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Kumaraguru College of Technology

Department of Computer Science and Engineering
Coimbatore – 641006.
September 2003

WAN ROUTING AND CAMPUS NETWORKING

Project Work done at

P-1084

Global Software Ltd., Chennai

PROJECT REPORT

Submitted in partial fulfillment of the
Requirements for the award of the degree of

M.Sc Applied Science (Software Engineering)
Bharathiar University, Coimbatore

Submitted by

S.Shalini
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KUMARAGURU COLLEGE OF TECHNOLOGY

(Affiliated to Bharathiar University)

COIMBATORE – 641006

BONAFIDE CERTIFICATE

This is to certify that this is the Bonafide Project Record Work done by **Shalini.S,** Reg.No **0037S0108** in Partial fulfillment for the award of Degree of M.Sc. [SOFTWARE ENGINEERING] , during the academic year 2002 –2003.

29/9/03.

Prof &.HOD

Guide

SUBMISSION

This Project entitled "WAN Routing and Campus Networking " is submitted for the VII semester of M.Sc. [SOFTWARE ENGINEERING] for Bharathiar University Project Viva-voce examinations held on ...29.9.03.....

29/9

Internal Examiner

29/9

External Examiner

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16/09/03

CERTIFICATE

This is to certify that Ms. Shalini .S. of IV th year Msc (S/w Engineering) student of Kumaraguru College of Technology , Coimbatore , has done her project on "Wan Routing & Campus Networking " under my guidence during June 2003 to September 2003 . We find her project work satisfactory.

J. Selvamuthukumar
(Deputy – Manager Training)

S.N . Jeevan Krishna
(Project Guide)

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DECLARATION

I hereby declare that the project entitled **WAN ROUTING AND CAMPUS NETWORKING**, submitted towards the fulfillment of M.Sc Applied Science (Software Engineering) from BharathiarUniversity is a record of original work done by me under the supervision of **Mr.J.Selvamuthu Kumar** Dy Manager –Training, Global Software Chennai and **Ms.J.Cynthia M.E.,** Lecturer, Dept of Computer Science, Kumaraguru College Of Technology and this project work has not formed the basis for the award of any Degree/ Diploma/Associate-ship/Fellow-ship or any other similar title to any candidate of any University.

Place: COIMBATORE

Shalini S

Date: 29.9.03

Signature of the Student

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ACKNOWLEGEMENT

I express my sincere gratitude to **Dr. K.K Padmanabhan,** PhD., esteemed Principal, Kumaraguru College Of Technology for giving me this opportunity to do the project work and providing facilities in the college to make it possible for me to complete my work without difficulties.

I express my profound gratitude to **Mr. Thangasamy, B.E (Hons), Ph.D, Head** of Department, Computer Science, and Kumaraguru College of Technology who motivated me with his valuable ideas and support in doing this project.

I am grateful to **Mr. Selvamuthu Kumar Dy Manager-Training** of Global Software Ltd. for giving me an opportunity to do the project in their esteemed organization.

I am greatly privileged to express my deep sense of gratitude to **Mr.Jeevan Krishna** and **Mr. Deepak Rao**, Global Software Ltd. for their support and guidance in doing this project.

I express my deep sense of gratitude and indebtedness to **Ms. J.Cynthia**, **M.E**, Lecturer Kumaraguru College of Technology for his invaluable guidance throughout the length of this project.

I also thank my **Beloved Parents** who have been a pillar of support for me in completing this project, my friends and the department teaching and non-teaching staff for their support in completing this project.

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SYNOPSIS

This project deals with planning and designing of WAN and Campus networks using and configuring network devices like routers and switches, testing and monitoring the network by the use of the protocol.

A Corporate office with a Branch Office is to be networked. The Company's own network has to be restructured to support emerging Technologies. The company has to be divided based on organizational and functional requirements. The divisions have to be planned. Access from the remote branch office has to be a setup. Advantages/Disadvantages provided by different network devices have o be studied. Layout of the company's network has to be designed using the network devices.Implemntation of the whole network has to be done. Post implementation study has to be carried out.

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INTRODUCTION

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OVERVIEW OF THE PROJECT:

The project deals with planning and designing WAN and campus networks using devices like routers and switches and then testing and monitoring the network by use of the software.

The purpose is to create networking between the main office and the branch office and to monitor traffic using software which is used for viewing the traffic in the network.

Scope of the Product:

While analyzing the scope of the network design, the main reference is given to the CISCO proprietary model to specify the types of functionality the new network design must address.

In addition to this, the following terms also define the scope of the network and project.

SEGMENT: A single network based on a particular layer protocol. It may include hubs, repeaters & multi station-access units.

LAN: A set of bridged or switched segments usually based on a particular layer-2 protocol. It may have one or more layer-3 protocols associated with it.

CAMPUS NETWORK: Multiple buildings within a local geographical area usually connected to a campus-backbone network.

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REMOTE ACCESS: Dial in/dial out solutions which are either analog or digital.

WAN: A geographical dispersed network including point-point, frame relay and other long distance connections.

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ORGANIZATION PROFILE:

Global software limited (GSL) is promoted by an industrial group in the IT area. It is a technology focused multinational company that focuses on contemporary ESM solutions anchored by quality.

With a world class research and development center for operating systems, databases,networks and enterprise security,GSL provides ESM solutions from min-size to large organizations, portals and ISPs.

The company has offices in US, UK, Singapore, Mauritius and India with 150 experienced ESM professionals. It is backed by core technology teams with 100+ many years of experience in systems software and networking technologies.

Global Software Ltd, India, is a backend system integration company, focusing on enterprise systems management,(ESM).The company has excellent resources to offer the entire range of backend systems integration services in IT with specialization in the following areas.

- Managed services.
- Operating system services
- Network services
- ESM solution consulting

Our company is unique with 100% certified, thoroughly experienced, highly qualified professionals offering tangible,scalacle ESM solutions to achieve increase in service deliverables: sound knowledge and vast experience to handle heterogeneous complexity of multiple systems.

