University of Khartoum
Faculty of Engineering and Architecture
Electrical and Electronics Engineering Department

Server Hardware ,Software and Architecture

A Thesis Submitted in Partial Fulfillment of the Requirement for the Degree of M.Sc in Computer Architecture and Networking.

By :

Abeer El Hadi El Zein El Nahas

Supervisor :

Dr. El Rasheed Osman Khidir

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Abstract

A server is a very important element in the network. It is required to be up and running 24 hours during the seven days of the week. A server must be working and serving its users all the time. Server's software, hardware and applications are sensitive and costly. There are many new technologies in the Information Technology market. This study will specify the important keys to choose an optimal server by selecting proper hardware, software and applications specifications. Also, it will introduce the server high availability principles and how to select a server with high availability.

The case study example is PetrodarDar Operating Company (PDOC). It upgraded its web and mail systems with new servers. The study concentrates on the determination and selection of specifications, installation and configurations for the servers. The performance and availability of the new servers were monitored and compared with the old ones.

Finally there are many guidelines; by which the optimal server can be selected and the required availability can be achieved.

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المستخلص

يعتبر الحاسوب المخدم المُكون الأكثر أهميةً في شبّكة الحواسيب ، ومن الضروره بمكان أن يعمل مستخدِميه باستمرار. ولا يخفى أن للحاسوب ,بكفاءة و فعّالية على مدار الساعة . و يجب أن يخدم المخدم برمجيات وأجهزة وتطبيقات عالية الحساسية وباهظة التكلفة، ومما يزيد التحدي وجود العديد من الخيارات التقنيّة المتجدده باستمرار في هذه الصناعة التي تمتاز بالتغير السريع .

هذه الدراسة ستحدّد العناصر الرئيسية لإختيار الحاسوب المخدم الأمثل، وذلك عن طريق إختيار المواصفات المناسبه للمعدات والبرمجيات والتطبيقات. كما ستقدِّم المبادئ الأساسية لتوافر الخدمة ، وكيفية تصميم حاسوب مخدم بتوافر خدمة عالي.

تُمثل شركة بترودار لعمليات البترول الحالة التي أُخضِعت للدراسة ، إذ أنها قامت بتطوير موقعها الإلكتروني و أنظمتها البريديه وتدعيمها بحواسيب مخدمة جديده. ركزت الدّراسة على تحليل إختيار الشّركة للمواصفات المطلوبة ، كما تناولت تركيب وتعريف الحواسيب المخدمة الجديده. ومن ثمّ تم رصد الأداء وتوافر الخدمة لها ومقارنتها مع الحواسيب المخدمة القديمة.

وأخيراً قدمت الدراسة العديد من المبادئ التوجيهيه التي يمكن من خلالها إختيار الحاسوب المخدم الأمثل و تحقيق توافر خدمة محدد له.

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Abbreviation

Big O(x): An expression of the *order* of a computation: how the storage required by a program increases as the size of the problem becomes large.

CMP: Core Multi Processors System

SMP: Symmetric Multi-Core Or Multi-Processor System

SMT: Simultaneous Multithreading

RISC: Reduced Instruction Set Computer

ROPs: Reduced Operations

μops: Micro Operations

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Chapter One

INTRODUCTION

Information and communication are two of the most important strategic issues for the success of every enterprise. While today nearly every organization uses a substantial number of computers and communication tools (like telephone or fax), they are often still isolated if they aren't networked together. If an enterprise has more than one computer, it could benefit more from them by networking. There are many reasons for networking the computers:

- Cost reduction by sharing hardware and software resources.
- High reliability by having multiple sources of supply.
- Cost reduction by downsizing to microcomputer-based networks instead of using mainframes.
- Greater flexibility because of possibility to connect devices from various vendors.
- Allowing the users to access remote programs and remote databases either of the same organization or from other organizations or public sources.
- Providing communication possibilities faster than other facilities.

There are two types of network architectures: peer-to-peer network and client /server network. Peer-to-Peer network is a collection of heterogeneous distributed resources which are connected by a network, if the participants share a part of their own hardware resources. These shared resources are necessary to provide the service and content offered by the network. They are accessible by other peers directly, without passing intermediary entities. The participants of such a network are resource providers as well as resource requestors.

A peer-to-peer computer network is a network that relies on computing power at the computers rather than in the network itself. A peer-to-peer network can also mean grid computing.

A client/server network is a distributed network which consists of one higher performance system (the server) and several mostly lower performance systems (the clients). The server is the central registering unit as well as the only provider

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of content and service. A client only requests content or the execution of services, without sharing any of its own resources. The client/server network provides the following features:

- Centralization: Resources and data security are controlled through the server.
- Scalability: Any or all elements can be replaced individually as need increase.
- Flexibility: New technology can be easily integrated into system.
- Interoperability: All components (client/network/server) work together.
- Accessibility: Server can be accessed remotely and across multiple platforms.
- Speed: Network will run far better as data and resources are handled by a dedicated machine. Also, the user machine experiences poor performance when everyone accesses its resources.
- Backup: As all data is stored centrally, it is easy to create a backup.
- Support and Management: As the server controls the majority of settings on the network, the job of support is far easier as the main element of support is provided to the server and not to the individual machines. Global changes are easy to make from one location.

Based on the above entries, it is better for any organization to implement client/server networks.

1.1 The Server

The server is the spirit and heart of the network. In information technology, a server is a computer system that provides services to other computing systems (clients) over a computer network. The server automatically organizes everything, queues requests and sets priorities.

The typical server is a computer system that operates continuously on a network and waits for requests for services from other computers on the network.

Since a server is a system specifically designed to hold, manage, send and process data, the technology behind servers is to make them more reliable than

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desktop systems. It helps them process data faster, more efficiently and reduces data bottlenecks, so information flows more freely and quickly. Servers are designed to scale as needs scale. Therefore, the server hardware, software and application need to be selected carefully to fulfill the needs.

- **Introduction to Server Hardware**

  Servers can be built from commodity computer components. But the dedicated, high-load, mission-critical servers use specialized hardware that is optimized for their needs. They host hardware resources which they make available on a controlled and shared basis to client computers. The selection of the server hardware depends on the role the server will perform, the availability level that must be met and the service performance that is required from it. Each hardware component has an impact on the server performance and availability. Therefore, the hardware must be selected carefully [1].

- **Introduction to Server Software**

  The major difference between servers and desktop computers is not in the hardware but in the software. Servers often run operating systems that are designed specifically for use in servers. They also run special applications that are designed specifically to carry out server tasks.

  - **Server Operating Systems:** The operating system is the interface between the server hardware and the server application. It has important role in improving the performance of the server. Server-oriented operating systems tend to have certain features in common that make them more suitable for the server environment. Many functions of the operating system are very important in choosing an operating system for server so as to improve its performance and availability [1].

  - **Server Applications:** They are tailored to the tasks performed by servers. Most server applications are distinguished by the fact that they are completely non-interactive on the local server itself. They run

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unobtrusively within the server and interact only with client computers on the network. They are called daemons in UNIX terminology, and services in Windows terminology. Since there is no way for the server to predict when a given service might be requested by a client computer, a server usually runs the same set of applications all times. Some server applications are automatically started when a request from a client is received, and then stopped when request has been satisfied. A server can run more than one application. Some servers can work as a group to run one application [1].

- **Introduction to Server Selection Criteria**

  There are many selection criteria for professionals to use in choosing a server. They are availability, performance, scalability (the ability of server to match the dimension of the problem to be managed) and the price (To select system with suitable total cost of ownership which integrates internal costs, system management and user support costs and the economic impact on the company when the system become unavailable). All these criteria' are affecting the server software and hardware selection[1].

1.2 Statement of the Problem

The company ability to do business often depends on the information processing system. Its unavailability reflects immediately into lost of business. Therefore, it is important for such systems to minimize the likelihood of being unavailable. The server unavailability indicates business downtime and business productivity decreases. Therefore, it is critical for the servers to be available and accessible all the time. The server availability is a measure of the server's ability to deliver its capabilities when needed. It is measured by the ratio of the time server is available for its purpose to the sum of this time and the time during which the server is unable to perform the required service.

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1.3 Objectives

High availability is a system design protocol. The design of high availability servers follows number of principles which are modularity; fail fast, independence of failure modes, redundancy and repair and eliminating single points of failure. The study will find the main keys and specifications for implementing high availability servers. Also the factors for better server availability will be found

1.4 Methodology

There are two means for implementing high availability servers:

- Software-based: It requires that the hardware platform have a number of properties. The software can't be used as the only approach to make any hardware platform capable of continuous service [1].
- Hardware-based: It tolerates hardware failures and it relies on redundancy[1].

Since sever hardware, software, applications and architecture reflect directly on the server availability, they must fulfill the high availability principles. The study will focus on different hardware, software and applications of the server and see the characteristics of each technology .The most popular of technologies will be compared together to clarify the differences among them.

1.5 Thesis Layout

It consists of six chapters. The contents of the chapters are as follows:

- *Chapter 1: Introduction:*

  It is an introduction of the study, it consists of statement of the problem, and how the study is organized.

- *Chapter 2: Server Hardware:*

  It describes hardware components processor, memory, I/O interconnection, data storage and network and communication subsystems technologies. It discusses the hardware architectures.

- *Chapter 3*: Server Software:

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It describes operating systems of the server and the differences among them .It also describes some server common applications.

- *Chapter 4: Server Availability:*

  It describes the availability of the server and how it is measured.

- *Chapter 5: Implementation and Results:*

  It is about the case study, how its servers have been upgraded, the software used to measure its servers availability and its result.

- *Chapter 6: Conclusion and Recommendations:*

  It includes the conclusion and recommendations for the server hardware, software and high availability.

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Chapter Two

Server Hardware

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A server is a computer system in a network that is shared and accessed by multiple users. A server is referred to software that performs the service. Its hardware may or may not be dedicated to that service. It is made up of high-grade components that tolerate long periods of availability and provide high performance. The server hardware is determined by the application type that it will handle. The server hardware is divided into:

- **Server Hardware Components:** At the hardware components level several factors can contribute in the improvement of server performance and availability. They are processor performance, memory capacity and access time, input/output and bus systems interconnections throughput, magnetic peripherals performance and server internal/external network throughput [1].
- **Server Hardware Architectures:** The server processing performance is limited by the microprocessor performance .To reach the high performance and high availability the servers have turned to multiprocessors servers. There are two major multiprocessor servers: Tightly-coupled or symmetrical Multiprocessors (SMP) and Loosely-coupled Multiprocessors (Clusters or Massively Parallel systems) [1].

2.1. Server Hardware Components

2.1.1. Processor

As the technology develops and improves, it is clear that microprocessor power doubles regularly. The processor performance and speed influence directly on the server performance. This growth of processor speed and strength will make the server faster and better in performance.

There are different microprocessor technologies in market. Table (2.1) compares them from different processor characteristics:

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Table (2.1): Characteristics of some Microprocessors (March 2003) [1]

	AMD Opteron	HP-PA 8700	Intel Itanium 2	Intel Pentium 4 Xeon MP	Power 4	Ultra Sparc III
Architecture	IA-32 plus 64 bit extensions	PA	IA-64 + IA-32 compatibility mode	IA-32	PowerPC-64 with AS400 extensions	SPARC
SMP/CMP approach	-	-	-	SMT(2 threads)	CMP (2 processors)	-
Clock (MHz)	2000	875	1000	2000	1300	600-1050
Integrated cache (I/D)	L1: 64KB/64KB L2: 1 MB	0.75 MB/1.5 MB	L1: 16KB/16KB L2: 256KB L3: 4 MB	L1: 12Kμops/8KB L2: 256KB L3: 2MB	L1: 16KB/32KB L2: 1.5 MB	L1: 32KB/64KB
Superscalar degree	9 ROPs	4	6	6 μops	8 (5 simultaneous	4
Pipe stages	12(integer) 17 (floating point)	-	10?	20	12	14
Out-of-order execution (number of in-flight instruction)	-	56	Yes	126(μops)	200	No

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SPEC 2000 performance (int/fp)	1202/1170 (estimated)	542/600	810/1427	816/677	790/1098	439/269 @ 900 MHz
Other characteristics	Integrated memory controller; SMP interface logic integrated (coherent Hyper-Transport interface)	-		Integrated micro-opcache-holding translated IA-32 instructions	Integrated L3 cache controller; integrated SMP interface logic	Integrated L2 cache controller (<=8MB) Integrated memory controller

As the above processor technologies have different characteristics they have different values in market. Fig (2.1) shows their market values changes.

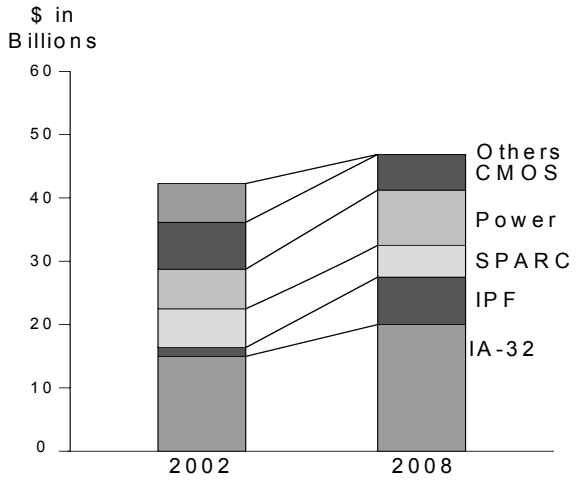

Fig (2.1): Microprocessor Market [1]

2.1.2. Server Memory

There is performance gulf between processors, memory and disks. It is not only expressed in term of latency, but also in term of throughput. The memory access time needs to be reduced. This access time depends on both memory chip

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technology and memory system organization. Fig (2.2) shows levels and access times of each memory in system. The concept of a cache, or memory hierarchy, was invented to provide the effect of a very large and very fast memory by combining a large capacity and cheap memory with much smaller and faster but more expensive memory. The behavior of the memory cache is similar to large fast memory, but its cost is very close to large slow memory.

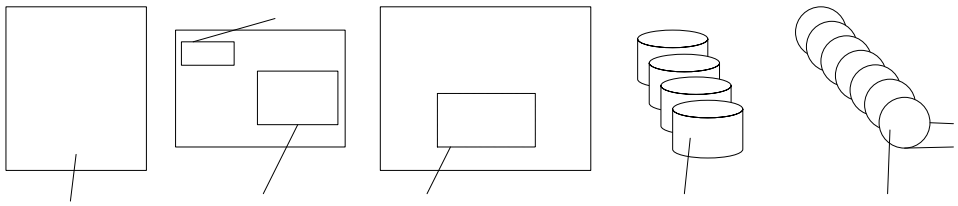

Fig (2.2): Levels of Memory in System

One of major barriers to increase the system performance is memory characteristics .The memory access time need to be reduced. The use of caches and organizing memory will provide high bandwidth and less access time. Table (2.2) illustrates the difference in access time for the various levels of memory hierarchy.

Table (2.2): Difference in Access Time for Memory Hierarchy Levels

Technology	Typical access time	Approximate capacity	Approximate price
Processor register	100 ps	64 x 64 bits	Part of microprocessor
Integrated cache	L1: ~1 ns L2 – L3: 4-16 ns (depend on	Fraction of a MB up to several MB	Part of microprocessor
External cache	10 – 20 ns	4-8 MB	~$10

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Main memory	~150 ns	>= 1GB	$ 0.125
Disk	~6 ms	> 70GB/disk	~$0.005
Tape (in a robot)	~10 s	~100GB/tape	<$0.001

Also, the use of caches memory provides high bandwidth and fast access time. There are many cache memory levels. Table (2.3) below summarizes characteristics of each cache level.

Table (2.3): Summary of the Characteristics of the Various Levels of Cache[1]

Cache Type and Properties	**Level 1 and Level 2**	**External**	**Disk Cache**	**External Storage Hierarchy**
Where its found	Internal to the processor	Between microprocessor and main memory	In memory	Disk
Technology	SRAM integrated in to the microprocessor	SRAM	DRAM	Disk
What is cached	External cache or memory contents	DRAM contents	Disk contents	Contents of tape cartridges in a robot
Characteristics				
Capacity	O (10 KB / 100 KB)	O (1 MB)	O (100 MB)	O (1 GB)
Granule size	O (10 / 100 B)	O (100 B)	O (10 MB)	O (100 KB)
Access time	3 ns	15 ns	~180 ns	~ 6 ms
Bandwidth	O (GB / s)	O (GB/s)	O (1GB/s)	O (100 MB/s)
Who manage	Hardware (internal	Hardware (internal	Software;	Software; the

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the cache	to the microprocessor)	to the microprocessor)	either the operating system, the file system or the DBMS	memory hierarchy manager

2.1.3. Processor, Memory and I/O Interconnection

I/O system has number of elements. They are illustrated in Fig (2.3).

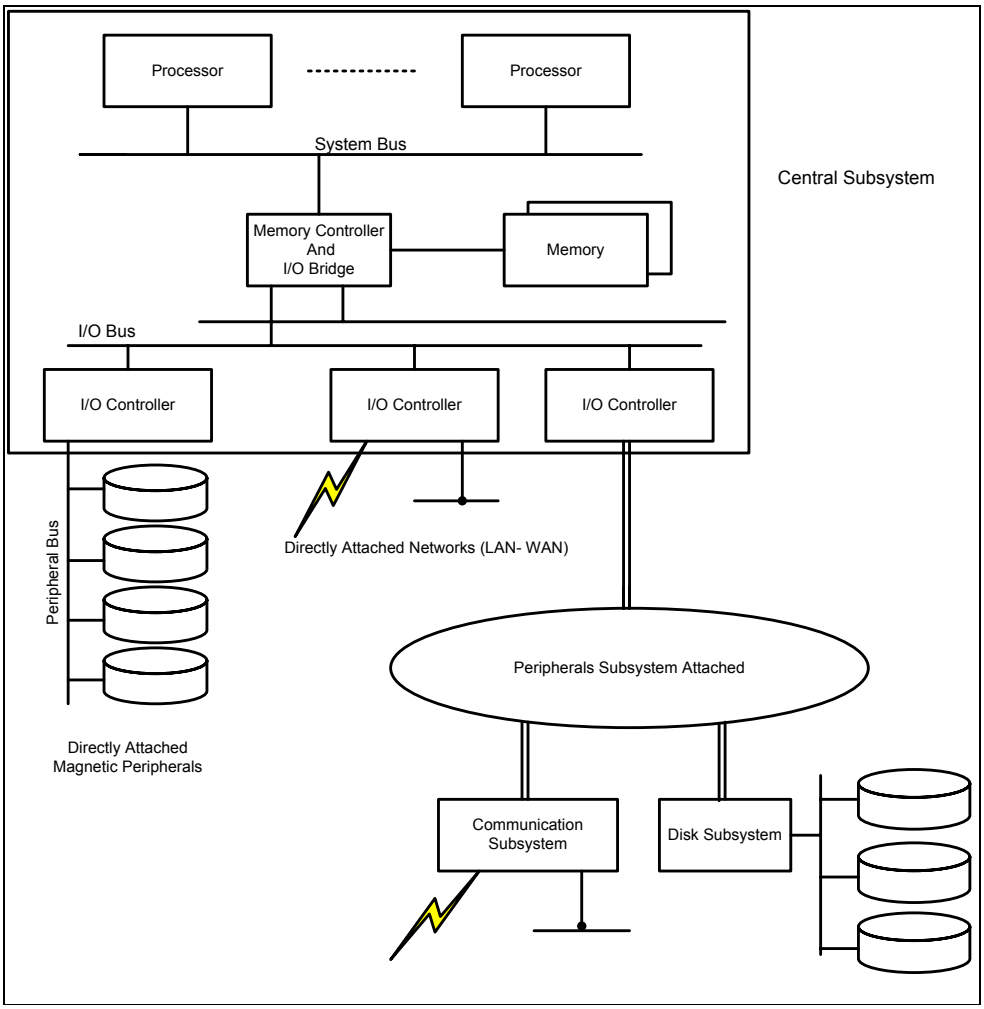

Fig (2.3): The Elements of I/O System

The classic I/O subsystems are:

- A system controller implementing the connection between processors, memory and I/O bus. This is often a chip integrating two functions; a memory controller and an I/O controller.
- I/O buses industry has converged on the PCI bus and its extensions.
- I/O controllers are connected to an I/O bus. Peripheral devices are connected to these controllers.

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- Directly attached magnetic peripherals such as SCSI.
- Specialized network are used to connect peripheral subsystems (SAN) or communication subsystem (LAN). Its industry is moving to fiber channel.

The connections types for input/output systems are:

- **The interconnection between processors and the system controllers:** It integrates a memory controller and an I/O bridge. It mostly uses bus. All elements are connected to the bus. Main advantage of bus is simplicity. Its throughput is a function of the number of bits it can convey in parallel and its operating frequency. But the length and connected elements limit its frequency. There are 2 types of bus:
  - Synchronous bus: It functions in high frequency. Its length must be short.
  - Asynchronous bus: It needs a protocol to manage its data transfer. It has no distance problem but its throughput is low.
- **PCI (Peripheral Component Interconnect):** It is the backbone bus of microprocessors. It's characteristics are:
  - Two data transfer width – 32 bits and 64 bits
  - Two clock rates – 33 MHz and 66 MHz.
  - Various available bandwidth (133, 266 and 532 MB/sec).
  - Ability to support both 32 and 64 controllers on same bus.
  - Ability to discover the configuration of devices on bus (plug and play)
  - Capability of hot plug
- **SCSI (Small Controller Single Interface):** It has been standard for the connection of magnetic peripheral for long time. It has:
  - Limited maximum length of connection.
  - Limited number of devices attached to it.
  - Bulkiness (weight of connections and cables).

- **FC-AL (Fiber Channel – Arbitrated Loop):** It can connect many more devices than SCSI can. It has no bulkiness. Industry is moving towards fiber channel. Fiber Channel simplifies and improves connectivity.

The large part of server complexity is from the I/O subsystems. It adds many peripheral devices in the server system, which has great impact on server performance and availability. Table (2.4) shows comparison between SCSI and Fiber Channel.

Table (2.4): Comparison of SCSI and Fiber Channel

Property	SCSI	Fiber Channel
Number of units per physical connection	15	126
Bandwidth	40, 80, 160 or 320 MB/s	100MB/s
Length of a physical connection	Copper: 30m(~100ft) 62.5µm or Up to 25m(~80 ft)	50µm fiber: 175-500m(~500-1600ft) 9µm fiber: several kilometers (mile)
Nature of the physical interface	64-wire cable	4-wire cable or 2-fiber optical interconnect

2.1.4. Data Storage

Data is a central, very precise and vital element in business. One of the major reasons why a server is needed is to centralize data on it; so business-critical information can be managed in better way. The characteristic of storage systems are significant issues in choosing sever. There are many storage availability issues must be considered are shown in Fig (2.4).

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The need to make data continuously available made the storage subsystems essential components of servers which lead to the introduction of RAID.

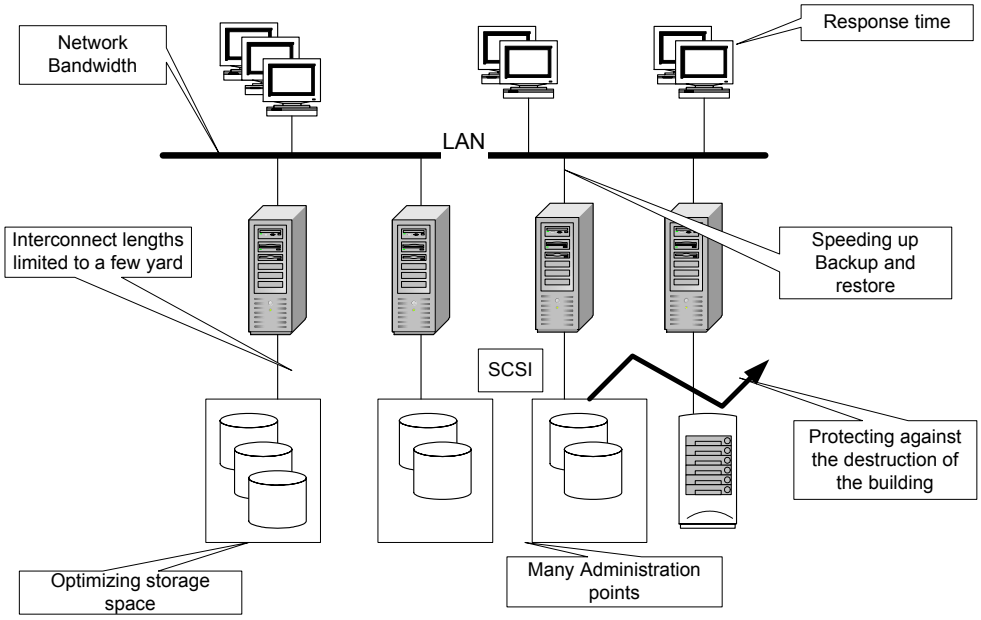

Fig (2.4): Storage Issues

2.1.4.1. Redundant Array of Independent Disks (RAID)

The small and cheap disks with lower reliability lead to propose of architecture for using various organize collection of disks. RAID provides high performance and improves performance and availability at cost much lower than mainframe storage system. It is principles are:

- Distribute data across several disks.
- Use redundancy so failure of a disk does not affect the availability of data.

The types of RAID are (see Fig (2.5)):

- RAID 0: It exploits data striping to provide higher bandwidth data transfer.
- RAID 1: It uses the disk mirroring technique. Each disk has a mirror disk. Writing happens on a disk and in parallel on its mirror. Reading happens from either a disk or its mirror.

- RAID 3: It is based on an exclusive OR (XOR) parity generation. The redundancy information is stored in a disk. It is the XOR of the data it is protecting. It is possible to reconstruct data in the event of failure on any one disk at a time by reconstructing the XOR of the protected data.
- RAID 5: It is same as RAID 3 but the data and parity are distributed among the disks.
- RAID 6: It is same as RAID 5 but with the ability to survive the concurrent failure of two disks.

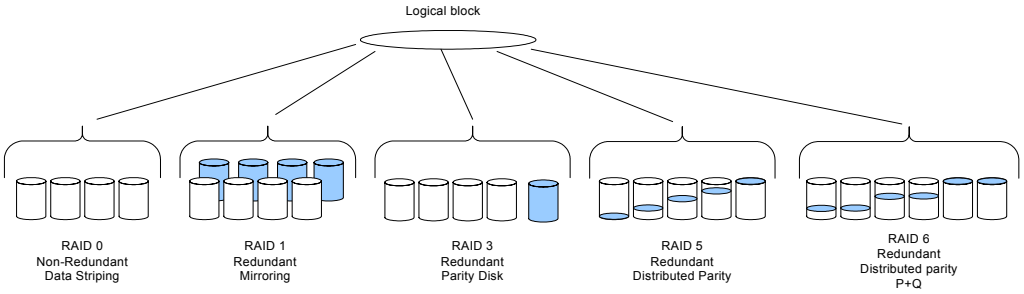

Fig (2.5): RAID Architecture

Each RAID type can provide different levels of performance and availability. Table (2.5) shows the comparison between RAID types.

Table (2.5): Comparison of the most Popular Types of RAID[1]

RAID Type	Name	Storage Cost	Relative Data Availability	Large Sequential Read Speed	Large Sequential Write Speed	Random Read Bandwidth	Random Write Bandwidth
0	Data striping	>1	Lower than that of a conventional organization	Highest depends on the number of parallel disks	Highest depends on the number of parallel disks	Higher	Higher

1	Mirroring (of order M;M-2 usually	x M[1]	>RAID 3 and RAID 5 < RAID 6	Up to M times a single disk	Lower than a single disc	Up to M times a single disk	Lower than a single disc
3	Parity disk	N^2+1	>> Conventional disk	Higher depends on the number of parallel disks and the need to compute parity (<RAID 0)	Higher depends on the number of parallel disks and the need to compute parity (<RAID 0)	Higher	Lower than equivalent RAID 0 – requires calculating and writing parity
5	"Spiral " parity	N+1	>> Conventional disk ~ RAID 3	< RAID 0 because of the parity check	< RAID 0	Higher > RAID 3	>> RAID 3
6	Double "spiral" parity	N+2	Higher than all the other types	Slightly > RAID 5	< RAID 5 (2 parity blocks)	Slightly > RAID 5	< RAID 5 (2 parity blocks)

RAID functionality is implemented:

- By software in the server.
- By a specialized controller connected via the standard I/O interconnect such as PCI to a server.

[1] M=2
[2] N is number of disks

– Within the storage subsystem itself that is connected to a server with a peripheral interface such as SCSI or FC-AL.

2.1.4.2. Storage Architectures

There are many storage architectures, shown in Fig (2.6). Their visibility in the server is given to software, which manages the storage resources.

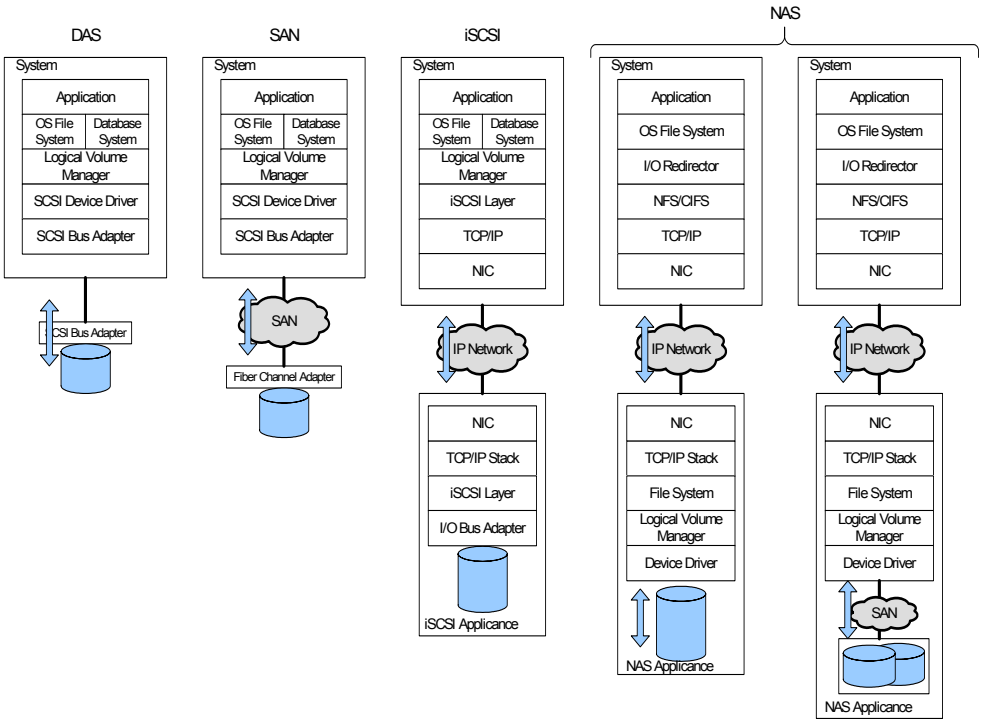

Fig (2.6): DAS, NAS, SAN and iSCSI

– DAS (Directly Attached Storage): The storage resource directly connected to a server and reserved for its exclusive use. The physical interface is usually SCSI or FC-AL.

– NAS (Network Attached Storage): The storage resources are distributed and the network accessed using high level protocols.

– SAN (Storage Area Network): It is specialized high-speed local networks used to connect storage systems. It is used with storage virtualization. It use fiber channel for connection.

– iSCSI: It allows a server to access remote storage over Internet. It implements the SCSI protocols within IP wrapper.

All these types differ in performance. Table (2.6) compares data storage architectures:

Table (2.6): Comparison of DAS, NAS, SAN and iSCSI[1]

	DAS	NAS	SAN	iSCSI
Type of connection	SCSI FC-AL	Fast Ethernet Fiber Channel	Fiber Channel	Internet
Remote connection	Typically no	Yes	Possible	Yes
Type of I/O	Block	File	Block	Block
Performance	High	Limited by network	Higher	Limited by network
Data sharing	Implies NFS or CIFS	Native	Difficult	Difficult
Cost reduction	No	Yes	Yes	Yes
Investment separation	No	Yes	Yes	Yes
Scalability	No	Yes	Yes	Depend on network support
Data availability	Limited	Yes if redundant	Yes if redundant	Yes if redundant
Centralization of	Typically no	Yes	Yes	Yes

	DAS	NAS	SAN	iSCSI
management and support				
Management	Traditional	SNMP	Difficult	Difficult
LAN free backup	No	Depend on NAS server	Yes	Depends on iSCSI server
Server-free backup	No	Depend on NAS server	Yes	Depends on iSCSI server
Security	By the server	By the servers and network	By the servers and storage network	By the servers and network
Installation	Specified on server	Simple	Difficult	Difficult

2.1.5. Network and Communication Subsystems

There are multiple communication networks within a server. They start from the chip handling internal connections up to long distance network.

There is an increase in the need for high connectivity with lower response time and large data throughput. These needs led to many communications technologies. Fig (2.7) shows them organized by their data bandwidth and the distance they intended to cover.

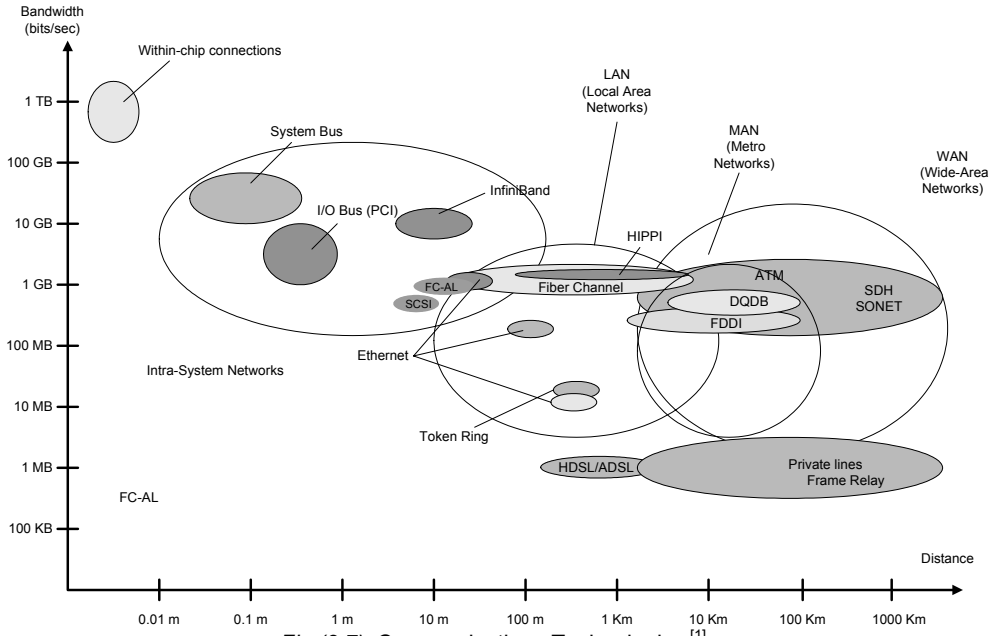

Fig (2.7): Communications Technologies [1]

2.2. Server Architectures

The server processing performance needed to be high to satisfy the required performance and availability. Servers have turned to multiple processors systems. The availability in processors can be obtained by:

- The addition of processors to nodes (as in the SMP dimension).
- The addition of nodes (in the cluster / MPP dimension).

