CTS2134
Introduction to Networking

Module 05 – Network Implementation

Binary to Decimal Conversion

Bit position:	7	6	5	4	3	2	1	0
Binary exponential:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value if bit = 1:	128	64	32	16	8	4	2	1

Figure 3-4 Components of a byte

10000000	010000000	00100000	00010000	00001000	00000100	00000010	00000001
128	64	32	16	8	4	2	1

Convert decimal to binary in Windows calculator

- **Go to Start, Run and type in: calc**
- **Type in a decimal number: 100**
- **Click on radio button beside bin (binary) and the binary equivalent will show in the answer box: 1100100** (7 bits)
- **Be careful, the answer box doesn't show leading 0s: 01100100** (8 bits)

IP Addresses

- The IP address includes both the network and the host address (network always on the left, host always on the right).
- The subnet mask (32-bit number) is associated with each IP address. The subnet mask identifies the network portion of the address.
  - In binary form, the subnet mask is always a series of 1's followed by a series of 0‘s.
  - A simple (decimal) mask might be 255.255.255.0.

IP Addresses

A computer only knows binary (0s and 1s)

An IP address in IP version 4 has

32 bits

(separated by periods into 4 octets)

11000000.10101000.00001010.10010110

IP Addresses

Humans are more familiar with decimal numbers, so we use a

Dotted decimal format

An IP address of 192.168.10.150

has a Binary equivalent of

11000000.10101000.00001010.10010110

IP Addresses

IP Addresses have 2 Parts:

Network Number and Host Number

In the IP Address 192.168.10.150,

the Network Number is 192.168.10

and the Host Number is 150.

The Correct Notation is 192.168.10.0

and 0.0.0.150

IP Addresses Classes

Class	Decimal in first octet	Binary in first octet
A	0-126	00000000 - 01111110
B	128-191	10000000 - 10111111
C	192-223	11000000 – 11011111

IP Addresses

To differentiate between the network portion and the host portion, network administrators use **subnet masks**.

The default **subnet mask** for the Class C IP address of 192.168.10.150 is 255.255.255.0

In binary:

11000000.10101000.00001010.10010110

11111111.11111111.11111111.00000000

11000000.10101000.00001010.00000000

192 .168 .10 .0

Default Subnet Mask

- **In binary, the highest number 8 bits can designate is 11111111 or 255 in decimal.**

IP Class Subnet masks		
Class	Subnet mask - Decimal	Subnet mask - Binary
A	**255.0.0.0**	**11111111.00000000.00000000.00000000**
B	**255.255.0.0**	**11111111.11111111.00000000.00000000**
C	**255.255.255.0**	**11111111.11111111.11111111.00000000**

Network Numbers

- The network number is the first address in an address range and is used to identify the network itself.
- For the network address, the host portion of the address contains all 0's.
  - Class A network address: 115.0.0.0
  - Class B network address: 154.90.0.0
  - Class C network address: 221.65.244.0

Broadcast Addresses

The last address in the range is used as the broadcast address.

The Broadcast Address is used to send messages to all hosts on the network. In binary form, the broadcast address has all 1's in the host portion of the address.

Network Number	Broadcast Address
115.0.0.0	115.255.255.255
154.90.0.0	154.90.255.255
221.65.244.0	221.65.244.255

Host Addresses

Each host must have a unique IP address.

Each host on the same network must use the same subnet mask.

When assigning IP addresses to hosts, you cannot use the first or last address in the range (reserved for the network and broadcast addresses)

For example:

Class A: 115.0.0.0, the host range is 115.0.0.1 to 115.255.255.254.

Class B:154.90.0.0, the host range is 154.90.0.1 to 154.90.255.254.

Class C: 221.65.244.0, the host range is 221.65.244.1 to 221.65.244.254.

Subnetting Facts

Subnetting is the process of dividing a large network into smaller networks.

As your network grows, you will need to create subnets to:

- Increase the number of devices that can be added to the LAN
- Reduce the number of devices on a single subnet to reduce congestion and collisions
- Reduce the processing load placed on computers and routers
- Combine networks with different media types within the same internetwork (subnets can not be used to combine networks of different media type on to the same subnet)

Note: It is possible to use subnet masks that do not use an entire octet. For example, the mask 255.255.252.0 uses six extra binary bits in the third octet.

Dynamic Host Configuration Protocol (DHCP)

A DHCP server is configured to pass out unique IP address and configuration information (default gateway, DNS server address) to network clients.

The DHCP server is configured with a range of IP addresses it can assign to hosts (Microsoft calls these ranges *scopes).*

The assignment is called a *lease, and includes a lease time that identifies how long the* client can use the IP address.

The DHCP lease process uses frame-level broadcasts that do not pass through routers to other subnets.

APIPA

Automatic Private IP Addressing is a feature that's built into Windows Operating Systems that enable the operating system to assign itself an IP address in the event that a DHCP server is unreachable.

If a host can't reach the DHCP server, APIPA automatically assigns the host an IP address in the range of 169.254.0.0 to 169.254.255.254, so they can communicate on the LAN.

Static (manual) assignment

Using static addressing, IP configuration information must be manually configured on each host.

Use static addressing:

•On networks with a very small number of hosts.

•On networks that do not change often or that will not grow.

•To permanently assign IP addresses to hosts that must have always have the same address (such as printers, servers, or routers).

•For hosts that cannot accept an IP address from DHCP.

•To reduce DHCP-related traffic.

Note: Static addressing is very susceptible to configuration errors and duplicate IP address configuration errors. Static addressing also disables both APIPA and DHCP capabilities on the host.

DNS Facts

•The Domain Name System (DNS) is a hierarchical, distributed database that maps logical host names to IP addresses.

The DNS hierarchy is made up of the following components:

•. (dot) domain (also called the *root domain)*

•Top Level Domains (TLDs) such as .com, .edu, .gov

•Additional domains such as yahoo.com, microsoft.com, etc.

•Hosts

The fully-qualified domain name (FQDN) includes the host name and all domain names, separated by periods. The final period (for the root domain) is often omitted and implied.

Routing Facts

A router is a device that routes packets from one network to another network. Routers receive packets, read their headers, find addressing information, and send them on to their correct destination. Routers can forward packets through an internetwork by maintaining routing information in a database called a routing table.

The routing table typically contains the following information:

- The address of a known network
- The interface or next hop router used to reach the destination network
- A cost value (*metric)* that identifies the desirability of the route to the destination network (using distance, delay, or cost)
- A timeout value that identifies when the route expires

Routing Protocol Characteristics Facts

Scope

- IGP or EGP

Metric

- *hop count or link cost*

Routing update method

- Distance vector or Link State

Classless Inter-Domain Routing (CIDR)

- Classful or classless

Routing Protocol Facts

- Routing Information Protocol (RIP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Open Shortest Path First (OSPF)
- Intermediate System to Intermediate System (ISIS)
- Border Gateway Protocol (BGP)