Final Project

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Problem 1

Question

I am sitting in front of my Intel PC, which is running a Windows 7 (or later) operating system, and I am using my Internet Explorer Web browser to access an ISP of your choice. I am doing this at 56 kbps modem speeds, but I want to join the broadband revolution.

You will hook my PC up to some broadband access method. You will describe the overall design; describe specific vendor hardware that makes up the design; describe the transmission media; and describe the protocols within the design (note that this includes TCP/IP and HTTP).

The three approved solutions for this problem are cable TV, DSL, or wireless. For DSL, you should describe the solution from my PC to the DSLAM or the first ATM switch. For cable or wireless, you will have to include an overview of their networks.

Introduction

For Problem 1, I choose DSL solution. The DSL service I chose is Yahoo! BB ADSL service, which is one of the most popular DSL services in Japan provided by Yahoo! Japan Corporation. ADSL stands for asymmetric DSL. By this solution, the download traffic speed will be up to 50 Mbps, and the upload traffic speed will be up to 12.5 Mbps. I suppose that the telephone company you are contracting is NTT, which is the largest telecommunications company in Japan.

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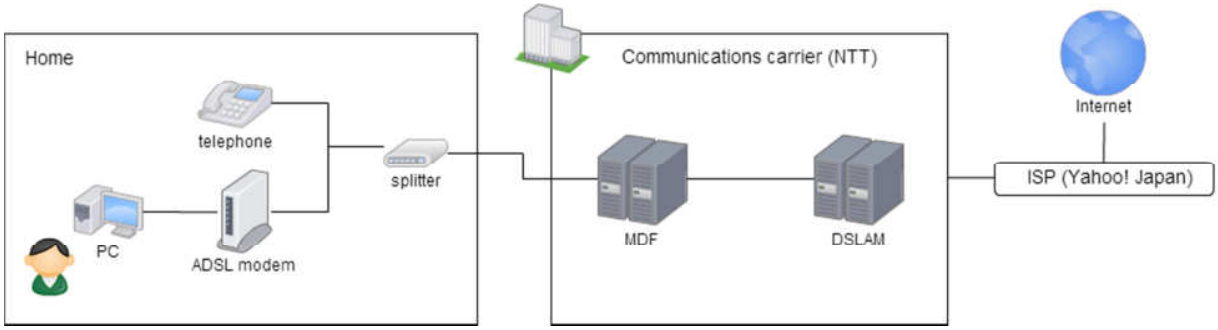
Overall design

My overall design is illustrated as below.



Since the Yahoo! BB ADSL modem is a bridged modem, you need a router to have multiple internet-connected devices.

Hardware

The hardware list used for Problem 1 is below.

End devices	Intel PC, which is running a Windows 7 operating system
Intermediary devices	An ADSL splitter in your home
	An ADSL modem in your home
	A main distributing frame in the communications carrier
	A DSLAM in the communications carrier

Transmission media

From the PC to the ADSL modem will be connected by a Category 5e unshielded twisted pair cable. Also I would connect the ADSL splitter to the RJ11 telephone socket by a Category 5e unshielded twisted pair cable by using a RJ45-RJ11 conversion connector produced by

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ELECOM CO., LTD. The reason why I will not use a Category 1 cable, commonly used for a telephone cable, instead of a Category 5 cable is that the maximum speed of Category 1 is up to 20 Kbps. Between your home and nearby telephone station will be connected by metallic cables

Protocol description

Even in a small network as this case, network mechanisms are based on the OSI reference model and TCP/IP. In understanding the OSI model, the concept of capsulation is very important.

When you send a message over a network, each layer from layer 4 to layer 1 adds its own headers to data as below. When you use Ethernet, Ethernet trailers in the data link layer in addition to Ethernet headers.

OSI reference model

Protocol data unit (PDU)	Layers
data	application
data	presentation
data	session
segments	transport
packets	network
frames	data link
bits	physical

That’s why the application layer protocol does not need to know or be made aware of a change of physical, link, and network layers.

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In this case, the transport layer protocol is TCP, and the application layer protocol is HTTP. TCP is a connection oriented protocol, TCP communications go through procedures for connection establishment before data transfer, so that its segment header includes meta-information for that. For this reason, the size of a TCP segment header is 20 bytes. On the other hand, UDP, which is a layer 4 protocol as well as TCP, is a connectionless protocol. The size of a UDP segment header is only 8 bytes because the header has just a source port number and a destination port number basically. For the different characteristics, TCP offers more accurate and stable communications in contrast to UDP which achieves rapid transmission of data.

Furthermore, when using TCP, the client and the server exchange meta information such as acknowledgements and control bits for connection establishment and sequence numbers to memorize the correct order of TCP segments before data transfer which is called the three-way handshake method. When establishing the three-way handshake, called the sliding windows protocol. For example, if the transfer of 5 data segments with a window size of 2, the sliding windows can be described as below. S means a segment and RR means an acknowledgement.

----S0----->

----S1----->

<---RR2-----

----S2----->

----S3----->

<---RR4-----

----S4----->

<---RR5-----

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Problem 2

Question

I want to set up an Ethernet LAN for my small office of 10 people. The parameters are similar to those of Problem 1, except you will be connecting to a LAN.