There are two main architecture options for a multiple processors server, which are:

– **Tightly Coupled or Symmetrical Multi Processors**

In SMP all processors can see and use all system resources (memory, I/O devices). An SMP operates under control of only one copy of the operating system .It is driven by the need for scalability (adopt systems to size of problem) to provide availability. It is an economical way for implementing a range of systems power of the various models. It is characterized not only by

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the capabilities of the processors used but also by the maximum number of processors that can be installed.

- **Loosely Coupled**

  It is constructed of interconnected number of independent computer systems using a fast local area network technology. Each having its own resources (processor, memory, I/O devices) and running under the control of its own copy of the operating system. Each system is called a node. It has two major classes.

  - **Clusters**

    It is some reasonable number of systems interconnected so that they can share resources. These resources are referred to as cluster resources. Each system in a cluster is called a node. Each node is a real complete system with all the resources it needs (processor, memory, I/O devices and storage subsystem). Cluster nodes are similar nodes but single system image. It is one big system. Various nodes composing a cluster are generally in close physical proximity. It can be comprised up to 10 nodes.

  - **Massively Parallel Processing (MPP)**

    It is a collection of systems called nodes connected by a specified interconnect network. Each node is a complete system with its resource and its own copy of operating system. It can be composed of large numbers of nodes (hundreds and thousands). Its architecture is characterized by its interconnection network.

These server architectures have different capabilities. They can be compared in many ways. Table (2.7) shows the characteristics for architectures:

Table (2.7): Summary of the Characteristics of SMP, Cluster and MPP Systems [1]

Characteristics	SMP	Cluster	MPP
Acceleration	Scale-Up	Scale-Up	Scale-Up

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Characteristics	SMP	Cluster	MPP
(speed-up) or Increase (scale-up)			
Load-Balancing	Implicit	Requires software intervention	Requires software intervention
High availability	Typically not	Principal objective	Possible (is generally not an objective)
Large configurations (100 processors and beyond)	Limited availability in commodity technology; proprietary hardware is needed for large configuration	Limited by the characteristic of the interconnect network (often of commodity technology)	Principal objective (custom interconnected network)
Single System Image	Complete (by definition)	Limited	Limited
Resource Sharing	All (including the memory and the operating system)	Limited (typically discs and network connections)	Limited (typically just network connections)
Programming	Single process or multiple processes and threads allowing exploitation of	Custom programming necessary insofar as the objective is to exploit	Custom programming necessary in order to exploit parallelism (a more crucial

Characteristics	SMP	Cluster	MPP
	parallelism	parallelism	issue for MPPs than for clusters)
Flexibility in Integration Different Generation Technology	Very limited	Yes	Limited
Ease of Maintainability	Limited (often implies first stopping the system)	Easy (no need to stop the system)	Easy (no need to stop the system)

But in this study, server architectures will be compared using the needs of the server users. These needs can be summarized as:

- Availability of applications and development tools
- Data integrity
- Availability
- Performance
- Scalability
- Price
- Client /server support
- Maturity of architecture

Table (2.8) shows the different ranges for these architectures in fulfilling the needs.

Table (2.8): How Architecture Approaches Match Users Needs [1]

Need	SMP	Cluster	MPP
Availability of applications and development tools	***	*	*
Data Integrity	***	***	***
Availability	** Reduced due to single point of failure	*** Key goal of architecture	* Not goal of MPP
Performance	*** Within the limits of system configuration	** Depend on application characteristics	** Depend on application characteristic
Scalability	*** Within the limits of system configuration	* Depend on application characteristics	* Depend on application characteristic
Price	*** Small and medium configuration	**	* Due to cost of system interconnect and innovative architecture
Client/Server	**	***	**

Need	SMP	Cluster	MPP
Support		Multi server architecture	Multi server architecture
Maturity of Performance	*** More than thirty years of experience	** More than fifteen years of experience	* Emergent technology

* Low Degree

** Medium Degree

*** High Degree

Chapter Three

Server Software

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Server software is a computer software application that carries out some tasks on behalf of another piece of software (client).

Severs are classified by their purpose and service area (follows are some servers' services but not all) like application server, audio server, database server, fax server, file server, intranet server, mail server, modem server, network access server, print server, proxy server, remote access server, telephone server, terminal server, video server, web server and wireless gateway server.

All operations on the data in servers must be implemented in a way of:

- Atomicity : The collection of operations in the transaction must either be carried out in their totality or not at all
- Consistency: The transaction operations as whole must not break any of the integrity constrains associated with the system state.
- Isolation: During the transaction, the data involved is manipulated. The intermediate values of the data created during the transaction are invisible to other transaction , only the final values are visible
- Durability: When transaction completes with commit, the modifications produced by it must not be lost.

3.1. Server Operating Systems

Server operating systems are designed to provide platforms for multi-user, frequently business-critical, networked applications. The focus of such operating systems tends to be security, stability and collaboration, rather than user interface [1].

The operating system is the interface between the server hardware and the server application. It has an important role in improving the performance of the server. There are many important factors in choosing a server operating system:

- Its functionality in handling number of processors supported in SMP version.
- Its robustness, availability and system administration.

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- Its ability for cluster support.

There are five useful technical areas to compare different server operating systems:

- Scalability: It is the measure of the ability of a system to match the dimension of a problem it must handle.
- RAS (Reliability, Availability and Serviceability): These characteristics drive the total availability of the servers and their capacity to support the uses for which they were required.
- Distribution services and internet support: This is the integration of the basic elements that allow operation in a distributed system (supporting basic internet capabilities and supporting PC clients).
- System management: It is a complete collection of facilities to manage the system.
- Capacity to simultaneously support various isolated workload: It is a system capability to be partitioned into several independent systems to support, in complete isolation, different workloads. The dynamic partitioning capability is a key feature in server consolidation. [2]

There are several server operating systems available today. Most of them are based on UNIX core. The main original server operating systems are Windows, UNIX and Linux (which is Intel version from UNIX). Three of them are compared depending on the selection points mentioned above:

- Stability: High marks go to UNIX and Linux (but at less complexity than UNIX), while Windows 2000 with a huge new code base must demonstrate promised improvements over NT v.4.
- SMP Scaling: UNIX enjoys superiority and Windows 2000 is demonstrating significantly better performance than NT, while Linux waits further scaling improvements in kernel version 2.4.

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- Clustering: Linux provides good clustering performance, which continues to improve. UNIX can match this performance (but more expensively), while Windows 2000 lags.
- High Availability: Only UNIX currently do extremely well, with Windows 2000 and Linux expected to improve in coming two to three years.
- Relational Database Management System Size: Linux is still weak in support of large numbers of disks and shared storage, while UNIX will maintain its current advantage for 24 to 36 months.
- Ease of Use: UNIX and Linux have more complexity than Windows, but technical users may prefer the greater customization and exposed Application Programming Interface features, especially in Linux.
- Plug-and-Play Drivers: Linux started from scratch and still lags well behind Windows.
- Technical Support: The operating system community is a big asset to Linux, but Linux lacks the vendor depth and enterprise experience of UNIX and Windows.
- Independent Software Vendor / Value-added Reseller Support: Linux is still mainly focused on web serving and is strong with ISPs (Internet Service Providers), but it lacks the vast breadth in applications of UNIX and Windows.
- System Management: Linux cannot handle the variety of functions of a managed distributed environment. UNIX and Windows have the necessary depth.
- Security: Linux and UNIX will approach comparable levels to one another, ahead of Windows 2000.
- Pricing: Pricing favors Linux at the low end and midrange, especially in replicated sites. UNIX as more complex deployments conceals the operating system [3].

Windows Server can be readily used as business servers. The strength of Windows lies in the familiarity of the interface, wide support – there is a mass of third party development for the platform, a reasonable price tag and a plentiful supply of available expertise. For Windows the improvements will continue in 64-bit architecture support, reduce the current limitation in SMP processor count and cluster size, improve the ability to properly support business-critical applications through provision of improved system robustness. The main weakness of Windows server operating system is the need for user-based licensing and significant maintenance for security resources is required (there is a history of viruses infecting IIS in particular) [3].

Linux actually cover a large range of products. Its purchase price ranges from freely downloadable to packaged and supported corporate products costing hundreds of dollars. Linux comes in a huge variety of distributions; some act and look much like Windows; others can be used to build an appliance server that are totally administered through a Web or other interfaces. The core, or Kernel, of the operating systems is the same. Linux is used as a bottom-end and midrange server with its known improvements in number of processors and cluster technologies supported [3].

UNIX systems gain a place in high-end systems because of their robustness, scalability and ability of supporting critical business applications. UNIX developers advance systems research to provide both long-term continuity and continuous improvement in the software's ability to do more or better with respect to throughput, reliability, security and communications [3].

It is clear that each of the operating system has its strengths and weaknesses, and its usage depends on your level of technical requirements.

3.2. Server Applications

Client/server is a computing architecture which separates a client from a server. It is always implemented over a computer network. It is divided into two applications, server application and client application .Each instance of the client application can send data requests to one or more connected servers. In turn,

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the server can accept these requests, process them, and return the requested information to the client. Unlike the client, the server must be continuously running because clients can request service at any time. Clients on the other hand only need to run when they require service. Many server applications allow multiple clients to request service. The characteristics of the server application side are:

- Passive (slave).
- Waits for requests from clients, during these waiting periods servers can perform other tasks or perform maintenance.
- Upon receipt of requests, processes them and then serves replies.
- Usually accepts connections from a large number of clients.
- Typically does not interact directly with end-users.

The interaction between client and server is often described as in Fig (3.1).

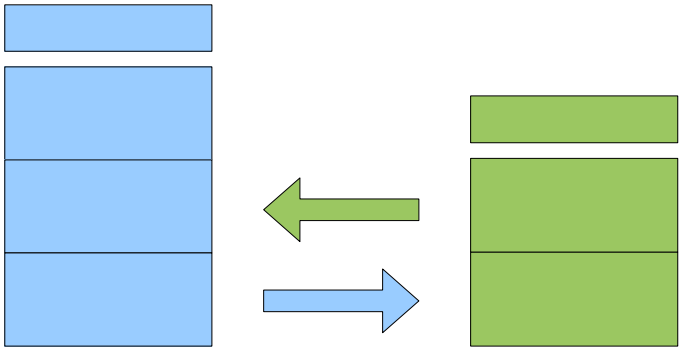

Fig (3.1): Communications between the server and its client

The actual architecture of the server client application depends on the particular needs, but this is the main concept [4]. There are many applications using server client architecture. In this study we will concentrate on the most popular applications such as directory server, mail server, web server, FTP (File Transfer Protocol) server and firewall server.

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3.2.1. Directory Server Software

A directory server is a software application that stores and organizes information about a computer network's users and network shares. It allows network administrators to manage users' access to the shares. Additionally, it acts as an abstraction layer between users and shared resources.

A directory service should not be confused with the directory itself, which is the database that holds the information about objects that are to be managed by the directory service. The directory service is the interface to the directory and provides access to the data that is contained in that directory. It acts as a central authority that can securely authenticate resources and manage identities and relationships between them.

A directory server maps the names of network resources to their respective network addresses. The user doesn't have to remember the physical address of a network resource; providing a name helps locate the resource. Each resource on the network is considered as an object on the directory server. Information about a particular resource is stored as attributes of that object. Information within objects can be made secure so that only users with the available permissions are able to access it[5].

A directory server defines the namespace for the network. A namespace is a set of rules that determine how network resources are named and identified. The rules specify that the names be unique and unambiguous. In LDAP (Lightweight Directory Access Protocol) the name is called the distinguished name (DN) and is used to refer to a collection of attributes which make up a directory entry [5].

LDAP provides an open directory access protocol running over TCP/IP. It is scalable to a global size and millions of entries for a modest investment in hardware and network infrastructure. The result is a global directory solution that is affordable enough to be used by small organizations, but which also can be scaled to support the largest of enterprises [5].

The entries in an LDAP directory server are often being organized in a tree-like structure. It mirrors the tree model used by most file systems. The tree's root point (first entry) appears at the top of the hierarchy. This is referred to as the directory tree. Fig (3.2a) and Fig (3.2b) show detailed architecture of directory server.

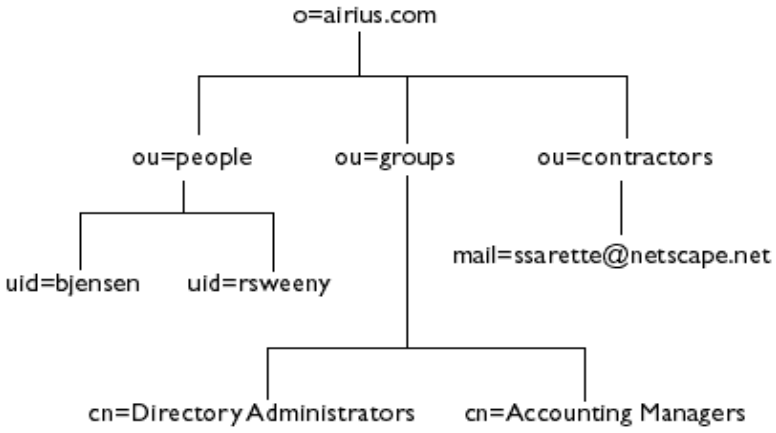


Fig (3.2a): Directory Server Tree [5]

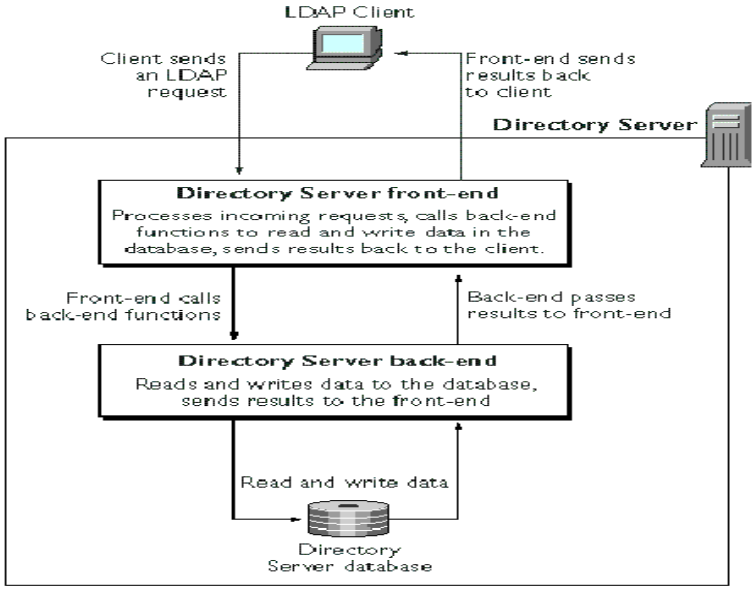


Fig (3.2b): Directory Server and LDAP Protocols [5]

Examples of directory services produced by different vendors include the following: Windows NT Directory Service (NTDS) for Windows NT Active Directory for Windows 2000 Novell Directory Service (NDS) for Novell NetWare version 4.x. The directory server architecture looks like Fig (3.3).

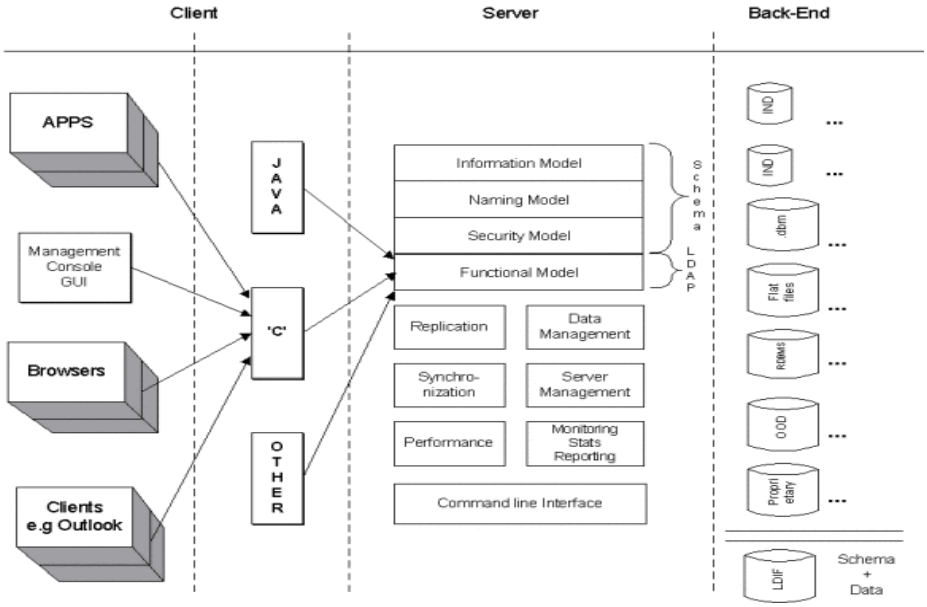


Fig (3.3) .Directory Server Architecture [5]

3.2.2. Mail Server Software

An E-mail Message has always been a simple text message with the ability to add attachments. Even with attachments, e-mail messages continue to be text messages.

E-mail client software: It is used to look at e-mail messages, create new e-mails, send e-mails and add attachments to e-mails. There are much well-known software like Microsoft Outlook, Outlook Express and Eudora.

E-mail system: It consists of two different services running on a server machine. One is called the SMTP (Simple Mail Transfer Protocol) service. SMTP service handles outgoing mail. The other is either a POP3 (Post Office Protocol) service or an IMAP (Internet Mail Access Protocol) service. They both handle incoming mail. A typical e-mail server looks like Fig (3.4).

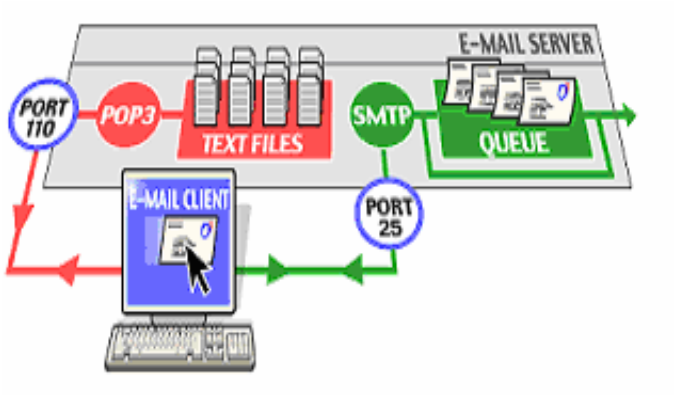


Fig (3.4): E- Mail Server

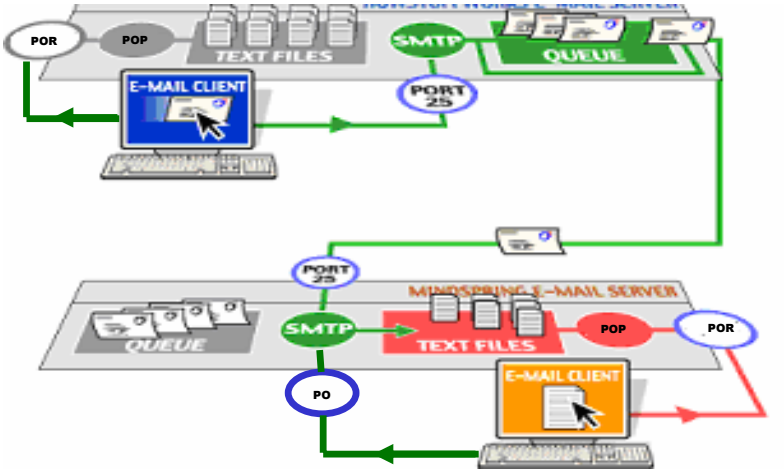
The SMTP listens to port number 25, POP3 listens to port 110 and IMAP uses port 143.

A SMTP Server: Whenever an e-mail to be sent, e-mail client interacts with the SMTP server to handle the sending. The SMTP server may have conversations with other SMTP servers to actually deliver the e-mail.

A POP3 Server: In the simplest implementations of POP3, the server really does maintain a collection of text files، one for each e-mail account. When a message arrives, the POP3 server simply appends it to the bottom of the recipient's file.

When a user checks his/her e-mail using client software, it connects to the POP3 server using port 110. The POP3 server requires an account name and a password. Once he/she has logged in, the POP3 server opens his/her text file and allows him/her to access it. Like the SMTP server, POP3 server understands a very simple set of text commands.

An IMAP Server: It is more advanced. With IMAP, the mail stays on the e-mail server. One can organize his/her mails into folders, and all the folders live on the server. When search the e-mail, the search occurs on the server machine, rather than on local machine. This makes it extremely easy for a user to access the e-mail from any machine. The user has access to all of his /her mails and folders. The e-mail client software connects to the IMAP server using port 143. It issues a set of text commands that allow it to do things like list all the folders on the server, list all the message headers in a folder, get a specific e-mail message from the server, delete messages on the server and search through all of the e-mails on the server. All the above interact between mail server and e-mail client are shown in Fig (3.5).



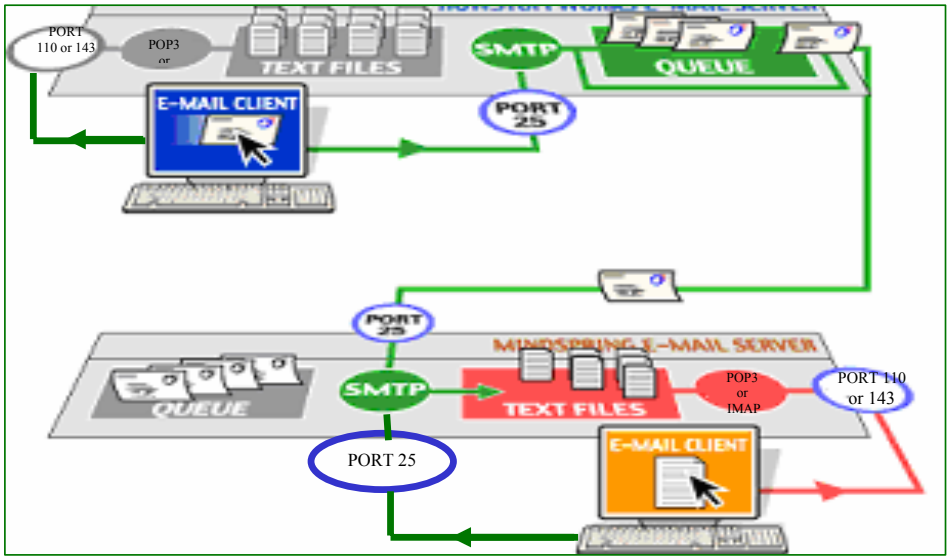


Fig (3.5): Mail Server and E-Mail Client Connections

3.2.3. Domain Names Server (DNS)

The Internet is a collection of millions of computers. All are linked together on a computer network. The network allows them to communicate one with another as Fig (3.6) shows.

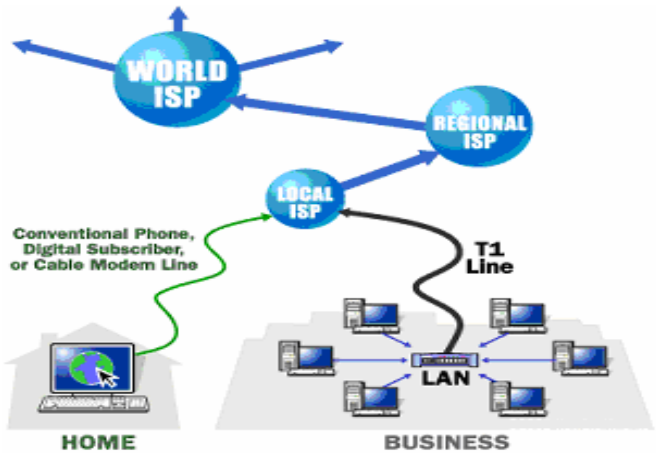


Fig (3.6): Internet Connections

Each machine on the Internet is assigned a unique address called an IP (Internet Protocol) address. Because it is difficult to remember the strings of numbers that make up IP addresses and because IP addresses sometimes need to change all servers on the Internet also have human-readable names, called domain names.

Domain names, arranged in a tree, cut into zones, each served by a nameserver.

The domain name space consists of a tree of domain names. Each node or leaf in the tree has one or more resource records, which hold information associated with the domain name. The tree sub-divides into zones. A zone consists of a collection of connected nodes authoritatively served by an authoritative DNS nameserver. (Note that a single nameserver can host several zones.).

The name www.XXXXXXX.com actually has three parts:

1. The host name ("www")
2. The domain name ("XXXXXXX")
3. The top-level domain name ("com")

The Domain Name System consists of a hierarchical set of DNS servers. Each domain or sub domain has one or more authoritative DNS servers that publish information about that domain and the name servers of any domains under it. The hierarchy of authoritative DNS servers matches the hierarchy of domains. At the top of the hierarchy stand the root name servers. They are distributed all over the Internet.

A resolver looks up the information associated with nodes. A resolver knows how to communicate with name servers by sending DNS requests and heed DNS responses. All DNS requests and response are done by using UDP port 52. Resolving usually entails iterating through several name servers to find the needed information.

For querying purposes, software interprets the name segment by segment, from right to left, using an iterative search procedure. At each step along the way, the program queries a corresponding DNS server to provide a pointer to the next server which it should consult.

The DNS resolve process is as simple as:

- The local system is pre-configured with the known addresses of the root servers in a file of root hints.
- Query one of the root servers is to find the server authoritative for the next level down.
- Then querying this second server for the address of a DNS server with detailed knowledge of the second-level domain.
- Repeating the previous step to progress down the name, until the final step which would return the final address needed.

3.2.4. Web Server Software

A web server is server program that is responsible for accepting Hypertext Transfer Protocol (HTTP) requests from clients (web browsers). It serves them HTTP responses along with optional data contents, which usually are web pages such as HTML documents and linked objects (images, etc.). It uses TCP protocol and listens to port 80. The most basic form of the protocol understood by an HTTP server involves just one command: GET. If a user connect to a server that understands the HTTP protocol and tell it to "GET filename". The server will respond by sending him/her the contents of the named file and then disconnects. But these are the basic steps that occurred behind the scenes:

- The browser broke the URL into three parts:
    1. The protocol ("http").
    2. The server name ("www.XXXXXXX.com").
    3. The file name ("web-server.htm").
- The browser communicates with a name server to translate the server name "www.XXXXXXX.com" into an IP address, which it uses to connect to the server machine.
- The browser forms a connection to the server at that IP address on port 80.

- Following the HTTP protocol, the browser sends a GET request to the server, asking for the file "http://computer.XXXXXXX.com/web-server.htm."
- The server will send the HTML text of the web page to the browser.
- The browser reads the HTML tags and formats the page onto screen.

The following Fig (3.7) shows the steps that brought the page to the screen:

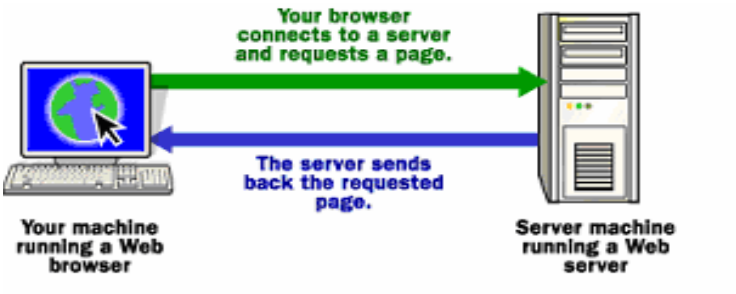


Fig (3.7): Web Server and Web Browser Connections

In the original HTTP protocol, the actual filename, such as "/" or "/web-server.htm." will be sent. The protocol is later modified to handle the sending of the complete URL. This has allowed companies that host virtual domains, where many domains live on a single machine, to use one IP address for all of the domains they host. It turns out that hundreds of domains are hosted on single IP address.

3.2.5. File Transfer Protocol Server (FTP Server) Software

A traditional FTP server is executed from inetd (the internet super server daemon). The standard FTP control port is 21. FTP port for data transfer is 20(Fig (3.8) show FTP server connections). When a user tries to log in, the FTP server uses a standard system call to check the user name and password against the entries in the system password file, or the NIS tables if are using NIS. If the login is correct, the user is given access to the system.

Anonymous FTP works differently. The user logs in with either the anonymous or the FTP username (this can be defined in the config file). He/she is then given

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access to a directory tree that he has authority on. This ensures that the user cannot gain access to directory trees he/she is not authorized for. The files for download are usually put in the public directory. The following Fig (3.8) shows the steps in FTP server

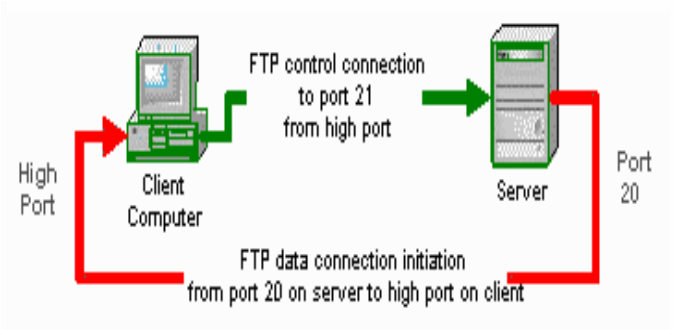

Fig (3.8): FTP Server *and FTP Client* Connections in Network

3.2.6. Firewall Server Software

A firewall is simply a program or hardware device that filters the information coming through the Internet connection into the private network or computer system. If an incoming packet of information is flagged by the filters, it is not allowed through as in Fig (3.9).

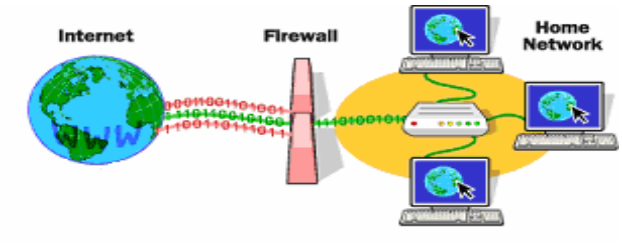

Fig (3.9): Firewall in Network

Firewalls use one or more of three methods to control traffic flowing in and out of the network. They are packet filtering, proxy service and state full inspection. The information traveling through the firewall is monitored for specific defining

characteristics. It is compared to these characteristics. If the comparison yields a reasonable match, it is allowed through. Otherwise it is discarded.

Firewalls are customizable. This means that filters are added or removed based on several conditions. Some of these are IP addresses, domain names, protocols ports and specific words or phrases. A firewall stops anyone on the outside from logging onto a computer in the private network.

With a hardware firewall, the firewall unit itself is normally the gateway. Hardware firewalls are incredibly secure and not very expensive.

3.2.7. Proxy Server Software

A function that is often combined with a firewall is a proxy server. The proxy server is used to access web pages by the other computers. When another computer requests a web page, it is retrieved by the proxy server and then sent to the requesting computer. The net effect of this action is that the remote computer hosting the web page never comes into direct contact with anything on private network, other than the proxy server.

Proxy server can make the internet access more efficiently. If a user accesses a page on a web site, it is cached (stored) on the proxy server. This means that the next time he/she goes back to that page, it normally doesn't have to load again from the web site. Instead it loads instantaneously from the proxy server.

Chapter Four

Server Availability

4.1 Availability Introduction

4.1.1. Reliability: Real time and embedded servers are now a central part of our lives. Reliable functioning of these systems is of paramount concern to the millions of users that depend on these servers everyday. Unfortunately most embedded servers still fall short of users' expectation of reliability.

The term reliability refers to the ability of a computer-related hardware or software component to consistently perform according to its specifications and free of failure [6].

4.1.2. Maintainability: In theory, a reliable product is totally free of technical errors. But this in theory only, in real live system, the server operates until it fails, then it is repaired and returned to its original operating state. It will fail again after some random time of operation, get repaired again, and this process of failure and repair will repeat. Therefore the maintainability is an expression of the ease with which a component, device or system can be maintained and repaired. Early detection of potential problems is critical in this respect. Some systems have the ability to correct problems automatically before serious trouble occurs. Ideally, maintenance and repair operations should cause as little downtime or disruption as possible [6].

4.1.3. Availability: It refers to the ability of the user community to access the server, whether to submit new work, update or alter existing work, or collect the results of previous work. If a user cannot access the server, it is said to be unavailable. Generally, the term downtime is used to refer to periods when a server is unavailable even if it is planned downtime (usually the result of some logical, management-initiated event) or unplanned downtime (typically arise from some physical event, such as a hardware failure or environmental anomaly) [7].

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4.2. What is Availability Metric

The metric availability is a performance criterion for repairable systems that accounts both the reliability and maintainability properties of a component or system. It is defined as the probability that the system is operating properly when it is requested for use. Availability is the probability that a server is not failed or undergoing a repair action when it needs to be used. Table (4.1) illustrates the relationship between reliability, maintainability and availability.

Table (4.1): Reliability, Maintainability and Availability Relationship

▬	↓	↓
▬	↑	↑
↑	▬	↑
↓	▬	↓

4.2.1. Availability Parameters

There are many metrics will be defined to quantify server availability: [8]

- **MTBF (Mean Time Between Failures)**

  It is the expected time between two successive failures of a server. It is the average time a manufacturer estimates before a failure occurs. [8]

- **FIT (Failures In Time)**

  FITs is a more intuitive way of representing MTBF. FITs is nothing but the total number of failures of the module in a billion hours (i.e. 1000,000,000 hours). [8]

- **MTTF (Mean Time To Failure)**

  It is the expected time to failure of a server. This value is often calculated by dividing the total operating time of the units tested by the total number of failures encountered. [8]

Reliability Maintai
Constant Decre
Constant Incre
Increases Cons
Decreases Cons

- **MTTR (Mean Time To Repair)**

  It is the time taken to repair a failed server to be properly operational. [8]

The values for uptimes and downtimes can also change with server age and reach their asymptotic values. The expected values of the uptime and downtime in the steady-state condition are known as the mean uptime (MUT) and mean downtime (MDT). Because the uptime is equivalent to the failure time, it is also known as MTTF. The downtime can consist of repair time and other delays. If there are no delays, then downtime is equivalent to the repair time. In this case MDT is equivalent to MTTR. MTTR is also known as mean corrective time. Under the steady-state condition, the following well-known relationships exist:

$$MCT = MUT + MDT$$

When there are no delays in repair:

$$MTBF = MTTF + MTTR$$

4.1.2. Availability Equation

Availability of a server is the percentage of time when the server is operational. It can be obtained by the formula given below [8].

$$\textbf{Availability} = \textbf{MTTF/MTBF} = \textbf{MTTF/ (MTTF + MTTR)}$$

The definition of availability is somewhat flexible and is largely based on what types of downtimes are chosen to be considered in the analysis. As a result, there are a number of different classifications of availability, such as:

- Instantaneous (or Point) Availability.
- Average Up-Time Availability (or Mean Availability).
- Steady State Availability.
- Inherent Availability.
- Achieved Availability.
- Operational Availability.

