

*FSA Integration Partner*  
United States Department of Education  
Federal Student Aid



**FAFSA on the Web 7.0**  
**in**  
**WAS 5.0 Architecture**  
**Performance Test Plan**

*Task Order #142*  
*Deliverable 142.1.1*

**Version 1.0**

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## Executive Summary

### *Introduction*

The U.S. Department of Education's Office of Federal Student Aid (FSA) administers and operates the "Free Application for Federal Student Aid" (FAFSA). While available in paper form, FSA also provides this service through a web site. U.S. college students seeking student financial aid use the FAFSA program. Starting from May, 2003, FSA had been under taking the task of upgrading its application server software from IBM WebSphere Application Server (WAS) v.3.5.6 to v.5.0. The upgrade is part of FSA ever greening work and it will allow FSA to take advantage of the new features and performance enhancements offered by WAS 5.0. As part of the process, applications that are running on WAS 3.5.6 will need to be validated against J2EE 1.3 specifications and packaged for deployment. For FAFSA 7.0, this re-platforming process will need to be verified in order to ensure it is working properly.

### *Background*

FAFSA 7.0 went live on January 1, 2003. FAFSA 7.0 is unique among FSA applications with its support of a 6 million user base. On the peak day, one hundred and one thousand application submissions were recorded. Architecturally, FAFSA 7.0 is hosted on HP servers utilizing WebSphere and IBM HTTP Server (IHS). The application connects to backend Oracle and DB2 databases. IBM WebSphere MQ and CICS are also used for enterprise messaging and transaction management.

### *Objective*

The purpose of our performance test is to:

1. Verify FAFSA 7.0 can handle production load of 1000 concurrent users.
2. Validate FAFSA 7.0 code on WAS 5.0 will operate under simulated production load.
3. Test the upgraded server software under simulated production load.

### *Expected Results*

The anticipated outcome of the performance test effort is the fulfillment of the performance test objectives. Iterative test cycles allow the testing effort to narrow its focus on the overall goal of optimizing the application and the architecture's performance.



### Amendment History

DATE	SECTION / PAGE	DESCRIPTION	Submitted BY
8/25/03	ALL	FAFSA 7.0 on WAS 5.0 version 1.0	Roshani Bhatt



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## 1 Introduction

### 1.1 Overview

This document provides the process and details on the performance goals that will guide the FAFSA 7.0 on WAS 5.0 test effort. This document will be utilized to communicate test plans prior to each cycle execution with all key participants as outlined in Section 3. This is an evolving document and will be updated throughout the FAFSA performance test.

### 1.2 Overall Goals

Performance Test runs will be executed with the following goals in mind:

1. Verify FAFSA 7.0 can handle production load.
2. Test FAFSA 7.0 with two business processes: Fill out FAFSA and FAFSA Correction.
3. Five performance test cycles will be executed within two weeks for this effort. The fifth cycle is optional.
4. If there are major issues after the fifth performance test cycle then remediation cycles will be required.

### 1.3 FAFSA software matrix

The following matrix captures the components of FAFSA that have been updated from the application's January 2003 release to August.

Number	Component	Previous version	New version
1	Operating System	HP-UX11	HP-UX 11i
2	IBM HTTP Server	1.3.12.6	1.3.26
3	WebSphere	3.5.6	5.0.1
4	WebSphere MQ (on application server)	5.2	5.3.1
5	Code Changes		



## 2 Performance Test Process

This section describes the Performance Test Process.

### 2.1 Performance Test Process

To achieve the overall goals, and set specific goals for tests, a process is required. The steps below explain the process that will be taken through the performance test effort:

#### 2.2 Establish a list of performance test areas that will be monitored.

Performance test areas include a wide range of measurements such as user response times, throughput, CPU and memory utilization, and number of concurrent users. These areas are established before the test so that monitoring points can be derived, and the teams have time to schedule the right people to monitor the tests. Specific monitoring points will be analyzed to identify issues/bottlenecks and will also provide the necessary data for analysis and response times. Table 7.1 includes all the performance test areas that need to be monitored and the responsible party for each.

