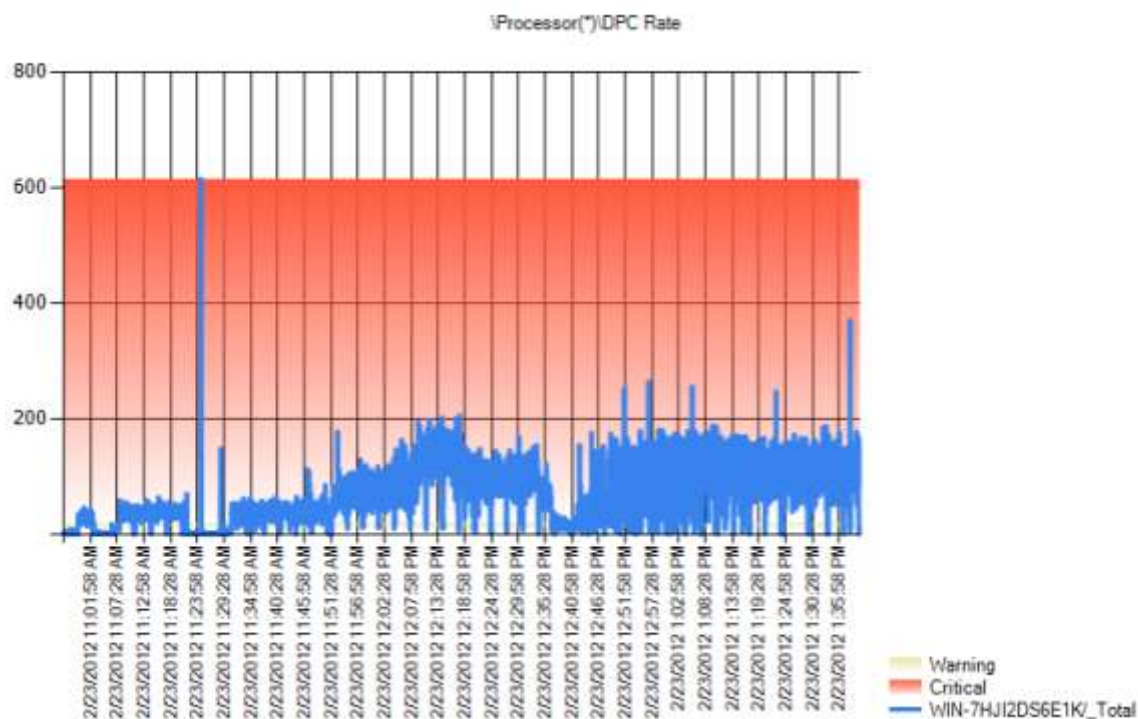