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4.3. System Availability Calculation

System Availability is calculated by modeling the system as an interconnection of parts in series and parallel. The following rules are used to decide if components should be placed in series or parallel:

- If failure of a part leads to the combination becoming inoperable, the two parts are considered to be operating in series. It is calculated by:[8]

$$A = A_x * A_y$$

  The combined availability of two components in series is always lower than the availability of its individual components.

- If failure of a part leads to the other part taking over the operations of the failed part, the two parts are considered to be operating in parallel. It is calculated by: [8]

$$A = 1-(1-A_x)^2$$

  The combined availability of two components in parallel is always much higher than the availability of its individual components. Thus parallel operation provides a very powerful mechanism for making a highly available server from low availability components. For this reason, all mission critical servers are designed with redundant components.

- Operation Availability: Operational availability is a measure of the average availability over a period of time and it includes all experienced sources of downtime, such as administrative downtime, logistic downtime… etc.

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Operational availability is the ratio of the server uptime and total time. Mathematically, it is given by: [8]

$$A_o = \frac{\text{uptime}}{\text{operating cycle}}$$

Where the operating cycle is the overall time period of operation being investigated and uptime is the total time the server was functioning during the operating cycle. (*Note: The operational availability is a function of time, t, or operating cycle.)*

The operational availability is the availability that the user actually experiences. It is the posteriori availability based on actual events that happened to the server. In many cases, operational availability cannot be controlled by the manufacturer due to variation in environment, resources and other factors that are the sole province of the end users of the server.

4.4. High Availability Server

High availability is a system design protocol. It is associated implementation that ensures a certain absolute degree of operation continuity during a given measurement period [1].

The most high availability servers hew to a simple design pattern. They are single, high quality, multi-purpose physical servers with comprehensive internal redundancy running all interdependent functions .The design of high available servers follows number of principles:

- **Modularity**
  Modularity is a well-entrenched principle of good design, and is not limited to use in the construction of high-availability servers. A server consists of a collection of modules. A module is a service unit. It is providing fault containment and setting repair boundaries [1].
- **Fail Fast**

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Fail Fast module that respects the Fail Fast principle. It either functions correctly or immediately stops execution upon the detection of an error. The fail fast concept implies that a server continuously watches all its components to distinguish between correctly-operating modules and failed ones. In practice, this generally implemented by requiring the components to exchange messages on an appropriately-frequent basis to indicate correct operation. This type of monitoring is often called heartbeat [1].

- **Independence of Failure Modes**

  The various modules constituting a server and their interconnections must be designed so that the failure of any module does not affect the other modules [1].

- **Redundancy and Repair**

  Replacement modules (at the physical level) must be installable during normal server operation, along with whatever is necessary to deploy them (at the logical level). In other words, installation must be possible in advance of need. This allows failing modules to be removed, repaired at leisure and subsequently reinstalled without any break in service. The greater contribution to availability is the ability to remove and repair a module as part of planned maintenance [1].

- **Eliminating Single Points of Failure**

  A Single Point of Failure (or SPOF) is a module whose failure automatically, results in the failure of the complete system. Identifying and eliminating messages SPOFs contributes to availability [1]. Some examples of SPOFs include:

  - The electrical power supply for a system without an uninterruptible power system.
  - The bus in an SMP.

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- The operating system in a uni-processor or SMP server; its failure causes the server to stop, requiring a reboot to regain normal operations.

The principles stated above are implemented at software and hardware levels, Table (4.2) show how these principles are implemented.

Table (4.2): Implementing High Availability Concepts

Concept	Hardware	Software
Modularity	Traditional	Traditional
Fail fast	Self-checking Comparison	Self-checking N-version programming
Independent failure modes	Inter-module coupling methods	Inter-module coupling methods
Redundancy and repair	N+ 1 module replacement approach Hot-swapping of modules	Redundancy for some software modules Replacement executing software
Elimination of single points of failure	Redundancy	Redundancy

To improve server availability, the time required to repair the failure must be reduced. Based on the concept of MTTF/MTTR, by decreasing the time required to fix a server failure, the server availability ratio can be increased. As the high availability design concepts implementation depend on the server self check and redundancy. Therefore, before the availability of a server can be improved, there must be mechanisms to first detect the failures. The goal of failure detection is to preserve network and service availability by identifying possible problems before they impact end users services. By detecting the server failures, notifications can

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be sent to network administrators immediately so that they can fix the problem. Then, the mean time to repair will be minimized and the server availability will increase.

Chapter Five

Implementation, Study Analysis and Results

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From the previous chapters, it is clear that there are many factors to be considered and compromised when selecting a server. Most of them were concerned in choosing the servers for the case study, which is PetroDar Operating Company (PDOC). In brief, PDOC is an operating company to carry out exploration, development and production of oil for Block 3E, 7E and 3D in Sudan. The company is incorporated under the laws of the British Virgin Islands and has a registered branch in Sudan. PDOC is the designated operator to manage and run the operations on behalf of the shareholders [9], who are:

- CNPC International (CNPC/DAR)
- Petronas Carilgali Overseas Sdn Bhd (PCOCB)
- Sudan Petroleum Company (Sudapet)
- Sinopec International Petroleum Exploration and Production Corporation
- Al Thani Corporation (ATC) [9]

It has about 500 users in main office and about 50 users in each of its 6 branch sites plus about 200 users on the remote sites (rigs). Its total number of users is about 1000. PDOC is hosting its own web site. It has its own e-mail system. PDOC is using e-mails as official documents to communicate within the company and with other companies inside and outside Sudan. It has registered a domain name under petrodar.com. Sudatel gave PDOC 6 public IP addresses for the mail and web servers. Since PDOC is petroleum operating company, any delay in its operations may cost it more than 25,000 USD per day. Therefore, it is very keen to have high availability and performance for both mail and web systems. Its old systems were designed for 250 users in main office and 1 site in year 2002. But now there are many expansions in PDOC operations and manpower. Therefore, it has decided to upgrade its mail and web system through stages:

- Stage 1: To select the best hardware for each server separately, one for web and one for mail.

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- Stage 2: To select the best operating system, web application and mail application to be installed in their respective servers.
- Stage 3: To configure the servers with high availability.

5.1. PDOC Servers Hardware

In old configuration two servers were installed in same machine. But after upgrading, each server has been installed in two separate machines. This consequently has increased their availability, as they become independent of each other.

Sun Microsystems Ultra SPARC platform has been chosen for both servers. But different hardware specification is used for each server depending on the service needed hardware.

Sun Fire 890 has been chosen for Mail server because of following features with which it can give the best mail service for the company:

- Sun's Ultra SPARC IV+ 64-bit Chip Multithreading (CMT) processor has significantly enhanced cores, 2-MB on-chip L2 cache, and a new 32-MB L3 cache using the latest 90nm process technology.
- RAS features include hot-pluggable disk drives; redundant, hot-swappable power supplies; environmental monitoring and fault detection; Automatic System Recovery (ASR); automatic failover capability; and error correction and parity checking for improved data integrity.

Since the e-mails are very important documents. Mail system must be always available and accessible from in and out the PDOC. For mail server, a sun fire 890 server has been selected. Table (5.1) contains its hardware specification.

Table (5.1): Mail Server Hardware Specifications

Processor	
Number	2

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Architecture	1.5GHz UltraSPARC IV+
Cache memory	64-KB data and 32-KB instruction per pipeline Secondary: 16-MB external (8-MB per pipeline)
Main Memory	
Capacities	8GB
Standard Interfaces	
Ethernet	One Gigabit Ethernet (1000BASE-SX)
PCI	PCI slots are hot-pluggable – Seven slots, 64 bit, operating at 33MHz (5V) – Two slots (slots 7 and 8), 64 bit, operating at 33 or 66MHz (3.3V)
Remote System Controller	– One EIA-232D serial port (RJ-45) – One 10 Mbps Ethernet port (RJ-45)
Serial	Two EIA-232D/EIA-423 serial ports (DB25) via splitter cable (X985A)
USB	Two USB 1.0 ports
Internal Mass Storage	
Disks	6 3.5" × 1" 10000 RPM FC-AL disks, each 146GB capacity.
DVD-ROM	16X ATAPI DVD-ROM Drive
Tape	4mm DAT 72 SCSI Tape
Power Supplies	
Type	3 redundancy, individual power cords

Output	1629W maximum per power supply

For the web server, a sun fire 420 server has been chosen. It has features make it very optimal as web server:

- The Sun Fire V240 server is a fast system designed to significantly improve network performance for web services. It has 4 build in Ethernet Gigabit ports.
- The J-bus interconnects, which operates 2.67 GB/sec., ensures scalability with minimal contention and latency between processing and I/O subsystems.
- It was designed with hot-swappable disks for online maintenance and repair, improving availability. Front and back LEDs provide quick identification of system status.
- ASR (Automatic System Recovery) monitors system components and automatically configures around failed memory DIMMs, PCI cards, disk drives, and USB and restores system to operation as quickly as possible--minimizing the need for manual intervention and enhancing system availability.

For the web server, Table (5.2) shows the hardware specifications selected.

Table (5.2): Web Server Hardware Specifications

Processor	
Number	Two
Architecture	1.5GHz Ultra SPARC® IIIi, 64 bit, 4-way Superscalar SPARC® V9
Cache memory	64 KB data, 32 KB instruction and 1 MB integrated L2
Main Memory	
Capacities	– 4 DIMM slots per processor, registered DDR-1 SDRAM

	– System configurations 2 GB
Standard Interfaces	
Ethernet	– Four 10/100/1000 BaseT Ethernet – One 10 BaseT Ethernet (Network Management)
PCI	– Three internal PCI 2.2 compliant expansion slots: – One 64 bit 33/66 MHz 3.3V full-length – Two 64 bit 33 MHz 5V full-length Note: Nominal power = maximum 25W per slot, maximum 45W across 3 slots
SCSI	One Ultra160 SCSI multimode (SE/LVD)
Serial	– One TIA/EIA-232-F asynchronous (DB9) Port – One TIA/EIA-232-F (RJ45) Port (Serial Management)
System Configuration Reader and Card	Front accessible for transfer of system configuration information, including host ID
USB	Two OHCI-1.0 Compliant Interfaces, supporting dual speeds of 12 and 1.5 Mbits/sec each
Internal Mass Storage	
Disks	2 hot-swap Ultra160 SCSI, each 146GB Disks
DVD-ROM	One Slim-line ATAPI DVD-ROM (Optional)

5.2. PDOC Servers Software

5.2.1. PDOC Servers Operating System

UNIX is very powerful operating system. The most power features are listed:

- UNIX is interactive time-sharing system. It is designed by programmers for programmers.
- UNIX is simple, elegant and consistent.
- UNIX is powerful and flexible. The system has small number of basic elements, which can be combined in an infinite variety of ways to suite the applications.
- UNIX is free from the useless redundancy.
- UNIX security is very strong compared to other operating systems.

In addition, Solaris 10 is a version of UNIX by Sun Microsystems. Beside the features of UNIX, Solaris 10 have its own features that make it the most preferred operating system especially with SPARC platform [10]:

- **Security**
  The Solaris 10 Operating System provides advanced security features such as Solaris Secure Execution and Process Rights Management.
- **Observability**
  The Solaris 10 release gives observability into the system with tools such as Solaris Dynamic Tracing (DTrace), which enables real-time application debugging and optimization.
- **Networking**
  It has optimized network stack and support for most advanced network computing protocols. Solaris 10 delivers high-performance networking to most applications without modification.
- **Utilization**
  It contains Solaris Containers, which consolidate, isolate, and protect many applications on a single server.
- **Data Management**

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Solaris 10 offers delivering virtually unlimited capacity and nears-zero administration in file system and volume management.

- **Availability**
  Solaris 10 features, such as Predictive Self Healing, support automatic diagnosis and recovery from hardware and application faults. These maximize system uptime.
- **Interoperability**
  Solaris 10 provides tools to enable seamless interoperability with hundreds of heterogeneous hardware and software platforms.

5.2.2. PDOC Servers Applications

PDOC has decided to use Sun Java™ Enterprise System (SJES). It is a set of software components that provide services needed to support enterprise-strength applications distributed across a network or Internet environment. These applications are distributed enterprise applications.

SJES is an integration of software products into a single software system. The components of this system have been tested together to ensure interoperability. Their integration is facilitated by a number of system-level features, which are:

- All components are synchronized on a common set of shared libraries.
- All Java Enterprise System components are installed using a single installer.
- All Java Enterprise System components can share an integrated user identity and security management system.

Java Enterprise System components can be grouped into three main categories [11]:

Category (1): System Service Components:

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The following components provide the main SJES infrastructure services that support distributed enterprise applications:

- Sun Java System Access Manager 6
- Sun Java System Application Server Enterprise Edition 8
- Sun Java System Calendar Server 6
- Sun Java System Directory Server 5
- Sun Java System Instant Messaging 7
- Sun Java System Message Queue 3
- Sun Java System Messaging Server 6
- Sun Java System Portal Server 6
- Sun Java System Web Server 6.1

Category (2): Service Quality Components:

These components enhance the availability, security, scalability, serviceability and other qualities of system service components, and distributed application components.

- Availability components
  - Sun Cluster 3.1 9/04 and Sun Cluster Agents
  - High Availability Session Store
- Access components
  - Sun Java System Communications Express
  - Sun Java System Connector for Microsoft Outlook 6
  - Sun Java System Directory Proxy Server 5 2005Q1
  - Sun Java System Portal Server Secure Remote Access 6
- Administrative components

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- Sun Java System Administration Server (and Console) 5
- Sun Java System Directory Preparation Tool
- Sun Java System Delegated Administrator 6
- Sun Remote Services Net Connect

– **Category (3):** Shared Components:

These components provide the environment in which many system service components and service quality components run. Shared components provide local services and technology support upon which Java ES system service components and service quality components depend. The Java ES installer automatically installs any shared components required to support.

Table (5.3) shows the specific relationships between the SJES service components. Since the study is interested in messaging and web server, Table (5.3) shows them and what they depend on.

Table (5.3): Relationships between Installed SJES Service Components

Component	Depends On	Provides Support To
Messaging Server	– Directory Server – Access Manager (for single sign-on)	– Calendar Server (for e-mail notifications) – Portal Server (for messaging channel)
Access Manager	– Application Server or Web Server – Directory Server	– Portal Server – If configured for single sign-on: ▪ Calendar Server ▪ Messaging Server

		○ Instant Messaging
Web Server	Access Manager (for access control)	– Portal Server – Access Manager
Directory Server	None	– Portal Server – Calendar Server – Messaging Server – Instant Messaging

To install Java Enterprise Messaging server and Web server, the components they depend on have to be installed. There are many good features in Sun Java Enterprise System that persuade PDOC to choose it for its mail and web servers [11]. These features are:

- It is Sun Microsystems release; it is the best with Solaris System and ideal for SPARC architecture.
- The interacting software components of distributed enterprise applications have an underlying set of infrastructure services that allows the distributed components to communicate with each other, coordinate their work, implement secure access, and so forth.
- Also provides service that enhances availability, scalability, serviceability, and other application or server qualities.
- SJES provides the infrastructure service levels which it needs and that can be configured as requested:
    - Different Operating system platforms: It supports all operating systems (such as Solaris™ Operating System, Linux, or Microsoft Windows)..They manage physical devices as well as memory, threads, and other

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resources necessary to support the Java Virtual Machine (JVM™ machine).

- Network transport: It provides basic networking support for communication between distributed application components running on different computers.
- Persistence: It provides support for accessing and storing both static data (such as user, directory, or configuration information) and dynamic application data (information that is frequently updated).
- Messaging: It provides support for both synchronous and asynchronous communication between application components.
- Runtime: It provides support required by any distributed component model, such as the J2EE or CORBA models.
- Security and policy: It provides support for secure access to application resources. These services include support for policies that govern group or role-based access to distributed resources, as well as *single sign-on* capabilities.
- User collaboration: Services are supporting direct communication between users and collaboration among users in enterprise and Internet environments.
- Integration: It provides a common interface for accessing the services, as a portal. Integration can also take place as business-to-business interactions between different enterprises.

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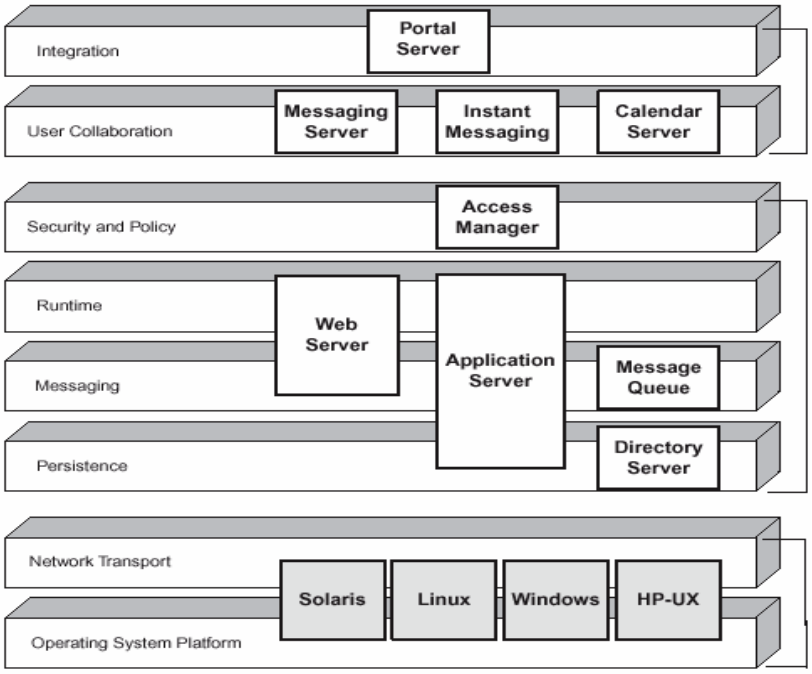

Fig (5.1): Java Enterprise System Infrastructure Service Levels [11]

5.3. Installation and Configuration

5.3.1. PDOC Mail Server Configuration

Following are the steps, which PDOC has followed for the installation and configuration:

- Installing Solaris 10 as operating system in mail server.
- Configuring RAID 1 in the server disks; each disk has its mirror.
- Configuring the server with its network configuration (host name and internal IP address and gateway).
- Installing DNS service in the server, BIND 8 is used as DNS software.
- Configuring the mail server as primary DNS for the domain petrodar.com.

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- Installing Sun java messaging server 2005Q4, and the other application which it depends on using the software wizard (installation steps in Appendix A). Table (5.4) describes the functions of each application that messaging server depended on.

Table (5.4): SJES Messaging Server Depending on Service Components Functions

Application	Function
SUN Java System Directory Server 5	Provides a central repository for storing and managing intranet and Internet information such as identity profiles (employees, customers, Suppliers, and so forth), user credentials (public key certificates, Passwords, and pin numbers), access privileges, application resource Information, and network resource information.
SUN Java System Administration Server	Provides a graphical administration tool that lets you configure and Manage Directory Server and Messaging Server.
Sun Java System Directory Preparation Tool	Provides a script for configuring Directory Server with the schema needed to provision users for Messaging Server.
SUN Java System Access Manager 7	Provides access management and digital identity administration Services. Access management services include authentication (Including single sign-on) and role-based authorization for access to Applications and/or services. Administration services include Centralized administration of individual user accounts, roles, groups, And policies.
Communication	Provides both command-line and GUI tools for populating

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Application	Function
Service Delegated Administrator	user entries In Directory Server with user attributes needed by Messaging Server .
SUN Java System Communication Express 6	Provides web-based access to Messaging Server and Directory Server depending on configuration.
SUN Java System Web Server	Provides J2EE™ web container services for Java web components, Such as Java Servlet, Java Server Pages™ (JSP™) components and SUN Java System Communication Express 6.

– The applications directories are configured in Table (5.5).

Table (5.5): Sun Java Enterprise Messaging Directories

Application	Directory
Directory Preparation Tool	/opt/SUNXcomds
Access Manager	/opt
Web Server	/opt/SUNWwbsvr
Delegated Administrator directory	/opt/SUNWcomm
Communication Express	/opt/SUNWuwc
Messaging Server	/opt/SUNWmsgsr

– Services ports have been selected as Table (5.6).

Table (5.6): Ports of Messaging Services

Service Port	Port Number
Directory Server port	389
POP3 Messaging Server port	110

IMAP Messaging Server port	25
HTTP Messaging Server port	82

- After the installation of the applications, some configurations have been done by the Sun Java System Directory Preparation Tool to link messaging server, directory server and administration server together (see appendix B).
- The users' accounts and inboxes in the old system were backuped and restored in the new directory and messaging server using steps illustrated by Sun Microsystems to upgrade from iPlanet 5 to Sun java messaging server 6.1.

5.3.2. PDOC Web Server Configuration

Also, the next steps were followed for the installation and configuration:

- Installing Solaris 10 as operating system in web server.
- Configuring RAID 1 in the server disks.
- Configuring the server with its network configuration (host name and internal IP address and gateway, make the mail server its primary DNS server).
- Installing Sun java web server, and the other application which it depends on using the software wizard (installation steps in appendix B). Table (5.7) describes the function of each application that Web server depended on.

Table (5.7): SJES Web Service Depending on Components Function

Application	Function
SUN Java System Access Manager 7	Provides access management and digital identity administration Services. Access management services include authentication and role-based authorization for access to Applications and/or services.

- Table (5.8) is the main configuration of the web server.

Table (5.8): PDOC Web Server Configuration

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Installation directory	/opt/SUNWwbsvr
Web server Admin Server user	Admin
Web server Admin Server port	8888
Web Server Port	80
Web Server Content Root	/opt/SUNWwbsvr/docs
Web sever start	At boot

5.4. Monitoring , Calculations and Effects on PDOC Network

The upgrading was done with increasing the servers' availability in concern. Therefore, PDOC has to monitor the availability of its servers from users point and to calculate the availability of the new servers.

5.4.1. Monitor PDOC Servers

WebWatchBot is a server monitoring application that runs in PC and it has the capability to monitor wide range of servers. The remarkable feature of WebWatchBot is its graphical user interface (GUI). It's extremely easy to use and configuring monitoring jobs The WebWatchBot manager is also a window that allows network administrators to control everything from adding monitoring jobs, view real time data, schedule monitoring jobs and observe health status of monitored servers. Another feature in WebWatchBot is the alerting abilities in the event of server failures [12].

WebWatchBot 5.0 is an agent-less monitoring tool, which means that nothing is installed on the server or network component being monitored. It uses industry standard protocols and gives accurate insight into actual end-user experience. It supports different monitoring types, including the ability to custom monitors and watch items. Table (5.9) shows some of WebWatchBot 5.0 capabilities [12].

Table (5.9): WebWatchBot 5.0 Monitoring Capabilities in Study Key Areas

HTTP/HTTPS	WebWatchBot verifies that a specified URL is available and responding within a defined threshold. It can download the

	content from a specified URL and verify that specific content strings are found. Web form monitoring is accomplished by automatically submitting form data to simulate user actions.
Servers	WebWatchBot provides many monitoring items, including: • Ping: queries any IP device that allows pinging over TCP/IP • Port: connects to a server via a URL or IP address and specified port number to verify availability and response time • SMTP (Outgoing E-mail Servers): monitors outgoing e-mail servers and user accounts for availability and performance • POP3 (Incoming E-mail Servers): monitors incoming e-mail servers and user accounts for availability and performance.

A monitor can be viewed and configured in any type of reports wanted. Table (5.10) includes the types of reports in WebWatchBot.

Table (5.10): WebWatchBot Monitor Reports

Report Name	Report Information
Summary Report	A summary of statistical data, e.g. average response time, number of times checked, etc.
Downtime Report	The Downtime Report displays detailed information on when failures occurred and how long downtime lasted.
Failure Report	The Failure Report displays detailed information on when failures occurred.
Response Time Report	The Response Time Report displays details on the response time each instance a Watch Item was monitored.
Status Report	The Status Report is a continuously and automatically updated report that offers an at-a-glance detailed view of Watch Items, Transactions,

	and Watch Groups.

WebWatchBot 5.0 was used to monitor the servers using listed monitors [10].

– **SMTP Monitor**

WebWatchBot monitors by connecting to an outgoing SMTP mail server, enabling:

- Monitoring of any outgoing SMTP mail server.
- Monitoring of a specific user account by SMTP authentication.
- Availability of an SMTP mail server.
- Reliability of an SMTP mail server.
- Simulation of the user experience of an SMTP mail server.

WebWatchBot connects to an SMTP mail server. SMTP authentication credentials are provided to the SMTP mail server. The message is addressed with TO and FROM e-mail addresses. Optionally, e-mail message subject and body are provided for further validation. An SMTP configuration setting is illustrated in Fig (5.2).

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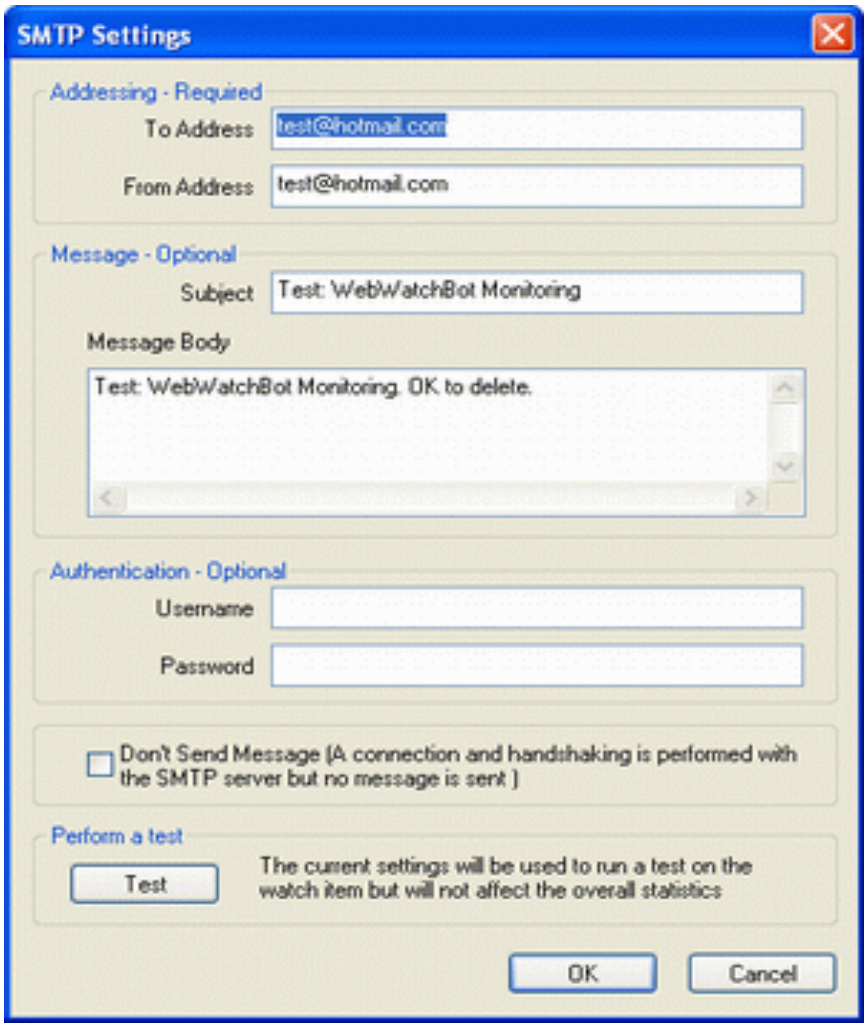

Fig (5.2): WebWatchBot 5.0 SMTP Monitor Configuration Window

WebWatchBot drills down by focusing on:

- Connecting to an SMTP mail server.
- Creating an e-mail message with common message parts that can be sent or tested against the SMTP mail server.
- Authenticating with the mail server.

– **POP3 Monitor**

WebWatchBot monitors by connecting to an incoming POP3 mail server, enabling:

- Monitoring of any incoming POP3 mail server.
- Monitoring of a specific user account by POP3 login.
- Availability of a POP3 mail server.
- Reliability of a POP3 mail server.
- Simulation of the user experience of a POP3 mail server.

WebWatchBot connects to a POP3 mail server. The supplied username and password are passed to the POP3 mail server. Optionally, the message header is downloaded, parsed, and searched for specific text. Optionally, the e-mail message is downloaded, parsed, and searched for specific text.POP3 configuration setting is illustrated in Fig (5.3).

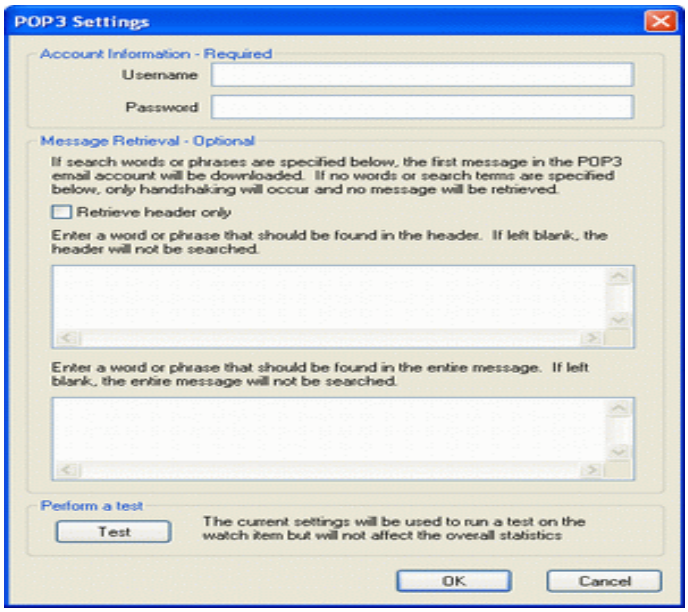

Fig (5.3): WebWatchBot 5.0 SMTP Monitor Configuration Window

WebWatchBot drills down by monitoring more than just summary information by focusing on:

- Connecting to a POP3 mail server.
- Logging into the POP3 mail server.
- Downloading an e-mail message and parsing common message parts.
- Searching the header and message body for specific text.

– **PING Monitor**

WebWatchBot provides support for monitoring of virtually any server or IP device that allows it to be pinged over TCP/IP) Web servers, Database servers, Mail servers, Routers, DNS servers and more).

WebWatchBot sends a small packet of information the number of times specified in the Ping configuration settings. The length of time (response time) of each echo is recorded and averaged to represent the response time of that monitoring run. Optionally, if any echo request fails, the entire run can be considered a failure, thereby triggering an alarm.

Ping configuration settings are shown in Fig (5.4).

Fig (5.4): WebWatchBot 5.0 PING Monitor Configuration Window

WebWatchBot monitors by sending a small packet of information that is echoed back, enabling:

- Monitoring of virtually any server or IP Device.
- Monitoring of the availability of virtually any server or IP Device.
- Measurement of responsiveness of virtually any server or IP Device.

– **WWW Monitor**

WebWatchBot monitors by connecting to a web server and downloading a specific web page using the HTTP/HTTPS protocol, enabling:

- Monitoring of any web server.
- Monitoring of a specific web page and drilling-down on its details.
- QA of web page content: ensure content integrity.
- Availability of a web page and website.
- Reliability of a web page and website.
- Simulation of the user experience of a web page.

WebWatchBot drills down by monitoring more than just summary information by focusing in:

- Downloading an entire web page and (optionally) images.
- Optionally saving the exact output for each run for later analysis through reporting.
- Case sensitive or insensitive searching for a specific word, small or large keyword phrases, and even HTML tags and text.
- Posting of form data to simulate a login or web page form submission.
- Allowing a custom HTTP header, cookies, or Basic authentication.

WebWatchBot connects to a web server, downloads the web page specified, and searches as Fig (5.5):

- The HTML for a specific word, small or large keyword phrases, and even HTML tags and text.
- Searches can be case insensitive (default) or sensitive.
- Searches can trigger a failure. This is useful for searching for keywords such as "error" or "not found".

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Fig (5.5): WebWatchBot 5.0 HTTP Monitor Search Configuration Window

WebWatchBot monitors web sites, e-commerce, shopping carts, store fronts, web applications and more:

- Physical servers' website is installed on.
- Web server software, e.g. Microsoft Internet Information Server (IIS), Apache, https, etc.
- Dependent services, middleware, databases, etc.

WebWatchBot has been used for 9 days to monitor PDOC mail and web servers. The software has many kinds of reports for the monitoring jobs. All reports can

be customized to display more or less data. HTML templates, images, colors, and style sheets can be customized. The downtime report was created because it is displays summary information, a failure and success graph, and detail on the failures for a Watch Item as shown in Fig (5.6). The report graph displays the number of successful (green) and failed (red) runs, grouped by the hour of the day to possibly show a trend over time. The detail shows when a failure happened and how long between the failures until the next success, represented by the column "Downtime".

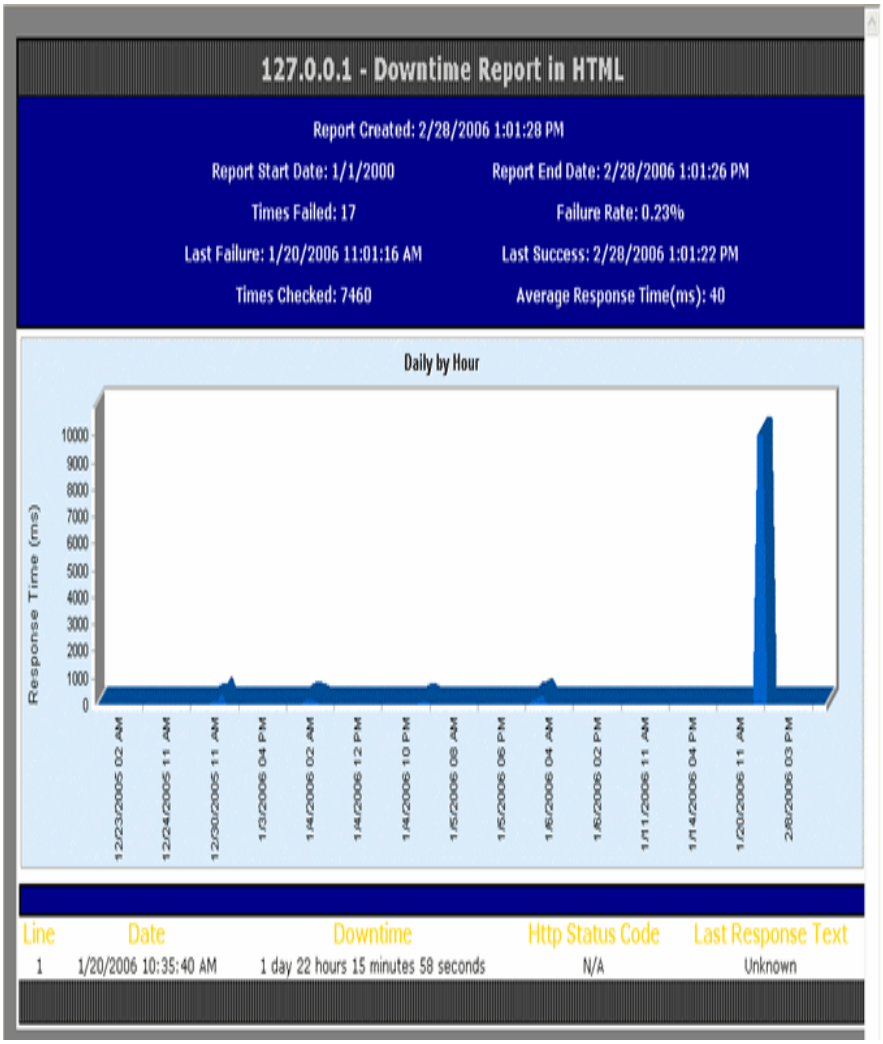

Fig (5.6): WebWatchBot 5.0 Downtime Report

The monitor jobs have created for the two servers. For mail server, SMTP monitor, POP3 monitor and Ping monitor have been created. For web server, HTTP monitor and Ping Monitor have been created. The downtime report was created to see the information collected by each monitor.