#### 2.3 Establish the data and parameters that need to be collected.

Data will need to be collected for analysis during and after each test cycle. Table 7.1 outlines the type of data that should be monitored, collected, and the responsible party for each monitoring point. Section 4.2 outlines the data analysis deliverables that CSC and ITA are to submit at the conclusion of each test cycle.

#### 2.4 Fixes and Changes made to the environment and application code.

Based on the analysis and recommendations of the team, configuration changes may need to be made after each test run. These changes should provide higher performance results in the next test run.

#### 2.5 Results are documented and FAFSA 7.0 on WAS 5.0 environment is validated.

The result of each test cycle will be documented and reported. A final presentation will be prepared once the performance tests are completed.

#### 2.6 Success Criteria

The performance test will validate that the FAFSA production run time environment will be able to support anticipated peak loads through December 2003 by:

- Supporting sustained peak load of 1,000 users executing the identified business cases.
- Resource utilization of memory and CPU utilization is within the range of 80% average utilization.
- Average page response time is less than 15 seconds per page.



### 3 Roles, Responsibilities and Deliverables

This section outlines the roles and responsibilities of all parties involved in FAFSA 7.0 on WAS 5.0 Performance testing.

#### 3.1 Performance Test Roles and Responsibilities

The following list outlines the roles and responsibilities of the FAFSA 7.0 Performance Planning team.

Role	Assigned	Phone	Responsibility
Performance Test Lead	Roshani Bhatt	202 962-0740	<p>Coordinate with all teams and resources to ensure that the capacity planning, performance test planning and performance test execution are completed on time.</p> <p>Define the detailed goals for each test cycle/test types – stress, stability, SSL, Cache, DB, and Mainframe.</p> <p>Determine the length of each run and starting and stopping points.</p> <p>Ensure the performance test requirements are met successfully.</p> <p>Define and set goals for each cycle.</p>
Performance Test Resource	Musab Alkateeb Diahann Butler Ashfaq Khan	202 962-0729 202 962-0728 202-962-0758	<p>Coordinate test dates with all testing resources (ITA, Pearson, CSC, and Integration Partner).</p> <p>Work with all the teams to verify administrator contact information and attendance.</p> <p>Set up pre-test and test day conference calls.</p> <p>Execute tests and monitor test servers.</p> <p>Fix the scripts after test cycle if necessary.</p> <p>Work with CSC to measure the performance of each component (CPU, Mem, IO, Network).</p> <p>Identify bottlenecks.</p> <p>Document Executive Summary of test cycle results.</p>
Application Contact	Matt Kain Dan Butler Gabe Perez	319-339-6902 319-665-7763 319-665-7748	<p>Responsible for application changes and recommendations.</p> <p>Monitor application performance at each test cycle.</p>
EAI Administrator	Scott Gray/ Brian Whisnat	202 962-0795 202 962-0748	<p>Monitor WebSphere MQ on FAFSA and CPS.</p> <p>Monitor CICS DPL bridge.</p> <p>Capture information for MQ Series.</p> <p>Make recommendations on ways to improve the EAI components.</p>
WebSphere Administrator	Roshani Bhatt /Bob Wehrle	202 962-0740 202 962-0760	<p>WAS configuration changes and updates.</p> <p>Monitor key areas and deliver summary results.</p>