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With its unique competency center Global's competency center-hardware and software global continually update the competency center in line with market changes. The ESM competency in center in Chennai is a true world -class infrastructure with state-of -the-art equipments. The company has high-speed links to internet and to all its world wide offices. The links can be extended to the client's location for off shore support/remote management there by providing cost effective solutions.

GSL is an IBM/Tivoli business partner, Microsoft certified solution provider and authorized prometric testing center.

Hardware:

The following are the wide range of hardware available at GLOBAL in India.

- IBM S/390 Enterprise Server
- IBM RS/6000 SSP @ Enterprise Server with SAN
- Sun Enterprise Server -3500 Series
- IBM Netfinity 5500 Servers
- CISCO Routers and Switches

Software:

The software platform includes:

- **Operating Systems** :IBM OS/390,IBM AIX,Sun Solaris,HP-UX,True Unix and Windows NT
- **Database Management** :IBM DB2,IBM UDB,Oracle,Sybase,SQL
- **Storage Management** :IBM ADSM/TSM, Veritas,Legato And Solstice Disk Suite
- **System Management** :IBM Tivoli, CA Unicenter TNG,BMC Patrol
- **Network Management** : IBM Net view CISCO Works 2000 and HP-view

SYSTEM STUDY

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EXISTING SYSTEM:

Head Office: totally contains

Department	number of hosts
Human Resource	6
MCSE	64
IBM	154
Administration	30
Technical Support	14
Application development	30
Server systems	5

In the existing system hubs are used for connectivity between the departments. Hubs are connected to a backbone cable. Each floor has a modem connected with the branch office network. Network is a star topology.

Branch Office:

The branch office has totally 15 systems.

Drawbacks of the existing system:

- The existing network is based on a star topology, when hubs fail, that particular sub network will go flat.
- In hubs we were able to connect only 16 ports.
- Hub has only a single collision domain and broadcast domain. hence traffic is more when hubs are used as means of transfer.
- Hubs can only repeat the signals. Since the existing system used hubs for connectivity, many modems are needed for branch office connectivity.
- Hubs are not extendable.
- Hubs do not contain table data structure.
- If more than one system tries to broadcast some message then congestion occurs. Because of this problem the transferring duration increases.
- Traffic monitoring software in the existing system (IBM Tivoli) is not proprietary. it can be aligned very easily based on the organization's own requirements.

PROPOSED SYSTEM

Switches are used in this system, in order to separate the network into multiple broadcast domains. Here **VLAN** (Virtual Local Area Network) concept is implementated.**VLAN** is a logical broadcast domain that can span multiple physical LAN segments. Any user in this **VLAN** can receive a broadcast from other members of the **VLAN,** whereas users of other **VLANS** can't receive these broadcasts.

In order to put a port into a **VLAN,** you must assign membership on the switch. There are two membership modes available. They are Static and Dynamic.

- **Static**: Assignment of the **VLAN** to the port is statically configured by the administrator.
- **Dynamic**: Dynamic **VLAN** uses a **VLAN** Membership Policy Server (VMPS).The VMPS contains the database that maps MAC address to the VLAN assignment.

ISL (Inter Switch Link) is a Cisco propriety protocol used to interconnect multiple switches and to maintain **VLAN** information as traffic go between switches.ISL provides **VLAN** capabilities while maintaining full overall speed performance over fast Ethernet links in full or half duplex mode. The purpose of ISL is to maintain**VLAN** information. This function allows the switch to forward information about in which **VLAN** the Traffic is maintained.

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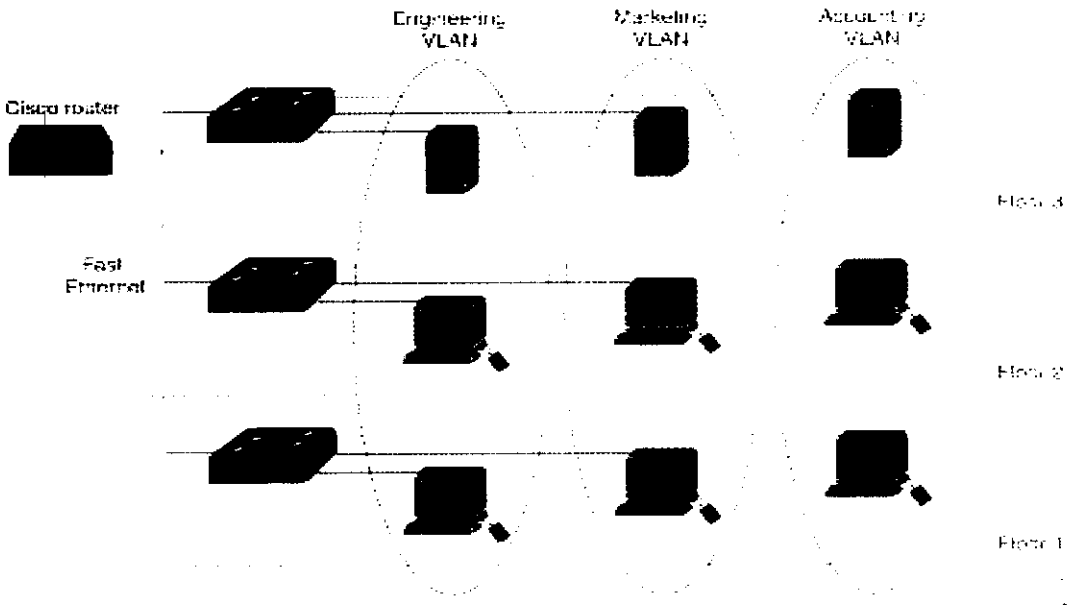
Example Vlan:



REQUIREMENTS FOR THE PROPOSED SYSTEM

The proposed system aims at removing most of the drawback found extensively in existing system. It can be thought of as maintenance friendly.

Thus, the following benefits are obtained from the proposed system.

- Traffic congestion is reduced.
- Reliability increases.
- Department wise data transfer is restricted within a single department.
- Extensibility is improved.

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USER CHARACTERISTICS

Constraints:

- It is important that policy discussion with the customer should be made compulsory.

- Finding out if the company has standardized on any transport, routing, desktop or other protocols is essential.

