

Computer Networks and Internets

《计算机网络与因特网》课件

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PART IV Internetworking

Chapter 22 (1)

IP Datagrams and Datagram Forwarding

IP数据报和数据报转发

22.2 Connectionless Service

无连接服务

- Connection-oriented service.
- Connectionless service.

22.3 Virtual Packet虚拟包

- To overcome heterogeneity, internet protocol software defines an internet packet format that is independent of the underlying hardware.
- The result is a universal , virtual packet.

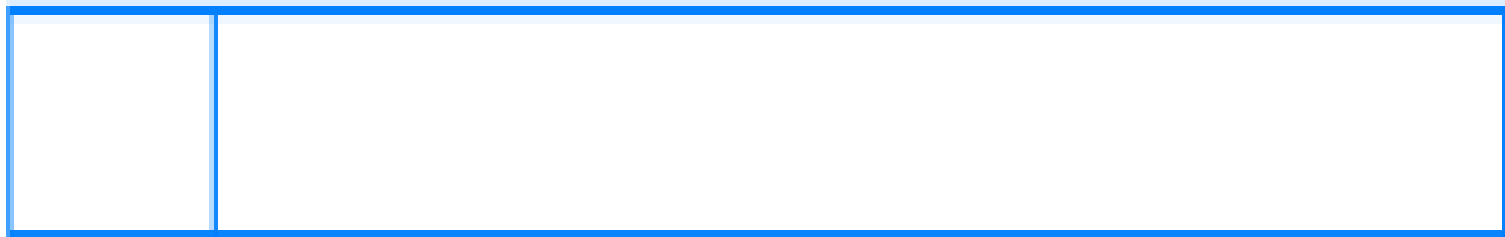
- **The underlying hardware does not understand or recognize the internet packet format.**
- **Each host or router in a internet contains protocol software that understands internet packets.**

22.4 The IP Datagram IP数据报

- TCP/IP protocol use the name IP datagram to refer to an internet packet.
- In IPv4, a datagram can contain as little as a single octet of data or at most 64K octets, including the header.

Header

Data Area



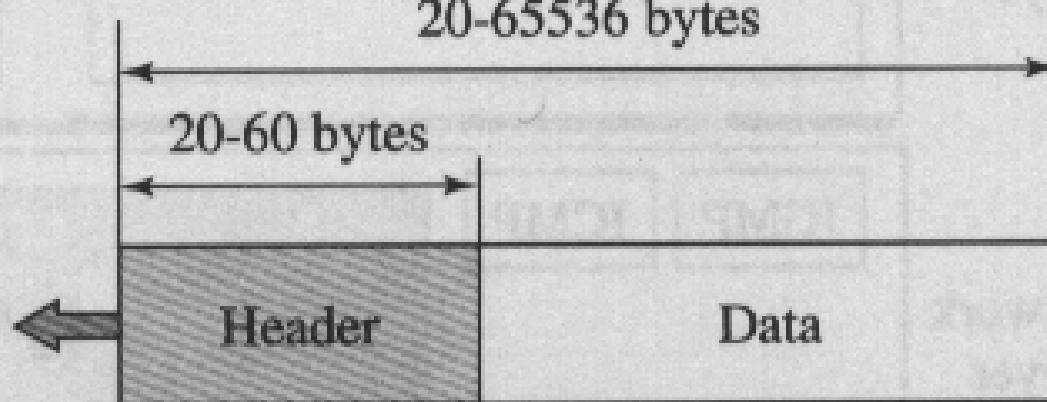
IP报文格式(1)

- IP报文的基本格式
 - IP报头
 - 有效数据



•The IP Datagram Header Format

0	4	8	16	19	24	31
版本	头部长度的	服务类型	总长			
标识			标志	段偏移		
生存时间		类型	头部校验和			
源IP地址						
目的地IP地址						
IP可选项(可省略)					填充	
数据开始 ⋮						



VER 4 bits	HLEN 4 bits	DS 8 bits	Total length 16 bits	
Identification 16 bits			Flags 3 bits	Fragmentation offset 13 bits
Time to live 8 bits		Protocol 8 bits	Header checksum 16 bits	
Source IP address				
Destination IP address				
Option				

IP报文格式(2)

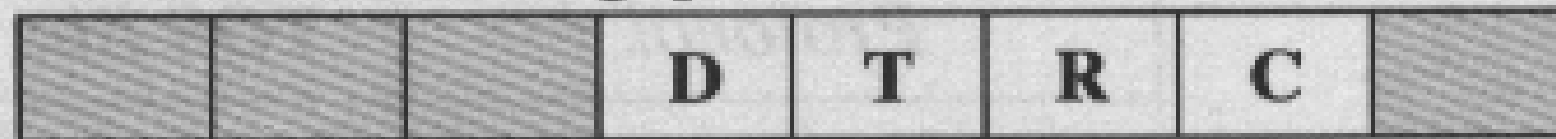
- IP报文头格式的组成（基本长度：20B）
 - 版本号：4bits
 - 报头长度：4bits
 - 服务类型：8bits
 - 总长度：16bits
 - 标识：16bits
 - IP分片标志：3bits
 - 片偏移：13bits