	Joe Hala		
IHS Administrator	Roshani Bhatt / Bob Wehrle Joe Hala	202 962-0740 202 962-0760	IHS configuration changes and updates. Monitor key areas and deliver summary results.
eNetwork Dispatcher Administrator	Roshani Bhatt / Bob Wehrle Joe Hala	202 962-0740 202 962-0760	Load Balancer configuration changes and updates. Monitor key areas and deliver summary results.
HP System Administrator	Bill Gardner / Paul Izzo/	860-290-0871 203-317-2175	Monitor hardware to ensure optimal configuration. Monitor CPU, Mem, IO, capacity levels.  Record hardware capacity levels at different intervals throughout the test cycle.
Oracle Administrator	Rich Ryan Malcolm Brown	860-425-6336 434-572-4922	Monitor Oracle Database to ensure the optimal configuration.  Monitor the Oracle Database performance throughout the test cycle.  Make recommendations on ways to improve Oracle performance.
Mainframe Administrator	Tom Puddicombe / Nancy Mathisen	860-290- 2201 817-762-8061	Monitor Mainframe to ensure optimal configuration.  Monitor capacity levels at different intervals throughout the test cycle.  Monitor MQSeries and the communication between App server and DB.
Windows Administrator	Craig Gates	203-317-5174	Troubleshoot the issues that arise with Load Generator boxes.
CICS	Walt Barrett/ Carol Greer	937-320-6629 860-513-5860	Monitor the CPS performance.

### 3.2 Documentation

The following documents will be submitted to the FAFSA project team within the dates specified. Table 7.1 provides a guide as to the data that needs to be captured and presented to the team at the conclusion of each test cycle.

#### 3.2.1 Test Cycle Reports

ITA will collect data from each test cycle. The data collected for each test cycle will be analyzed based on load, response time, throughput and other matrices. The analyzed data will be documented and reported. The reports will be completed one day after the test executed.

### 3.3 Formal Deliverables

ITA will provide the following formal deliverables:

#### 3.3.1 FAFSA 7.0 – WAS 5.0 Performance Test Plan

The test plan will include the following:



- Scope of the performance test
- Performance test goal
- Performance test dates
- Roles and Responsibilities

### 3.3.2 FAFSA 7.0 – WAS 5.0 Performance Test presentation

Document the performance test results for each cycle including the following:

- Summary of troubleshooting issues
- Summary of resolutions
- Summary of open issues (if any)

### 3.3.3 Configuration Change Report

At the conclusion of performance testing, a report detailing all configuration changes made to the run time environment will be created. This report can be attached to the weekly updates providing teams with iterative updates throughout the testing period.



## 4 FAFSA 7.0 Business Processes

Herewith are the business processes that will be targeted for the performance test.

### 4.1 Business Processes

The following list outlines the business processes:

1. Fill out a FAFSA and Submit- Form to fill out and submit a FAFSA.
2. FAFSA Corrections - Correct an existing FAFSA application.

### 4.2 Business Processes Table

The following table outlines the architecture components that comprise the FAFSA 7.0 Application. These components are the FAFSA web server, FAFSA application server, PIN web server, PIN application server, PIN database, and FAFSA Database servers. Each business process test scripts will test the outlined architecture components.

Business Process	Web Server	Application Server	Oracle DB	Pin DB	CPS DB2	CPS CICS
Fill out a FAFSA and Submit	X	X	X		X	X
Corrections	X	X	X	X	X	X



## 5 Detailed Goals per Cycle

This section will include detailed goals for each test cycle. The goals for each cycle are not static; hence depending on the events encountered during a given cycle, the goals may expand for a couple of cycles and vice versa.

### 5.1 Performance Test Cycles

#### 5.1.1 Performance Test Cycle 1 – Scheduled 08/21/2003 9:00 AM – 1:00 PM

Call in #: August 21: 1-866-813-3021; 5879

Detailed Goals for test cycle one:

- 1 FAFSA business process – Fill Out a FAFSA
- Target at least 500 concurrent users

Pearson:

- Clean out temp save databases prior to 8:30 am ET.
- Mainframe will process the submitted FAFSA records. Once these records are processed, ITA will need to increment Fill Out a FAFSA SSNs. These records will be used for cycle 2 (ITA will need this on or before 08/22).