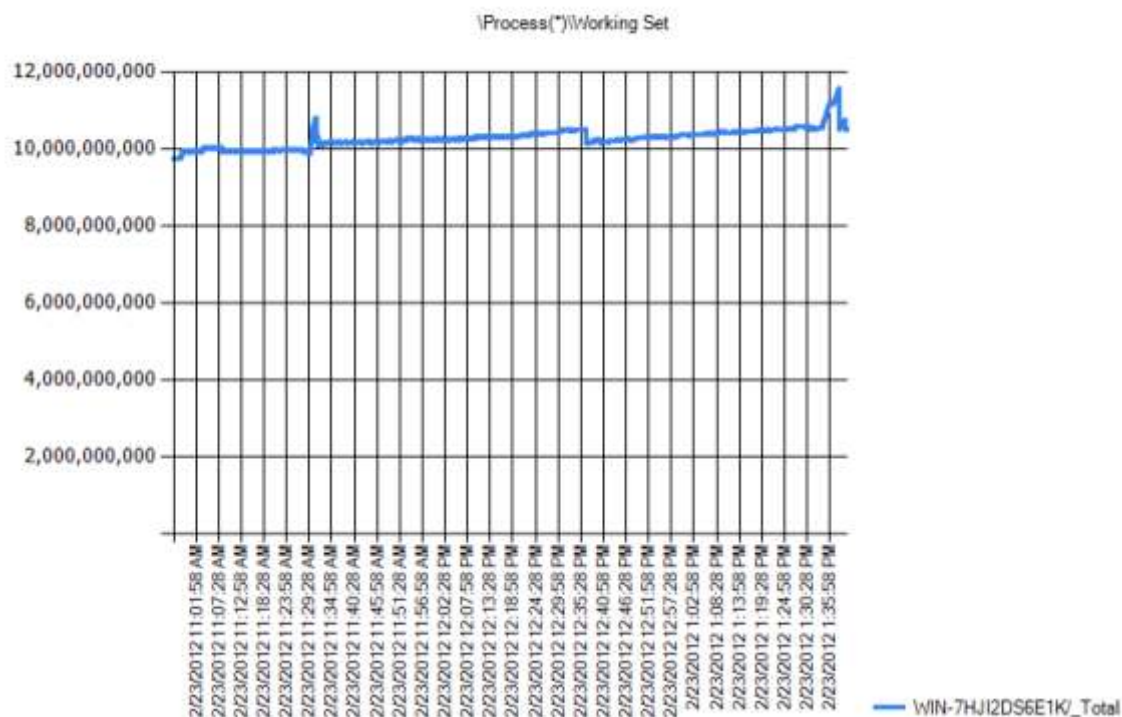
ODIN™ Performance Testing Exercise