- Determine if there is any doctrine regarding open versus proprietary solutions.

- Finally it is important to find out if there are any policies regarding distributed authority for network design and implementation.

Design Constraints:

This project involves the job of changing an existing system network in to a proposed network. This change in the entire network is carried on because of the disadvantages in the existing system. All the disadvantages in the existing system are analyzed and answered by forming a new network.

Before building the new network the entire structure of the company has to be studied. Based on the number of the systems networking devices availability and traffic the new system is built.

SYSTEM REQUIREMENTS

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Functional Requirements:

Hardware specification:

PROCESSOR : INTEL PENTIUM III 733 MHZ

RAM	: 64 MB
FDD	: 1.44 MB
HARD DISK	: 20 GB
MONITOR	: 14"COLOUR MONITOR
KEY BOARD	: 101/102 KEYS

Switches: Cisco 2820, 3548

Routers: Cisco 2500, 3600, 3660

Software Specification:

OPERATING SYSTEM	: Ms WINDOWS 2000
LANGUAGE USED	: C++
INTERFACE S/W	: HYPERTERMINAL

Non Functional Requirements:

Interface Requirements:

Modems:

DAX -56K

Dlink-56K

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Cables:

Cat -10 base 2

Cat -10 base 5

Fast Ethernet -100 base 5

SYSTEM DESCRIPTION

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MODULES:

- System Analysis
- Network Design
- Configuration
- Testing & Maintenance

Analysis:

This module involves analysis of existing network in s\both head office and branch offices network speed and traffic. Based on the results of this analysis phase new network is built such that it has less traffic than the existing network. The disadvantages that are indicated by the analysis phase will pave way to analyze and arrange the new network. Analysis phase also considers cost factors of the old network.

Network Design:

This phase involves designing of the new network which has less traffic when compared to the old network. Network is designed such that there is a provision for extending the network as desired without affecting the network traffic, so the final network is one which has effective traffic management mechanism for every department in the company.

Configuration and Coding:

In this phase network devices like the router and the switches are configured and their startup configuration coding are written in their memory in order to enable them at startup.

- **Router Configuration**:

  All routers follow the same method of configuration. Only commands with respect to certain serial/Ethernet interfaces may change as per the requirement of the routers.

- **Switch Configuration**:

  Every switch has unique configuration coding, so as per the requirement of the different switches the configuration is made.

Coding involves the process of writing code for the network monitoring software. This software performs the job of reading the ip address from the user and finding the path for he particular host, displaying the hop counts for that specific host and reading the entries that will enter into the Network Interface Card and determining whether it is for the Address Resolution Protocol. If it is not for the particular host then the count will increase. The count of that particular host in the old network and that of the one in the new network is compared. If the count is reduced, then can conclude that traffic maintenance is effective in the new network.

Testing and Maintenance:

This Module Performs the maintenance of the entire new network based on the traffic show by the network monitoring software.

Testing of the entire network is performed by using the router's and switch's built-in commands. In testing there are provisions available in the network monitoring

software to test whether a particular host is in connection with this system or not and to test the gateway of the host.

Positioning Servers:

It is very common for an enterprise to centralize servers. In some cases, services are consolidated into a single server. In other cases, servers are grouped at a data center for physical security or easier administration. At the same time, it is increasingly common for workgroups or individuals to publish a Web page locally and make it accessible to the enterprise.

With centralized servers directly attached to the backbone, all client/server traffic crosses one hop from a subnet in the access layer to a subnet in the core. Policy-based control of access to enterprise servers is implemented by access lists applied at the distribution layer. As mentioned, servers attached directly to the core must use proxy ARP, IRDP, GDP, or RIP snooping to populate their routing tables. HSRP would not be used within core subnets, because switches in the distribution layer all connect to different parts of the campus.

Policy controlling access to these servers is implemented with access lists on the core switches. Another big advantage of the server distribution model is that HSRP can be used to provide redundancy with fast failover. The server distribution model also keeps all server-to-server traffic off the backbone.

Integrated Cisco IOS Switching Solution

- Cisco Group Management Protocol (CGMP) enables a switch to selectively and dynamically forward routed IP multicast traffic to targeted multimedia end stations, reducing overall network traffic

- Virtual LAN trunks can be created from any port using either standards-based 802.1Q tagging or the Cisco Inter Switch Link (ISL) VLAN architecture

- Cisco Discovery Protocol (CDP) enables a Cisco Works network management station to automatically discover a switch in a network topology

Superior Manageability

- Built-in Web-based management interface provides easy-to-use management through a standard browser such as Netscape Navigator or Microsoft Explorer

- Manageable through CiscoWorks2000 network management software on a per-port and per-switch basis, providing a common management interface for Cisco routers, switches, and hubs

- Configurable network port, supporting unlimited Media Access Control (MAC) addresses for backbone connectivity

- Domain Name System (DNS) client support provides IP address resolution with user-defined device name

Security and Redundancy

- MAC-based port-level security prevents unauthorized stations from accessing the switch

- User-selectable address learning mode simplifies configuration and enhances security

