

Chettinad College of Engineering and Technology

Department of ECE

EC3401 NETWORKS AND SECURITY

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AP/ECE

UNIT II

NETWORK LAYER

What is IPv4?

- Introduction
- Notations
- Addressing Types
- Subnetting

“An IPv4 address is a 32-bit address that uniquely and universally defines the connection of a device (for example, computer or a router) to the Internet”

- Universal Communication
- Within an IP address, it encodes its network number and host number
- **Advanced Research Projects Agency Network**
- Address space – “ The total number of addresses used by the protocol” [2^{32} = 4 billion addresses]
- Example- 192.0.2.126 could be an IPv4 address.

PARTS OF IPV4

Network part:

- The network part conjointly identifies the category of the network that's assigned.

Host Part:

- The host part uniquely identifies the machine on your network. This part of the IPv4 address is assigned to every host.
- For each host on the network, the network part is the same, however, the host half must vary.

Addressing Types

- Classful Addressing
- Classless Addressing

Classful addressing

- In Classful addressing, the address space is divided into five classes: A, B, C, D, and E

Finding the classes in binary and dotted-decimal notation

	First byte	Second byte	Third byte	Fourth byte
Class A	0			
Class B	10			
Class C	110			
Class D	1110			
Class E	1111			

a. Binary notation

	First byte	Second byte	Third byte	Fourth byte
Class A	0-127			
Class B	128-191			
Class C	192-223			
Class D	224-239			
Class E	240-255			

b. Dotted-decimal notation

Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127**	00000000-01111111	N.H.H.H	255.0.0.0	128 nets (2^7) 16,777,214 hosts per net (2^{24-2})
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets (2^{14}) 65,534 hosts per net (2^{16-2})
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets (2^{21}) 254 hosts per net (2^{8-2})
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

Hierarchy in Addressing

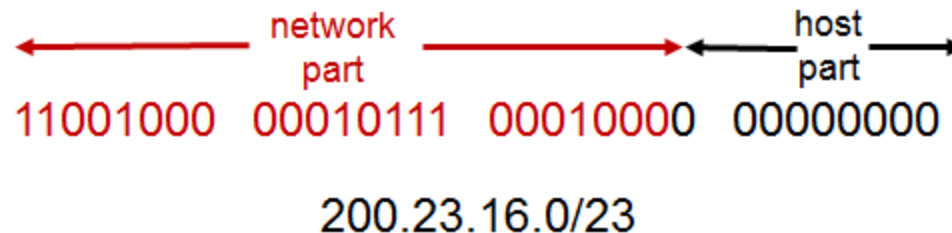
- Prefix – Defines the network
- Suffix – Defines the node

Classful IPv4 addressing

- Class A:
 - For very large organizations
 - $2^{24} = 16$ million hosts allowed
- Class B:
 - For large organizations
 - $2^{16} = 65$ thousand hosts allowed
- Class C
 - For small organizations
 - $2^8 = 255$ hosts allowed
- Class D
 - Multicast addresses
 - No network/host hierarchy

Classless IPv4 addressing

- Also called classless inter-domain routing (CIDR)
- Key idea: Network component of the address (ie: prefix) can have any length (usually from 8—32)
- Address format: a.b.c.d/x, where x is the prefix length
 - Customary to use 0s for all suffix bits



SUBNET MASK

- The 32-bit IP address contains information about the host and its network.
- It is very necessary to distinguish both.
- For this, routers use Subnet Mask, which is as long as the size of the network address in the IP address.
- Subnet Mask is also 32 bits long.
- If the IP address in binary is ANDed with its Subnet Mask, the result yields the Network address.

For example, say the IP Address is 192.168.1.152 and the Subnet Mask is 255.255.255.0 then –

IP	192.168.1.152	11000000	10101000	00000001	10011000	} ANDed
Mask	255.255.255.0	11111111	11111111	11111111	00000000	
<hr/>						
Network	192.168.1.0	11000000	10101000	00000001	00000000	Result

This way the Subnet Mask helps extract the Network ID and the Host from an IP Address. It can be identified now that 192.168.1.0 is the Network number and 192.168.1.152 is the host on that network.

