AutomaTech™

IP Protocol

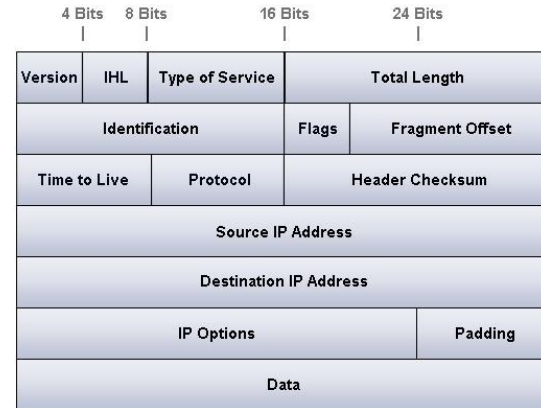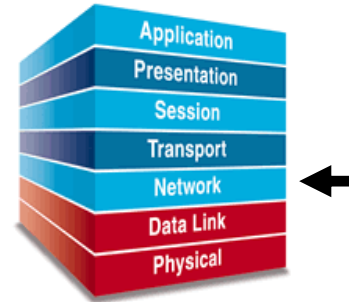Networking Basics
Marty Rubenstein
Presales Application Engineer
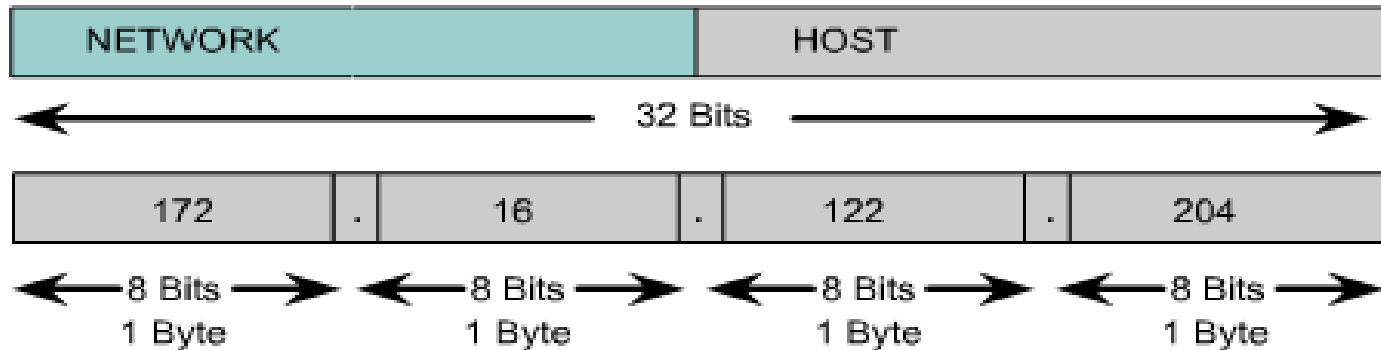mrubenstein@automatech.com

IP Protocol

- Exists at layer 3 of the OSI

- Main reason for existence: Routing

- Answers the questions:
  - Which network is a device on ?
  - What is its ID on the network ?

- IP Header contains IP Addresses

- PDU is the "Packet"

What is in an IP address ?

Each complete 32-bit IPv4 address is broken down into a network part and a host part. Kind of like area code and phone number. A bit or bit sequence at the start of each address determines the class of the address. There are 5 IP address classes.

NETWORK	HOST

← 32 Bits →

172	.	16	.	122	.	204

←8 Bits→   ←8 Bits→   ←8 Bits→   ←8 Bits→
1 Byte   1 Byte   1 Byte   1 Byte

An IP address will always be divided into a network and host portion. In a classful addressing scheme, these divisions take place at the octet boundaries.

Classful IP Address Classes

IP addresses are divided into classes to define the large, medium, and small networks.

Class A addresses are assigned to larger networks.
Class B addresses are used for medium-sized networks, &
Class C for small networks.

Address Class	Number of Networks	Number of Hosts per Network
A	126*	16,777,216
B	16,384	65535
C	2,097,152	254
D (Multicast)	-	-

*Some Addresses are reserved.

Classful IP & Subnet Masks

■ Subnet Mask

- Each IP Range has its own Subnet mask
- The subnet mask helps define the network and the host address

Address Class	Start	End	Subnet Mask
A	0.0.0.0	127.255.255.255	255.0.0.0
B	128.0.0.0	191.255.255.255	255.255.0.0
C	192.0.0.0	223.255.255.255	255.255.255.0
D (Multicast)	224.0.0.0	239.255.255.255	N/A
Experimental	240.0.0.0	255.255.255.254	N/A

Some addresses are reserved. More on that later.