SYSTEM ANALYSIS

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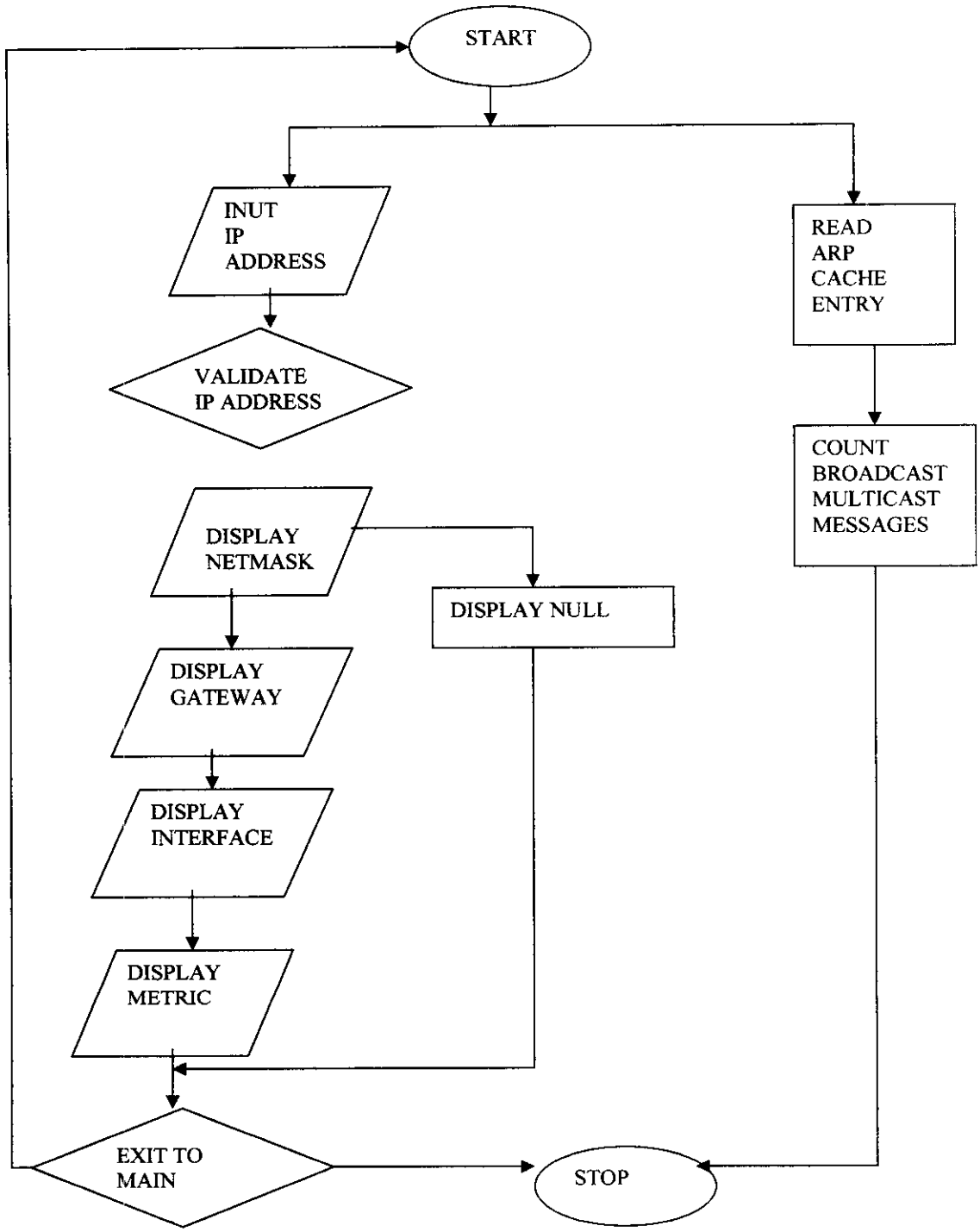
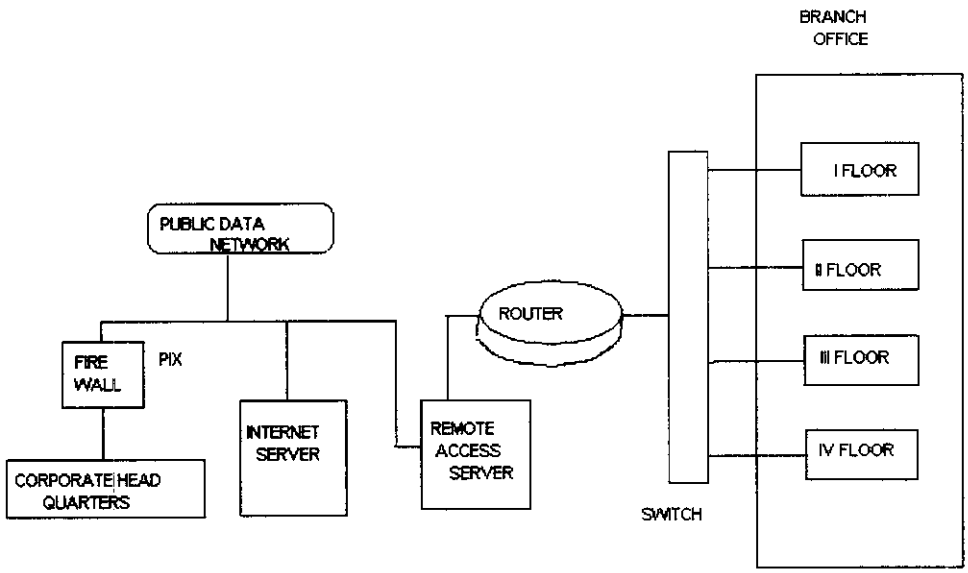
Flow Chart:



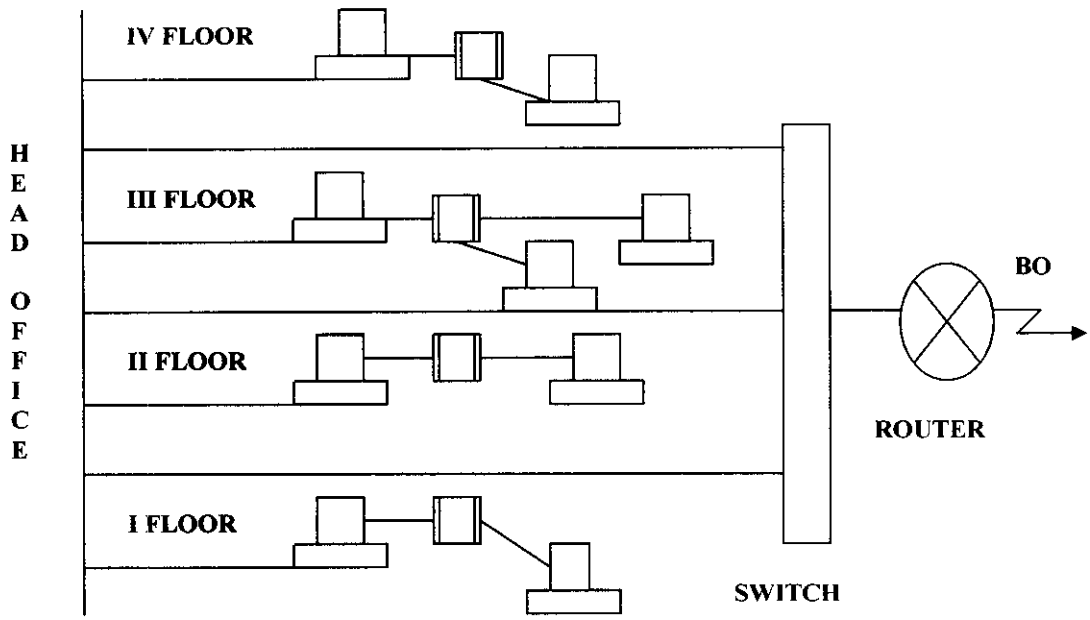
NETWORK DESIGN

CORPORATE & BRANCH OFFICE CONNECTIVITY



CORPORATE AND BRANCH OFFICE CONNECTIVITY

EXISTING NETWORK DESIGN



CAMPUS NETWORK DESIGN CONSIDERATIONS

- Routing and Scalability
- Layer 2 Switching
- Virtual LANs
- Redundancy and Load Balancing

Routing and Scalability

A router is a packet switch that is used to create an internet work or internet, thereby providing connectivity between broadcast domains. Routers forward packets based on network addresses rather than Media Access Control (MAC) addresses. Internets are more scalable than flat bridged networks, because routers summarize reach ability by network number. Routers use protocols such as OSPF and Enhanced IGRP to exchange network reach ability information.

Compared with STP, routing protocols have the following characteristics:

- Load balancing across many equal-cost paths (in the Cisco implementation)
- Optimal or lowest-cost paths between networks
- Fast convergence when changes occur
- Summarized (and therefore scalable) reach ability information

In addition to controlling broadcasts, Cisco routers provide a wide range of value-added features that improve the manageability and scalability of campus internets. These

features are characteristics of the Cisco IOS™ software and are common to Cisco routers and multilayer switches.

Layer 2 Switching

Layer 2 switching is hardware-based bridging. In particular, the frame forwarding is handled by specialized hardware, usually application-specific integrated circuits (ASICs). Layer 2 switches are replacing hubs at the wiring closet in campus network designs.

The performance advantage of a Layer 2 switch compared with a shared hub is dramatic. Consider a workgroup of 100 users in a subnet sharing a single half-duplex Ethernet segment. The average available throughput per user is 10 Mbps divided by 100, or just 100 kbps. Replace the hub with a full-duplex Ethernet switch, and the average available throughput per user is 10 Mbps times two, or 20 Mbps. The amount of network capacity available to the switched workgroup is 200 times greater than to the shared workgroup. The limiting factor now becomes the workgroup server, which is a 10-Mbps bottleneck. The high performance of Layer 2 switching has led to some network designs that increase the number of hosts per subnet. Increasing the hosts leads to a flatter design with fewer subnets or logical networks in the campus. However, for all its advantages, Layer 2 switching has all the same characteristics and limitations as bridging. Broadcast domains built with Layer 2 switches still experience the same scaling and performance issues as the large bridged networks of the past. The broadcast radiation increases with the number of hosts, and broadcasts interrupt all the end stations. The STP limitations of slow convergence and blocked links still apply.

Virtual Lans

VLAN (Virtual Local Area Network) concept is implementated.VLAN is a logical broadcast domain that can span multiple physical LAN segments. Any user in this VLAN can receive a broadcast from other members of the VLAN, whereas users of other VLANS can't receive these broadcasts.

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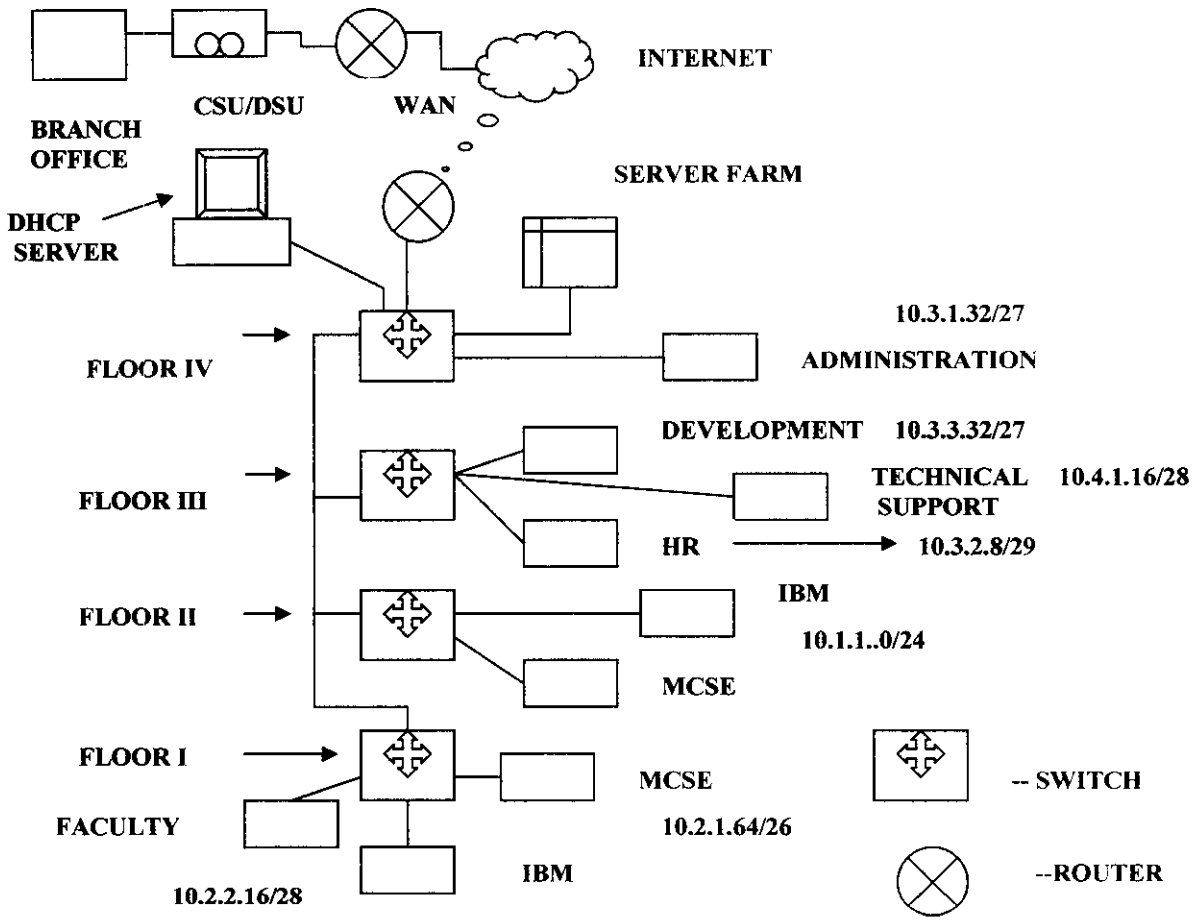
Redundancy and Load Balancing