5.4.2. Reports of PDOC Servers Monitors

– **SMTP For Mail Server**

Mail SMTP Report			
Report Created:	4/4/2007 1:40:00 AM		
Report Start Date:	3/26/2007 2:51:35 AM	**Report End Date:**	4/4/2007 1:40:00 AM
Times Failed:	0	**Failure Rate:**	0.00%
Times Checked:	985	**Average Response Time(ms):**	92
Last Failure:	1/1/1900	**Last Success:**	4/4/2007 1:38:44 AM
Uptime:	100.00% : 8 days 22 hours 48 minutes 25 seconds (8.22:48:25)	**Downtime:**	0 seconds (0.00:00:00)

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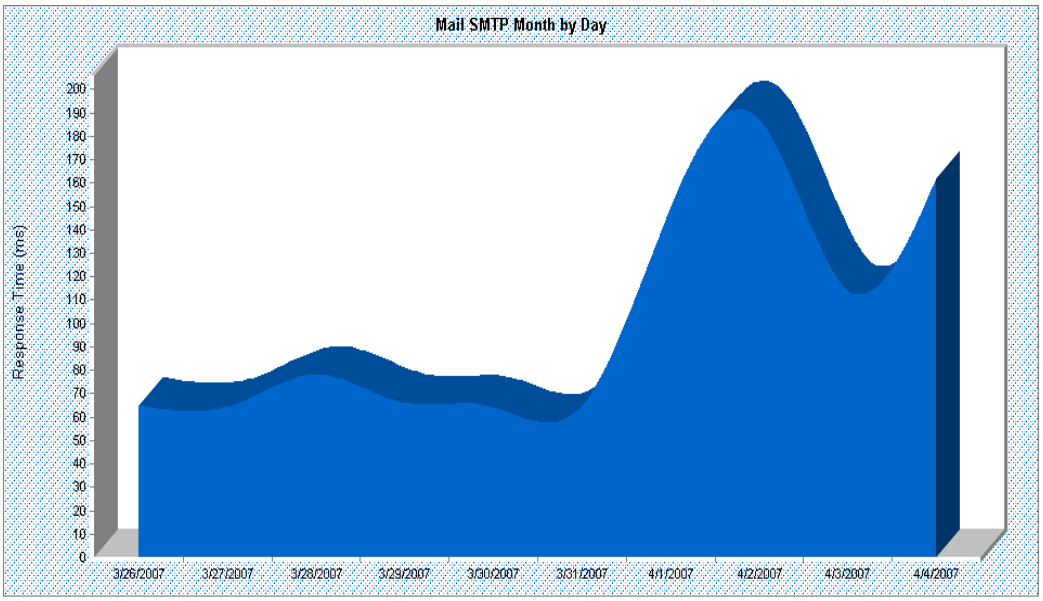


Line	Date	Downtime	Status	Response Time (ms)	Watch Type	Last Response Text
There has been no recorded downtime.						

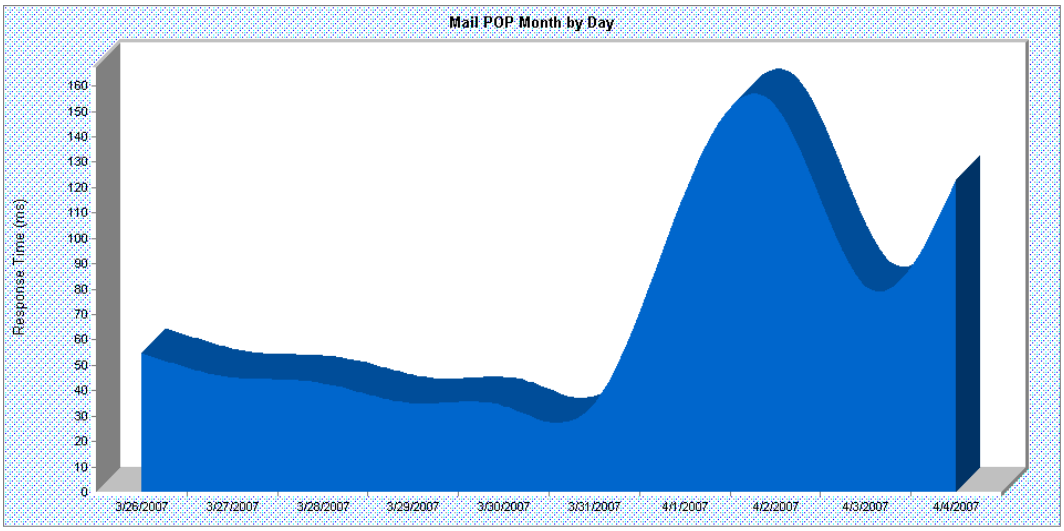
Fig (5.7): WebWatchBot 5.0 Downtime PDOC Mail SMTP Report

In this monitor the average response time was 92ms. The maximum SMTP response time 200ms was on Mondays, which is first working day from outside Sudan. In other days the response time was approximately steady around 75ms. There was no downtime recorded.

– **POP3 For Mail Server**

Mail POP3 Report			
Report Created:		4/4/2007 1:38:26 AM	
Report Start Date:	3/26/2007 2:51:27 AM	**Report End Date:**	4/4/2007 1:38:26 AM
Times Failed:	0	**Failure Rate:**	0.00%
Times Checked:	985	**Average Response Time(ms):**	65

Last Failure:	1/1/1900	**Last Success:**	4/4/2007 1:37:13 AM
Uptime:	100.00% : 8 days 22 hours 46 minutes 59 seconds (8.22:46:59)	**Downtime:**	0 seconds (0.00:00:00)



Line	Date	Downtime	Status	Response Time (ms)	Watch Type	Last Response Text
There has been no recorded downtime.						

Fig (5.8): WebWatchBot 5.0 Downtime PDOC Mail POP3 Report

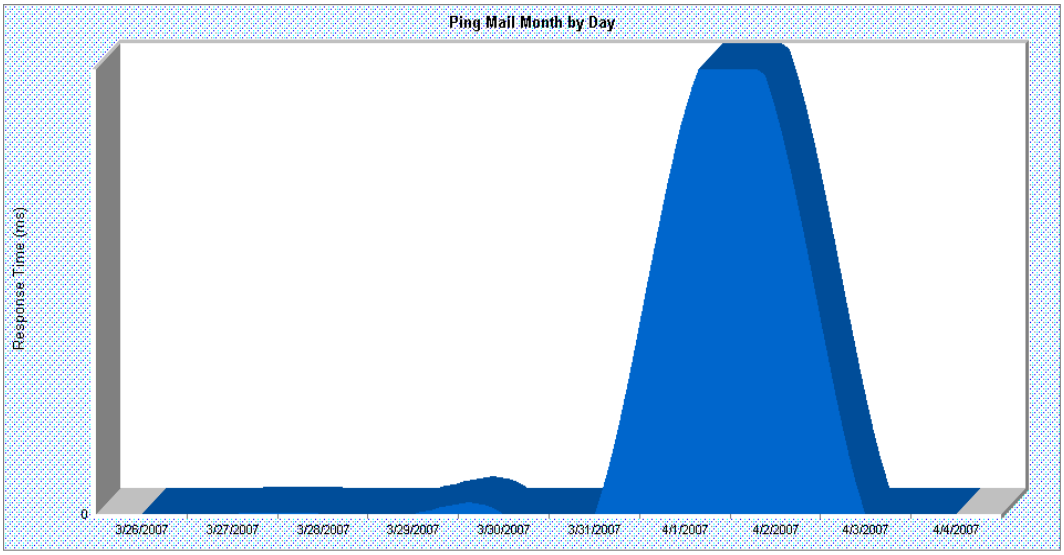
In this monitor the average response time was 65ms. The maximum SMTP response time 160ms was on Mondays, like SMTP. There was no downtime recorded. The minimum response time was in Fridays, Sudan's weekend holidays.

– **PING For Mail Server**

Ping Mail Report

Report Created:		**4/4/2007 1:28:09 AM**	
Report Start Date:	3/26/2007 2:51:41 AM	**Report End Date:**	4/4/2007 1:28:09 AM
Times Failed:	0	**Failure Rate:**	0.00%

Times Checked:	855	**Average Response Time(ms):**	0
Last Failure:	1/1/1900	**Last Success:**	4/4/2007 1:15:11 AM
Uptime:	100.00% : 8 days 22 hours 36 minutes 28 seconds (8.22:36:28)	**Downtime:**	0 seconds (0.00:00:00)



Line	Date	Downtime	Status	Response Time (ms)	Watch Type	Last Response Text
There has been no recorded downtime.						

Fig (5.9): WebWatchBot 5.0 Downtime PDOC Mail PING Report

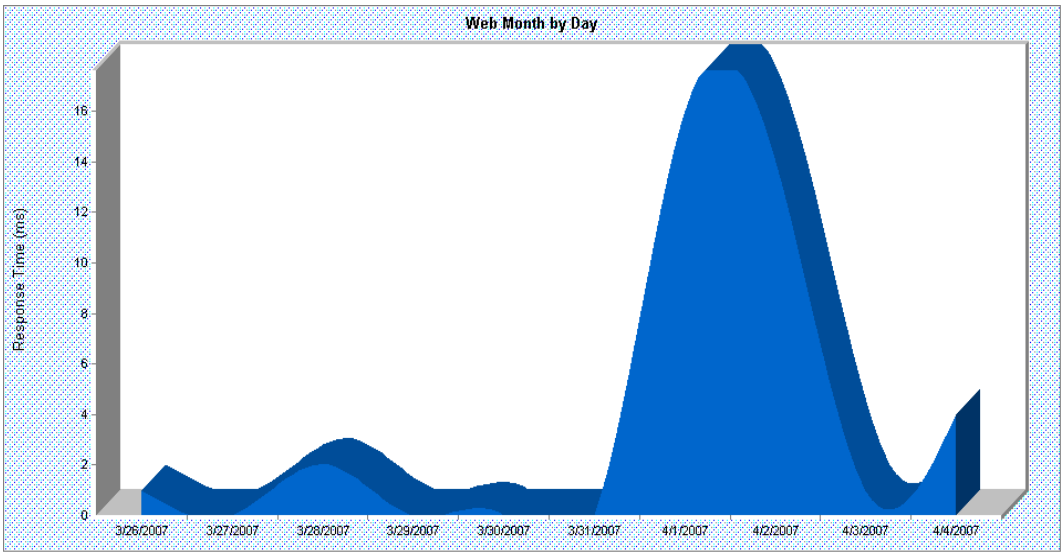
In this monitor the average response time was 0ms. It means that the response time is less than 1ms. It indicates that the server's network is always available. No downtime recorded.

– **WWW For Web Server**

Web Report in HTML

Report Created:		4/4/2007 1:35:32 AM	
Report Start Date:	3/26/2007 2:51:52 AM	**Report End Date:**	4/4/2007 1:35:32 AM

Times Failed:	0	**Failure Rate:**	0.00%
Times Checked:	986	**Average Response Time(ms):**	3
Last Failure:	1/1/1900	**Last Success:**	4/4/2007 1:32:52 AM
Uptime:	100.00% : 8 days 22 hours 43 minutes 40 seconds (8.22:43:40)	**Downtime:**	0 seconds (0.00:00:00)



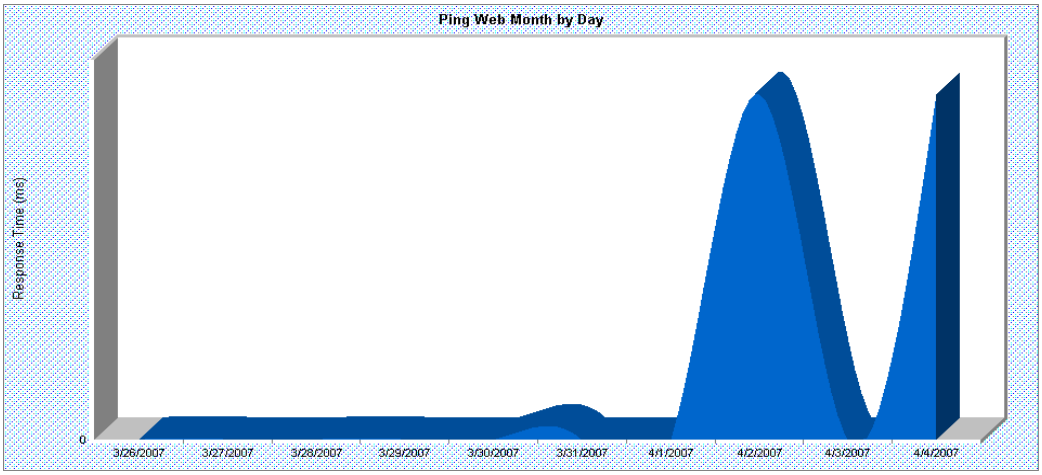
Line	Date	Downtime	Status	Response Time (ms)	Watch Type	View Saved Web Page	Http Status Code	Http Status Code (Descriptive)	Last Response Text
There has been no recorded downtime.									

Fig (5.10): WebWatchBot 5.0 Downtime PDOC Web HTTP Report

In this monitor the average response time was 3ms. The maximum WWW response time 16ms was on Mondays. The most use for web is for checking the e-mail from outside PDOC, especially for the foreign PDOC employees outside Sudan. There was no downtime recorded. The minimum response time was in Fridays, Sudan holidays. No downtime recorded.

– **Ping For Web Server**

Ping Web Report			
Report Created:		4/4/2007 1:32:18 AM	
Report Start Date:	3/26/2007 2:51:46 AM	**Report End Date:**	4/4/2007 1:32:18 AM
Times Failed:	0	**Failure Rate:**	0.00%
Times Checked:	931	**Average Response Time(ms):**	0
Last Failure:	1/1/1900	**Last Success:**	4/4/2007 1:30:11 AM
Uptime:	100.00% : 8 days 22 hours 40 minutes 32 seconds (8.22:40:32)	**Downtime:**	0 seconds (0.00:00:00)



Line	Date	Downtime	Status	Response Time (ms)	Watch Type	Last Response Text

There has been no recorded downtime.

Fig (5.11): WebWatchBot 5.0 Downtime PDOC Web PING Report

In this monitor the average response time was 0ms. It means that the response time is less than 1ms. It indicates that the server's network is always available. No downtime recorded. Still the higher response time is on Mondays.

5.4.3. The Availability Calculations

The old server was installed in Feb. 2002. Its downtime and its' causes are shown in Table (5.11).

Table (5.11): Old Mail Server and Web Server Downtime Track

Server	Date	Time Period	Cause
Mail & Web	2003	600 min	Inboxes unlinked
Mail & Web	2004	660 min	Software problem. Restore its backup
Mail & Web	2005	7200 min	Link problem
Mail & Web		7200 min	Sum of partial power failure and new devices reinstallation
Total		**15660 min**	

– **PDOC Old Mail and Web Server Availability**

Total System downtime = 15660 min

Total System Mean Time To Failure = 2180340 min

Therefore,

Availability = 2180340 / (15660 + 2180340)

Availability = 0.992869 = 99.2869 %

The new servers have been installed and online since 09 March 2006. Both servers are connected to the same UPS and network switch. In other words, they face the same environment, power and network factors. Table (5.12) shows the track of servers' downtime and its cause inside PDOC Company.

Table (5.12): New Mail Server and Web Server Downtime Track

Server	Date	Time Period	Cause
Mail	10-2-2007	54 min	Install new UPS system
Mail	30-12-2006	100 min	UPS system Failure

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Mail	8-11-2006	45 min	Unknown reason , after restart it work fine
Mail	20-4-2006	30 min	Switching between UPS
Total		**229 min**	
Web	10-2-2007	54 min	Install new UPS system
Web	30-12-2006	100 min	UPS system Failure
Web	20-4-2006	30 min	Switching between UPS
Total		**184 min**	

As seen from above table that most downtime was due to UPS, but there was not technical downtime except for 45 min in mail server. Following are the calculations of the availability for:

- **PDOC New Mail Server Availability**

  Total System downtime = 229

  Total System Mean Time To Failure = 780251

  Therefore,

  Availability = 780251 / (229 + 780251)

  Availability = 0.999707 = 99.9707 %

- **PDOC New Web Server Availability**

  Total System downtime = 184

  Total System Mean Time to Failure = 780296

  Therefore,

  Availability = 780251 / (184 + 780296)

  Availability = 0.999764 = 99.9764 %

5.4.4. Effects on PDOC Network

1. The old mail and web system availability was 0.992869 or 99.2869 %.The both systems have same availability since they where in same hardware. If one of them is down or needs any maintains, both of them have to be stopped.
2. The web server availability value is higher than the mail server availability.
3. The new availability value is higher than the old one.
4. PDOC network and users have benefited from that upgrade in:
   - Increase Availability of the services and data:
     - Hardware availability is achieved by :
       - Hot-pluggable features in new servers for disks power supply and cards.
       - RAID 0 configurations in SCSI disks in new servers Software backup.
     - Software availability is achieved by :
       - New Solaris 10 have Solaris Dynamic Tracing (DTrace) and Predictive Self Healing.
       - New mail software has a new build in backup features for inboxes and web files.
     - Mail and Web servers each is in separate server hardware. So the fault in one service does not affect the other service as before.
   - Decrease of response time:
     - For the web server with the high hardware performance and new Java software the browse of web site is very quick (from graph above average response time = 3ms).
     - For the messaging server with the new hardware and new software installed the access-time for e-mails (sends and receives) from any e-mail clients software or web mail is very quick even outside Sudan.

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(From graph above average response time = 92ms for SMTP and 65 ms for POP3).

- Increase the security of the systems by combining of Solaris security with SUN Java System security.
- Easy Administration: Web base administration for web server is from any PC. Web base administration page for massaging server and directory server are from any PC (easy create of users and groups giving them e-mail privileges).

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Chapter Six

Conclusions and Recommendations

6.1. Conclusions

6.1.1. Hardware Conclusions

It is found that several hardware factors can contribute to the improvement of server performance:

1. Improvement in the performance of processor.
2. Increase of system memory capacity and decrease of system memory access time.
3. Increase in the throughput of the interconnections between sub-systems.
4. Increase in the performance of magnetic peripherals.
5. Increase in server networks throughput.
6. Increase in the performance of date storage.

Hardware high availability options focus on constant of availability of the hardware component. If a component fails, a backup component is in place to recover the fault. It can be implemented by:

1. RAID: It allows for continued hard drive access in the case of single hard drive failure
2. Hot plug hard drive: They can be removed and added to the system while system is operating
3. Hot plug PCI cards: They can be deactivated, allowing removal and replacement of a PCI card while the system is operating
4. Hot-plug power supply: It provides redundant power to the server in the case of component failure
5. Hot-plug CPU/Memory board: It can add this board, which has processor and memory on it, while the system is running.

6.1.2. Software Conclusions

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Several operating system factors can contribute in the improvement of server performance:

1. Reducing the setup time of the operating system.
2. Use buffering (which is memory area that stores data while they are transferred between device and program).
3. Use spooling (which is a large buffer on disc that holds output for the device).
4. Use multiprogramming so the CPU is never idle.
5. Increase the security of the system and use efficient small workload security monitors.

For applications, the factors contribute in improvement of the server performance are:

1. Maximize the uptime by using a multithreaded, multiprocessing engine, process monitors and keep-alive connection handling.
2. Automatic fail-over, restart configuration and data recovery.
3. Dynamic reconfiguration without restart.
4. Integration with leading load-balancing solutions.
5. Easy administration and management.

Software high availability depends on the software design. It is implemented by:

1. Self-checking represents a particular design style for software modules in which the input parameters are checked for validity upon entry, and the results are checked for plausibility (e.g., range checking). The module code may also be decorated with assertions which require certain properties to be true; this allows appropriate assumptions about the module's correct functioning to be checked during execution. This sort of approach is termed Defensive Programming.

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2. Multiple implementations in software involve implementing the same functionality in several different ways and comparing their results. If the results differ, execution may be suspended; if there is an odd number of implementations, one may choose majority voting over requiring unanimity.

6.1.3. High Availability Server Conclusion

Finally, here are some keys to consider when selecting high available server:

1. Over-engineering, which is designing server to specifications better than minimum requirements.
2. Duplication is extensive use of redundant servers and components.
3. Recoverability is the use of fault-tolerant engineering methods.
4. Automatic updating keeps operating systems and applications current updated without user intervention.
5. Data backup prevents catastrophic loss of critical information.
6. Data archiving keeps extensive records of data in case of other recovery needs.
7. Power-on replacement is the ability to hot swap components or peripherals.
8. Use of surge suppressors minimizes risk of component damage resulting from power-line anomalies.
9. Continuous power is the use of an uninterruptible power supply. It keeps systems operational while switching from commercial power to backup or auxiliary power.
10. Backup power sources include batteries and generators to keep systems operational during extended interruptions in commercial power.

6.2. Recommendations

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The study has considered only the server hardware, software and availability. But in real life, a server is a part of a system which includes network components, users' applications...etc. These affect the server performance and availability directly. For further studies, it is recommended to divide the server and its environment into subsystems and calculate availability of each. Then the total availability for the whole system is calculated. This will give the exact services availability provided to its users.

More studies need to be conducted on the hardware and software companied together availability implementation. Since software has different performance on different hardware.

There must be cost / availability analysis to determine the availability requirements because the high system availability requirements the higher cost of maintaining the level of performance.

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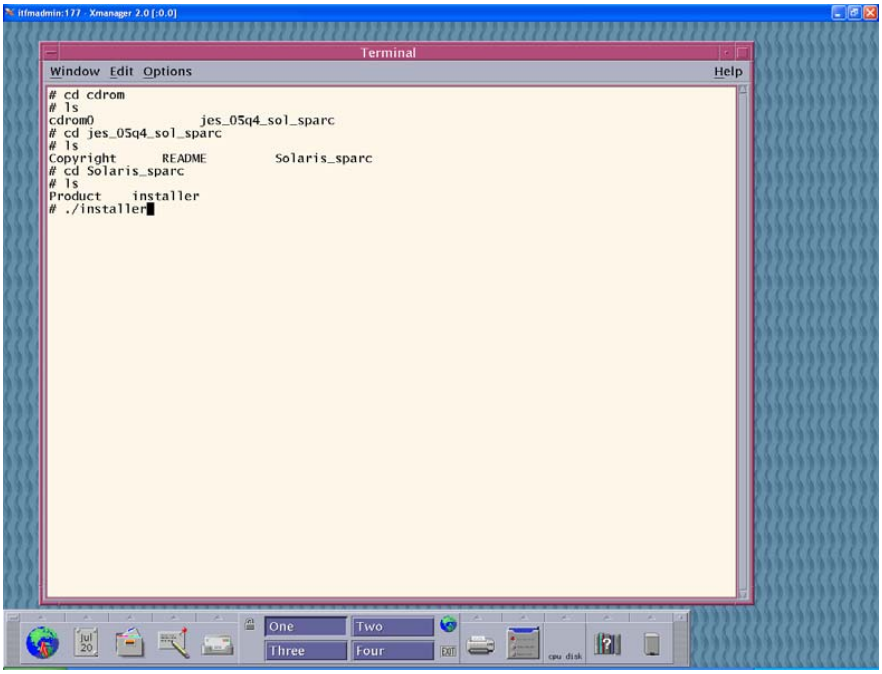
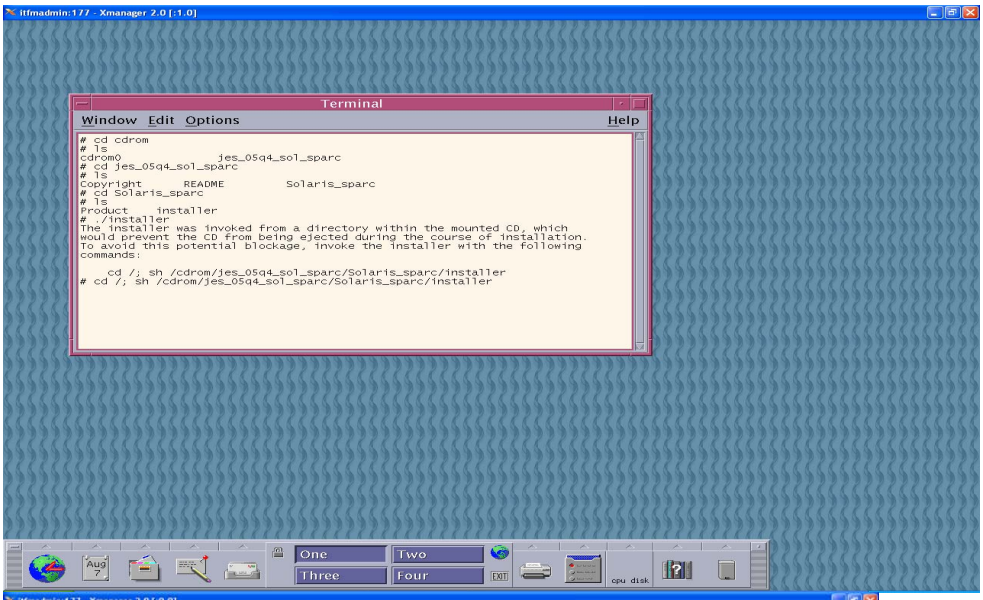
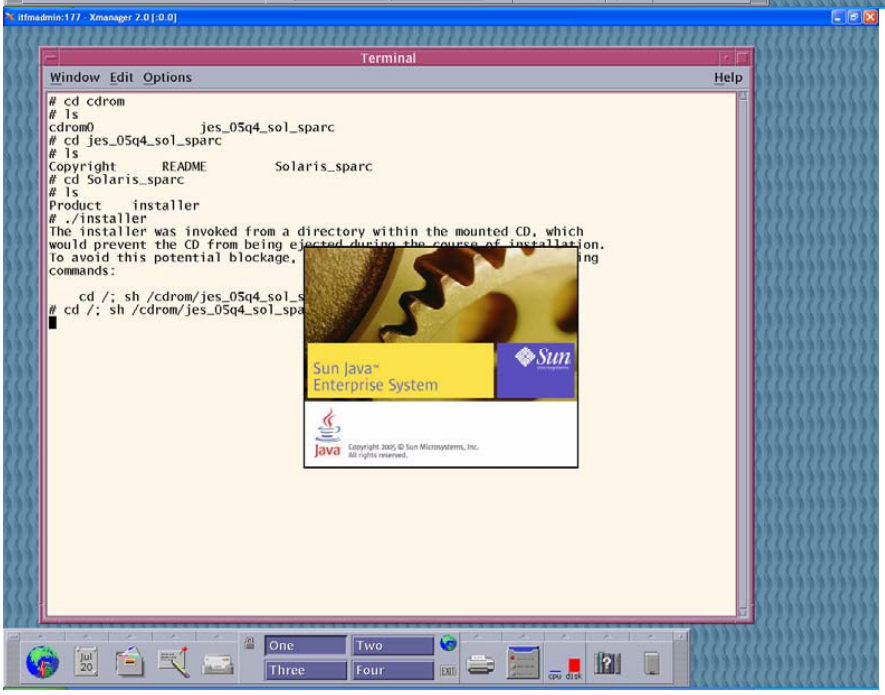
Appendix A

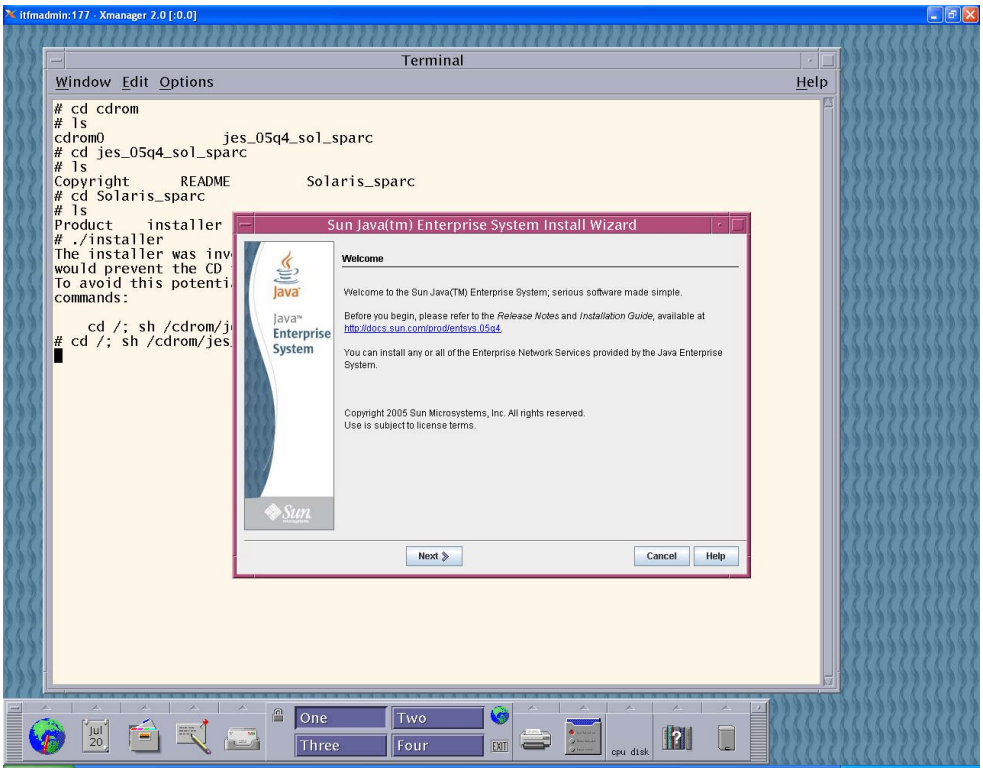
Mail Server Installation

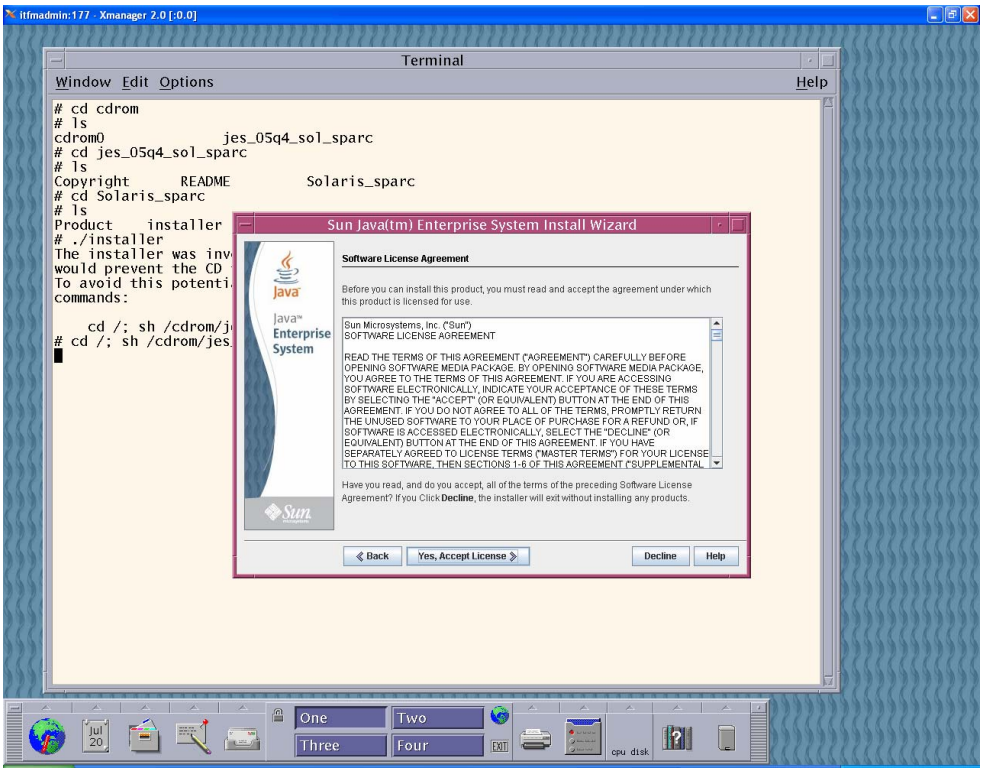
The following screens will give a guide for the installation steps of Sun Java Enterprise Messaging Server.