For either problem, your design should include the link from my PC or office workstation to the Internet Service Point (ISP) access point within the vendor's network.

You will have to research one of these solutions and then write your paper. For the DSL solution, you should go to one of the DSLAM vendors, such as Lucent; select a DSLAM; and then describe it.

For the cable, wireless, or LAN solutions, you will have to describe how the network components work in general. You will need to include descriptions on the home or office components, as well as an overview of their networks.

These terms will become clearer as the course advances. Fine-tuning of the concept will take place when you submit your one-page outline in week 4. The instructor is available for help and suggestions. You are encouraged to interact with the other members of your class.

Introduction

I designed a LAN for a small office for Problem 2. The DSLAM vendor I chose is Alcatel-Lucent, which Alcatel based in France merged with Lucent Technologies based in the

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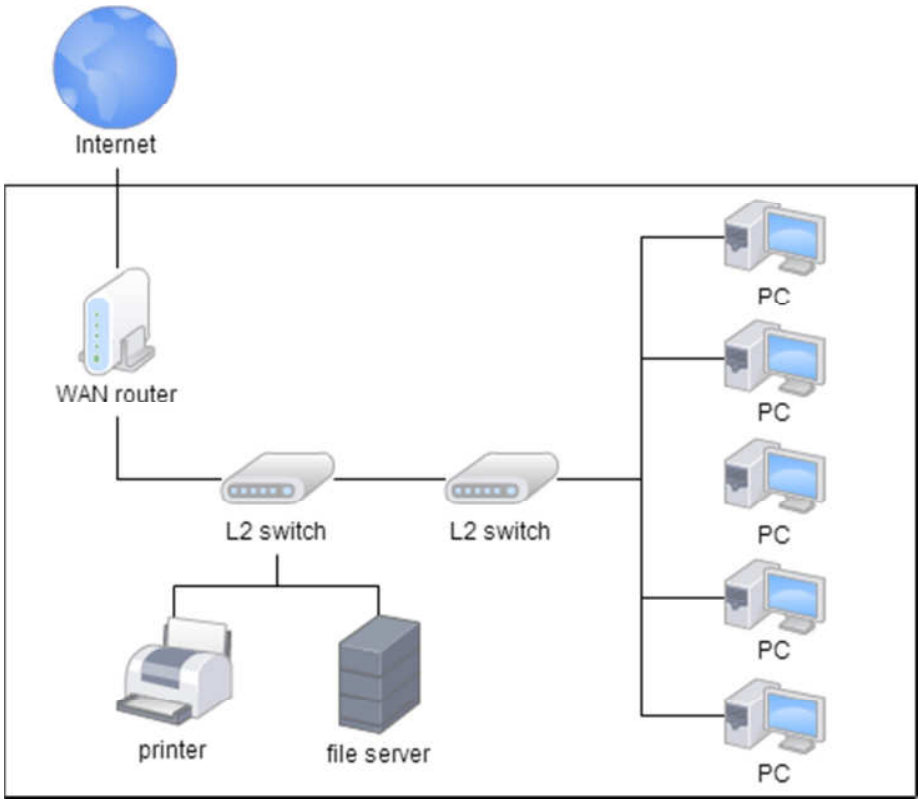
U.S. Actually Nokia announced that they are going to acquire the company recently. For cables, I choose LAN solution.

Overall design

My overall design is illustrated as below.



Hardware

The hardware list used for Problem 2 is below.

End devices	Workers' PCs (10 hosts)
	A printer
	A file server

Intermediary devices	A WAN router
	Layer 2 switches (Switching HUBs)

A L2 switch or a switching HUB is a network device for layer 2 data transfer. Actually, there was a called repeater HUB which is a network device for layer 1 data transfer; however, this kind of devices is rarely used nowadays.

Transmission media

All of end and intermediary devices will be connected by Category 5e unshielded twisted pair cables.

Protocol description

In this case, you need at least 10 network addresses. You need a class C network block of addresses which is composed of 24-bit network addresses and 8-bit host addresses. Since a class C network can have 2^8 (254) addresses. This is a little many in this situation; therefore, you can divide your network into appropriate subnets by using netmasks. For example, if you have a class C network 198.1.0.0, you should use 255.255.255.0 netmask which is typically noted 198.1.0.0/255.255.255.240 or 198.1.0.0/28. Because a /28 network block can have 2^4 (16) addresses, you can assign 10 network addresses.

Since the IP network is a virtual network, you can use the address resolution protocol or ARP to get an IP frame over an Ethernet LAN. ARP maps IP addresses to MAC addresses by using the ARP table. ARP is actually a layer 3 protocol which uses ARP packets instead of IP

packets, TCP/IP requires source and destination IP addresses in an IP packet and source and destination MAC addresses in a frame for all data communications; therefore, if a sender device such as a router doesn't know the destination MAC address, it sends a ARP request which is a broadcast message, and the receiver which has the destination IP address receives the request and sends a ARP reply to the sender. Other receivers of the message discard the packet. After that, the sender inserts an entry to map the sender to the receiver into its ARP table.

If your WAN router has an AS number, when you access the Internet, the router routes to the destination address by using EGP protocol.

References

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