#### 5.1.2 Performance Test Cycle 2 – Scheduled 08/26/2003 9:00 AM – 1:00 PM

Call in #: August 26: 1-866-813-3021; 5879

Detailed Goals for test cycle two:

- 2 FAFSA business processes – Fill out a FAFSA, FAFSA Correction
- Target at least 750 concurrent users
- Resolve any issues witnessed in test cycle 1, if any

Pearson:

- Clean out temp save databases prior to 8:30 am.
- Mainframe will process the submitted FAFSA records. Once these records are processed, ITA will need to increment Fill Out a FAFSA SSNs. These records will be used for cycle 3 (ITA will need this on or before 08/27).

#### 5.1.3 Performance Test Cycle 3 – Scheduled 08/27/2003 9:00 AM – 1:00 PM

Call in #: August 27: 1-866-813-3021; 5879

Detailed Goals for test cycle three:

- 2 FAFSA business processes – Fill out a FAFSA, FAFSA Correction
- Target 1000 concurrent users
- Resolve any issues that occurred in test cycle 2, if any

Pearson:

- Clean out temp save databases prior to 8:30 am.



- Mainframe will process the submitted fafsa records. Once these records are processed, ITA will need to increment Fill Out a FAFSA SSNs. These records will be used for cycle 3 (ITA will need this on 8/27).

#### 5.1.4 Performance Test Cycle 4 - Scheduled 08/28/2003 9:00 AM - 1:00 PM

Call in #: August 28: 1-866-813-3041; 3529

Detailed Goals for test cycle four:

- 2 FAFSA business processes - Fill out a FAFSA, FAFSA Correction
- Target 1000 concurrent users
- 2 web servers and 2 application server clones
- Resolve any issues that occurred in test cycle 3, if any.

Pearson:

- Clean out temp save database prior to 8:30 am.
- Mainframe will process FAFSA records. Once these records are processed, ITA will need to increment Fill Out a FAFSA SSNs. These records will be used for cycle 3 (ITA will need this on or before 08/29).

CSC:

- Wiley will be configured in the Performance Test environment for cycle 4.
- Monitor application by using Wiley.

#### 5.1.5 Performance Test Cycle 5 (Optional) - Scheduled 09/03/2003 9:00 AM - 1:00 PM

Call in #: TBD

Detailed Goals for test cycle five:

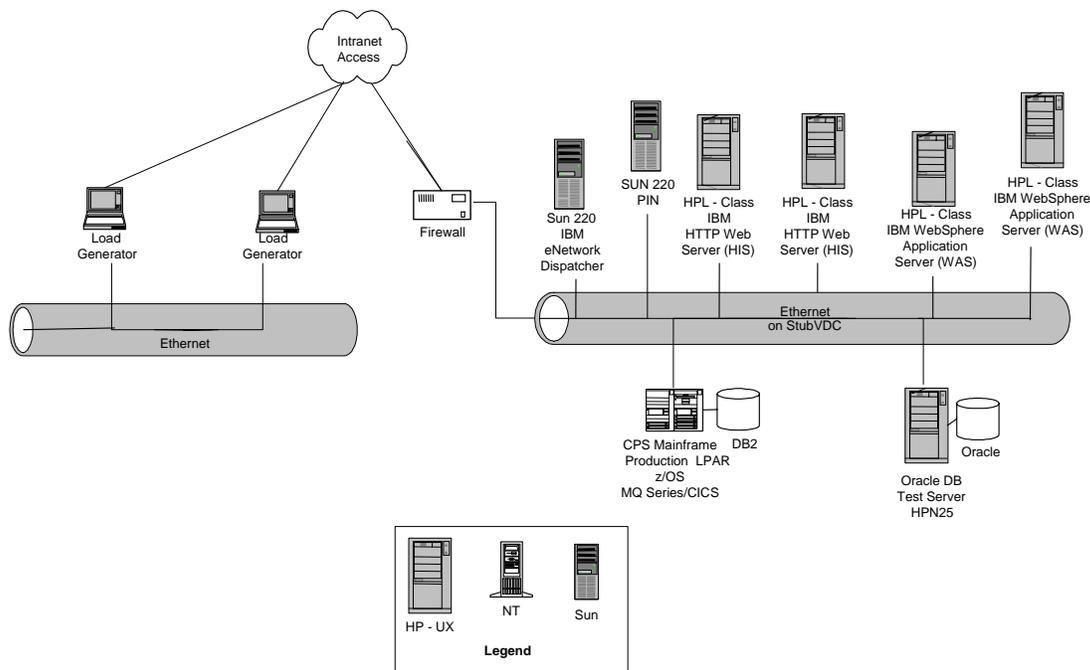
- 2 FAFSA Business Processes - Fill out a FAFSA, FAFSA Correction
- Resolve any issues that occurred in test cycle 4.