Assigning Dynamic Addresses

The image shows two windows from a Windows XP system. The left window is 'Internet Protocol (TCP/IP) Properties' with the 'General' tab selected. It has two radio buttons: 'Obtain an IP address automatically' (which is selected and pointed to by an orange arrow) and 'Use the following IP address:'. Below these are input fields for 'IP address', 'Subnet mask', and 'Default gateway'. The right window is a 'Command Prompt' showing the output of the command 'ipconfig /all'. It displays network configuration for 'Host-1', including DNS suffix, IP routing, and details for the 'Ethernet adapter Local Area Connection'. A yellow box highlights the DHCP-related information in the command prompt output. Arrows point from this box to a list of dynamically assigned addresses on the left.

Using DHCP

These addresses are assigned dynamically:

- IP Address
- Subnet mask
- Default gateway
- DHCP server

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☒ Obtain an IP address automatically

☐ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

☐ Obtain an IP address automatically

☐ Use the following IP address:

Preferred

Alternate

Command Prompt

```
C:\>ipconfig /all

Windows IP Configuration

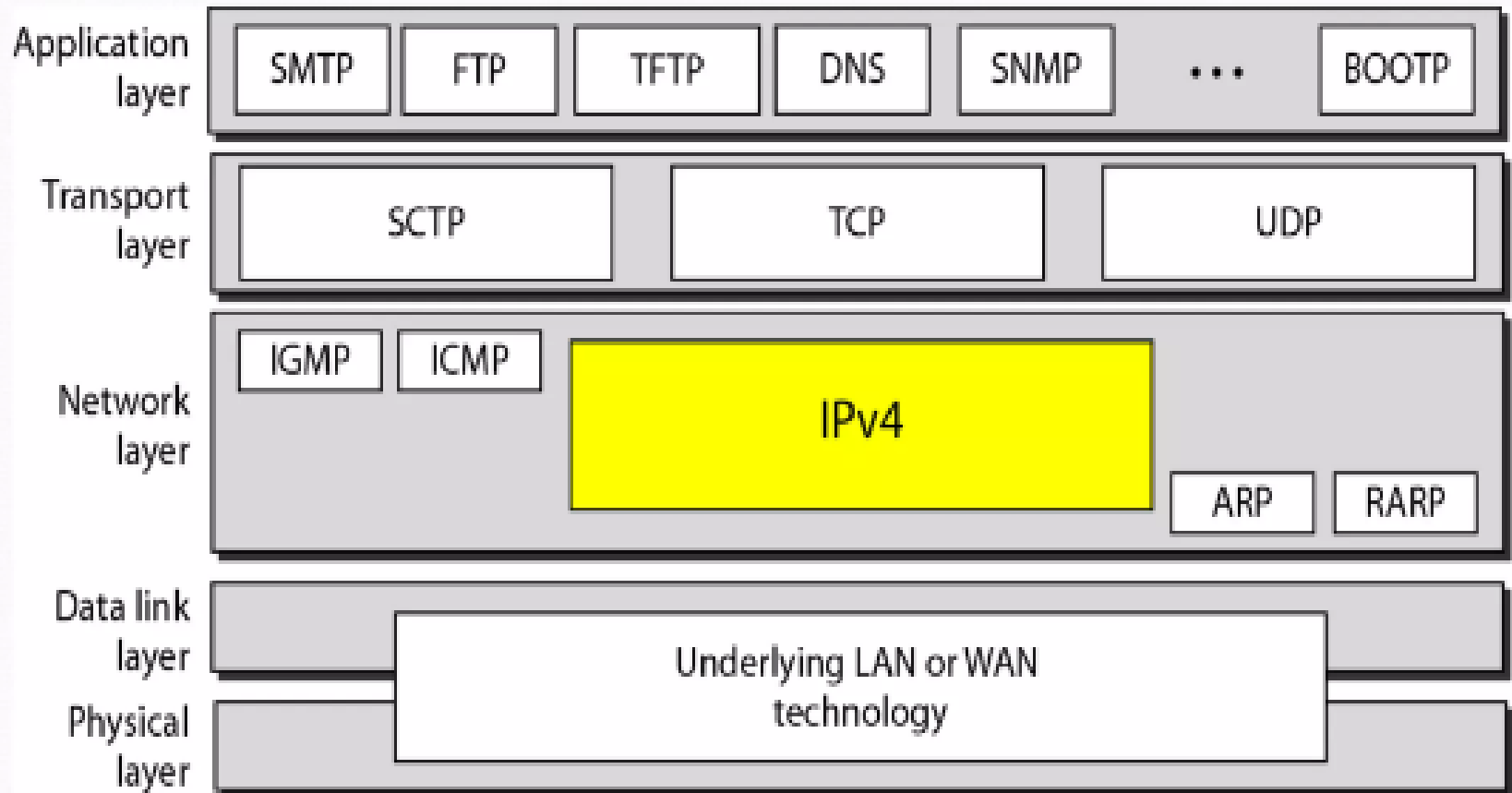
Host Name . . . . . : Host-1
Primary Dns Suffix . . . . . :
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : woh.rr.com

Ethernet adapter Local Area Connection:

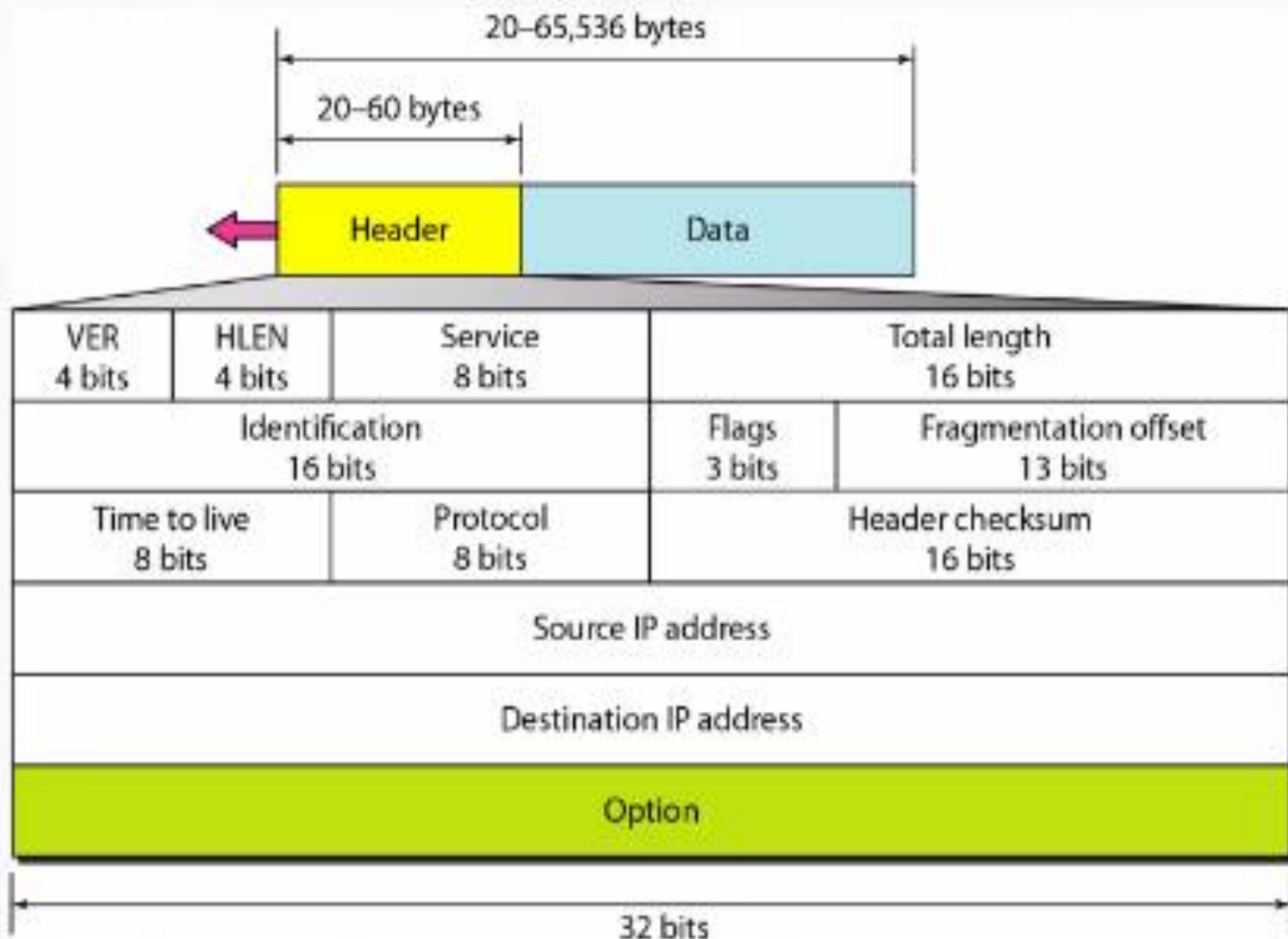
Connection-specific DNS Suffix . : woh.rr.com
Description . . . . . : Intel(R) PRO/100 VE Network Connection
Physical Address. . . . . : 00-07-E9-63-CE-53
Dhcp Enabled. . . . . : Yes
Autot Configuration Enabled. . . . . : Yes
IP Address. . . . . : 192.168.1.100
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
DHCP Server . . . . . : 192.168.1.1
DHCP Server . . . . . : 192.168.1.1
Lease Obtained. . . . . : Thursday, December 28, 2006 10:50:49 AM
Lease Expires . . . . . : Friday, December 29, 2006 10:50:49 AM

C:\>
```