A distribution-layer switch represents a point of failure at the building level. One thousand users in Building A could lose their connections to the backbone in the event of a power failure. If a link from a wiring closet switch to the distribution-layer switch is disconnected, 100 users on a floor could lose their connections to the backbone. Multilayer switches provide redundant connectivity to domain "North." Redundant links from each access-layer switch connect to distribution-layer switches .Redundancy in the backbone is achieved by installing two or more Catalyst switches in the core. Redundant links from the distribution layer provide failover as well as load balancing over multiple paths across the backbone.

Redundant links connect access-layer switches to a pair of Catalyst multilayer switches in the distribution layer. Fast failover at Layer 3 is achieved with Cisco's Hot Standby Router Protocol. The two distribution-layer switches cooperate to provide HSRP gateway routers for all the IP hosts in the building. Fast failover at Layer 2 is achieved by Cisco's Uplink Fast feature. Uplink Fast is a convergence algorithm that achieves link failover from the forwarding link to the backup link in about three seconds.

Load balancing across the core is achieved by intelligent Layer 3 routing protocols implemented in the Cisco IOS software.

NEW NETWORK DESIGN-HEAD OFFICE



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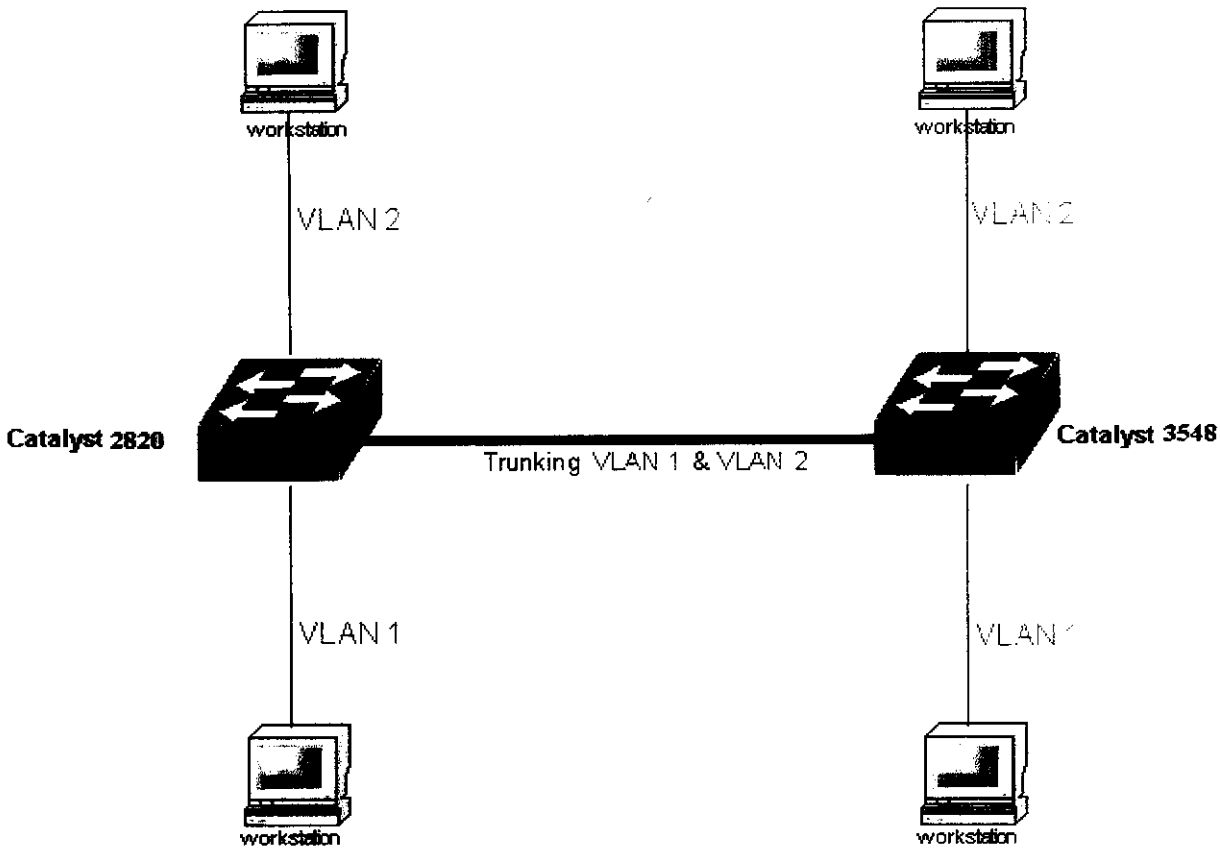

Departments under VLAN's and their subnetting

Departments under Vlan 1

1. HR - 10.3.2.8/29
2. Development - 10.3.3.32 / 27
3. Technical support - 10.4.1.16 / 28
4. Administration - 10.3.1.32 / 27