## 6 Technical Infrastructure

### 6.1 FAFSA 7.0 Performance Test Environment

FAFSA 7.0 Performance Test Environment Diagram



#### 6.1.1 Performance Test Environment Requirements

- This environment mirrors the proposed production environment as closely as possible.
- Oracle Test Server should be configured to handle peak session usage.
- Network Bandwidth will handle at least 1000 concurrent users.
- eNetwork Dispatcher Load Balancing will handle at least 1000 concurrent users.
- Network Bandwidth will give more than 100 mb/sec.

#### 6.1.2 Configurations

- Network Dispatchers: Sun E220/1 CPU/1 GB RAM: SU22E20 Primary, SU22E24 Secondary. OS: Solaris 2.8 and Network Dispatcher 4.0
- Web Servers: HPL14 (4X450 CPU and 8 GB memory), HPL17 (4X450 CPU and 8 GB memory). OS: HPUX 11i and IHS 1.3.26
- App Servers: HPN3 (8X360 CPU and 8 GB memory), HPN8 (8X750 CPU and 16 GB memory). OS: HPUX11i and WAS 5.0



## 7 Performance Monitoring

Performance monitoring detailed information:

### 7.1 Performance Monitoring Table

The table lists each performance area, its' associated performance monitoring points, a general description of the performance area, and the group responsible to monitor that area. This document will be supplied to those monitoring the test. It will ensure that all required areas are monitored.

Performance Areas	Performance Monitoring Point	Description	Monitored By:
<b>Run Time</b>	<ul style="list-style-type: none"> <li>Total memory available for the JVM</li> <li>Amount of free memory for the JVM</li> </ul>	Application server - Memory used by a process as reported by the JVM.	ITA
<b>Database connection pools</b>	<ul style="list-style-type: none"> <li>Average size of the connection pool (number of connections)</li> <li>Average number of threads waiting for a connection</li> <li>Average wait time in milliseconds for a connection to be granted</li> <li>Average time the connection was in use</li> </ul>	Application server - Reports usage information about connection pools for a database.	ITA
<b>Servlet engines</b>	<ul style="list-style-type: none"> <li>Average number of concurrent requests for a servlet</li> <li>Amount of time it takes for a servlet to perform a request</li> <li>Average number of concurrently active HTTP sessions.</li> </ul>	Application server - Reports usage information for Web applications, servlets, Java Server Pages (JSPs), and HTTP sessions.	ITA
<b>Network Dispatcher</b>	<ul style="list-style-type: none"> <li>Completed number of connections per web server</li> <li>Number of connection errors per web server</li> <li>Active number of connections to the web servers</li> </ul>	eNetwork Dispatcher is an IBM load-balancing tool. It balances http requests between web servers.	ITA