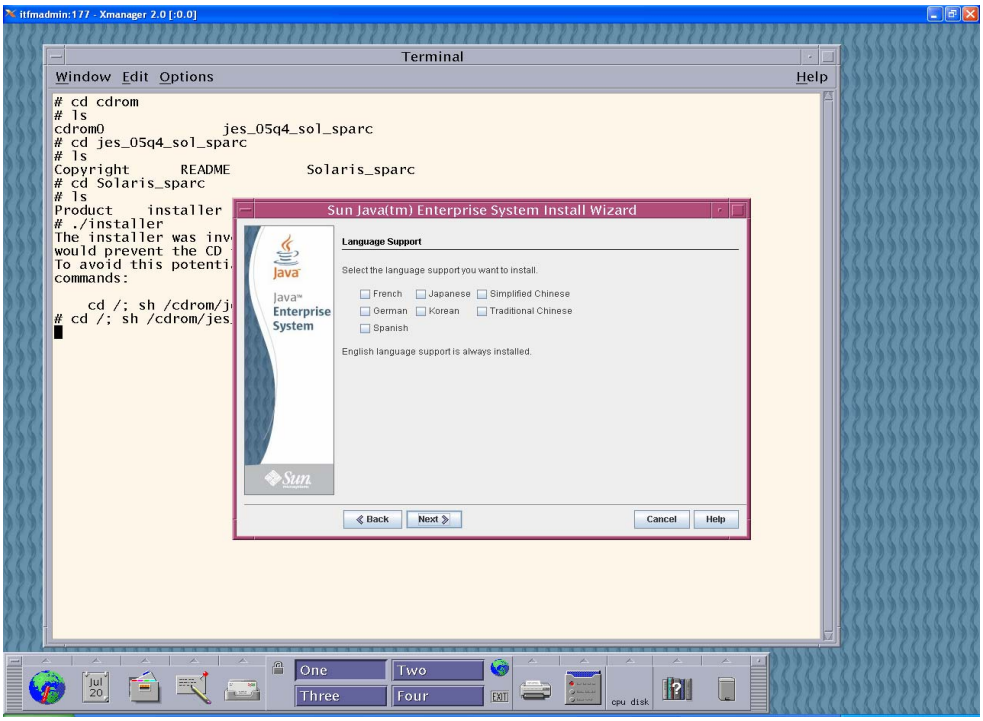


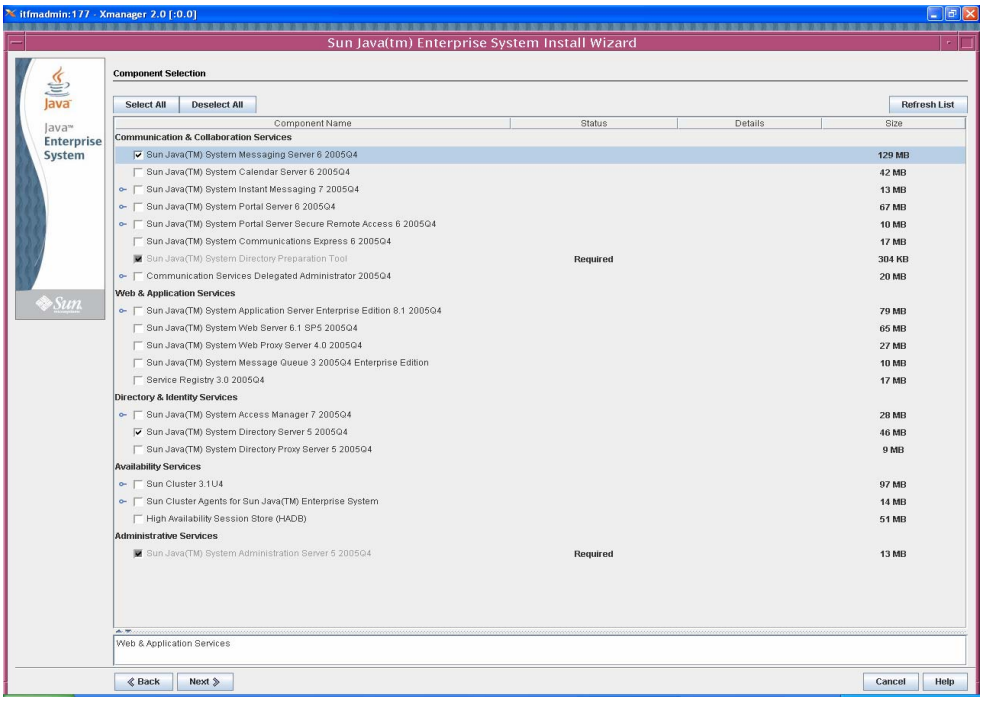

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was invoked from a directory within the mounted CD, which
would prevent the CD from being ejected during the course of installation.
To avoid this potential blockage, invoke the installer with the following
commands:
cd /; sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
cd /; sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
One
Two
Three
Four
EXIT
cpu disk

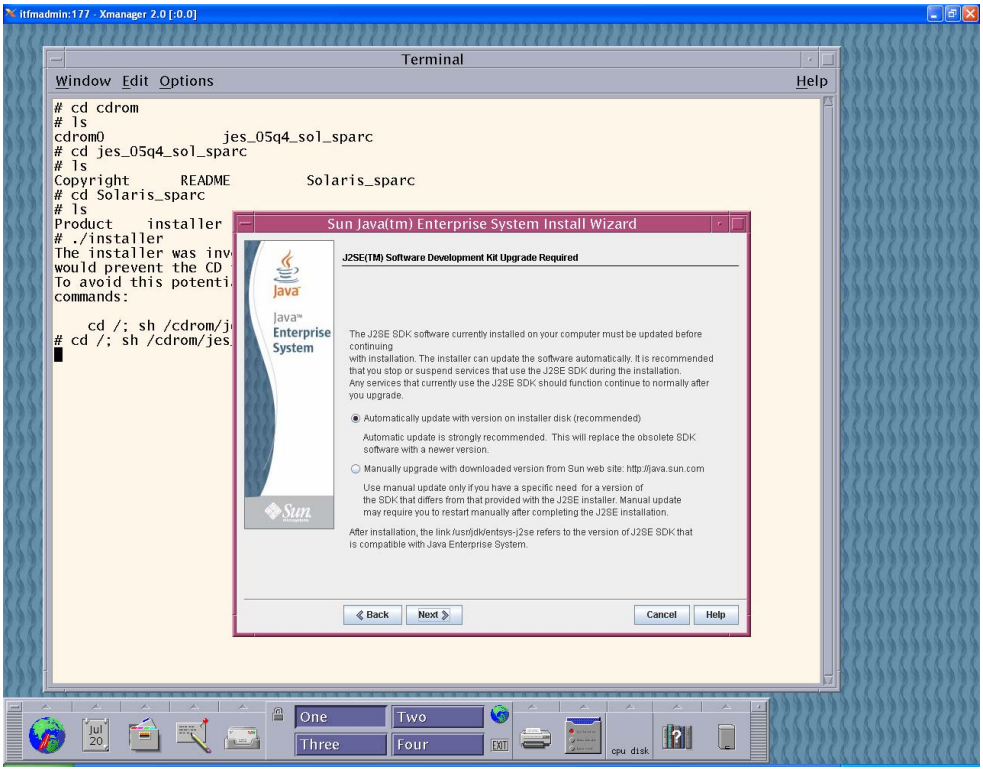

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was invoked from a directory within the mounted CD, which
commands:
Sun Java™
Enterprise System
Sun
Java
One
Two
Three
Four
EXIT
cpu disk

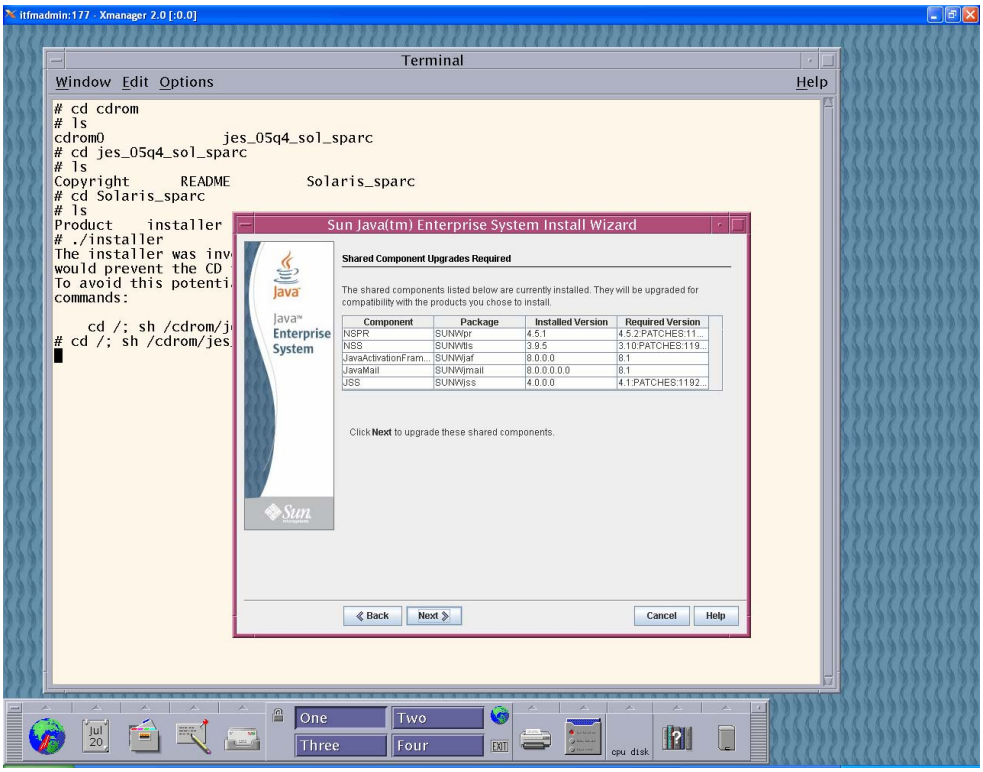

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Welcome
Welcome to the Sun Java(TM) Enterprise System; serious software made simple.
Before you begin, please refer to the Release Notes and Installation Guide, available at http://docs.sun.com/prod/entsys.05q4.
You can install any or all of the Enterprise Network Services provided by the Java Enterprise System.
Copyright 2005 Sun Microsystems, Inc. All rights reserved.
Use is subject to license terms.
Java
Java™ Enterprise System
Sun
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

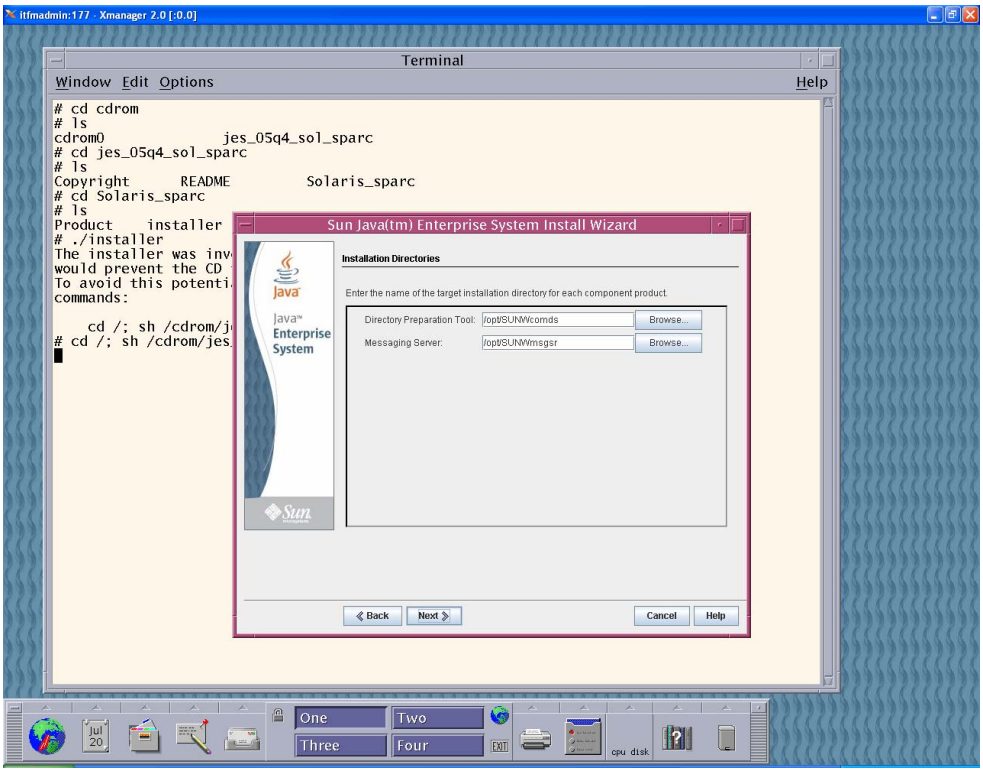

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Software License Agreement
Before you can install this product, you must read and accept the agreement under which this product is licensed for use.
Sun Microsystems, Inc. ("Sun")
SOFTWARE LICENSE AGREEMENT
READ THE TERMS OF THIS AGREEMENT ("AGREEMENT") CAREFULLY BEFORE OPENING SOFTWARE MEDIA PACKAGE. BY OPENING SOFTWARE MEDIA PACKAGE, YOU AGREE TO THE TERMS OF THIS AGREEMENT. IF YOU ARE ACCESSING SOFTWARE ELECTRONICALLY, INDICATE YOUR ACCEPTANCE OF THESE TERMS BY SELECTING THE "ACCEPT" (OR EQUIVALENT) BUTTON AT THE END OF THIS AGREEMENT. IF YOU DO NOT AGREE TO ALL OF THE TERMS, PROMPTLY RETURN THE UNUSED SOFTWARE TO YOUR PLACE OF PURCHASE FOR A REFUND OR, IF SOFTWARE IS ACCESSED ELECTRONICALLY, SELECT THE "DECLINE" (OR EQUIVALENT) BUTTON AT THE END OF THIS AGREEMENT. IF YOU HAVE SEPARATELY AGREED TO LICENSE TERMS ("MASTER TERMS") FOR YOUR LICENSE TO THIS SOFTWARE, THEN SECTIONS 1-6 OF THIS AGREEMENT ("SUPPLEMENTAL
Have you read, and do you accept, all of the terms of the preceding Software License Agreement? If you Click Decline, the installer will exit without installing any products.
Back
Yes, Accept License
Decline
Help
Sun
One
Two
Three
Four
EXIT
cpu disk

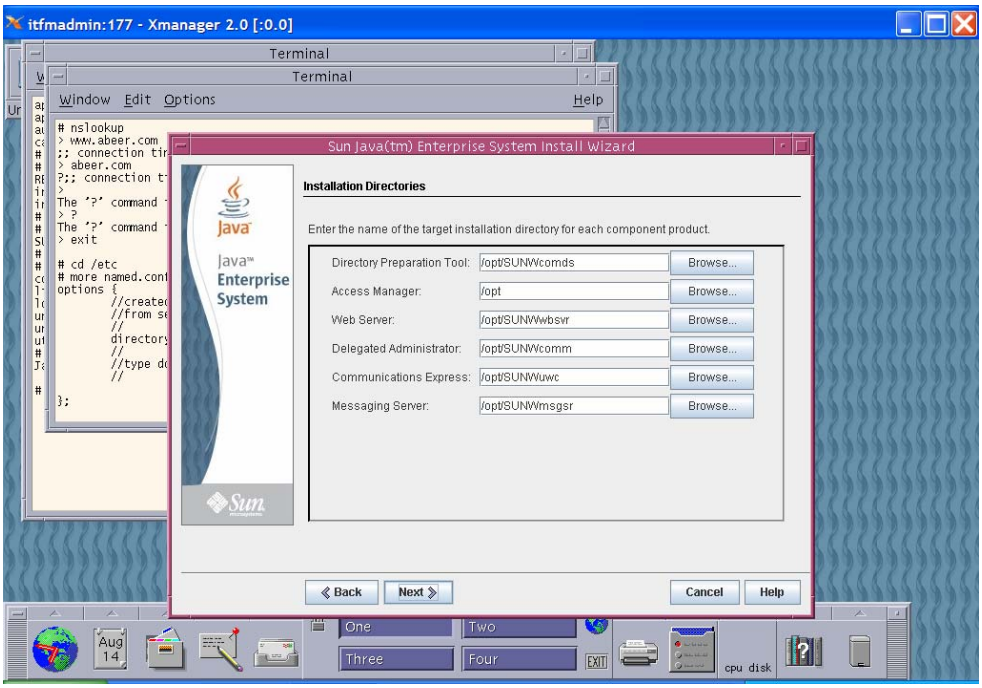

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Language Support
Select the language support you want to install.
French
Japanese
Simplified Chinese
German
Korean
Traditional Chinese
Spanish
English language support is always installed.
Back
Next
Cancel
Help
One
Two
Three
Four

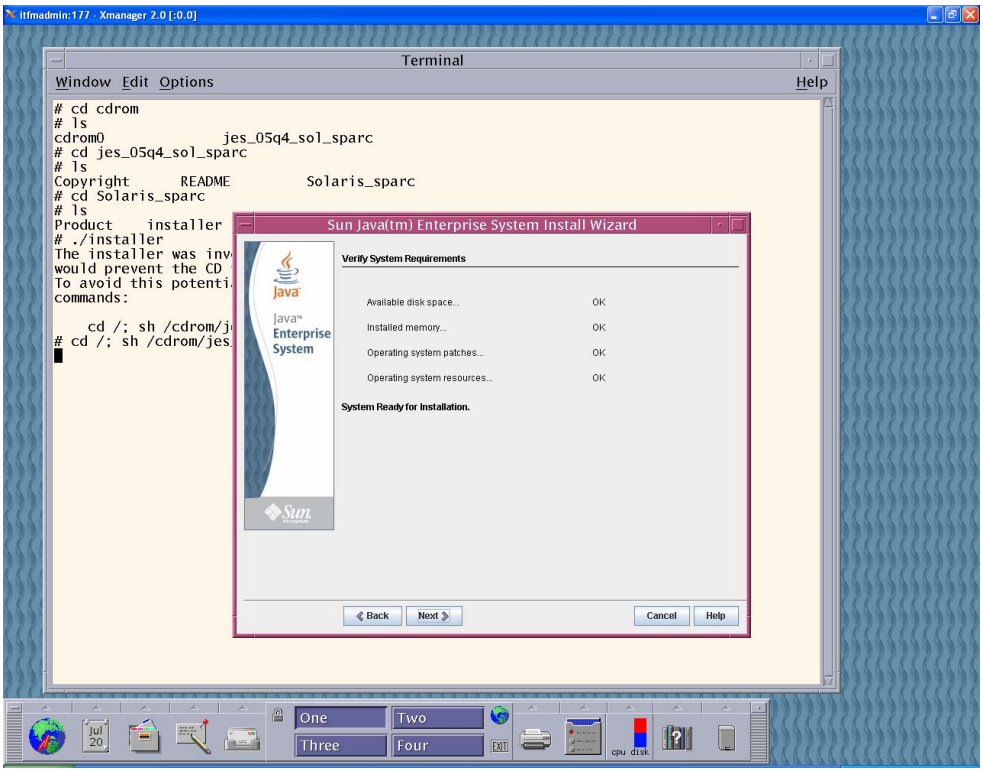

itfmadmin:177 - Xmanager 2.0 [:0.0]
Sun Java(tm) Enterprise System Install Wizard
Component Selection
Select All
Deselect All
Refresh List
Component Name
Status
Details
Size
Communication & Collaboration Services
Sun Java(TM) System Messaging Server 6 2005Q4 129 MB
Sun Java(TM) System Calendar Server 6 2005Q4 42 MB
Sun Java(TM) System Instant Messaging 7 2005Q4 13 MB
Sun Java(TM) System Portal Server 6 2005Q4 67 MB
Sun Java(TM) System Portal Server Secure Remote Access 6 2005Q4 10 MB
Sun Java(TM) System Communications Express 6 2005Q4 17 MB
Sun Java(TM) System Directory Preparation Tool Required 304 KB
Communication Services Delegated Administrator 2005Q4 20 MB
Web & Application Services
Sun Java(TM) System Application Server Enterprise Edition 8.1 2005Q4 79 MB
Sun Java(TM) System Web Server 6.1 SP5 2005Q4 65 MB
Sun Java(TM) System Web Proxy Server 4.0 2005Q4 27 MB
Sun Java(TM) System Message Queue 3 2005Q4 Enterprise Edition 10 MB
Service Registry 3.0 2005Q4 17 MB
Directory & Identity Services
Sun Java(TM) System Access Manager 7 2005Q4 28 MB
Sun Java(TM) System Directory Server 5 2005Q4 46 MB
Sun Java(TM) System Directory Proxy Server 5 2005Q4 9 MB
Availability Services
Sun Cluster 3.1U4 97 MB
Sun Cluster Agents for Sun Java(TM) Enterprise System 14 MB
High Availability Session Store (HADB) 51 MB
Administrative Services
Sun Java(TM) System Administration Server 5 2005Q4 Required 13 MB
Web & Application Services
Back
Next
Cancel
Help

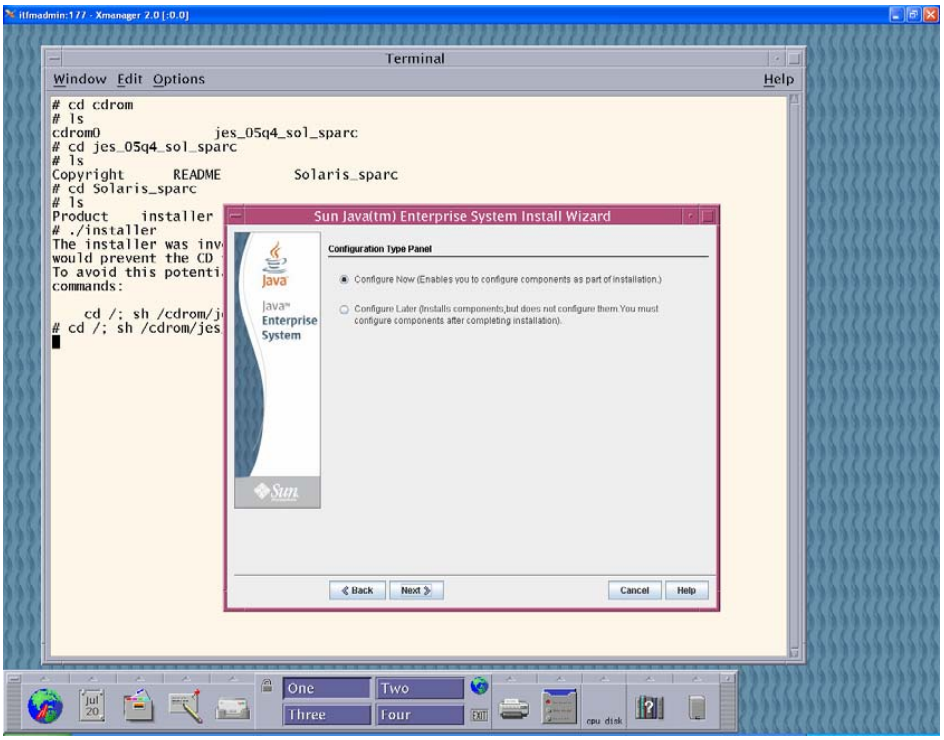

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
J2SE(TM) Software Development Kit Upgrade Required
The J2SE SDK software currently installed on your computer must be updated before continuing
with installation. The installer can update the software automatically. It is recommended that you stop or suspend services that use the J2SE SDK during the installation.
Any services that currently use the J2SE SDK should function continue to normally after you upgrade.
Automatically update with version on installer disk (recommended)
Automatic update is strongly recommended. This will replace the obsolete SDK software with a newer version.
Manually upgrade with downloaded version from Sun web site: http://java.sun.com
Use manual update only if you have a specific need for a version of the SDK that differs from that provided with the J2SE installer. Manual update may require you to restart manually after completing the J2SE installation.
After installation, the link /usr/jdk/entsys-j2se refers to the version of J2SE SDK that is compatible with Java Enterprise System.
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk


itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Shared Component Upgrades Required
The shared components listed below are currently installed. They will be upgraded for compatibility with the products you chose to install.
Component | Package | Installed Version | Required Version
NSPR | SUNWpr | 4.5.1 | 4.5.2:PATCHES:11...
NSS | SUNWtls | 3.9.5 | 3.10:PATCHES:119...
JavaActivationFram... | SUNWjaf | 8.0.0.0 | 8.1
JavaMail | SUNWjmail | 8.0.0.0.0.0 | 8.1
JSS | SUNWjss | 4.0.0.0 | 4.1:PATCHES:1192...
Click Next to upgrade these shared components.
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk


itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Installation Directories
Enter the name of the target installation directory for each component product.
Directory Preparation Tool: /opt/SUNWcomds
Messaging Server: /opt/SUNWmsgsr
Browse...
Browse...
Java
Java™ Enterprise System
Sun
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk
Jul 20


itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Terminal
Window Edit Options Help
nslookup
> www.abeer.com
;; connection tir
> abeer.com
P;; connection t
>
The '?' command
> ?
The '?' command
> exit
# cd /etc
# more named.conf
options {
//create
//from se
//
directory
//
//type do
//
};
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Sun
Installation Directories
Enter the name of the target installation directory for each component product.
Directory Preparation Tool: /opt/SUNWcomds Browse...
Access Manager: /opt Browse...
Web Server: /opt/SUNWwbsvr Browse...
Delegated Administrator: /opt/SUNWcomm Browse...
Communications Express: /opt/SUNWuwc Browse...
Messaging Server: /opt/SUNWmsgsr Browse...
Back
Next
Cancel
Help
Aug 14
One
Two
Three
Four
EXIT
cpu disk


itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Verify System Requirements
Available disk space... OK
Installed memory... OK
Operating system patches... OK
Operating system resources... OK
System Ready for Installation.
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk


itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
Sun Java(tm) Enterprise System Install Wizard
Configuration Type Panel
Configure Now (Enables you to configure components as part of installation.)
Configure Later (Installs components,but does not configure them.You must configure components after completing installation).
Back
Next
Cancel
Help
One
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Three
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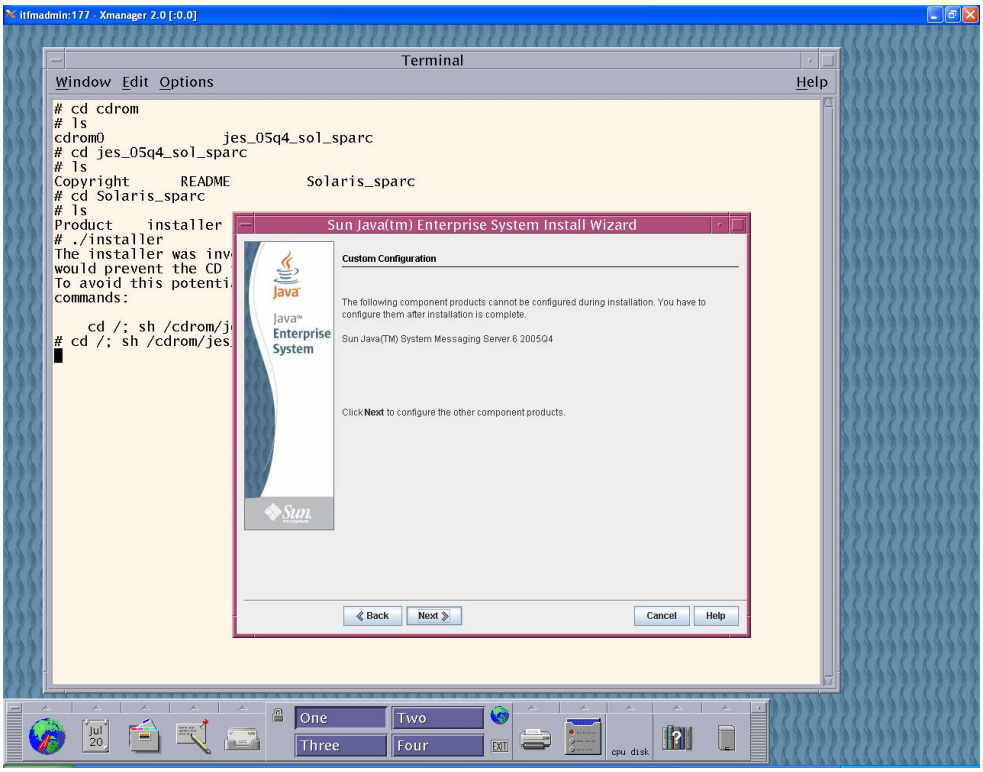
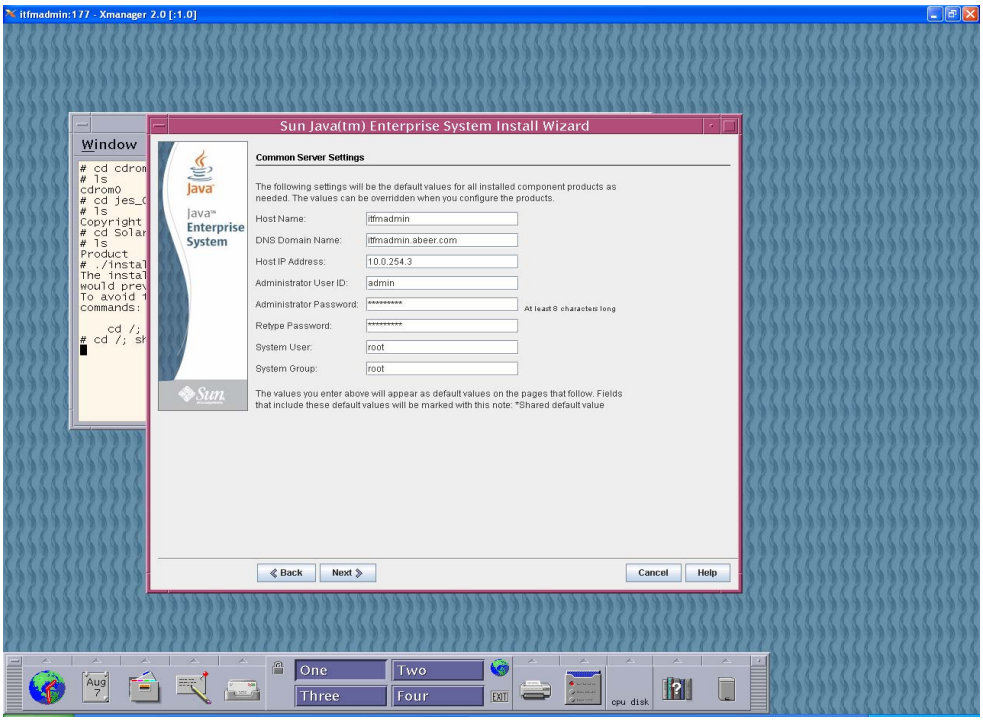
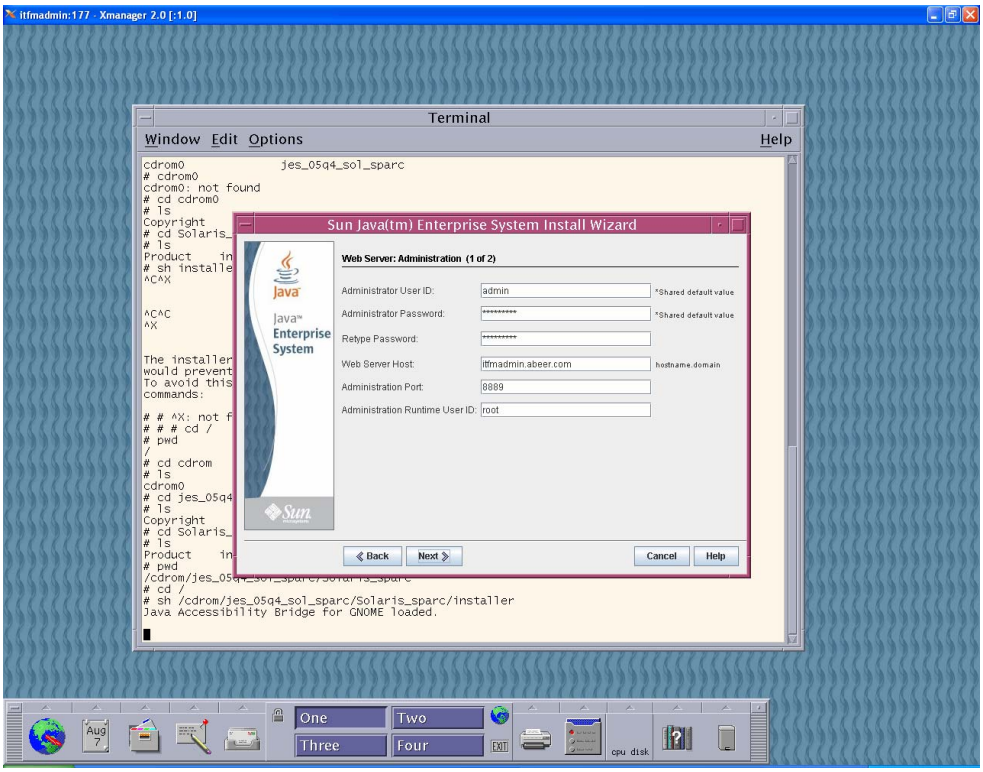
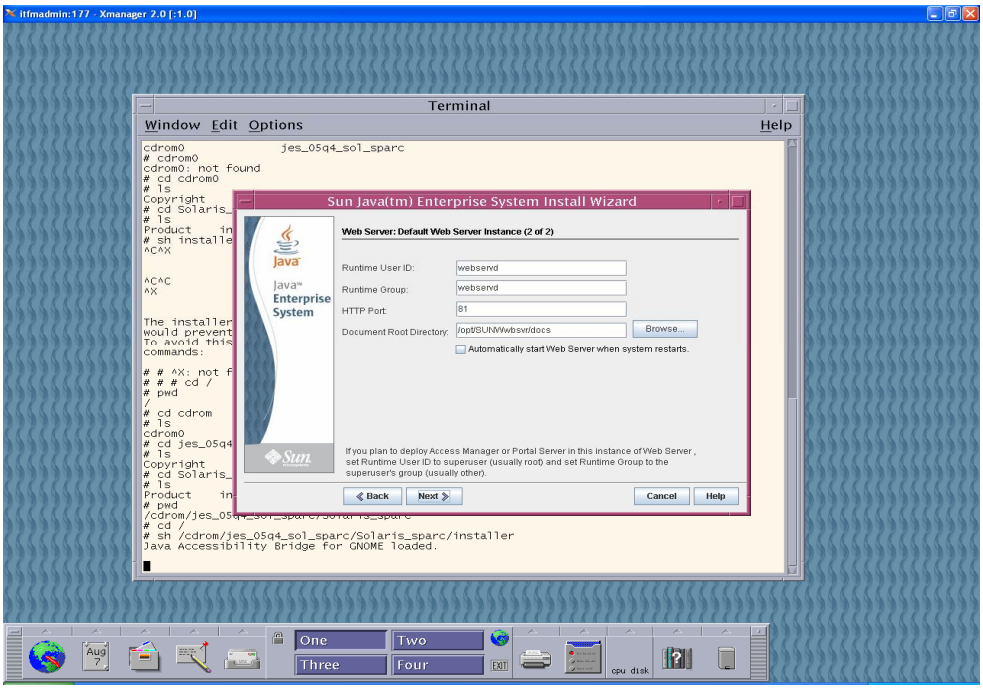
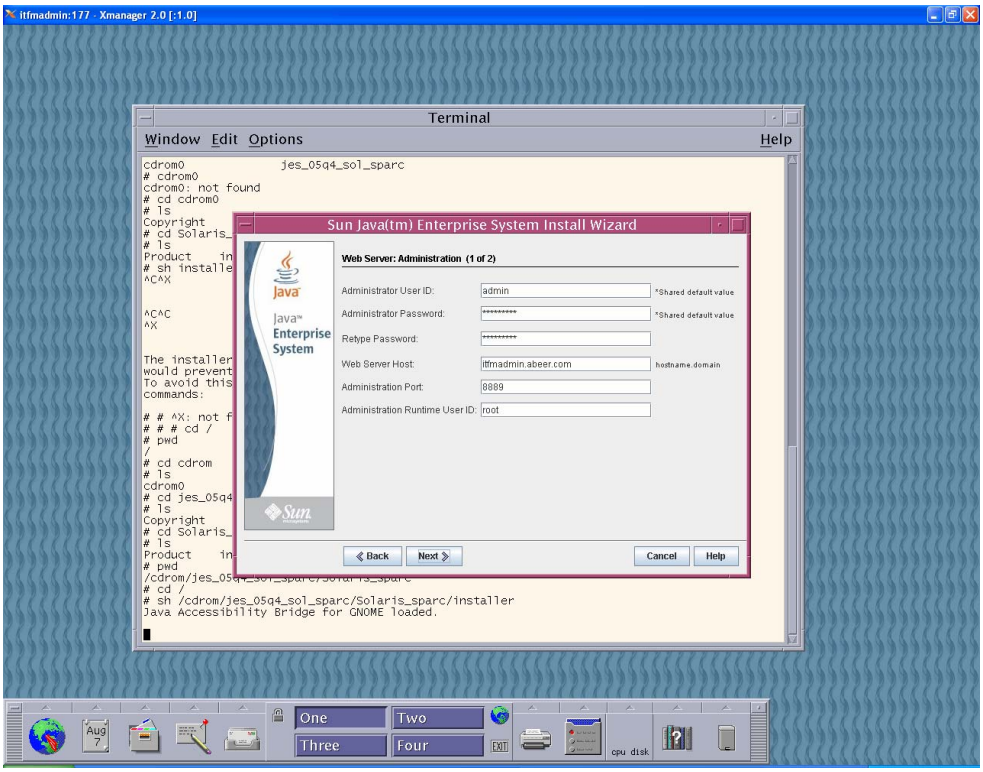
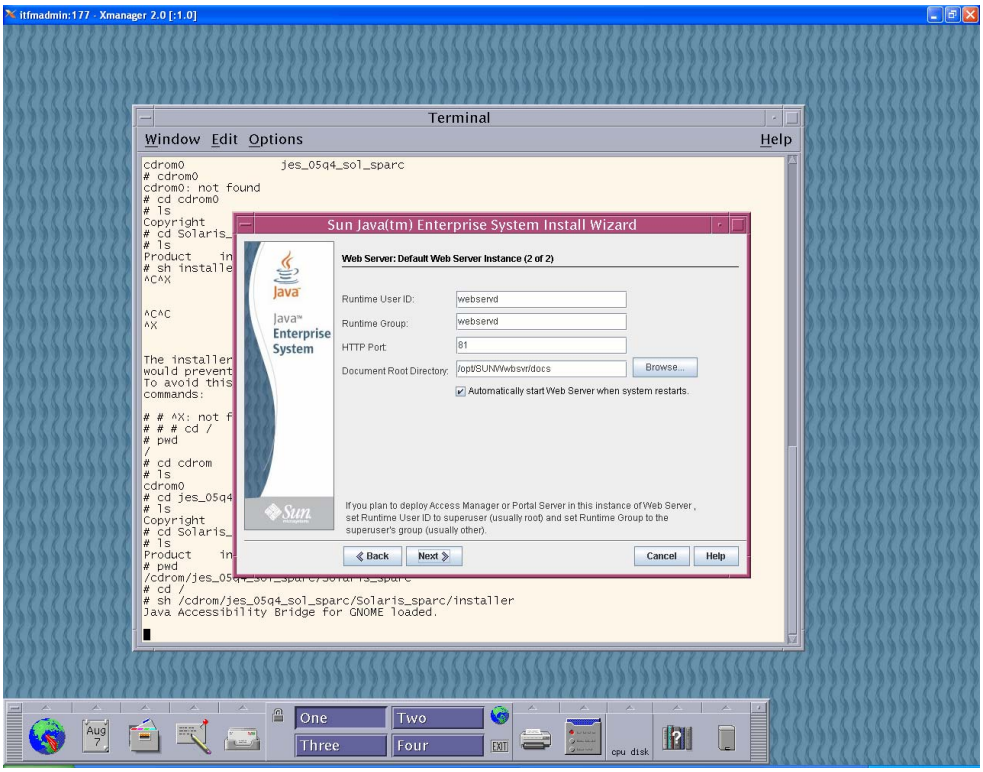