Classless Inter-domain Routing -CIDR

AutomaTech®
We Make Plant Information Flow

Classful

/8
24 Bits

Class A : | Network | Host | Host | Host |

/16
16 Bits

Class B : | Network | Network | Host | Host |

/24
8 Bits

Class C : | Network | Network | Network | Host |
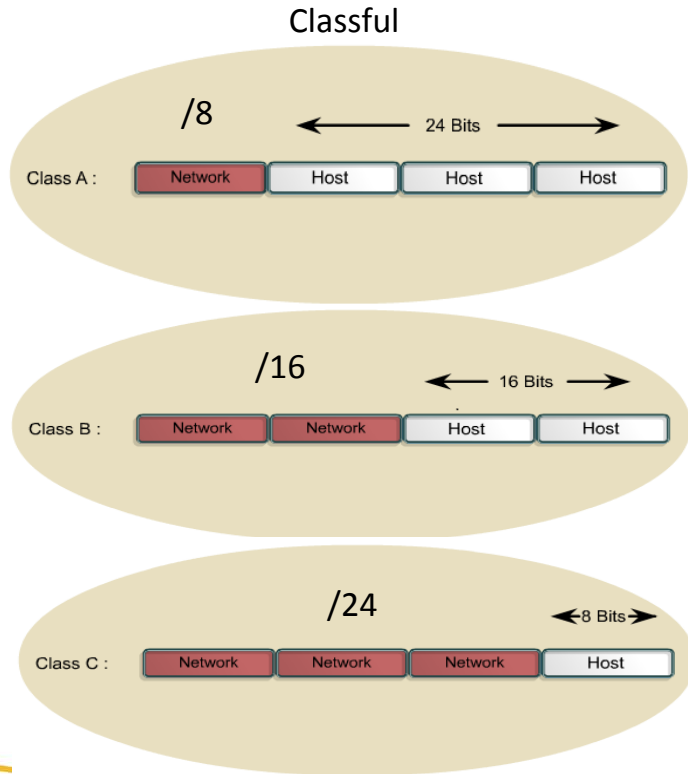
▪In order to create smaller networks and conserve on the number of public IP addresses, Classless IP addresses were created.
▪This takes host bits and uses them for further subdividing networks.

▪These subnet masks are represented in "slash" or prefix notation.

/24 = 255.255.255.0   254 host
/25 = 255.255.255.128 126 host
/26 = 255.255.255.192   62 host
/27 = 255.255.255.224   30 host
/28 = 255.255.255.240   14 host
/29 = 255.255.255.248   6 host
/30 = 255.255.255.252   2 host

Public IP Addresses

- Unique addresses are required for each device on a network.

- Internet Assigned Numbers Authority (IANA) controls the allocation

- No two machines that connect to a public network can have the same IP address because public IP addresses are global and standardized.

- All machines connected to the Internet agree to conform to the system.

- Public IP addresses must be obtained from an Internet service provider (ISP) or a registry at some expense.

Private IP Addresses

Private IP addresses are another solution to the problem of the impending exhaustion of public IP addresses. As mentioned, public networks require hosts to have unique IP addresses.

Class	RFC 1918 internal address range
A	10.0.0.0 to 10.255.255.255
B	172.16.0.0 to 172.31.255.255
C	192.168.0.0 to 192.168.255.255

• **Private addresses are not routable on the internet.**

• Some addresses have special purposes
   • 0 in Node ID used for network address
   • 127.0.0.1 for loopback
   • 255.255.255.255 broadcast

Routing Example

- Routers serve as gateways to other networks
- Run routing protocols like RIP and OSPF exchange information about the connected networks between routers

Routing table ←→ Routing table

Broadcast Domain

Network A
192.168.0.0 /24

192.168.0.254

dst=172.16.0.1

dst=172.16.0.1

Device 1
192.168.0.1

Default Gateway = 192.168.0.254

Broadcast Domain
Network B
30.10.10.0 /24

Router   Router

•When a host wants to send data it first checks its local routing table to see if it is on the destination network. If it is not it forwards the packet to the default gateway.

•The gateway checks its routing table to see if it has a route to the destination network. If it does, it sends the packet to the next hop router. Which repeats the process.

172.16.0.254

dst=172.16.0.1

Broadcast Domain

Network C
172.16.0.0 /24

Device 2
172.16.0.1

Default Gateway = 172.16.0.254

Thank you! Please contact AutomaTech or visit www2.automatech.com/solution-briefs for additional information on future Solution Briefs and technology