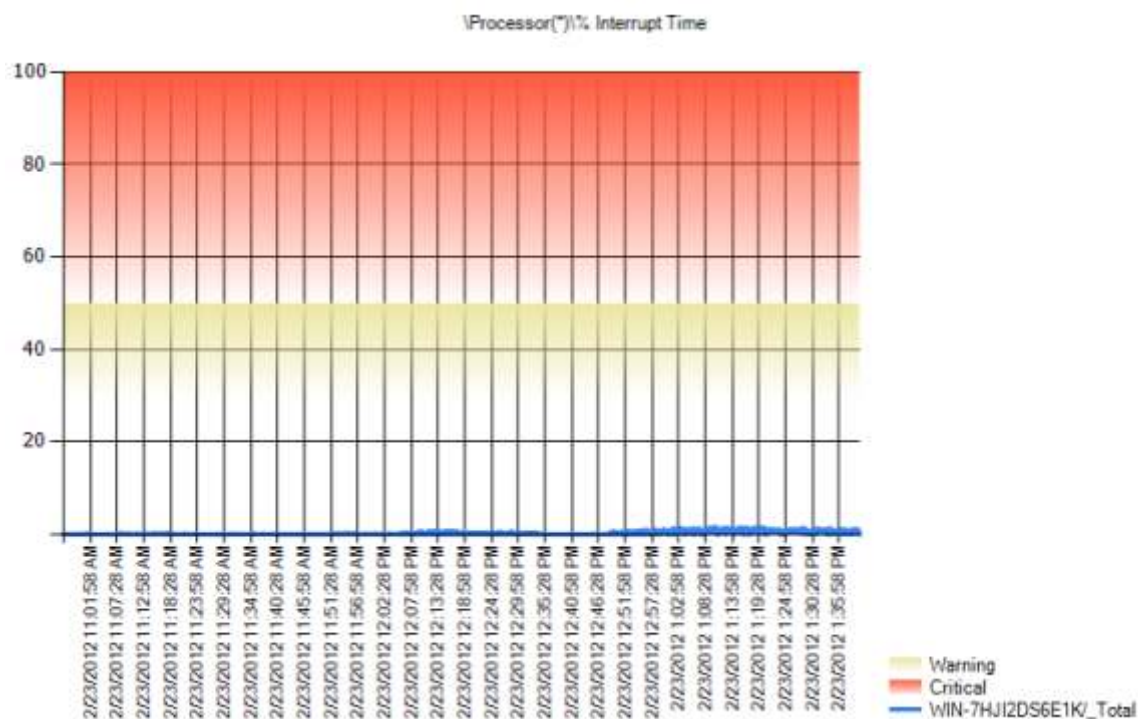
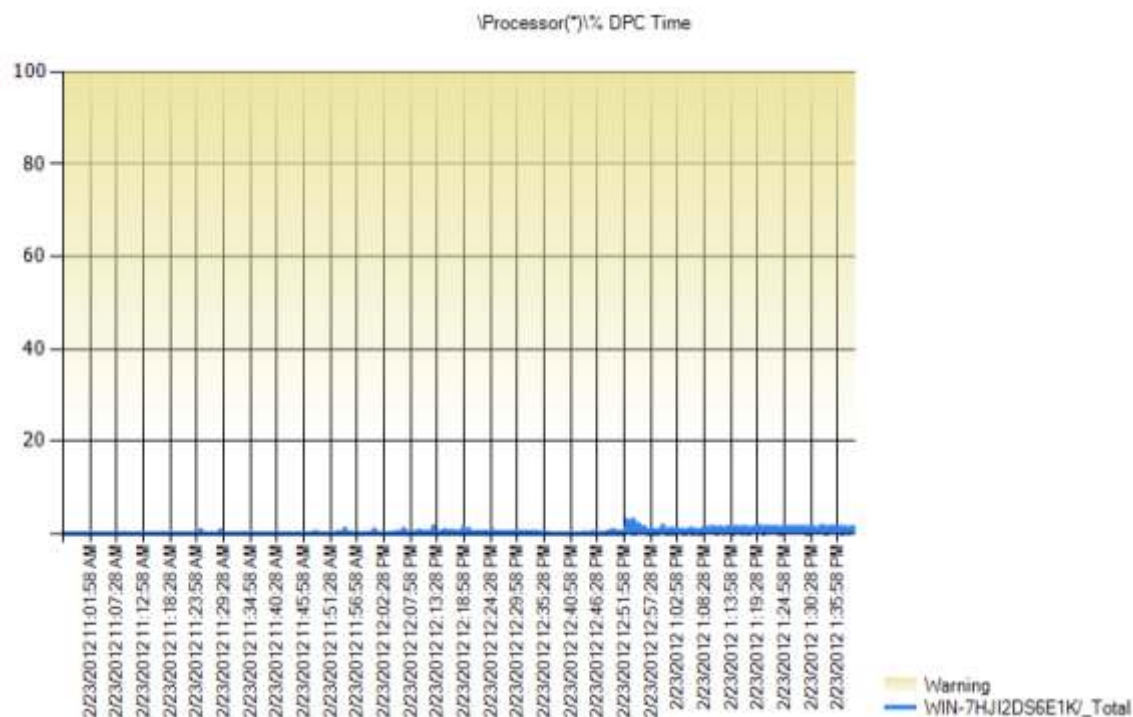
ODIN™ Performance Testing Exercise