Departments under Vlan 2

1. Faculty - 10.2.2.16/28
2. IBM - 10.1.1.0/24
3. MCSE - 10.2.1.64/26

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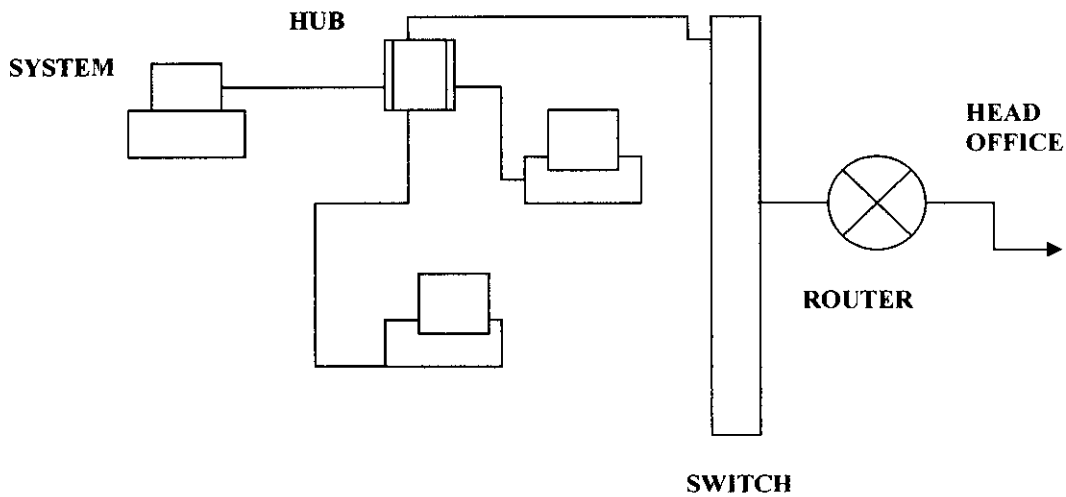
NEW NETWORK DESIGN-BRANCH OFFICE



CONFIGURATION

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Router Configuration

Sh ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

* - candidate default, U - per-user static route, o - ODR

P - Periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

10.0.0.0/24 is sub netted, 2 subnets

C 10.10.10.0 is directly connected, FastEthernet0/0.2

C 10.10.20.0 is directly connected, FastEthernet0/0.3

C 192.168.1.0/24 is directly connected, FastEthernet0/0

C 195.1.1.0/24 is directly connected, Serial3/2

S* 0.0.0.0/0 is directly connected, Serial3/2

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Routing Analysis:

ROUTING TABLE:

A routing table is present on all ip nodes. The routing table stores information about IP networks and how they can be reached (either directly or indirectly), because all IP nodes perform some form of IP routing. Routing tables are not exclusively to IP routers. Any node loading the TCP/IP protocol has a routing table. There are a series of default entries according to the configuration of the node and the additional entries are entered either manually through TCP/IP utilities or dynamically through interaction with routers.

When an IP packet is o be forwarded, the routing table is used to determine:

- The forwarding or next-hop IP address.
- For a direct delivery the forwarding IP address is the destination IP address in the IP packet, and for an indirect delivery, the forwarding IP address is the IP address of the router.
- The interface to be used for the forwarding:

  The interface identifies the physical or logical interface such as a network adapter that is used to forward the packet to either its destination or the next router.

IP ROUTING TABLE ENTRIES:

An entry in the IP routing table contains the following information in the order presented:

- **Network ID:** The network ID or destination corresponding to the route. The network ID can be class-based, subnet, or super net network ID, or an IP address for host route.

- **Network Mask**: The mask that is used to match a destination IP address to the network ID.

- **Next Hop**: Then IP address of the next hop.

- **Interface**: An indication of which network interface is used to forward the IP packet.

- **Metric**: A number used to indicate the cost of the route so that the best route among possible multiple routes to the same destination can be selected. The common use of the metric is to indicate the number of hops (routers crossed) to the network ID.

- **Directly Attached Network ID's**: Routes for the network IDs that are directly attached. For directly attached network, the next hop field can be blank or contain the IP address of the interface on that network.

- **Remote Network IDs**: Routes for the network IDs that are not directly attached but are available across other routers. For remote networks, the next hop field is the IP address of a local router in between the forwarding node and the remote network.

- **Host Routes**: A route to a specific IP address. Host routes allow routing to occur as per IP address basis. For host routes, the network ID is the IP address of the specified host and the network mask is 255.255.255.255(generic broadcast).

- **Default Route**: The default route is designed to be used when a more specific network ID or host route is not found. The default route network ID is 0.0.0.0 with the network mask of 0.0.0.0

ROUTE DETERMINATION PROCESS:

To determine which routing table entry is used for the forwarding decision, IP uses the following process:

- For each entry in a routing table, perform a bit-wise logical AND between the destination IP address and the network mask. Compare the result with the network ID of the entry for a match

- The lists of matching routes are compiled. The route that has the longest match (the route that matched the most number of nits with the destination IP address) is chosen. The longest matching route is the most specific route to the destination IP address. The multiple entries with the longest match are found (multiple routes to the same network ID, for example), the router uses the lowest metric, the router is free to choose which routing table entry to use.

- The end result of the route determination process is the choice of a single route in the routing table. The route chosen yields a forwarding IP address (the next hop IP address) and an interface (the port).If the route determination process fails to find a route, IP declares a routing error. For the sending host, an IP routing error is internally indicated to the upper layer protocol such as TCP or UDP.For a router, an ICMP destination unreachable-host unreachable is sent to the source host.

Vlan Configuration

Building configuration...

Current configuration: 1091 bytes

!

version 12.2

service timestamps debug uptime

service timestamps log uptime

no service password-encryption

!a

hostname Router

!

!

ip subnet-zero

!

!

!

ip audit notify log

ip audit po max-events 100

ip ssh time-out 120

ip ssh authentication-retries 3

!

call rsvp-sync

!

!

!

!