Protocol Suite



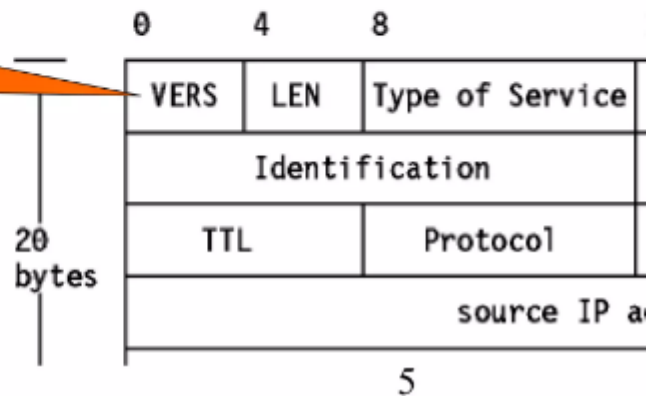
Datagram Format



VERS - Version

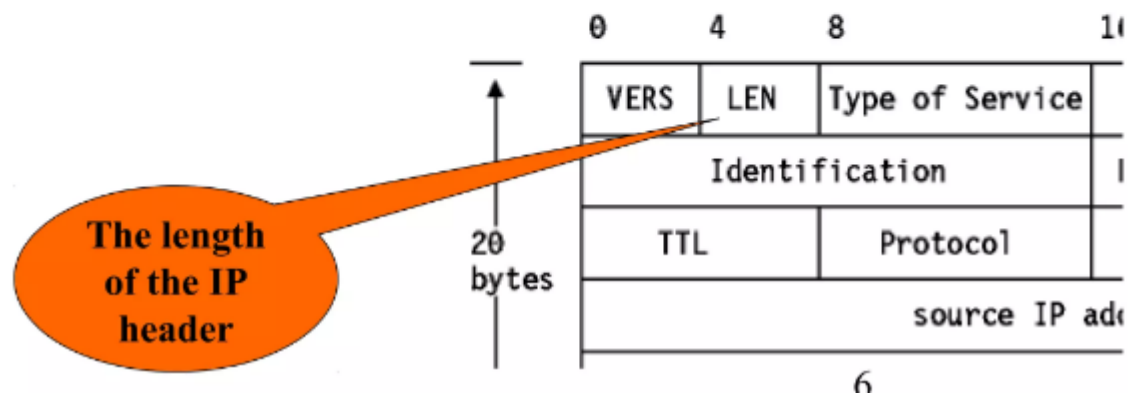
The version of the IP protocol. The current version is 4. 5 is experimental and 6 is IPng (see IP: The Next Generation (IPng)).

The version
of the IP
protocol



LEN - Length

The length of the IP header counted in 32-bit quantities. This does not include the data field.



Type of Service

The type of service is an indication of the quality of service requested for this IP datagram.