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options
Help
cd cdrom
ls
cdrom0 jes_05q4_sol_sparc
cd jes_05q4_sol_sparc
ls
Copyright README Solaris_sparc
cd Solaris_sparc
ls
Product installer
./installer
The installer was inv
would prevent the CD
To avoid this potenti
commands:
cd /; sh /cdrom/j
cd /; sh /cdrom/jes
Sun Java(tm) Enterprise System Install Wizard
Custom Configuration
The following component products cannot be configured during installation. You have to configure them after installation is complete.
Sun Java(TM) System Messaging Server 6 2005Q4
Click Next to configure the other component products.
Java
Java™ Enterprise System
Sun
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

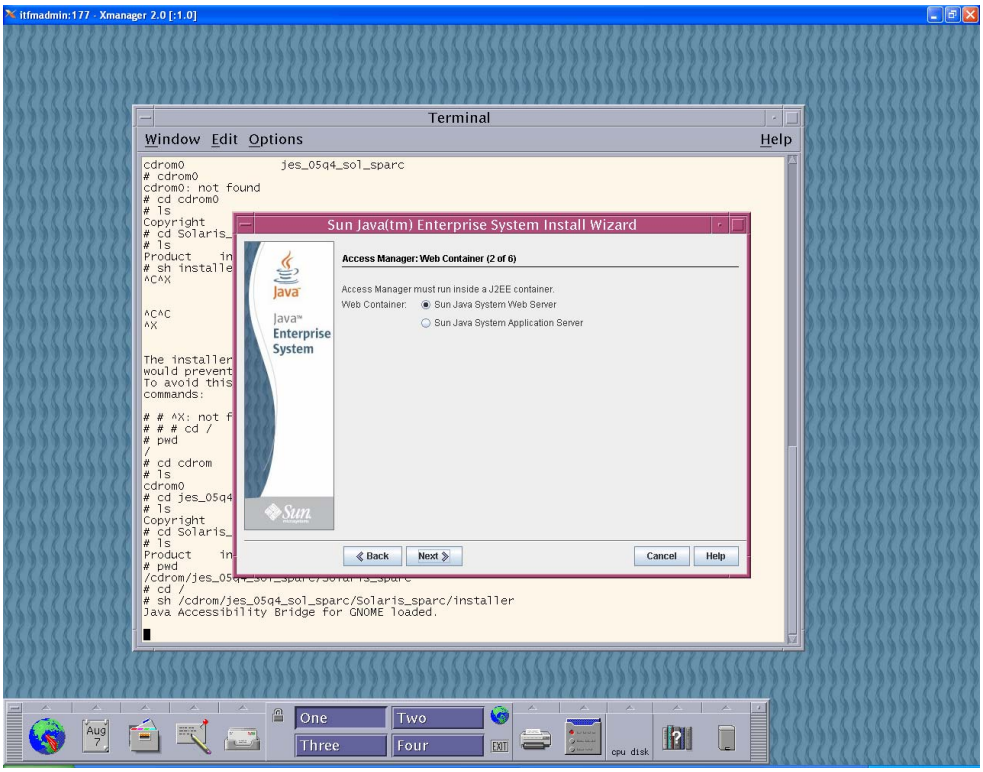

itfmadmin:177 - Xmanager 2.0 [:1.0]
Window
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Common Server Settings
The following settings will be the default values for all installed component products as needed. The values can be overridden when you configure the products.
Host Name: itfmadmin
DNS Domain Name: itfmadmin.abeer.com
Host IP Address: 10.0.254.3
Administrator User ID: admin
Administrator Password: *********
At least 8 characters long
Retype Password: *********
System User: root
System Group: root
The values you enter above will appear as default values on the pages that follow. Fields that include these default values will be marked with this note: *Shared default value
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

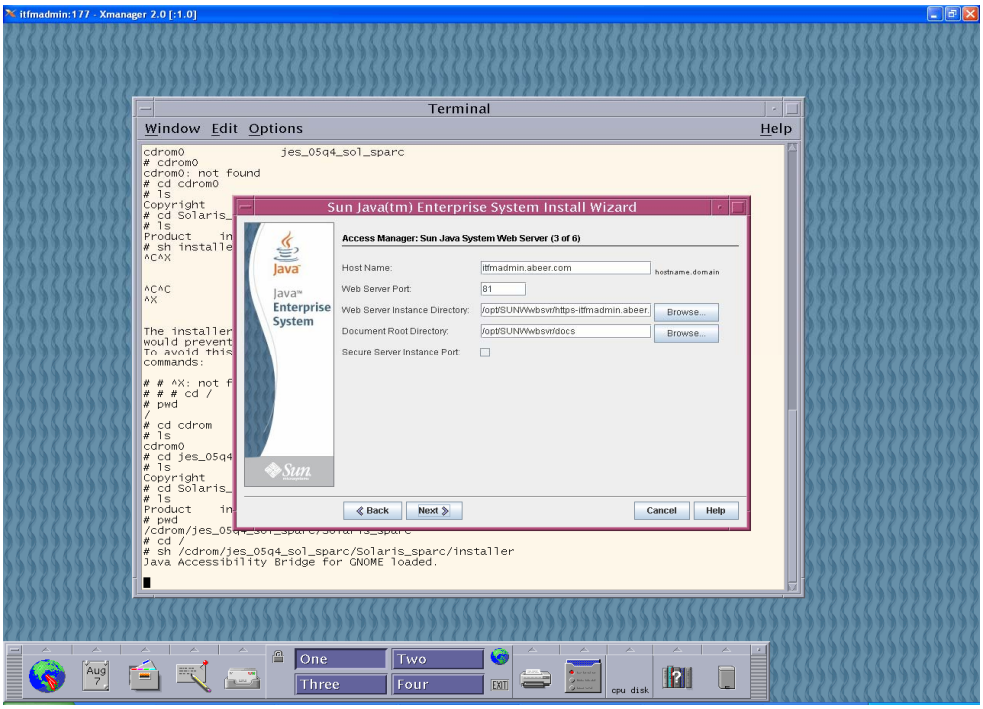

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Web Server: Administration (1 of 2)
Administrator User ID:
admin
*Shared default value
Administrator Password:
*Shared default value
Retype Password:
Web Server Host:
itfmadmin.abeer.com
hostname.domain
Administration Port:
8889
Administration Runtime User ID:
root
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

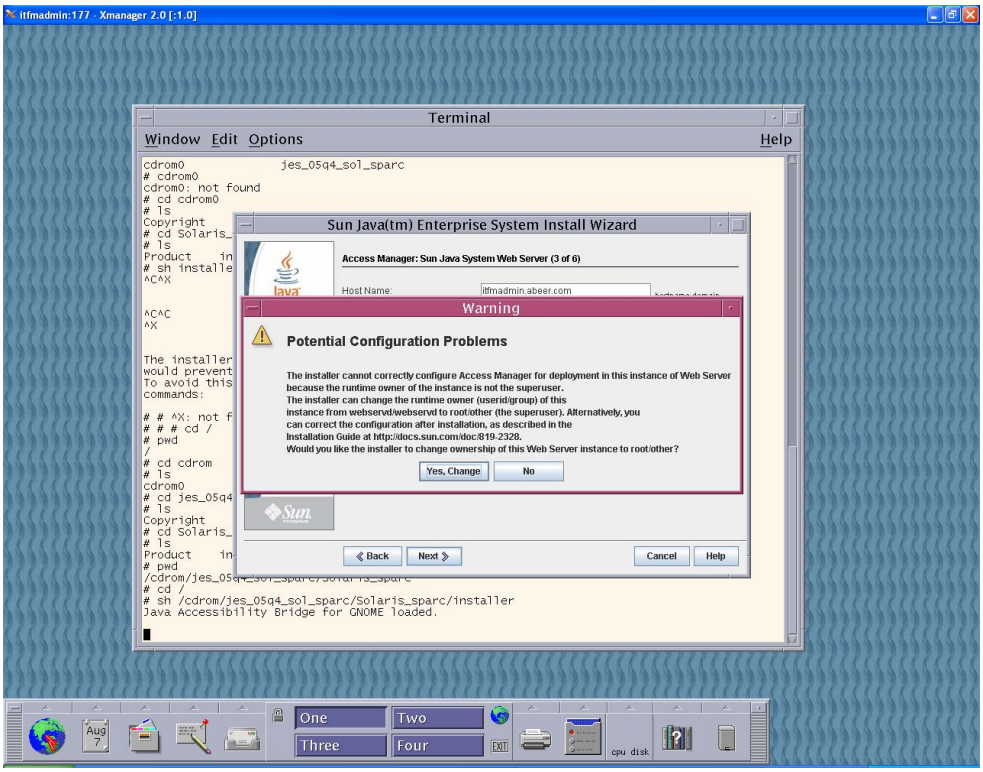

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Web Server: Default Web Server Instance (2 of 2)
Runtime User ID:
webservd
Runtime Group:
webservd
HTTP Port:
81
Document Root Directory:
/opt/SUNWwbsvr/docs
Browse...
Automatically start Web Server when system restarts.
If you plan to deploy Access Manager or Portal Server in this instance of Web Server, set Runtime User ID to superuser (usually root) and set Runtime Group to the superuser's group (usually other).
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

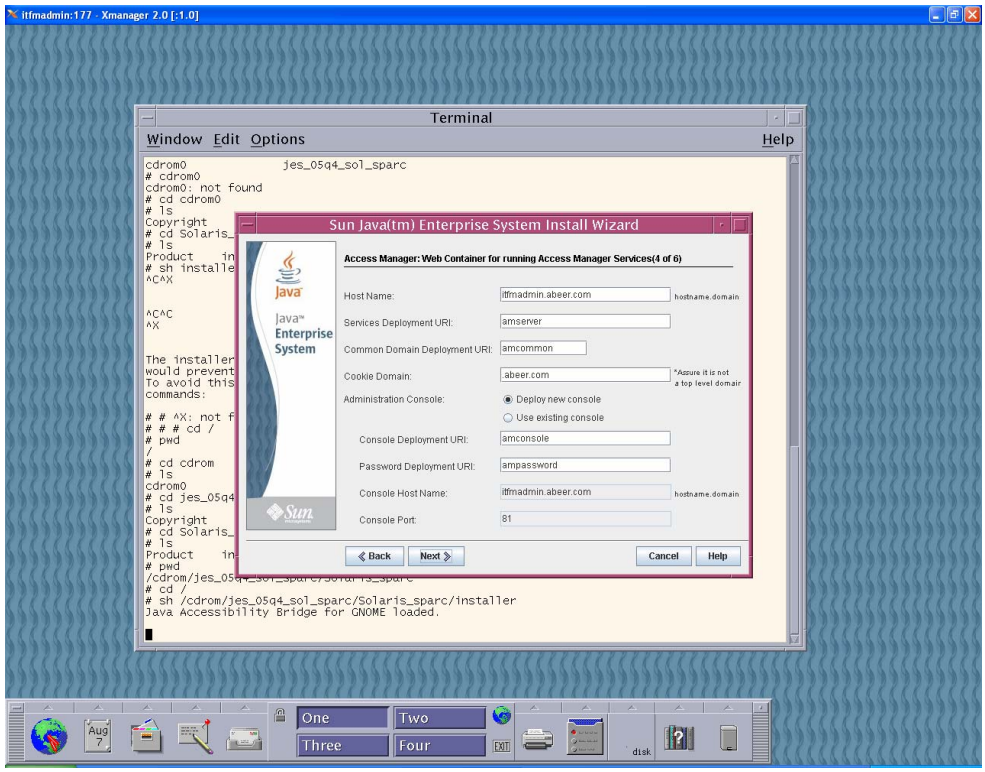

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Web Server: Administration (1 of 2)
Administrator User ID:
admin
*Shared default value
Administrator Password:
*Shared default value
Retype Password:
Web Server Host:
itfmadmin.abeer.com
hostname.domain
Administration Port:
8889
Administration Runtime User ID:
root
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

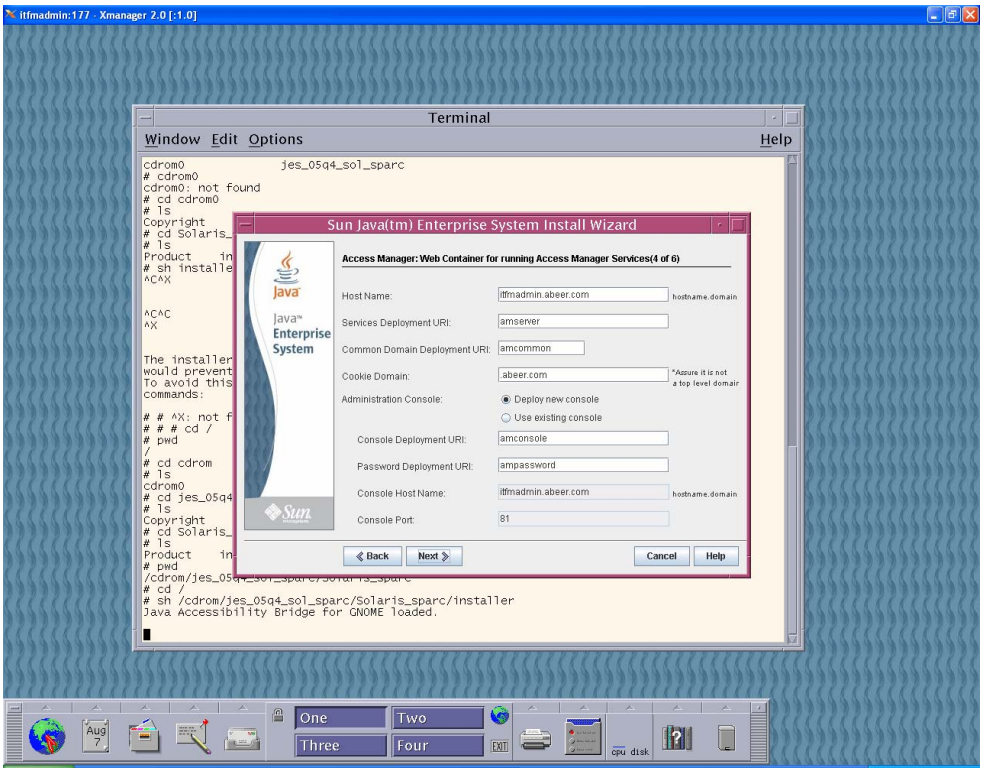

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Web Server: Default Web Server Instance (2 of 2)
Runtime User ID:
webservd
Runtime Group:
webservd
HTTP Port:
81
Document Root Directory:
/opt/SUNWwbsvr/docs
Browse...
Automatically start Web Server when system restarts.
If you plan to deploy Access Manager or Portal Server in this instance of Web Server, set Runtime User ID to superuser (usually root) and set Runtime Group to the superuser's group (usually other).
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

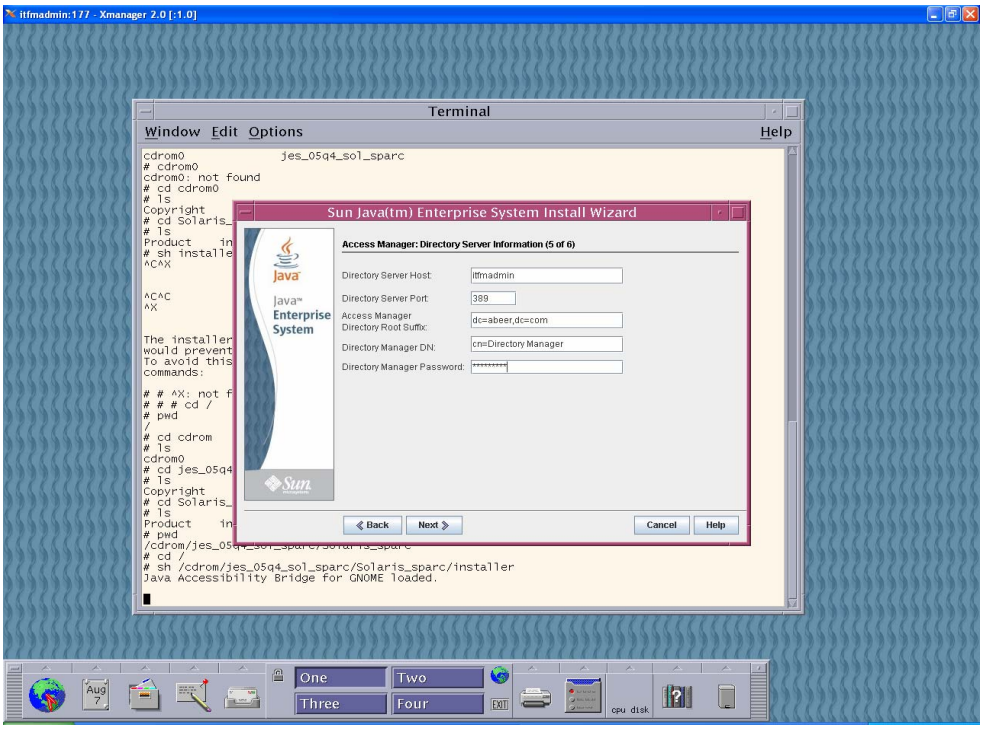

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Java
Java™ Enterprise System
Sun
Access Manager: Web Container (2 of 6)
Access Manager must run inside a J2EE container.
Web Container:
Sun Java System Web Server
Sun Java System Application Server
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

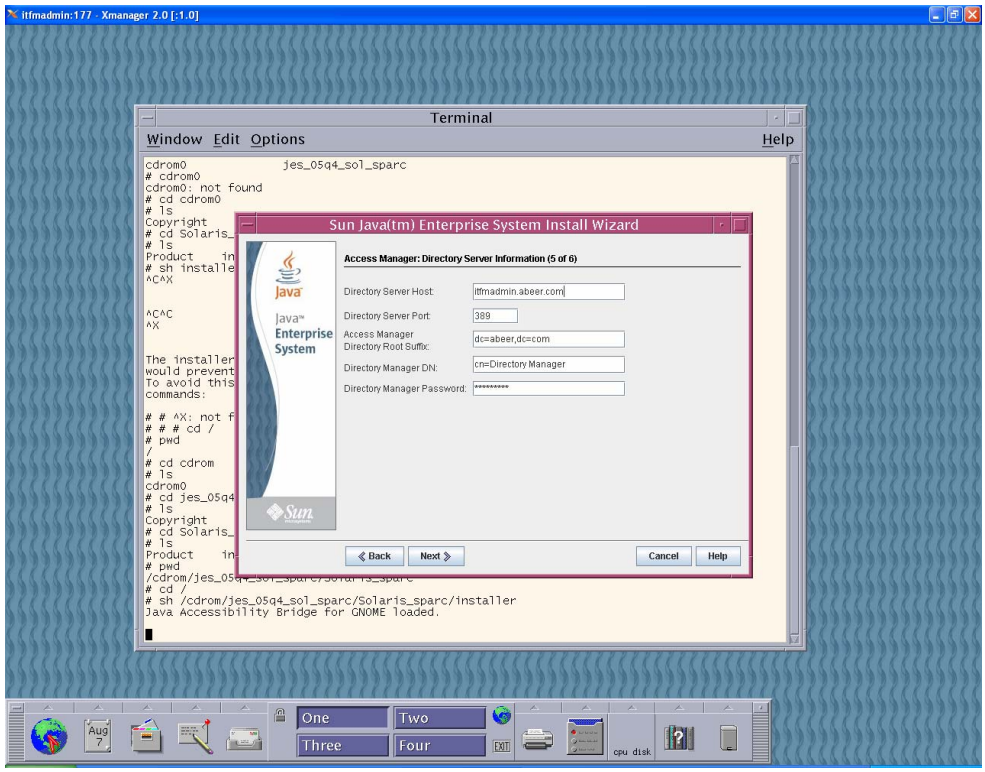

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
/cdrom/jes_05q4_sol_sparc/Solaris_sparc
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Sun Java System Web Server (3 of 6)
Java
Java™ Enterprise System
Host Name:
itfmadmin.abeer.com
hostname.domain
Web Server Port:
81
Web Server Instance Directory:
/opt/SUNWwbsvr/https-itfmadmin.abeer.
Browse...
Document Root Directory:
/opt/SUNWwbsvr/docs
Browse...
Secure Server Instance Port:
Back
Next
Cancel
Help
Sun
One
Two
Three
Four
EXIT
cpu disk

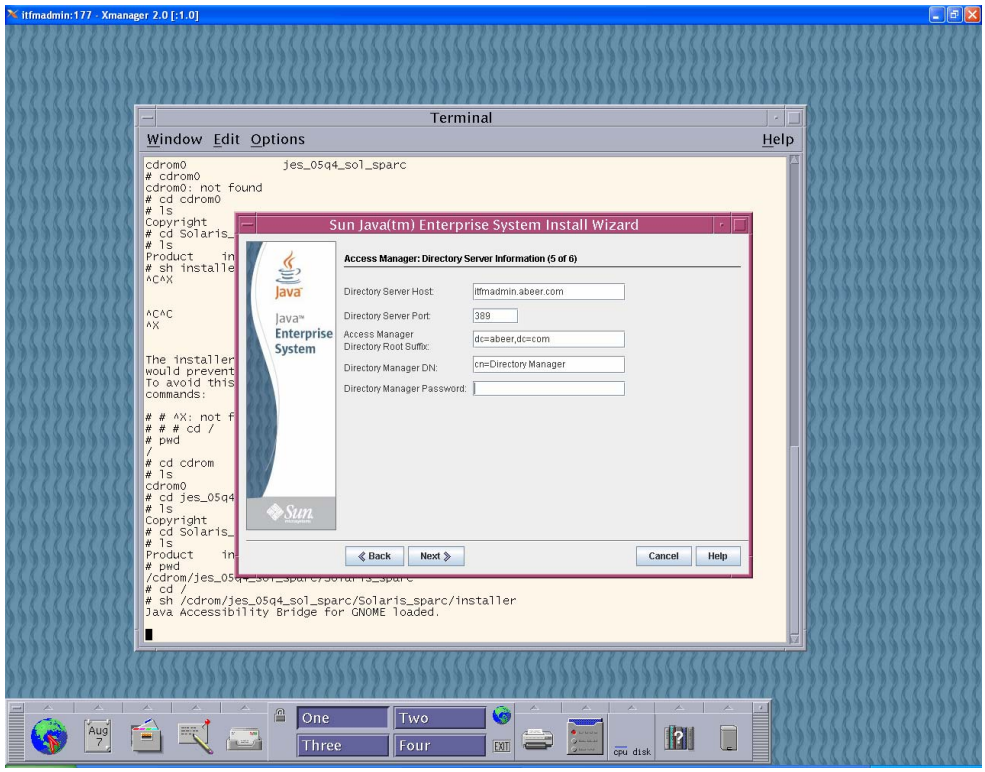

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Sun Java System Web Server (3 of 6)
Host Name:
itfmadmin.abeer.com
Warning
Potential Configuration Problems
The installer cannot correctly configure Access Manager for deployment in this instance of Web Server because the runtime owner of the instance is not the superuser.
The installer can change the runtime owner (userid/group) of this instance from webservd/webservd to root/other (the superuser). Alternatively, you can correct the configuration after installation, as described in the Installation Guide at http://docs.sun.com/doc/819-2328.
Would you like the installer to change ownership of this Web Server instance to root/other?
Yes, Change
No
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

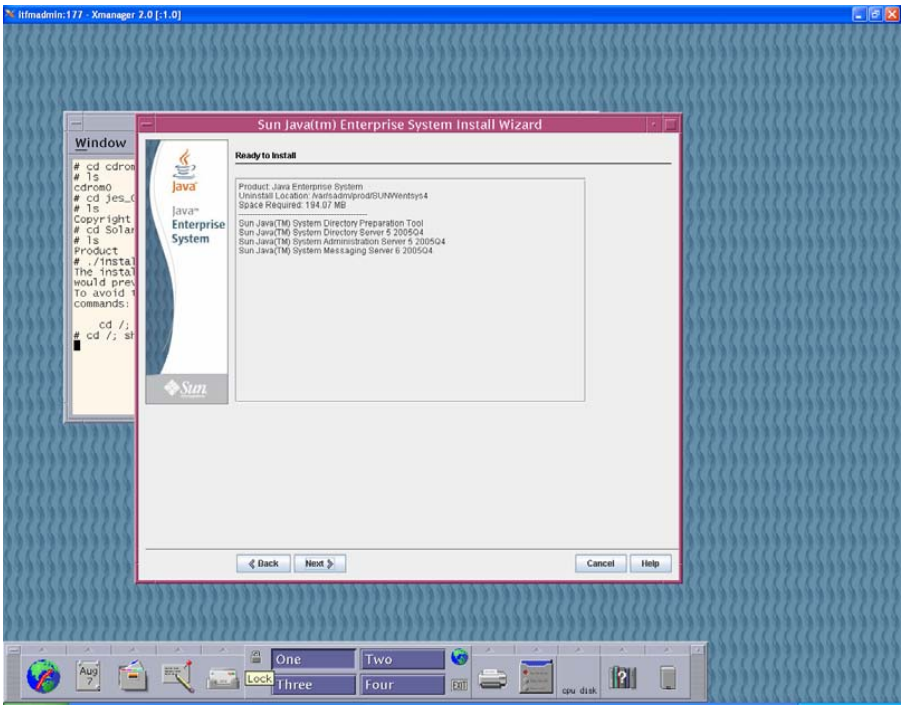

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Web Container for running Access Manager Services(4 of 6)
Host Name:
itfmadmin.abeer.com
hostname.domain
Services Deployment URI:
amserver
Common Domain Deployment URI:
amcommon
Cookie Domain:
.abeer.com
*Assure it is not a top level domain
Administration Console:
Deploy new console
Use existing console
Console Deployment URI:
amconsole
Password Deployment URI:
ampassword
Console Host Name:
itfmadmin.abeer.com
hostname.domain
Console Port:
81
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
disk

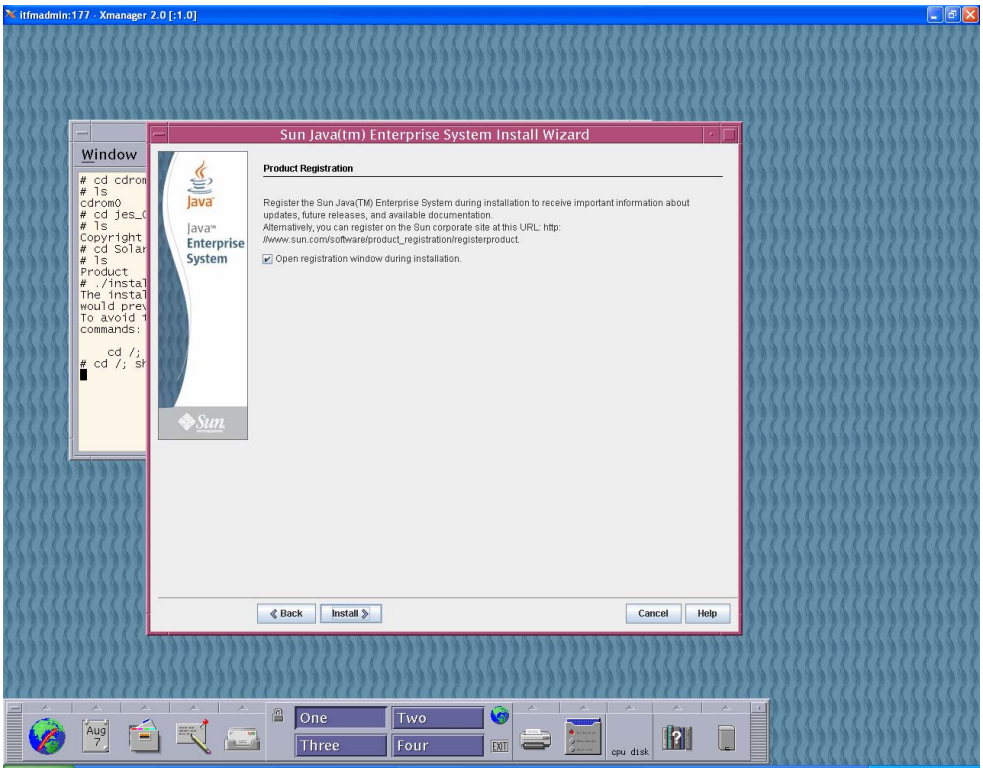

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Web Container for running Access Manager Services(4 of 6)
Host Name:
itfmadmin.abeer.com
hostname.domain
Services Deployment URI:
amserver
Common Domain Deployment URI:
amcommon
Cookie Domain:
.abeer.com
*Assure it is not a top level domain
Administration Console:
Deploy new console
Use existing console
Console Deployment URI:
amconsole
Password Deployment URI:
ampassword
Console Host Name:
itfmadmin.abeer.com
hostname.domain
Console Port:
81
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

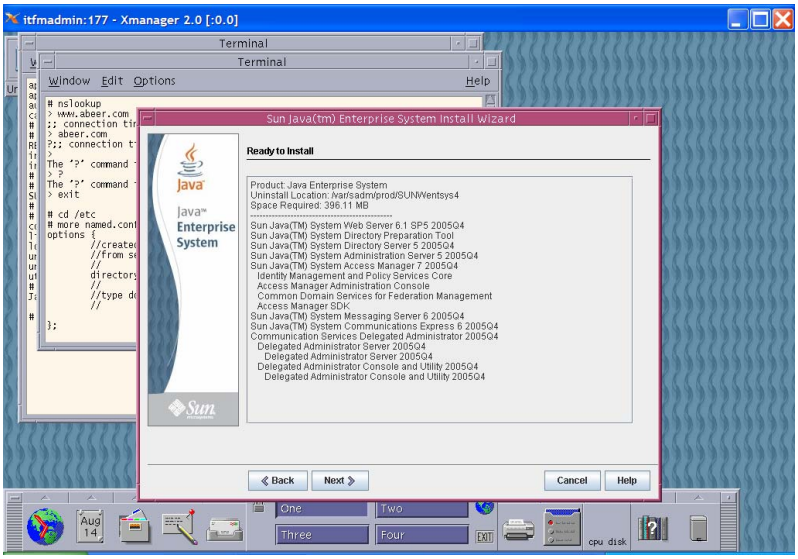

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
/cdrom/jes_05q4_sol_sparc/Solaris_sparc
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Directory Server Information (5 of 6)
Directory Server Host: itfmadmin
Directory Server Port: 389
Access Manager Directory Root Suffix: dc=abeer,dc=com
Directory Manager DN: cn=Directory Manager
Directory Manager Password: ********
Java
Java Enterprise System
Sun
Back
Next
Cancel
Help
One
Two
Three
Four
EXIT
cpu disk