!

fax interface-type modem

```
mta receive maximum-recipients 0
!
!
!
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/0.2
 encapsulation isl 2
 ip address 10.10.10.1 255.255.255.0
 no ip redirects
!
interface FastEthernet0/0.3
 encapsulation isl 3
 ip address 10.10.20.1 255.255.255.0
 no ip redirects
!
interface Serial3/0
 ip address 10.0.0.1 255.255.255.252
 shutdown
 no fair-queue
!
interface Serial3/1
 ip address 10.2.0.1 255.255.255.252
!
interface Serial3/2
 no ip address
```

```
 shutdown
!

interface Serial3/3

 no ip address
 shutdown
!
ip classless
ip http server
ip pim bidir-enable
!
!
!
voice-port 4/0/0
!
voice-port 4/0/1
!
voice-port 4/1/0
!
voice-port 4/1/1
!
dial-peer cor custom
!
!
!
!
!
line con 0
 logging synchronous
```

line 65 80

line aux 0

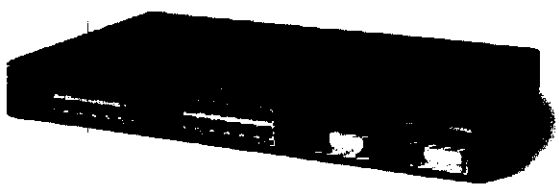
line vty 0 4

!

end

Router#

CISCO CATALYST SWITCH-3548



Switching Analysis:

PHYSICAL ADDRESS RESOLUTION:

Based on the destination IP address and the route determination process,IP determines the forwarding IP address and interface to be used to forward the packet.IP then hands the IP packet, the forwarding IP address, and the interface to the ARP.

If the forwarding IP address is the same as the destination IP address, then the ARP performs a direct delivery. In a direct delivery, the MAC address corresponding to the destination IP address must be resolved.

If the forwarding IP address is not the same as the destination IP address, then ARP performs an indirect delivery. The forwarding IP address is the IP address of a router between the current IP node and the final destination. In an indirect delivery, the MAC address corresponding to the IP address of the router must be resolved.

To resolve a forwarding IP address to its MAC address,ARP uses the broadcasting facility on shared access networking technologies(such as Ethernet or token ring) to send out a broadcast ARP request frame. An ARP reply containing the MAC address corresponding to the requested forwarding IP address is sent back to the sender of the ARP request.

ARP CACHE:

To keep the number of broadcast ARP request frames to a minimum, many TCP/IP protocol stacks incorporate an ARP cache, a table of recently resolved IP addresses and their corresponding Mac address. The ARP cache is checked first before sending an ARP request frame. Each interface has its own ARP cache.

Depending on the vendor implementation, the ARP cache can have the following qualities:

- ARP cache entries can be dynamic (based on ARP replies) or static. Static ARP entries are permanent and are manually added using a TCP/IP utility such as the ARP utility provided with windows 2000.Static ARP cache entries are used to prevent ARP requests for commonly-used local IP addresses, such as routers and servers, The problem with static ARP entries is that they have to be manually updated when network interface equipment changes.

- Dynamic ARP cache entries have a time-out value associated with them to remove entries in the cache after a specified period of time. Dynamic ARP cache entries for Windows 20000 TCP/IP are given a maximum time of 10 minutes before being removed.

ARP PROCESS:

IP sends information to the ARP, ARP receives the IP packet, the forwarding IP address, and the interface to be used to forward the packet. When performing a direct or indirect delivery, ARP performs the following process:

- Based on the interface and the forwarding IP address, the ARP consults the appropriate ARP cache for an entry for the forwarding IP address. If an entry is found, ARP skips to step 6.

- If the entry is not found,ARP builds an ARP request frame containing the MAC address of the interface sending the ARP request, the IP address of the interface

sending the ARP request, and the forwarding IP address.ARP then broadcasts the ARP request using the appropriate interface.

- All the hosts receive the broadcasted frame and the ARP request is processed. If the receiving host's IP address matches the requested IP address (the forwarding IP address), its ARP cache is updated with the address mapping of the sender of the ARP request.
- If the receiving host's IP address does not match the requested IP address, the ARP request is silently discarded.

- The receiving host formulates an ARP reply containing the requested MAC address and sends it directly to the sender of the ARP request.

- When the ARP reply is received by the sender of the ARP request, it updates its ARP cache with the address mapping.

- Between the ARP request and the ARP reply, both hosts have each other's address mappings in their ARP caches.

- The IP packet is sent to the forwarding host by addressing it to the resolved MAC address.

TESTING

TESTING:

The system entitled "Network Monitoring" has been thoroughly tested and found to have successfully passed all the tests. The system has been tested with every kind of data. The sequence flow of data has been altered and checked for. In case of extremity error messages has been generated.

The system has been tested for efficiency and has been found satisfactory. It has been implemented in parallel with the existing system and found to perform in a superior manner in both terms of speed and efficiency. In this system all the activities have to be very reliable and the system should have a high degree of accuracy, so efficient and effective working of this system is a must and this is checked using the following tests.

Unit testing:

Verification effort on the smallest unit of software design-module is termed as unit testing.

- Test cases are given for testing against requirements of the unit being tested. Test cases for path or branch coverage.
- Test cases for data-flow.

Validation testing:

It can be defined in many ways, but a simple definition is that validation succeeds when the software functions in the manner that is expected by the customer. This is achieved by a series of tests that demonstrates conformity with requirements. After validation tests have been conduced one of the following conditions exists.

- The function or performance characteristics confirm that it is as expected.

- The validation from the specification is uncovered and a deficiency created.

Deviation or errors discovered at this stage are corrected prior to the completion of the project with the help of the user by negotiating to establish a method for resolving deficiencies. Thus the proposed system has been tested by using validation testing and is found to be working satisfactorily.

IMPLEMENTATION:

Problems Faced:

- Reading the routing table from the router.
- Format of the routing table information was vague.
- Hop count and broadcast count determination was difficult.

Lessons Learnt:

- Routing table information from the router is read by the usage of commands.
- Hop count and broadcast count determination for a WAN node could be calculated by counting the counts of each LAN and by summing them up.

FUTURE ENHANCEMENT

Plans:

- Usage of protocols like OSPF can be implemented.
- ISDN backup can be used for failover.

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