TCP/IP Fundamentals

April 23, 2010

TCP/IP

Transmission Control Protocol – Internet Protocol (TCP/IP) was designed by Vinton Cerf and Robert Kahn. Both were presented with the Medal of Freedom by President Clinton for their achievement.

Since the release of TCP/IP in the early 1980's, the protocol and the Internet is constantly changing. Requests to modify and improve the protocols can be made by submitting a RFC.

The TCP/IP protocol is the most commonly found on the last link of the Internet from the ISP to organization and within Local Area Networks, so Network Administrators need to know the following concerning TCP/IP

- How many devices will be on the network
- Selection of the network class
- Constructing an IP address
- Choosing the correct subnet mask

TCP/IP is a Suite

Actually, TCP/IP is a number of protocols under one name. TCP/IP includes:

HTML - **H**yper**T**ext **M**arkup **L**anguage
- A protocol used to create web pages

HTTP - **H**yper**T**ext **T**ransfer **P**rotocol
- A protocol utilized to transfer hypertext from web server to browser

SMTP – **S**imple **M**ail **T**ransfer **P**rotocol
- The standard for electronic mail (email)

FTP – **F**ile **T**ransfer **P**rotocol
- Rules that allow files to travel data from one computer to another computer on a network

DNS - **D**omain **N**ame **S**ystem
- A set of TCP rules to define a point on the network by a domain name

DHCP – **D**ynamic **H**ost **C**ontrol **P**rotocol
- Rules that allows the server our router to automatically assign IP addresses

NAT – **N**etwork **A**ddress **T**ranslation
- A set of rules that allows the translation of one set of IP addresses to another address in another network

RIP – **R**outing **I**nformation **P**rotocol
- A set of rules defining how routers share information (tables)

Layers in the TCP/IP Protocol.

There are four layers in the TCP/IP protocol compared to the seven in the OSI Model.

The table shows the working of each layer.

Layer	Purpose
Network Interface Layer (Link)	For the transfer of packet. There is physical layer component that resides in the hardware such as NICs.
Network (Internet)	For sending the packets from one network to another network even if they are out of order
Transport	Flow congestion control, error checking, reordering of network packets. There are two services in this layer. TCP and UDP
Application	This layer is best defined by the services that are well known, such as SMTP (email), FTP, RIP, HTTP (browsing), Telnet, DNS, SNMP

Address Formation

IP addresses have two components:

Network and Computer ID

In the example of a Class C address commonly found in small networks, the network address is 192.168.0. Below a router or NAT server, all devices that we wish to communicate on this network must have the same group ID.

The computer ID is 1. We cannot use 0 or 255. On a class C network, we can have 1 through 254 or a total of 254 devices. If we have more, we will change to a class B network.

192.168.0.   1

Network   Computer

32 bits in TCP/IPv4 IP Address

There are four octets in the TCP address. We see in the example the three dots separating the four numbers. The numbers can range from 0 to 255, which is the largest figure represented by an eight bit number. The IP address in our example is actually 11000000.10100100.00000000.00000001 in binary.

So we can observe the four octets which total 32 bits.

192.168.0.   1

Network   Computer

Dividing TCP/IP

IP addresses are divided into five classes and some special purposes. Two components help the network administrator to classify the network, the first octet and the subnet mask.

TCP/IP is mostly ordered into three classes, A, B and C with special cases shown below the table.

The network manager will consider the total number of devices on the network when determining the IP address scheme.

Class	First Octet Range	Max Network IDs	Max IDs for Devices	Subnet Mask
A	1-126	126	16,777,214	255.0.0.0
B	128-191	16,384	65,534	255.255.0.0
C	192-223	2,097,152	254	255.255.255.0

0.0.0.0 is used by the default network
255.255.255.255 is a broadcast network
127.x.x.x is for administrator use
Class D is for multicast 224- 239
Class E is for future use

Class A Network

The class A network can communicate to 16,777,214 devices. We can pick our first octet of 1 to 126. In the example shown at the bottom of the slide, the network ID only resides in the first octet. The computer ID has three octets. The subnet mask the determines that this is a class A network is 255.0.0.0 and we can write both the addresses in binary.

00000001.00000000.00000000.00000001

11111111.00000000.00000000.00000000

The 1s in the subnet mask represent the network ID. The zeros in the subnet mask represent the computer device ID.

1.   0.0.1

Network   Computer

Class B Network

The class A network can communicate to 65,534 devices. We can pick our first octet of 128 to 191. In the example shown at the bottom of the slide, the network ID resides in the first two octets. The computer ID has two octets. The subnet mask the determines that this is a class B network is 255.255.0.0 and we can write both the addresses in binary.

10000000.00000000.00000000.00000001

11111111.11111111.00000000.00000000

The 1s in the subnet mask represent the network ID. The zeros in the subnet mask represent the computer device ID.

128.0.
Network

0.1
Computer

Class C Network

The class A network can communicate to 254 devices. We can pick our first octet of 192 to 223. In the example shown at the bottom of the slide, the network ID resides in the first three octets. The computer ID has one octet. The subnet mask the determines that this is a class C network is 255.255.255.0 and we can write both the addresses in binary.

11000000.00000000.00000000.00000001

11111111.11111111.11111111.00000000

The 1s in the subnet mask represent the network ID. The zeros in the subnet mask represent the computer device ID.

192.0.0.   1

Network   Computer

Subnetting

We can divide the network into smaller segments using a process called Subnetting

We can learn about Subnetting in the next lesson.