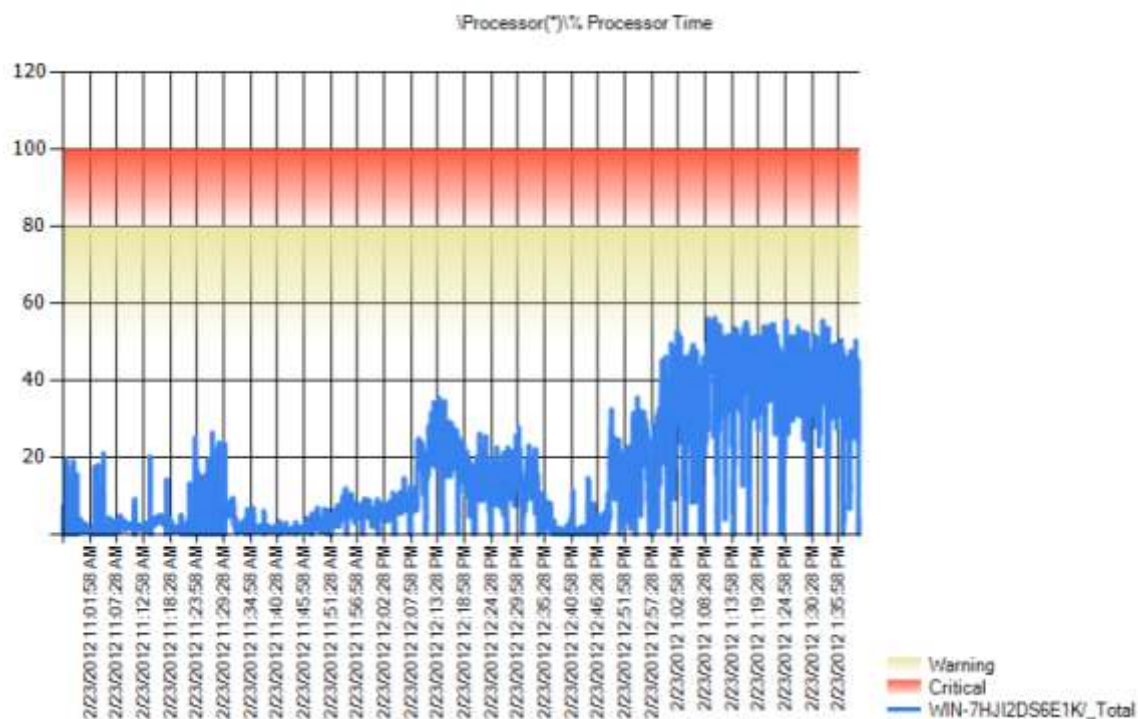
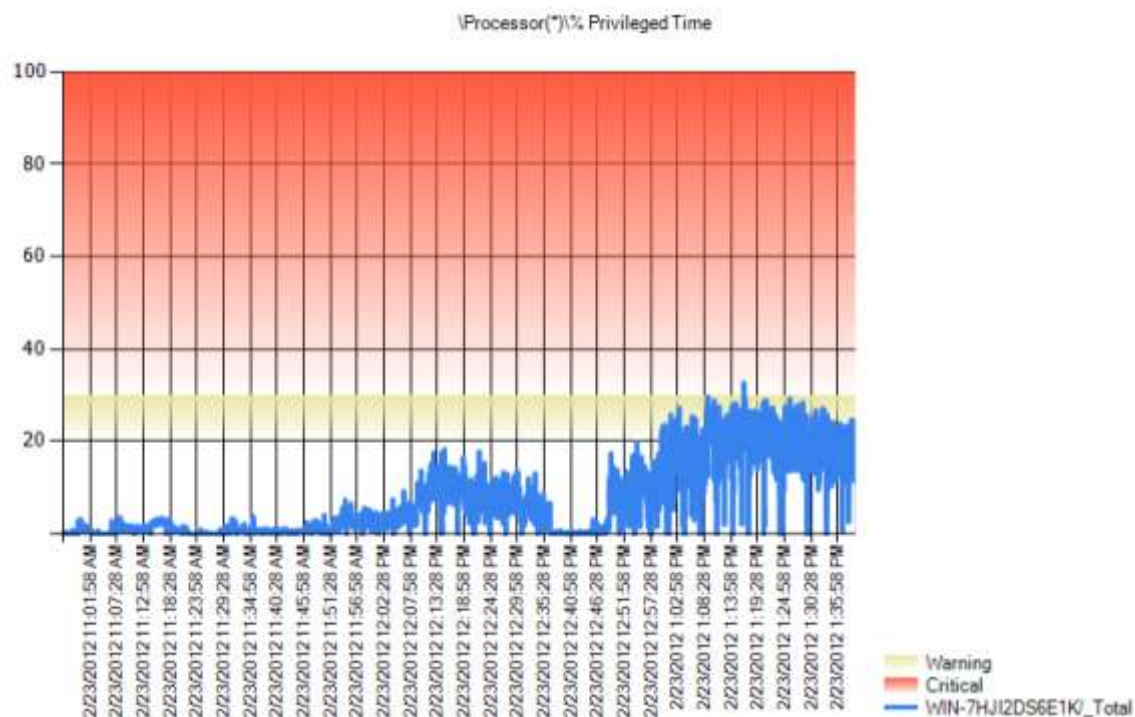
ODIN™ Performance Testing Exercise