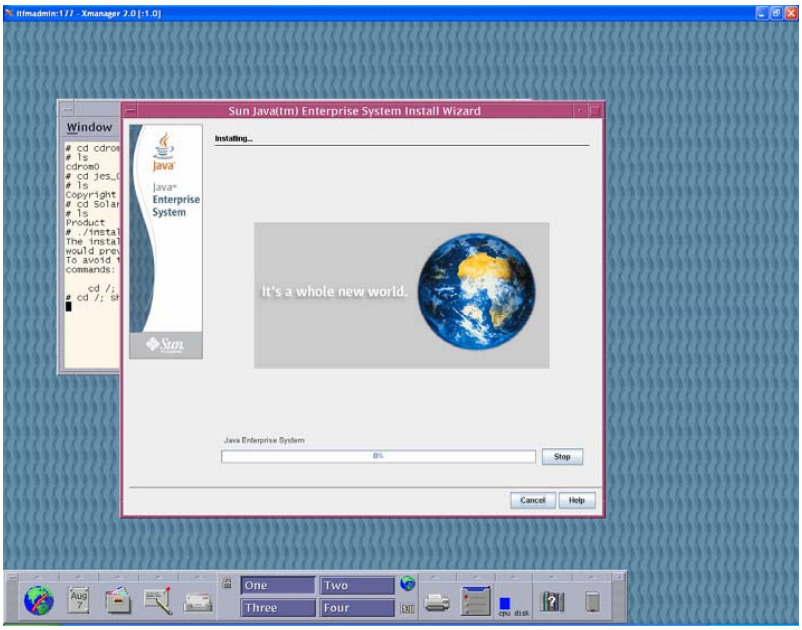

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Directory Server Information (5 of 6)
Directory Server Host: itfmadmin.abeer.com
Directory Server Port: 389
Access Manager Directory Root Suffix: dc=abeer,dc=com
Directory Manager DN: cn=Directory Manager
Directory Manager Password: *********
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

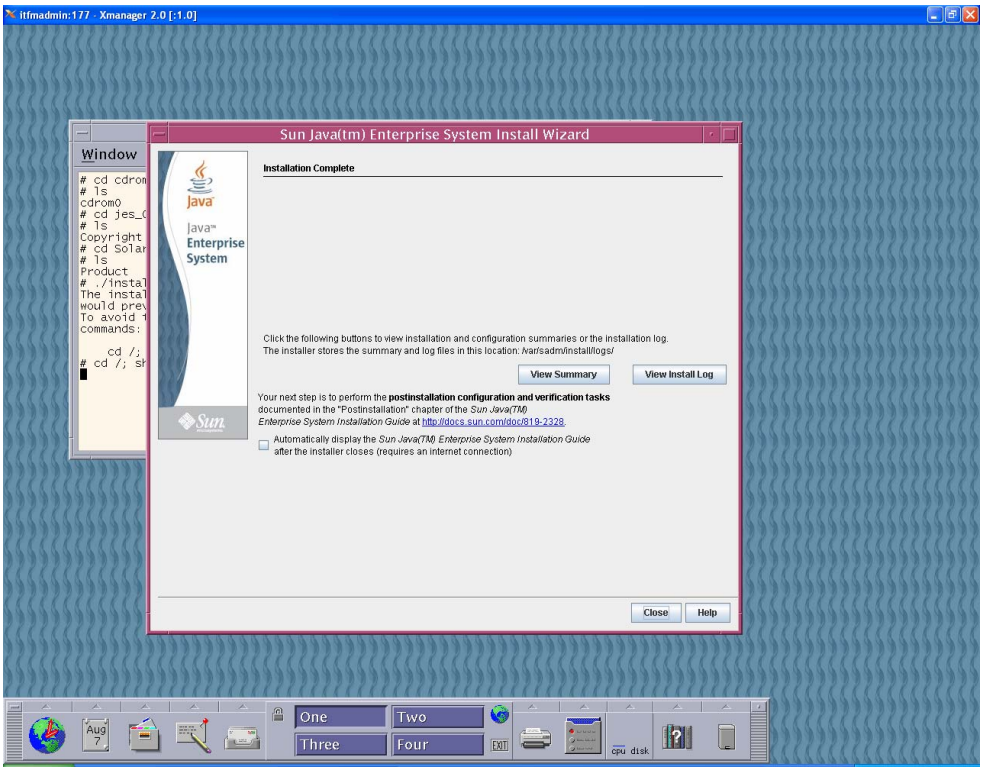

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options
Help
cdrom0 jes_05q4_sol_sparc
cdrom0
cdrom0: not found
cd cdrom0
ls
Copyright
cd Solaris_
ls
Product in
sh installe
^C^X
^C^C
^X
The installer
would prevent
To avoid this
commands:
^X: not f
cd /
pwd
/
cd cdrom
ls
cdrom0
cd jes_05q4
ls
Copyright
cd Solaris_
ls
Product in
pwd
cd /
sh /cdrom/jes_05q4_sol_sparc/Solaris_sparc/installer
Java Accessibility Bridge for GNOME loaded.
Sun Java(tm) Enterprise System Install Wizard
Access Manager: Directory Server Information (5 of 6)
Directory Server Host:
itfmadmin.abeer.com
Directory Server Port:
389
Access Manager Directory Root Suffix:
dc=abeer,dc=com
Directory Manager DN:
cn=Directory Manager
Directory Manager Password:
Back
Next
Cancel
Help
Java
Java™ Enterprise System
Sun
One
Two
Three
Four
EXIT
cpu disk

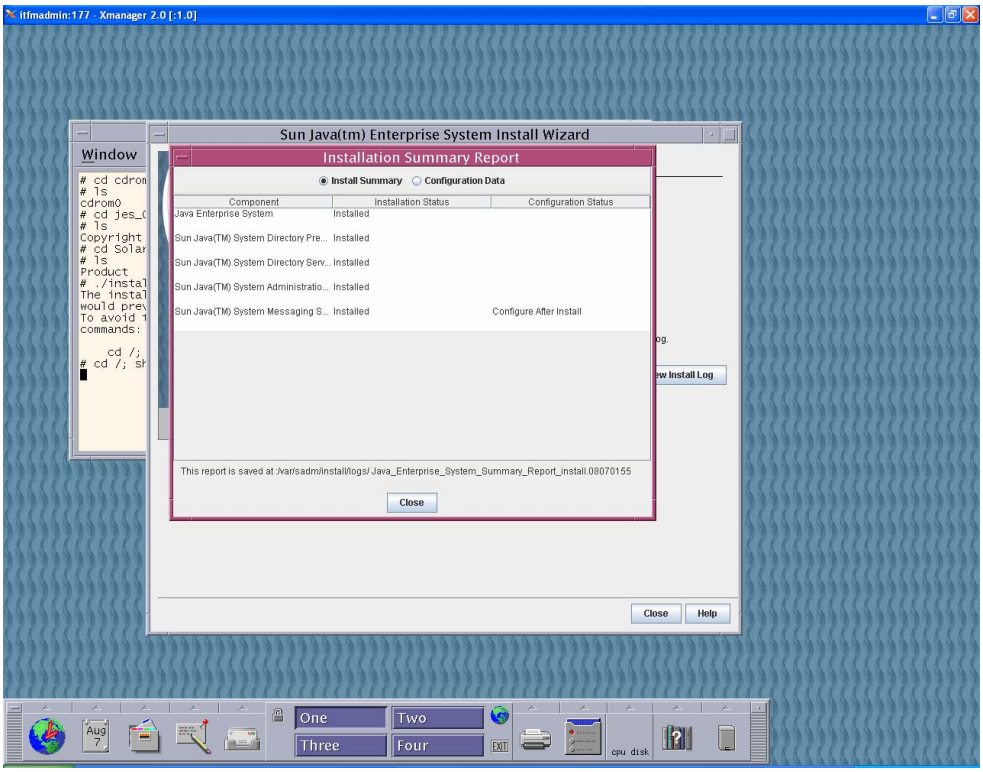

itfmadmin:177 - Xmanager 2.0 [:1.0]
Window
Sun Java(tm) Enterprise System Install Wizard
Ready to Install
Product: Java Enterprise System
Uninstall Location: /var/sadm/prod/SUNWentsys4
Space Required: 194.07 MB
Sun Java(TM) System Directory Preparation Tool
Sun Java(TM) System Directory Server 5 2005Q4
Sun Java(TM) System Administration Server 5 2005Q4
Sun Java(TM) System Messaging Server 6 2005Q4
Java
Enterprise System
Back
Next
Cancel
Help
One
Two
Three
Four
Lock
Exit
cpu disk


itfmadmin:177 - Xmanager 2.0 [:1.0]
Sun Java(tm) Enterprise System Install Wizard
Product Registration
Register the Sun Java(TM) Enterprise System during installation to receive important information about updates, future releases, and available documentation.
Alternatively, you can register on the Sun corporate site at this URL: http://www.sun.com/software/product_registration/registerproduct.
Open registration window during installation.
Back
Install
Cancel
Help
Window
One
Two
Three
Four

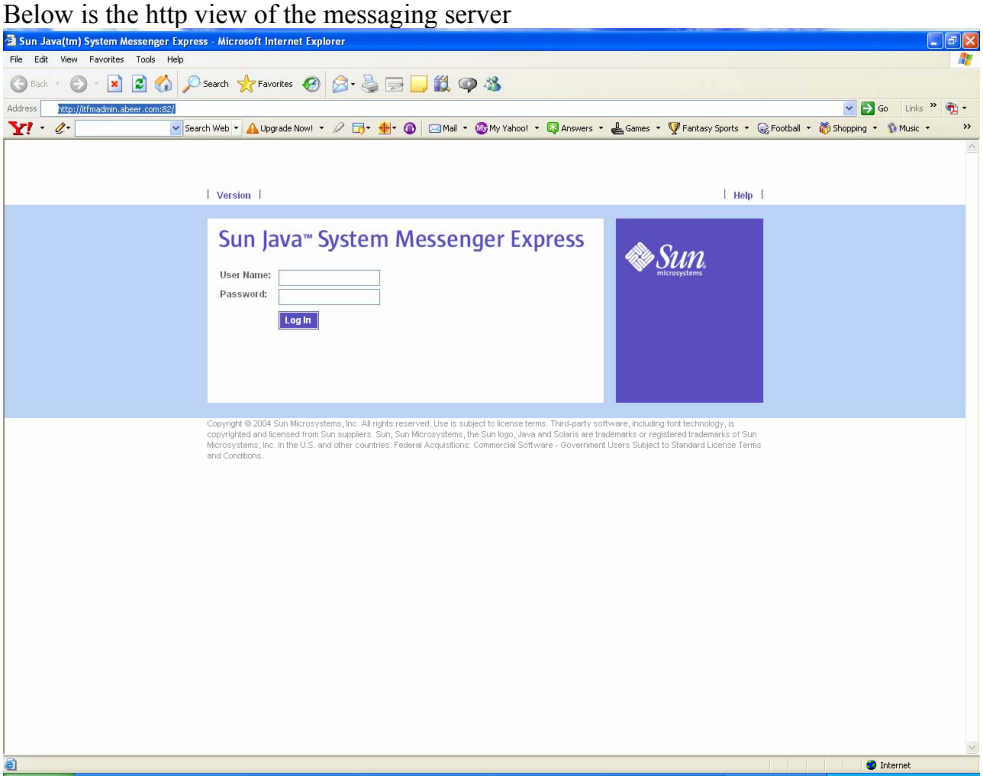

itfmadmin:177 - Xmanager 2.0 [:0.0]
Terminal
Window Edit Options Help
Sun Java(tm) Enterprise System Install Wizard
Ready to Install
Product: Java Enterprise System
Uninstall Location: /var/sadm/prod/SUNWentsys4
Space Required: 396.11 MB
Sun Java(TM) System Web Server 6.1 SP5 2005Q4
Sun Java(TM) System Directory Preparation Tool
Sun Java(TM) System Directory Server 5 2005Q4
Sun Java(TM) System Administration Server 5 2005Q4
Sun Java(TM) System Access Manager 7 2005Q4
Identity Management and Policy Services Core
Access Manager Administration Console
Common Domain Services for Federation Management
Access Manager SDK
Sun Java(TM) System Messaging Server 6 2005Q4
Sun Java(TM) System Communications Express 6 2005Q4
Communication Services Delegated Administrator 2005Q4
Delegated Administrator Server 2005Q4
Delegated Administrator Server 2005Q4
Delegated Administrator Console and Utility 2005Q4
Delegated Administrator Console and Utility 2005Q4
Back
Next
Cancel
Help

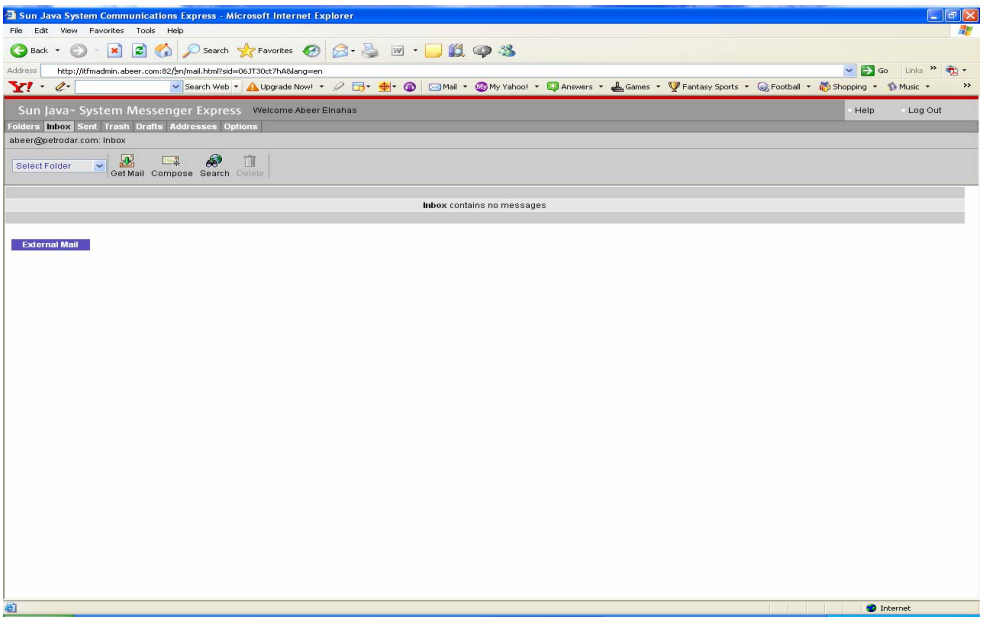

itfmadmin:177 - Xmanager 2.0 [:1.0]
Sun Java(tm) Enterprise System Install Wizard
Window
Installing...
Java
Java™ Enterprise System
It's a whole new world.
Java Enterprise System
0%
Stop
Cancel
Help
One
Two
Three
Four


itfmadmin:177 - Xmanager 2.0 [:1.0]
Sun Java(tm) Enterprise System Install Wizard
Window
Installation Complete
Java
Java™ Enterprise System
Click the following buttons to view installation and configuration summaries or the installation log.
The installer stores the summary and log files in this location: /var/sadm/install/logs/
View Summary
View Install Log
Your next step is to perform the postinstallation configuration and verification tasks documented in the "Postinstallation" chapter of the Sun Java(TM) Enterprise System Installation Guide at http://docs.sun.com/doc/819-2328.
Automatically display the Sun Java(TM) Enterprise System Installation Guide after the installer closes (requires an internet connection)
Close
Help
One
Two
Three
Four


itfmadmin:177 - Xmanager 2.0 [:1.0]
Sun Java(tm) Enterprise System Install Wizard
Window
Installation Summary Report
Install Summary
Configuration Data
Component
Installation Status
Configuration Status
Java Enterprise System
Installed
Sun Java(TM) System Directory Pre...
Installed
Sun Java(TM) System Directory Serv...
Installed
Sun Java(TM) System Administratio...
Installed
Sun Java(TM) System Messaging S...
Installed
Configure After Install
This report is saved at :/var/sadm/install/logs/ Java_Enterprise_System_Summary_Report_install.08070155
Close
Close
Help
One
Two
Three
Four
cpu disk

Below is the http view of the messaging server





Appendix B

Preparing Directory Server LDAP schema and Configuring Mail Server

This section explains how to prepare the Directory Server LDAP schema and configure Messaging Server.

➤ **To Apply Schema 2 to Your Directory Tree**

1. Run the `comm_dssetup.pl` script:

   ```
   cd /opt/SUNWcomds/sbin
   ```

   ```
   /opt/DSServers/bin/slapd/admin/bin/perl comm_dssetup.pl
   ```

2. Type **y** to continue.

   The perl script prompts for a series of options. The following table shows how to respond to the prompts.

Values for `comm_dssetup.pl` Script

Option	[Default Value]	Enter:
Directory server root	[/var/opt/mps/serverroot]	**/opt/DSServers**
Directory server instance	slapd-wireless	*accept default*
Directory Manager DN	[cn=Directory Manager]	*accept default*
Directory Manager Password	–	**adminpass**
Use directory server for users/groups	[Yes]	*accept default*
Users/Groups base suffix	[o=isp]	*accept default*
Schema type?	[2]	*accept default*
Update the schema files?	[yes]	*accept default*
Configure new indexes?	[yes]	*accept default*
Reindex new indexes?	[yes]	*accept default*

3. Confirm your choices and type **y** to continue. The `comm_dssetup` script proceeds.

4. When prompted, type **y** to continue with script.

   Continue with the next step after the `comm_dssetup` script finishes and displays its "Successful Completion" message.

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Configuring Delegated Administrator and Communications CLI

This section describes configuring Delegated Administrator console and utility, which are used for user management.

➤ To Configure Delegated Administrator

1. Run the configurator script:

   ```
   cd /opt/SUNWcomm/sbin
   ./config-commda
   ```

2. Accept the default for the Directory to store User Mgmt data files: [/var/opt/SUNWcomm]

   If the directory does not exist, click Create Directory to create the directory.

3. Install Delegated Administrator Utility, Console, and Server.

   The installation script prompts for a series of options. Use the following table to respond to the configuration options:

Values for `config-commda` Script

Option	[Default Value]	Enter:
AM Hostname	[pdocm.petrodar.com]	*accept default*
AM Port	[8080]	**80**
Default Domain	[petrodar.com]	*accept default*
Default SSL Port	[443]	*accept default*
Web Container	[Web Server]	*accept default*
Web Server Root Directory	[/opt/SUNWwbsvr]	*accept default*
Web Server Instance Identifier	[pdocm.petrodar.com]	*accept default*
Web Virtual Server Identifier	[https-pdocm.petrodar.com]	*accept default*
Web Server HTTP Port	[80]	**80 (default)**
Default Domain Separator	[@]	*accept default*
Access Manager Base Directory	[/opt/SUNWam]	*accept default*
Web Server Root Directory	[/opt/SUNWwbsvr]	*accept default*
Web Server Instance Identifier	[pdocm.petrodar.com]	*accept default*
Web Virtual Server Identifier	[https-pdocm.petrodar.com]	*accept default*
Web Server HTTP Port	[80]	**80 (default)**

Values for `config-commda` Script *(Continued)*

Option	[Default Value]	Enter:
URL of Directory Server	[ldap://pdocm.petrodar.com:389]	*accept default*
Bind As	[cn=Directory Manager]	*accept default*
Password	–	**adminpass**
AM Top level admin	[amadmin]	*accept default*
AM admin password	–	**adminpass**
Access Manager Internal LDAP Auth Username	amldapuser	*accept default*
AM Internal LDAP Auth Password for amldapuser	--	**nonadminpass**
Organization DN	[dc=petrodar.com,o=pdocm]	*accept default*
Top Level Admin for Default Organization	[admin]	*accept default*
Password	--	**adminpass**
Load Sample Service Packages	–	**Yes (Checked)**
Load Sample Organizations	–	**Yes (Checked)**
Preferred Mailhost for Sample	[pdocm.petrodar.com]	*accept default*

4. Select Configure Now.

   The script begins to run.

5. When the panel displays "All Tasks Passed," click Next to continue.

   Two warnings appear: one is remind you to restart Web Server; the other is to remind you to enable the mail and calendar services in the domain. The next steps correct these problems.

6. Click Close to complete the configuration.

7. Restart Web Server:

   ```
   cd /opt/SUNWwbsvr/https-pdocm.petrodar.com
   ./stop
   ./start
   ```

8. Modify the mail and calendar domains, and create users by using the `commadmin` utility:

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```
/opt/SUNWcomm/bin/comrnadmin domain modify -D admin -w adminpass -x  pdocm.petrodar.com -n
petrodar.com -p 80 -d petrodar.com -g mail/cal -H pdocm.petrodar.com

/opt/SUNWcomm/bin/comrnadmin user create -D admin -F John -I jdoe -L Doe -n petrodar.com -p 80 -w
adminpass -w demo -x  pdocm.petrodar.com -g mail/cal -E jdoe@ petrodar.com -H pdocm.petrodar.com -k
legacy

/opt/SUNWcomm/bin/comrnadmin user create -D admin -F Calendar -I calmaster -L Master -n
petrodar.com -p 80 -w adminpass -w adminpass -x pdocm.petrodar.com -g mail/cal -E calmaster@
petrodar.com -H pdocm.petrodar.com -k legacy
```

Create as many users as you need. Steps later in this document show how to add Presence and Instant Messaging services to those users.

Configuring Messaging Server

This section describes configuring Messaging Server, including configuring the Webmail port.

➤ **To Configure Messaging Server**

1. Run the Messaging Server configure script:

   ```
   cd /opt/SUNWmsgsr/sbin
   ./configure
   ```

   The Configuration Wizard appears. Read the introductory information and proceed by clicking Next.

2. Verify the following:

   a. Fully qualified host name of Messaging Server, FQHN: [[pdocm.petrodar.com]

   b. Directory to store config/data files: [`/var/opt/SUNWmsgsr`]

      When prompted, choose to create the new directory.

   c. Install MTA, MS store, and Messenger Express. There is no need to install the Multiplexor for this deployment.

   d. Name of the mail server Unix user: Unix username [`mailsrv`]

   e. Unix group: [`mail`]

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3. The installation script prompts for a series of options. Use the following table to respond to the configuration options:

Table 14 Values for Messaging Server `configure` Script

Option	[Default Value]	Enter:
URL of Directory Server	[ldap://pdocm.petrodar.com:389]	*accept default*
Bind As	[cn=Directory Manager]	*accept default*
Password	–	**adminpass**
User/Group Server LDAP	[ldap://pdocm.petrodar.com:389]	*accept default*
Bind As	[cn=Directory Manager]	*accept default*
Password	–	**adminpass**
Postmaster email address	–	[admin@pdocm.petrodar.com]
Password for Messaging Server accounts	–	**adminpass**
Default email Domain	[petrodar.com]	*accept default*
Organization DN	[dc=petrodar.com,o=pdocm]	*accept default*

4. Click Next, then click Configure Now.

   You receive an error about the Webmail port being in use. Click Next to continue. The following step corrects this problem.

5. When the configuration is finished, click Next to continue, then click Close to exit.

6. Configure the Webmail port:

   ```
   /opt/SUNWmsgsr/sbin/configutil -o service.http.port -v 8080
   ```

7. Start Messaging Server:

   ```
   /opt/SUNWmsgsr/sbin/stop-msg
   /opt/SUNWmsgsr/sbin/start-msg
   ```

Appendix C

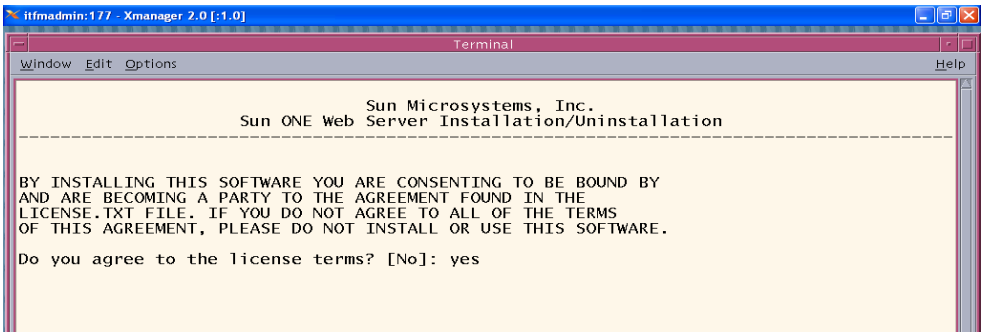
Web Server Installation

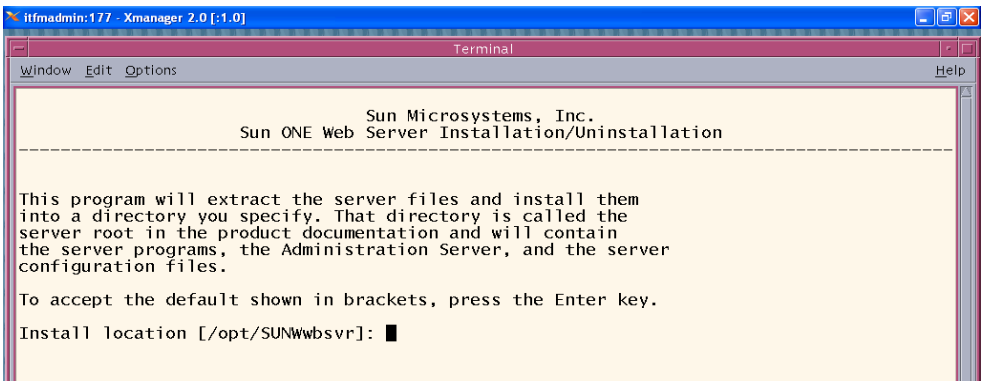
The following screens will give a guide for the installation steps of Sun Java Enterprise Web Server.

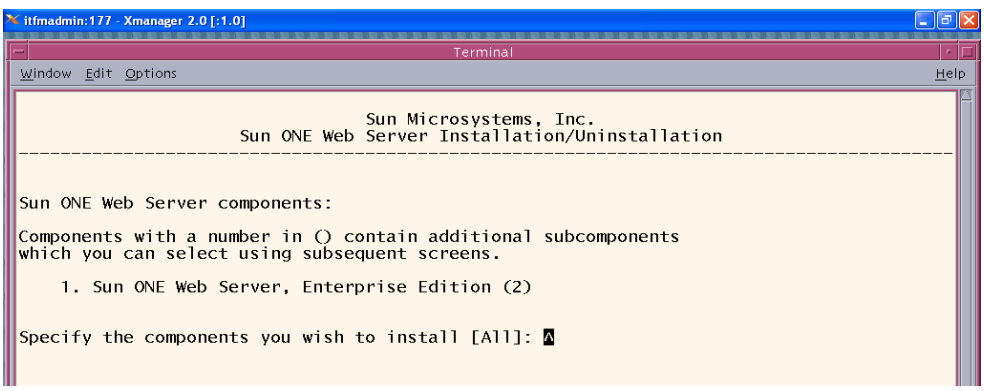
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help
# cd cdrom
# ls
# ls
cdrom0              s1ws61sp2_disk1
# cd s1ws61sp2_disk1
# ls
Linux_i686      Solaris_i386    Solaris_sparc  Windows
# cd Solaris_sparc
# ls
3RD-PARTY-LICENSE.txt  WebServer                setup
LICENSE.txt            installWrapper           setup.inf
README.txt             lib                      template.inf
# pwd
/cdrom/s1ws61sp2_disk1/Solaris_sparc
# cd WebServer
# ls
WebServer.inf        jdk.zip              preinstall-core      webcore.zip
cleanup.zip          mktempfile           preinstall-i18n
java.zip             preinstall-cleanup   snmp.zip
# cp cd ..
cp: cannot access cd
# cd ..
# ls
3RD-PARTY-LICENSE.txt  WebServer                setup
LICENSE.txt            installWrapper           setup.inf
README.txt             lib                      template.inf
# ./setup
```

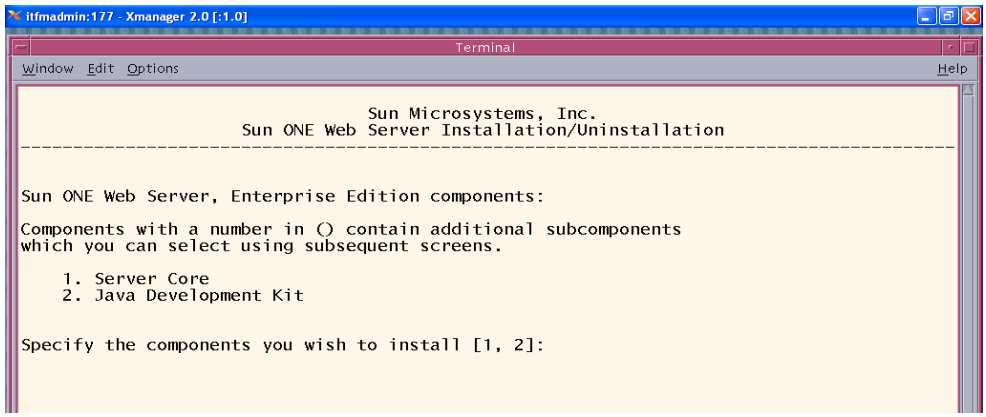
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help
                                Sun Microsystems, Inc.
                      Sun ONE Web Server Installation/Uninstallation
--------------------------------------------------------------------------------

Welcome to the Sun ONE Web Server installation program
This program will install Sun ONE Server Products and the
Sun ONE Console on your computer.

It is recommended that you have "root" privilege to install the
software.

Tips for using the installation program:
  - Press "Enter" to choose the default and go to the next screen
  - Type "Control-B" to go back to the previous screen
  - Type "Control-C" to cancel the installation program
  - You can enter multiple items using commas to separate them.
    For example: 1, 2, 3

Would you like to continue with installation? [Yes]:
```

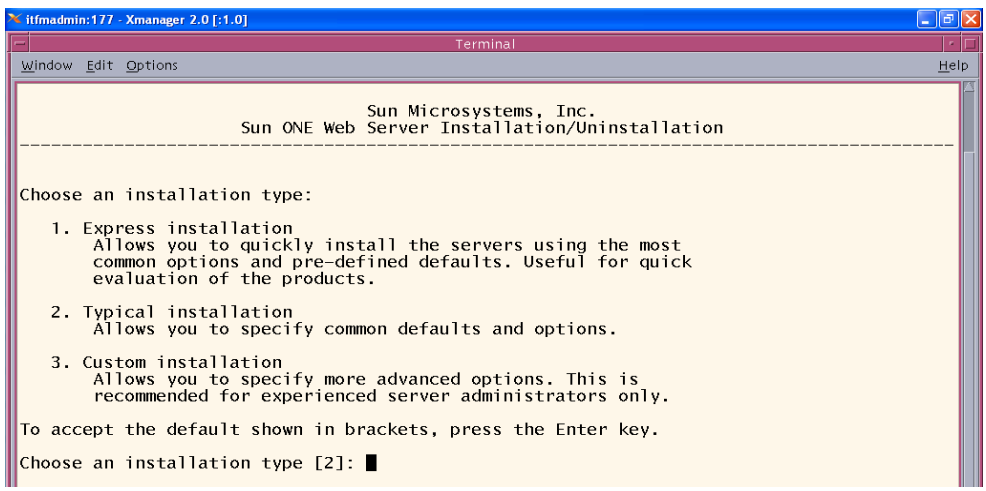
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help
                                Sun Microsystems, Inc.
                      Sun ONE Web Server Installation/Uninstallation
--------------------------------------------------------------------------------


BY INSTALLING THIS SOFTWARE YOU ARE CONSENTING TO BE BOUND BY
AND ARE BECOMING A PARTY TO THE AGREEMENT FOUND IN THE
LICENSE.TXT FILE. IF YOU DO NOT AGREE TO ALL OF THE TERMS
OF THIS AGREEMENT, PLEASE DO NOT INSTALL OR USE THIS SOFTWARE.

Do you agree to the license terms? [No]:
```

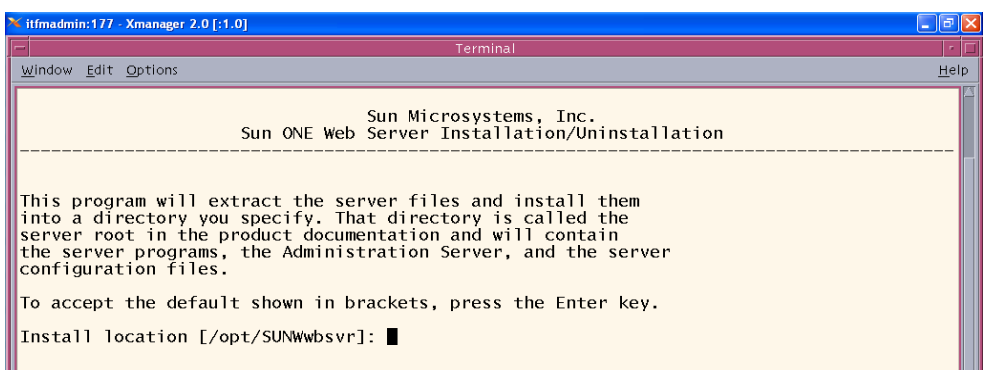

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
BY INSTALLING THIS SOFTWARE YOU ARE CONSENTING TO BE BOUND BY
AND ARE BECOMING A PARTY TO THE AGREEMENT FOUND IN THE
LICENSE.TXT FILE. IF YOU DO NOT AGREE TO ALL OF THE TERMS
OF THIS AGREEMENT, PLEASE DO NOT INSTALL OR USE THIS SOFTWARE.
Do you agree to the license terms? [No]: yes


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
This program will extract the server files and install them
into a directory you specify. That directory is called the
server root in the product documentation and will contain
the server programs, the Administration Server, and the server
configuration files.
To accept the default shown in brackets, press the Enter key.
Install location [/opt/SUNWwbsvr]:


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
Sun ONE Web Server components:
Components with a number in () contain additional subcomponents
which you can select using subsequent screens.
1. Sun ONE Web Server, Enterprise Edition (2)
Specify the components you wish to install [All]: A


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
Sun ONE Web Server, Enterprise Edition components:
Components with a number in () contain additional subcomponents
which you can select using subsequent screens.
1. Server Core
2. Java Development Kit
Specify the components you wish to install [1, 2]:


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
Choose an installation type:
1. Express installation
Allows you to quickly install the servers using the most
common options and pre-defined defaults. Useful for quick
evaluation of the products.
2. Typical installation
Allows you to specify common defaults and options.
3. Custom installation
Allows you to specify more advanced options. This is
recommended for experienced server administrators only.
To accept the default shown in brackets, press the Enter key.
Choose an installation type [2]:

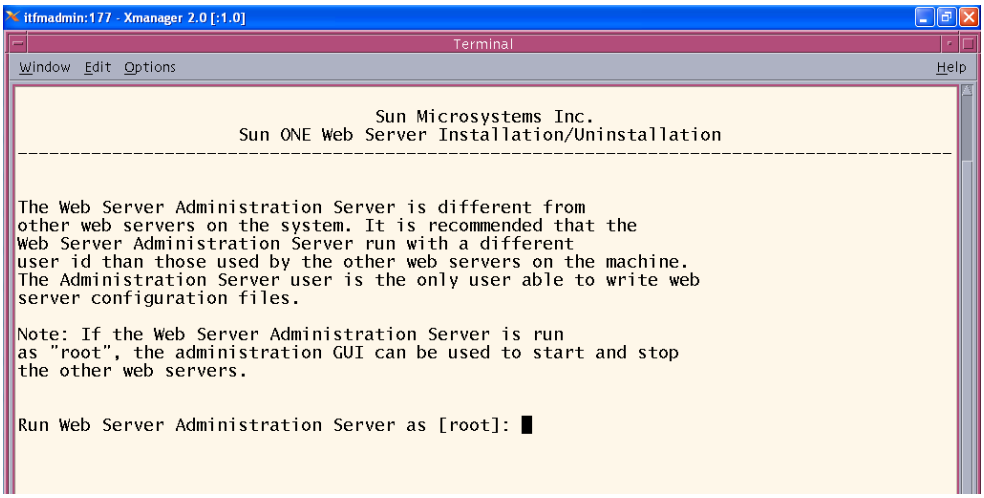

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems, Inc.
Sun ONE Web Server Installation/Uninstallation
This program will extract the server files and install them
into a directory you specify. That directory is called the
server root in the product documentation and will contain
the server programs, the Administration Server, and the server
configuration files.
To accept the default shown in brackets, press the Enter key.
Install location [/opt/SUNWwbsvr]:

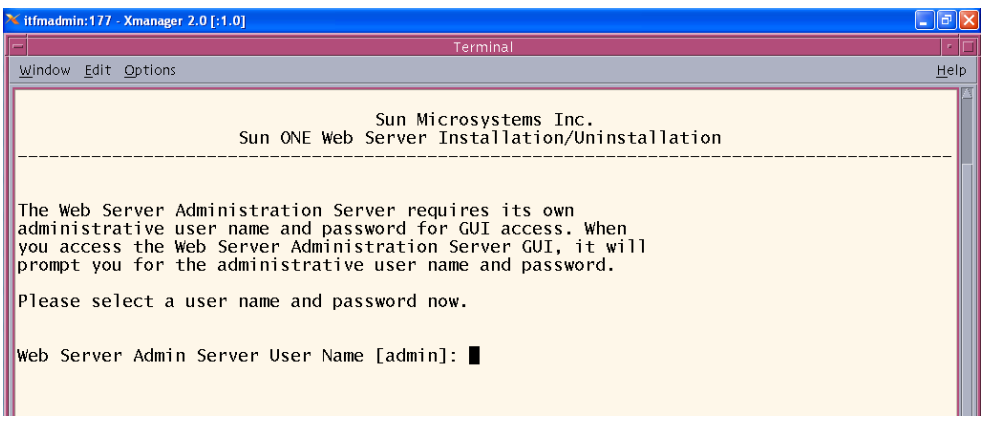
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help

                                Sun Microsystems, Inc.
                      Sun ONE Web Server Installation/Uninstallation
--------------------------------------------------------------------------------


Enter the fully qualified domain name of the computer
on which you're installing server software. Using the form
<hostname>.<domainname>
Example: eros.airius.com.