D: Minimize delay

R: Maximize reliability

T: Maximize throughput

C: Minimize cost



Service Type

Table 8.1 *Types of service*

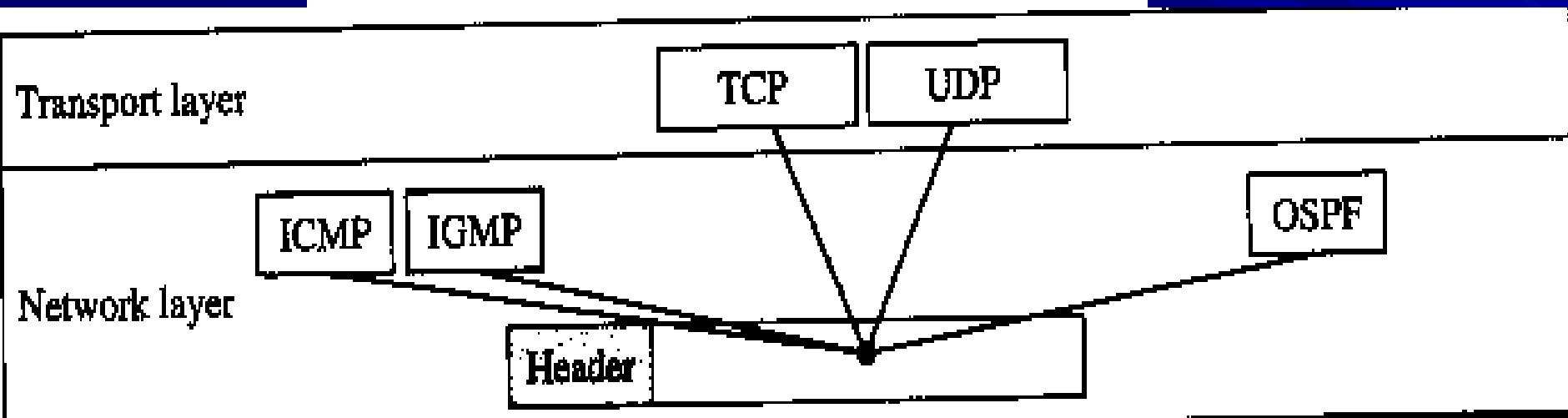
<i>TOS Bits</i>	<i>Description</i>
0000	Normal (default)
0001	Minimize cost
0010	Maximize reliability
0100	Maximize throughput
1000	Minimize delay

Table 8.2 *Default types of service*

<i>Protocol</i>	<i>TOS Bits</i>	<i>Description</i>
ICMP	0000	Normal
BOOTP	0000	Normal
NNTP	0001	Minimize cost
IGP	0010	Maximize reliability
SNMP	0010	Maximize reliability
TELNET	1000	Minimize delay
FTP (data)	0100	Maximize throughput
FTP (control)	1000	Minimize delay
TFTP	1000	Minimize delay
SMTP (command)	1000	Minimize delay
SMTP (data)	0100	Maximize throughput
DNS (UDP query)	1000	Minimize delay
DNS (TCP query)	0000	Normal
DNS (zone)	0100	Maximize throughput

Table 8.4 *Protocols*

<i>Value</i>	<i>Protocol</i>
1	ICMP
2	IGMP
6	TCP
17	UDP
89	OSPF

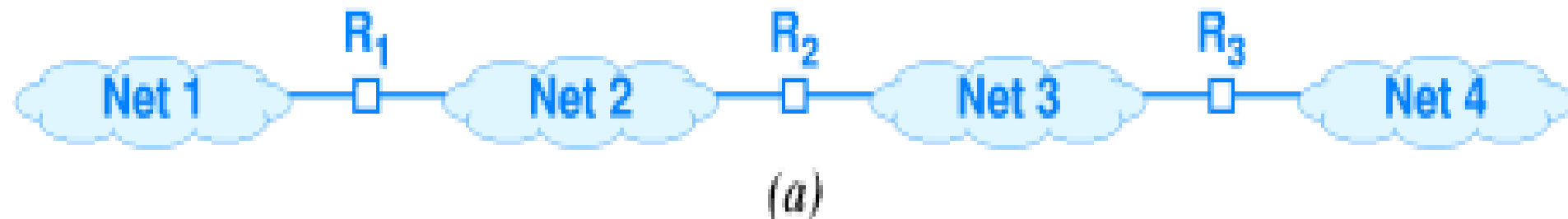


IP报文格式(3)