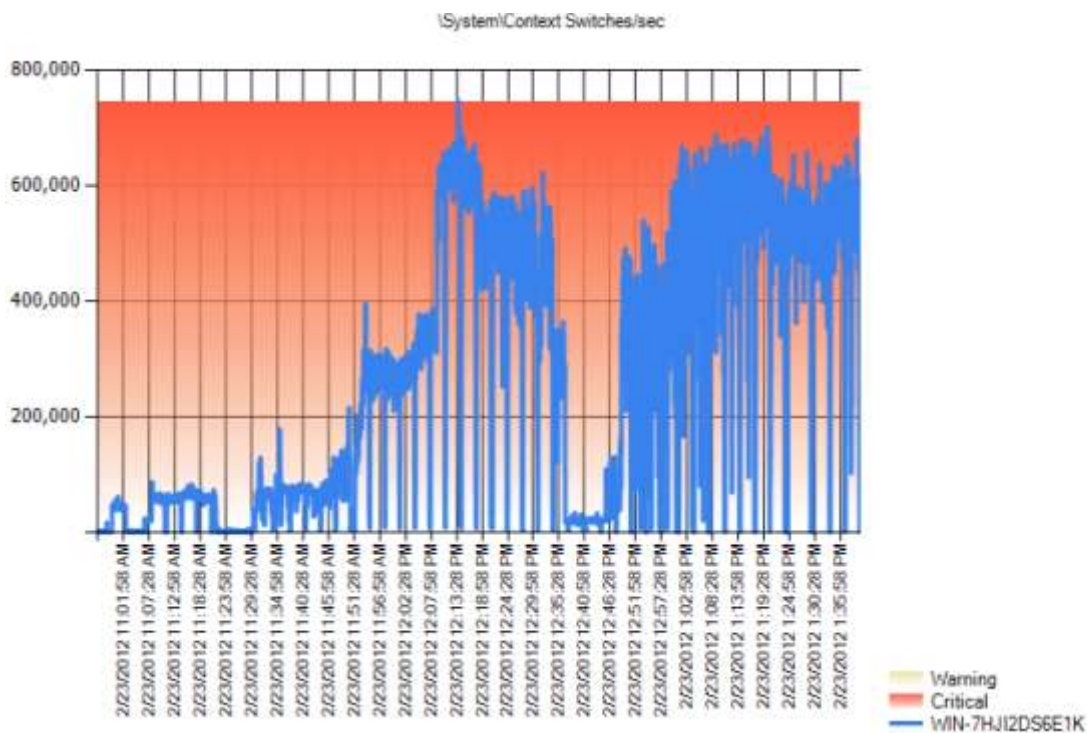
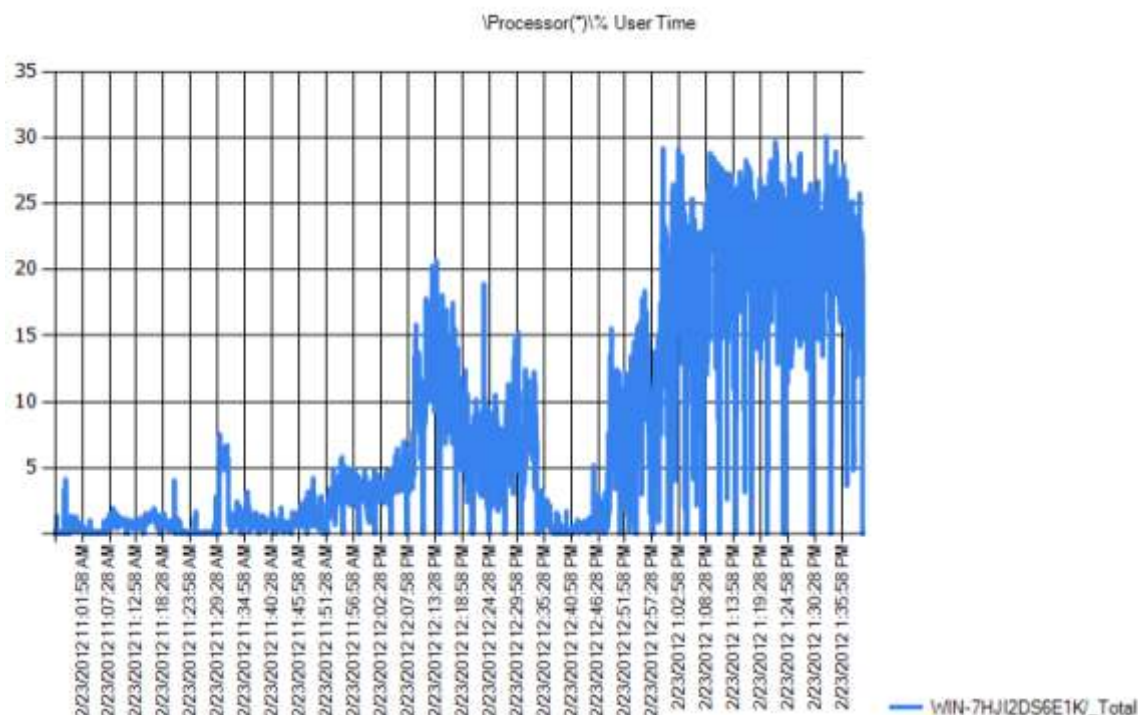
ODIN™ Performance Testing Exercise