To accept the default shown in brackets, press the Enter key.

Computer name [itfmadmin]: ▌
```

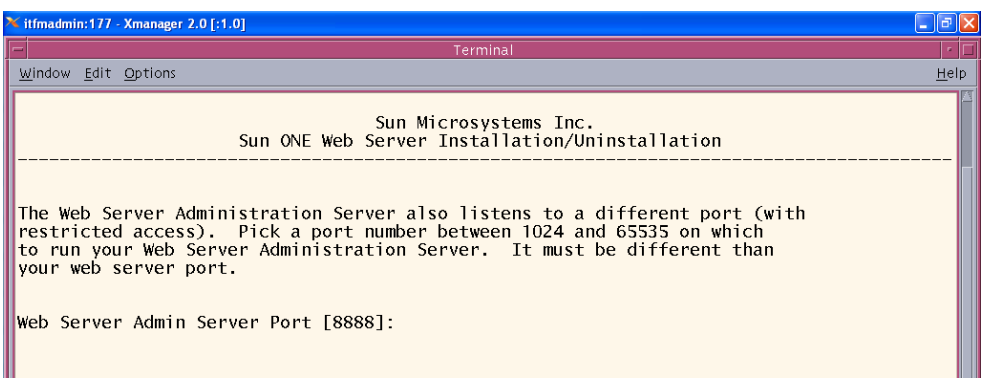
Pdocweb.petrodar.com

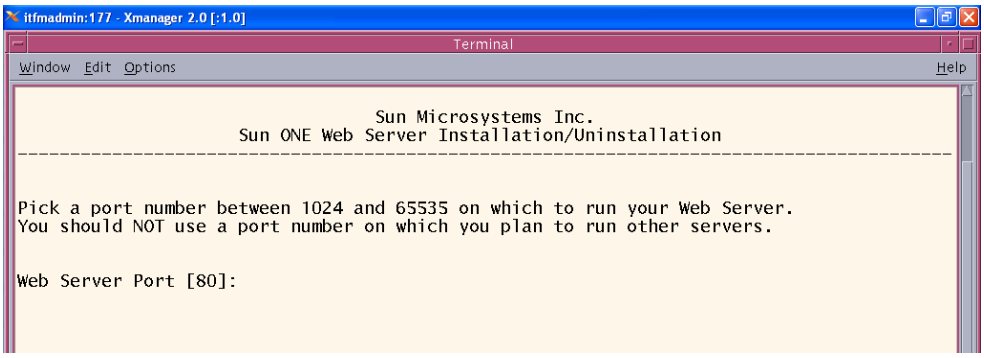
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help

                                Sun Microsystems Inc.
                      Sun ONE Web Server Installation/Uninstallation
--------------------------------------------------------------------------------


Choose a Unix user and group to represent the Sun ONE Web Server
in the user directory.  The Web Server will run as this user.
It is recommended that this user should have no privileges
in the computer network system.  The Administration Server
will give this group some permissions in the server root
to perform server-specific operations.

If you have not yet created a user and group for the Web Server,
create this user and group using your native UNIX system utilities.


System User [webservd]: ▌
```

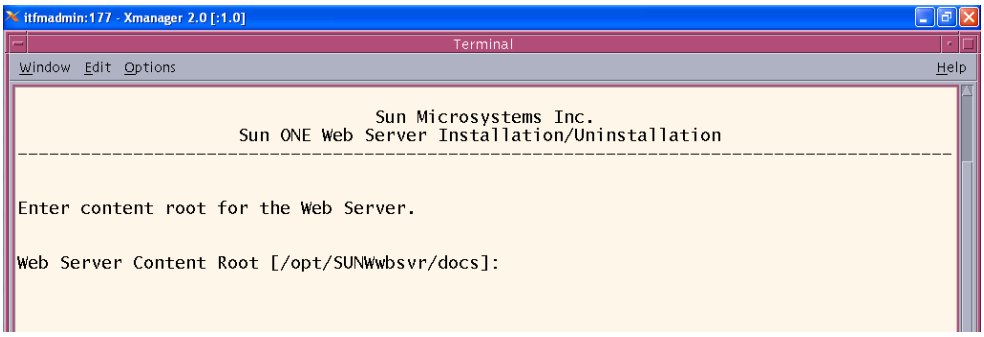
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help

                                Sun Microsystems Inc.
                      Sun ONE Web Server Installation/Uninstallation
--------------------------------------------------------------------------------


Choose a Unix user and group to represent the Sun ONE Web Server
in the user directory.  The Web Server will run as this user.
It is recommended that this user should have no privileges
in the computer network system.  The Administration Server
will give this group some permissions in the server root
to perform server-specific operations.

If you have not yet created a user and group for the Web Server,
create this user and group using your native UNIX system utilities.


System User [webservd]:
System Group [webservd]:
```

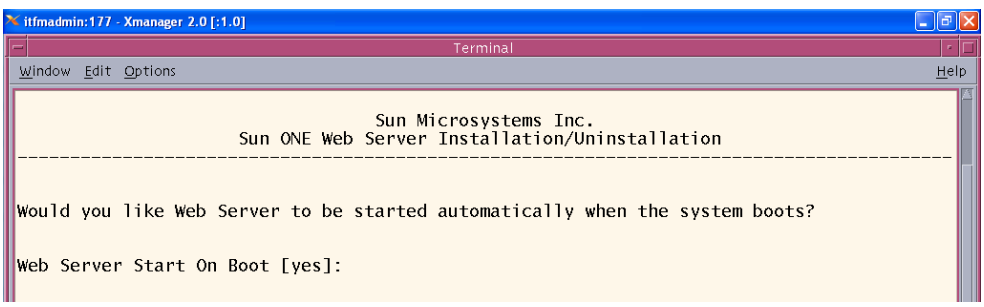

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
The Web Server Administration Server is different from
other web servers on the system. It is recommended that the
Web Server Administration Server run with a different
user id than those used by the other web servers on the machine.
The Administration Server user is the only user able to write web
server configuration files.
Note: If the Web Server Administration Server is run
as "root", the administration GUI can be used to start and stop
the other web servers.
Run Web Server Administration Server as [root]:

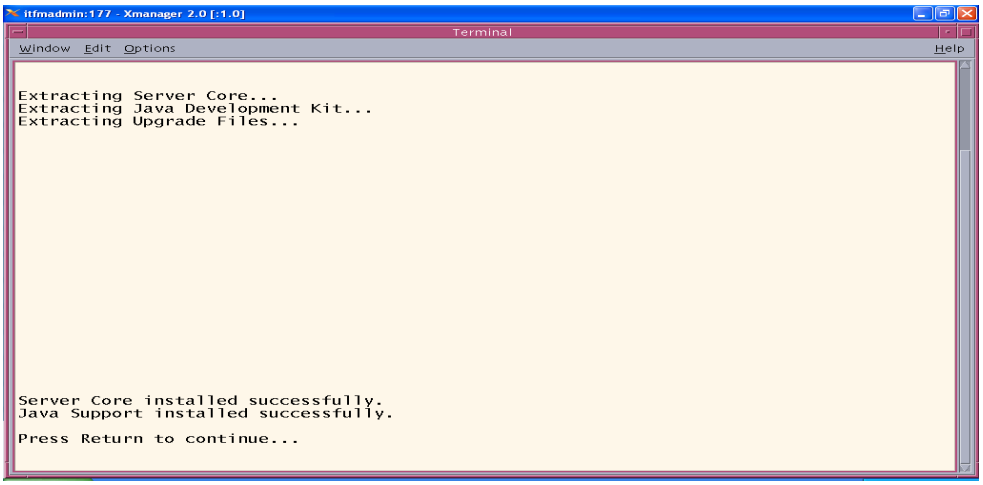

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
The Web Server Administration Server requires its own
administrative user name and password for GUI access. When
you access the Web Server Administration Server GUI, it will
prompt you for the administrative user name and password.
Please select a user name and password now.
Web Server Admin Server User Name [admin]:

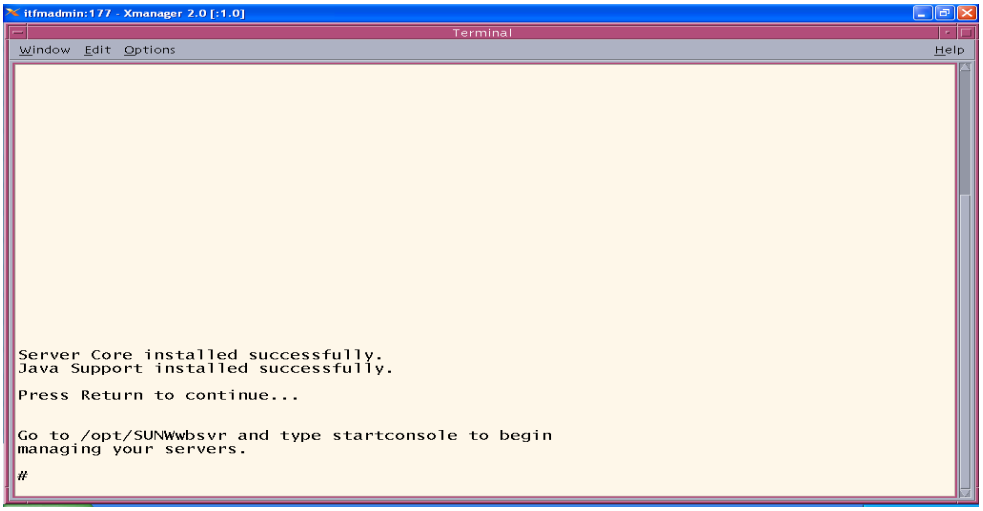

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
The Web Server Administration Server also listens to a different port (with
restricted access). Pick a port number between 1024 and 65535 on which
to run your Web Server Administration Server. It must be different than
your web server port.
Web Server Admin Server Port [8888]:


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
Pick a port number between 1024 and 65535 on which to run your Web Server.
You should NOT use a port number on which you plan to run other servers.
Web Server Port [80]:


itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
Enter content root for the Web Server.
Web Server Content Root [/opt/SUNWwbsvr/docs]:

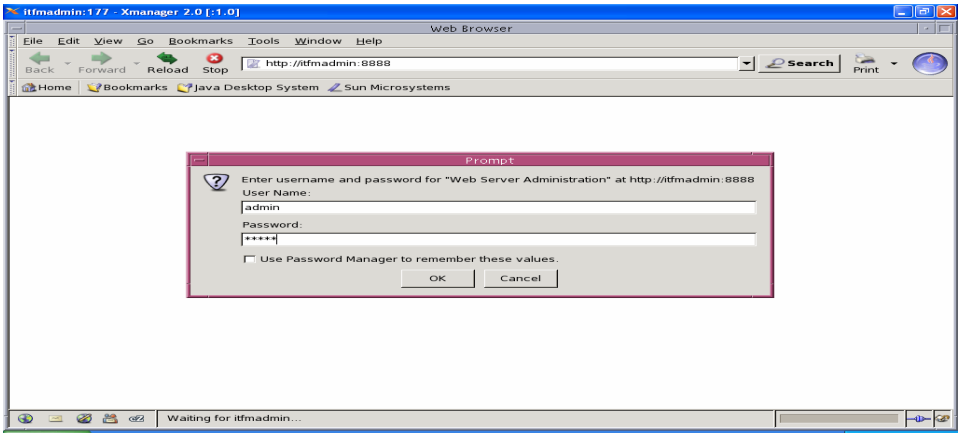

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Sun Microsystems Inc.
Sun ONE Web Server Installation/Uninstallation
Would you like Web Server to be started automatically when the system boots?
Web Server Start On Boot [yes]:

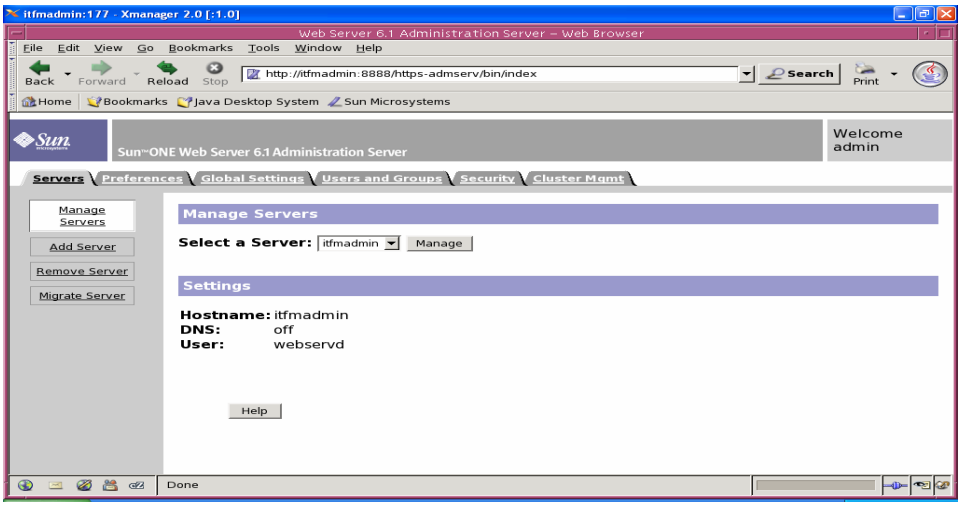

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Extracting Server Core...
Extracting Java Development Kit...
Extracting Upgrade Files...
Server Core installed successfully.
Java Support installed successfully.
Press Return to continue...

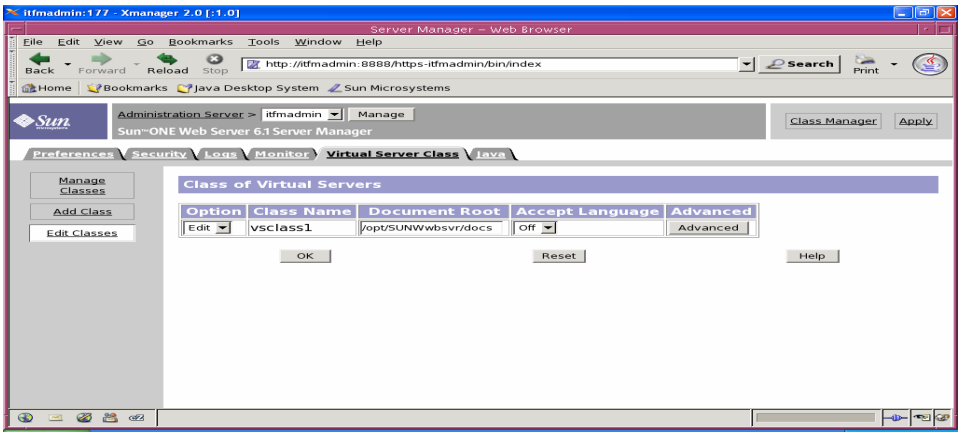

itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window Edit Options Help
Server Core installed successfully.
Java Support installed successfully.
Press Return to continue...
Go to /opt/SUNWwbsvr and type startconsole to begin
managing your servers.
#

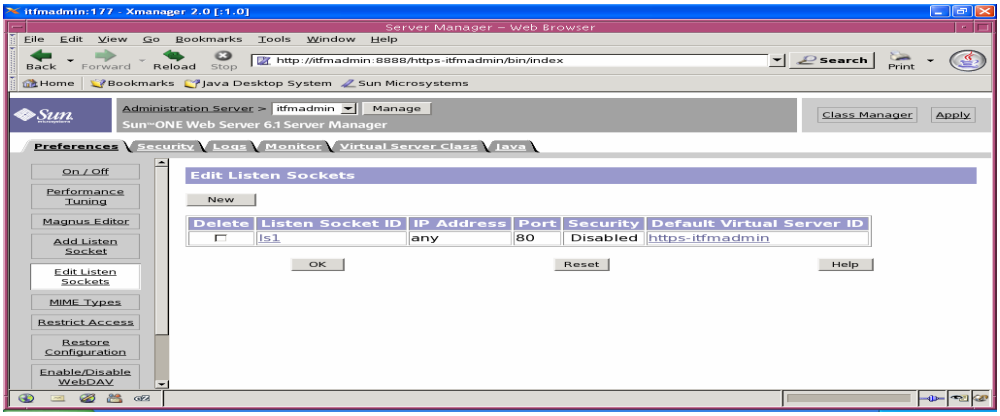
```
itfmadmin:177 - Xmanager 2.0 [:1.0]
Terminal
Window  Edit  Options                                                    Help

Server Core installed successfully.
Java Support installed successfully.

Press Return to continue...


Go to /opt/SUNWwbsvr and type startconsole to begin
managing your servers.

# cd /opt/SUNWwbsvr
# ls
README.txt       docs             https-admserv    ns-icons         startconsole
alias            extras           https-itfmadmin  plugins          uninstall
bin              httpacl          manual           setup            userdb
# ./startconsole
Sun ONE Web Server 6.1SP2 B04/07/2004 16:09
info: CORE3016: daemon is running as super-user
info: CORE5076: Using [Java HotSpot(TM) Server VM, Version 1.4.2_04] from [Sun Microsyste
ms Inc.]
info: WEB0100: Loading web module in virtual server [vs-admin] at [/admin-app]
info: HTTP3072: [LS ls1] http://itfmadmin:8888 ready to accept requests
startup: server started successfully
Launching browser....
./startconsole: netscape: # not found
```

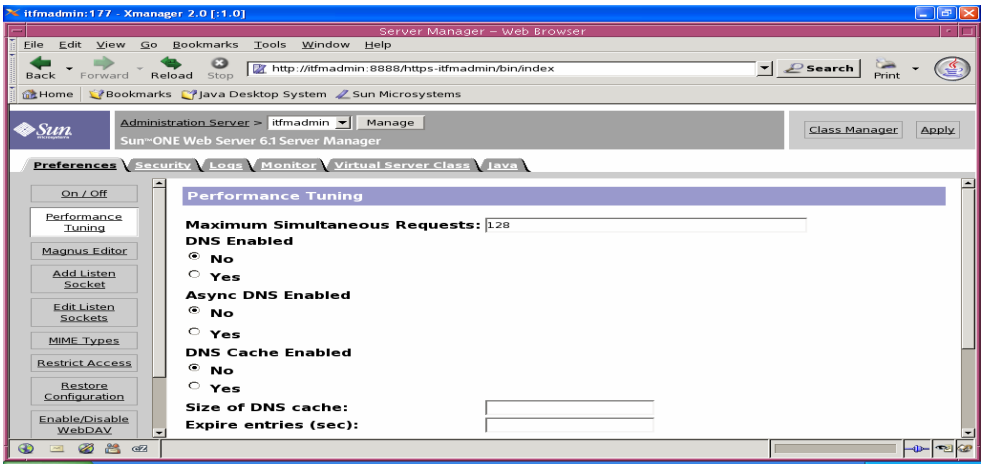
Below is the http view of the web server administration console

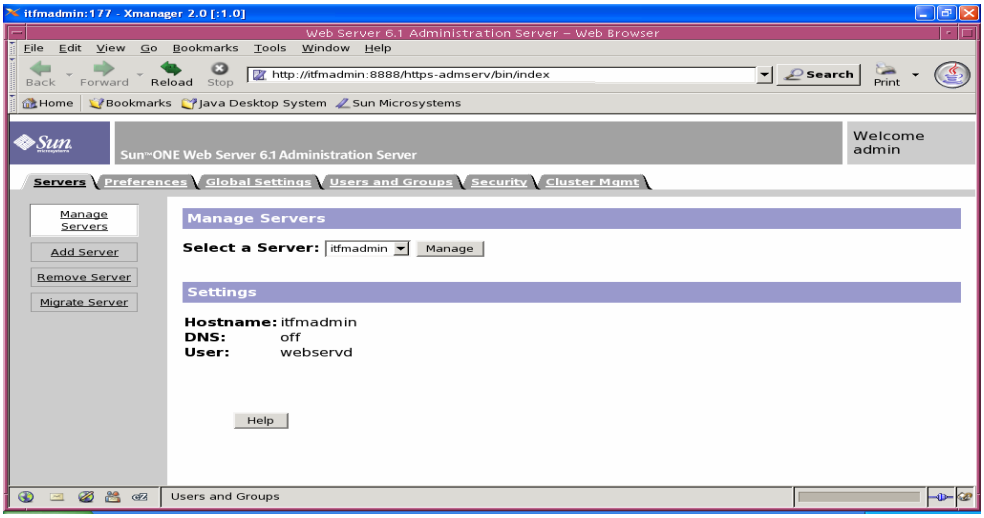


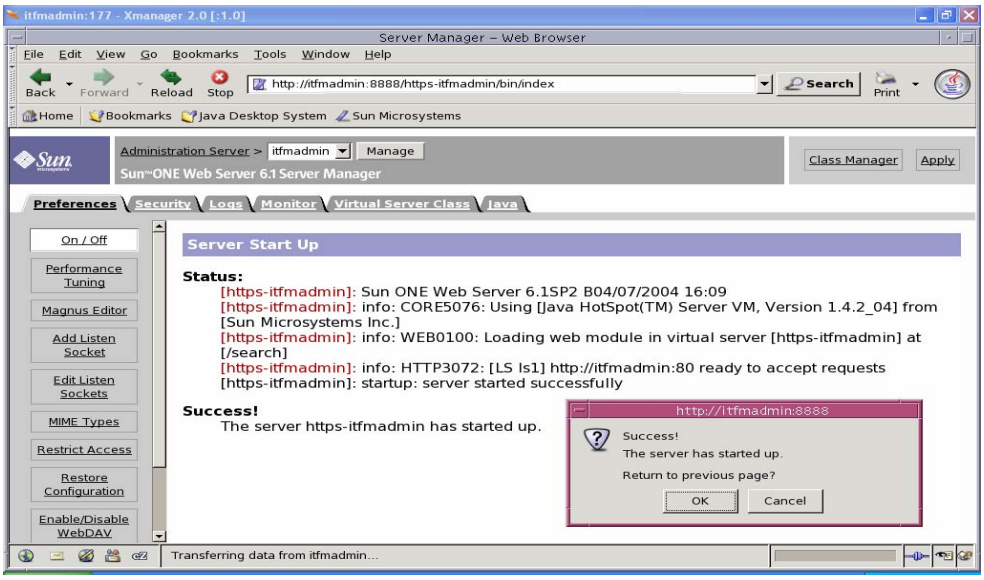

itfmadmin:177 - Xmanager 2.0 [:1.0]
Web Server 6.1 Administration Server – Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-admserv/bin/index
Search Print
Home Bookmarks Java Desktop System Sun Microsystems
Sun
Sun™ONE Web Server 6.1 Administration Server
Welcome admin
Servers Preferences Global Settings Users and Groups Security Cluster Mgmt
Manage Servers
Add Server
Remove Server
Migrate Server
Manage Servers
Select a Server: itfmadmin Manage
Settings
Hostname: itfmadmin
DNS: off
User: webservd
Help
Done

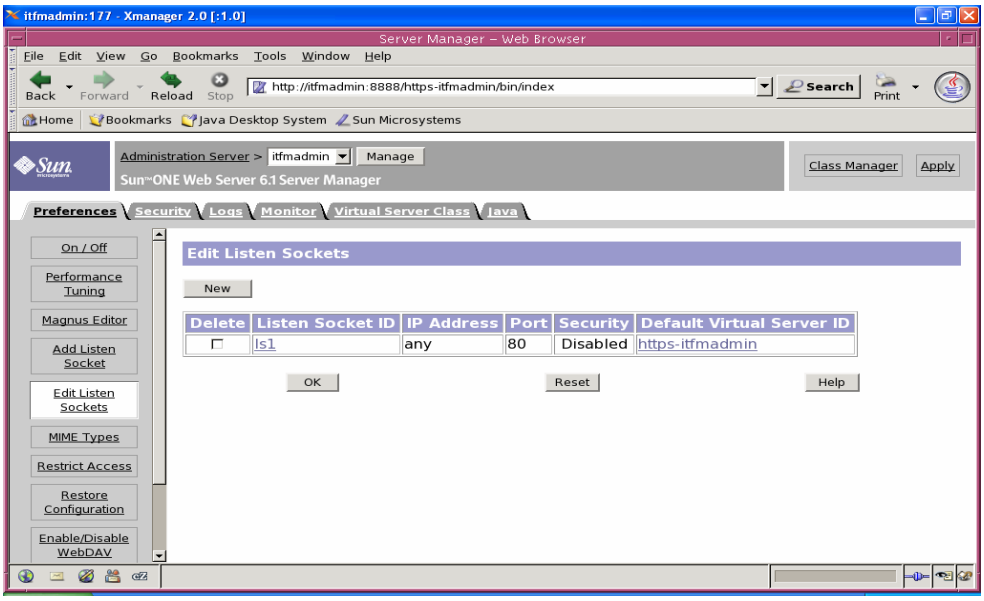

itfmadmin:177 - Xmanager 2.0 [:1.0]
Server Manager – Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-itfmadmin/bin/index
Search Print
Home Bookmarks Java Desktop System Sun Microsystems
Sun
Administration Server > itfmadmin Manage
Sun™ONE Web Server 6.1 Server Manager
Class Manager Apply
Preferences Security Logs Monitor Virtual Server Class Java
Manage Classes
Add Class
Edit Classes
Class of Virtual Servers
Option Class Name Document Root Accept Language Advanced
Edit vsclass1 /opt/SUNWwbsvr/docs Off Advanced
OK Reset Help


itfmadmin:177 - Xmanager 2.0 [:1.0]
Server Manager – Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-itfmadmin/bin/index
Search Print
Home Bookmarks Java Desktop System Sun Microsystems
Sun
Administration Server > itfmadmin Manage
Sun™ONE Web Server 6.1 Server Manager
Class Manager Apply
Preferences Security Logs Monitor Virtual Server Class Java
On / Off
Performance Tuning
Magnus Editor
Add Listen Socket
Edit Listen Sockets
MIME Types
Restrict Access
Restore Configuration
Enable/Disable WebDAV
Edit Listen Sockets
New
Delete Listen Socket ID IP Address Port Security Default Virtual Server ID
ls1 any 80 Disabled https-itfmadmin
OK Reset Help


itfmadmin:177 - Xmanager 2.0 [:1.0]
Server Manager - Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-itfmadmin/bin/index
Search
Print
Home Bookmarks Java Desktop System Sun Microsystems
Administration Server > itfmadmin Manage
Sun~ONE Web Server 6.1 Server Manager
Class Manager Apply
Preferences Security Logs Monitor Virtual Server Class Java
On / Off
Performance Tuning
Magnus Editor
Add Listen Socket
Edit Listen Sockets
MIME Types
Restrict Access
Restore Configuration
Enable/Disable WebDAV
Performance Tuning
Maximum Simultaneous Requests: 128
DNS Enabled
No
Yes
Async DNS Enabled
No
Yes
DNS Cache Enabled
No
Yes
Size of DNS cache:
Expire entries (sec):


itfmadmin:177 - Xmanager 2.0 [:1.0]
Web Server 6.1 Administration Server - Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-admserv/bin/index
Search
Print
Home Bookmarks Java Desktop System Sun Microsystems
Sun~ONE Web Server 6.1 Administration Server
Welcome admin
Servers Preferences Global Settings Users and Groups Security Cluster Mgmt
Manage Servers
Add Server
Remove Server
Migrate Server
Manage Servers
Select a Server: itfmadmin Manage
Settings
Hostname: itfmadmin
DNS: off
User: webservd
Help
Users and Groups


itfmadmin:177 - Xmanager 2.0 [:1.0]
Server Manager – Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-itfmadmin/bin/index
Search
Print
Home Bookmarks Java Desktop System Sun Microsystems
Administration Server > itfmadmin Manage
Sun~ONE Web Server 6.1 Server Manager
Class Manager Apply
Preferences Security Logs Monitor Virtual Server Class Java
On / Off
Performance Tuning
Magnus Editor
Add Listen Socket
Edit Listen Sockets
MIME Types
Restrict Access
Restore Configuration
Enable/Disable WebDAV
Server Start Up
Status:
[https-itfmadmin]: Sun ONE Web Server 6.1SP2 B04/07/2004 16:09
[https-itfmadmin]: info: CORE5076: Using [Java HotSpot(TM) Server VM, Version 1.4.2_04] from [Sun Microsystems Inc.]
[https-itfmadmin]: info: WEB0100: Loading web module in virtual server [https-itfmadmin] at [/search]
[https-itfmadmin]: info: HTTP3072: [LS ls1] http://itfmadmin:80 ready to accept requests
[https-itfmadmin]: startup: server started successfully
Success!
The server https-itfmadmin has started up.
http://itfmadmin:8888
Success!
The server has started up.
Return to previous page?
OK
Cancel
Transferring data from itfmadmin...


itfmadmin:177 - Xmanager 2.0 [:1.0]
Server Manager – Web Browser
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://itfmadmin:8888/https-itfmadmin/bin/index
Search
Print
Home Bookmarks Java Desktop System Sun Microsystems
Administration Server > itfmadmin Manage
Sun~ONE Web Server 6.1 Server Manager
Class Manager Apply
Preferences Security Logs Monitor Virtual Server Class Java
On / Off
Performance Tuning
Magnus Editor
Add Listen Socket
Edit Listen Sockets
MIME Types
Restrict Access
Restore Configuration
Enable/Disable WebDAV
Edit Listen Sockets
New
Delete | Listen Socket ID | IP Address | Port | Security | Default Virtual Server ID
ls1 | any | 80 | Disabled | https-itfmadmin
OK
Reset
Help

Below is the http view of the web server
http://www.petrodar.com

Sun[tm] ONE Web Server, Enterprise Edition 6.1 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://ltfmadmin.abeer.com

Sun™ ONE Web Server

Enterprise Edition 6.1

Sun[tm] ONE Web Server, Enterprise Edition 6.1 enables companies to react quickly to market demands by providing a high performance, highly scalable and secure web server that delivers static and dynamic content to their web site(s). The virtualization of domains and robust security features in the Sun ONE Web Server 6.1 enables companies to provide a better quality of service to their customers.

Features

WebDAV Publishing and File Management Support
WebDAV support allows work groups to develop content and easily publish it to the Web Server. WebDAV provides integrated support for content metadata (author, creation date, etc), name space management (a representation of the content file system), and overwrite protection. These technologies combined with the numerous authoring tools supporting WebDAV provides an ideal development platform for collaborative environments.

HTTP Compression
Compressing data before it is sent to the browser enables system administrators to conserve bandwidth and improve the performance of their site for users on slower dial-up connections. Data can be compressed by MIME type, path, client, etc.

Virtual Server Support
The virtualization of servers enables companies to dynamically configure individual domain names, IP addresses, combine secure and non-secure sites within a single installed server instance. Multiple virtual servers can be grouped together in classes, making configuration and maintenance of the servers much easier.

Feature-rich Administration
The administration interface gives a customer fine-grained control over each virtual server without sacrificing ease-of-use. Administrators can control site access, delegate administration, configure multiple servers, replicate configuration across servers, change configuration dynamically, and much more - either via the GUI or command line.

Improved Scalability and Performance
The Sun ONE Web Server delivers high performance for dynamic and secure content with features such as HTTP/1.1 support, multiprocess and multithreading, and support for SSL hardware accelerators. Additionally, with results caching, improved keep-alive handling, HTTP compression, and a myriad of other performance enhancements, the Sun ONE Web Server is faster than ever before.

J2EE Web Container
Sun ONE Web Server includes a high-performance, in-process J2EE compliant implementation of Java Servlets 2.3 and Java Server Pages 1.2. With a J2EE compliant web container, customers now have the flexibility and reliability that is needed to design and deploy Web Applications that comply with Java standards. Web Applications can be deployed on a per-virtual-server basis.

Improved SSL Performance
The Sun ONE Web Server lets customers secure online transactions with Secure Socket Layer (SSL) v2 & v3, and Transport Layer Security (TLS) 1.0 connections.

Content Filters
Sun ONE Web Server's filters allow developers and administrators to modify content in real time. Filters can be used for template based content, compression, dynamic headers/footers, CSS/JS inclusion in files, etc.

Documentation and Useful Links

Reference Material contains Web Server documentation, including release notes, programmer's guides, and the installation and administration guides.

Performance Tuning and Sizing an online document on the Sun ONE web site, describes several techniques to optimize the Web Server for your particular environment.

Developer Portal contains valuable information for developers about all Sun ONE products and technologies. Look for the latest developments and technologies from Sun ONE.

Contact Sun

Sun ONE Web Server Home Site

Contact Sales

Technical Support

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Sun ONE

Internet

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