■ IP报文头格式的组成（续）

- **TTL（生存时间）：8bits**
- **协议类型：8bits**
- **报头校验和：16bits**
- **源IP地址：32bits**
- **目标IP地址：32bits**
- **选项内容：（可变长度）**
- **填充部分：（根据选项部分改变）**

22.5 Forwarding An IP Datagram

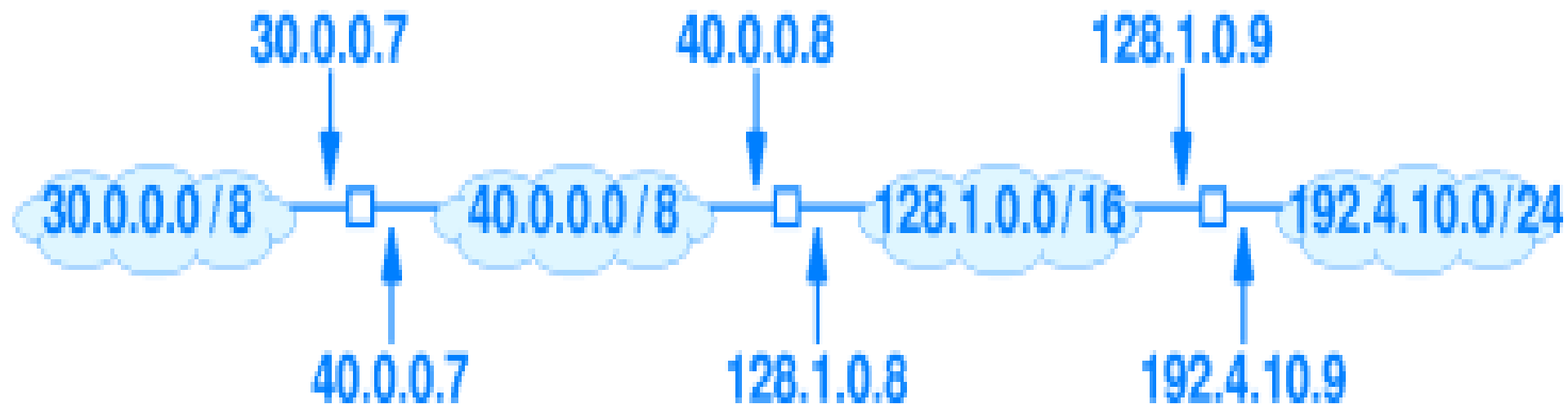


•Routing table (R_2 路由表)

Destination	Next Hop
net 1	R_1
net 2	deliver direct
net 3	deliver direct
net 4	R_3

(b)

20.6 IP Address and Router Table Entries



(a)

Destination	Mask	Next Hop
30.0.0.0	255.0.0.0	40.0.0.7
40.0.0.0	255.0.0.0	deliver direct
128.1.0.0	255.255.0.0	deliver direct
192.4.10.0	255.255.255.0	128.1.0.9

基于IP传输的路由表特征(2)

■ 路由表的组成

- 目标网络号
- 目标网络子网掩码
- 下一跳

- 直接传送标志

- 交换设备所在的子网IP地址

22.7 The Mask Field and Datagram Forwarding

- The process of using a routing table to select a next hop for a given datagram is called routing(路由) or forwarding(转发).
- The mask field in a routing table entry is used to extract the network part of an address during lookup.

IP子网掩码与数据转发

- 通过子网掩码进行计算的路由表匹配
 - 获得IP报文的目标IP地址D
 - 用D顺序逐条匹配路由表各个条目T1,T2,T3...
- 如果 $(D \& T(m)_i)$ 等于 $T(d)_i$, 则下一跳为 $T(n)_i$
- D: 目标端地址
- $T(d)_i$: 路由表中第i条目标子网网络号
- $T(m)_i$: 路由表中第i条目标子网掩码
- $T(n)_i$: 路由表中第i条下一跳IP地址

22.8 Destination and Next-Hop Addresses

- The destination address in a datagram header always refer to the ultimate destination:
- When a router forwards the datagram to another router, the address of the next hop does not appear in the datagram header.

22.9 Best-Effort Delivery

- IP is designed to operate over all types of network hardware,
- The underlying hardware may misbehave.
- IP datagrams may be lost, duplicated, delayed, delivered out of order, or delivered with corrupted data.
- Higher layers of protocol software are required to handle each of these errors.

作业

- 给出下面图形的路由器设备的路由表，格式参考书图例22.3