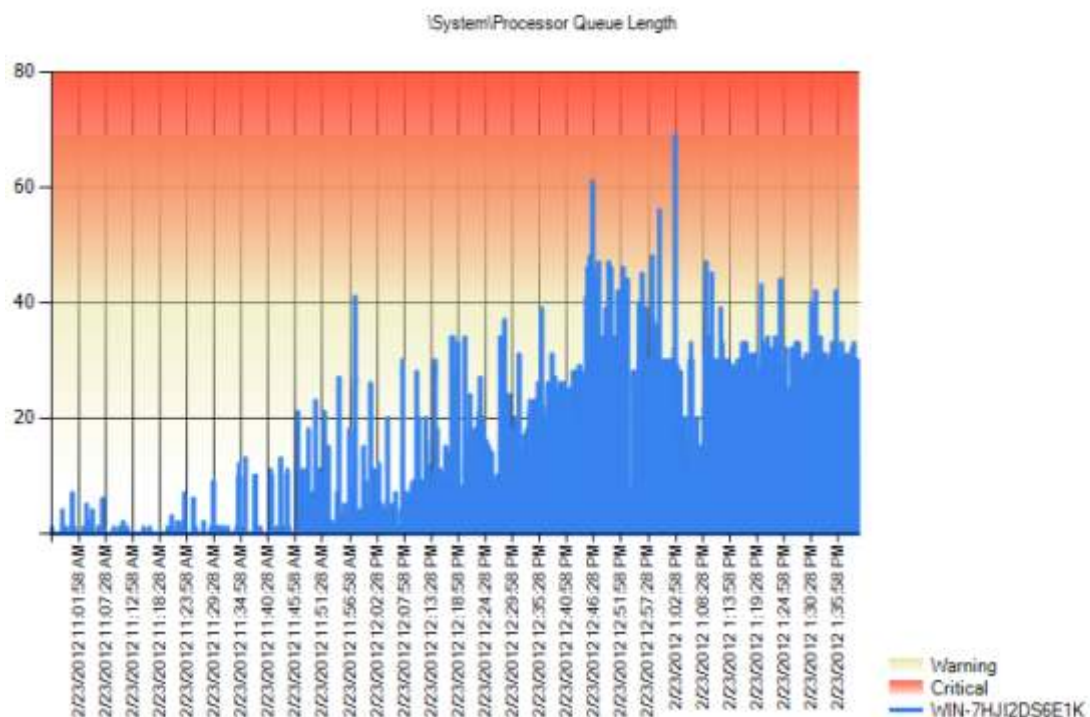
ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



ODIN™ Performance Testing Exercise



Conclusion

The performance testing of ODIN™ on Cisco Blade and Cisco Rack servers can certainly be thought of as a success. The testing environment was debugged, and the skills gained during that process will help in the future environments for both testing and production. The performance testing process also gained insight into the current performance profile of many areas of ODIN™ on Cisco servers.

Overall, the application's performance on Cisco servers were observed to be very efficient.

Our tests show that ODIN™ has not only the capacity to handle current and future market loads, but is also capable of supporting operations over extended periods of time. The system is scalable, both horizontally and vertically, thereby providing the client with an ideal platform that can support the growing business requirements.

The tests have also conclusively demonstrated that ODIN™ is a well-designed software that is robust and capable of functioning over the extended market period.

ODIN™ is, therefore, the ideal software to support the mission critical trading operations of brokerage house.

We would also like to take this opportunity to thank the FTIL management for choosing the Cisco and Cisco Center for test their flagship product, ODIN™, on Cisco Rack and Cisco Blade servers. We also appreciate all the support that we received in terms of functional as well as business understanding with regard to the product.