<b>CPU utilization</b>	<ul style="list-style-type: none"> <li>• Network Dispatcher Server (SU22E20 and SU22E24)</li> <li>• 2 web servers (HPL14 and HPL17)</li> <li>• 2 application servers (HPN3 and HPN8)</li> <li>• HPN25 databases (FAFSASTG, SESSST2, EACSTG)</li> <li>• CPS Mainframe DB2 database server</li> <li>• MQSeries and CICS</li> </ul>	<p>Depicts the utilization of the CPU. High CPU utilization can be an indicator of a CPU bottleneck. CPU bottlenecks may occur when Global CPU utilization exceeds 75%. However, some workloads can operate with very high CPU utilization with the CPU becoming a bottleneck.</p>	<p>CSC</p>
<b>Memory utilization</b>	<ul style="list-style-type: none"> <li>• Network Dispatcher Server (SU22E20 and SU22E24)</li> <li>• 2 web servers (HPL14 and HPL17)</li> <li>• 2 application servers (HPN3 and HPN8)</li> <li>• HPN25 databases (FAFSASTG, SESSST2, EACSTG)</li> <li>• CPS Mainframe DB2 database server</li> <li>• MQSeries and CICS</li> </ul>	<p>Indicates the utilization of memory. If memory utilization is below 95%, it is not a bottleneck. Memory can reach 100% utilization without necessarily being a bottleneck. The combination of high memory utilization and Virtual Memory reads &amp; writes indicates that memory is a bottleneck.</p>	<p>CSC</p>
<b>Disk I/O</b>	<ul style="list-style-type: none"> <li>• Network Dispatcher Server (SU22E20 and SU22E24)</li> <li>• 2 web servers (HPL14 and HPL17)</li> <li>• 2 application servers (HPN3 and HPN8)</li> <li>• HPN25 databases (FAFSASTG, SESSST2, EACSTG)</li> <li>• CPS Mainframe DB2 database server</li> <li>• MQSeries and CICS</li> </ul>	<p>Illustrates the percentage of time that a disk I/O is pending on a disk device. High disk utilization can be an indicator of a disk bottleneck. Disk utilization greater than 50% may indicate a disk bottleneck. The service times, not charted, will determine if the I/O subsystem is performing poorly.</p>	<p>CSC</p>



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<b>Network Utilization</b>	<ul style="list-style-type: none"> <li>• Connections from firewall to eNetwork Dispatcher</li> <li>• eNetwork Dispatcher to Web Servers</li> <li>• Web servers to Application servers</li> <li>• App Servers to Oracle database servers</li> <li>• App servers to CPS mainframe</li> </ul>	The bandwidth required to support an application. It can refer to the application traffic in and out of a data center, or between servers.	CSC
<b>Throughput</b>	<ul style="list-style-type: none"> <li>• Megabytes per second</li> </ul>	Volume processed in a specified period by the system or system component	ITA
<b>Hits Per Second</b>	<ul style="list-style-type: none"> <li>• Hits per second</li> </ul>	The number of hits per second on the application.	ITA
<b>User Response Times</b>	<ul style="list-style-type: none"> <li>• Average, minimum, and maximum times for SSL pages</li> <li>• Average, minimum, and maximum times for non-SSL pages</li> </ul>	Elapsed time between two events measured at specific points	ITA
<b>Servlet Performance</b>	<ul style="list-style-type: none"> <li>• Servlet and JSP performance</li> </ul>	The performance of each of the servlets and JSPs as they are accessed by the test script.	ITA
<b>Database Optimization</b>	<ul style="list-style-type: none"> <li>• Database performance</li> <li>• Tables and Indexes</li> <li>• Database calls</li> </ul>	The database performance should be monitored. Oracle and DB2 database should be optimized.	CSC
<b>EAI Performance</b>	<ul style="list-style-type: none"> <li>• Number of transactions between FAFSA and CPS</li> <li>• Number of transaction queued in CPS</li> <li>• Message across channel per second</li> </ul>	EAI component should be monitored and optimized.	EAI
<b>CPS Performance</b>	<ul style="list-style-type: none"> <li>• CPS performance</li> </ul>	Monitor and optimized CPS	CSC
<b>Application Performance</b>	<ul style="list-style-type: none"> <li>• Application Code</li> </ul>	NCS will monitor the application log file(s). Monitor and optimized the application code.	Pearson



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