Chapter 3 Networking and Internetworking

1. DHCP
   1. Dynamic Host Configuration Protocol
   2. Purpose: sever assigns IP to a host
   3.
2. ARP

   - **address resolution protocol (ARP). (broadcast)**

3. Protocols
   1. Protocol为进行网络中的数据交换而建立的规则、标准或约定。用于不同系统中实体间的通信。两个实体要想通信，必须有"同一种语言"，而且，对于通信内容，怎样通信和何时通信，都必须遵守一定的规定，这些规定就是协议

      - **a specification of the sequence of messages that must be exchanged;**

      - **a specification of the format of the data in the messages.**

4. Protocol layers

   Figure 3.5   OSI protocol summary

Layer	Description	Examples
Application	Protocols at this level are designed to meet the communication requirements of specific applications, often defining the interface to a service.	HTTP, FTP, SMTP,CORBA IIOP
Presentation	Protocols at this level transmit data in a network representation that is independent of the representations used in individual computers, which may differ. Encryption is also performed in this layer, if required.	TLS security, CORBA data representation
Session	At this level reliability and adaptation measures are performed, such as detection of failures and automatic recovery.	SIP
Transport	This is the lowest level at which messages (rather than packets) are handled. Messages are addressed to communication ports attached to processes. Protocols in this layer may be connection-oriented or connectionless.	TCP, UDP
Network	Transfers data packets between computers in a specific network. In a WAN or an internetwork this involves the generation of a route passing through routers. In a single LAN no routing is required.	IP, ATM virtual circuits
Data link	Responsible for transmission of packets between nodes that are directly connected by a physical link. In a WAN transmission is between pairs of routers or between routers and hosts. In a LAN it is between any pair of hosts.	Ethernet MAC, ATM cell transfer, PPP
Physical	The circuits and hardware that drive the network. It transmits sequences of binary data by analogue signalling, using amplitude or frequency modulation of electrical signals (on cable circuits), light signals (on fibre optic circuits) or other electromagnetic signals (on radio and microwave circuits).	Ethernet base-band signalling, ISDN

   1.
5. Ports and port assignment
   1. port is a transport layer software construct

    2. 16 bit integer
    3. 65536 different ports an application can communicate on
    4. assignment
        1. 0-1023 well known ports(need IANA, system-type-service)
        2. 1024-29151 registered ports(need IANA ,application level)
        3. 49152-65535 dynamic/private
6. addressing (MAC, IP, and ports)
    1. MAC
        1. MAC-media access control address
        2. fixed by manufacturer
        3. used to pass messages around a single pysical network segment
    2. IP address
        1. pass message around between networks
7. datagrams
    1. The IP protocol transmits datagrams from one host to another
    2. The essential feature of datagram networks is that the delivery of each packet is a 'one-shot' process; no setup is required, and once the packet is delivered the network retains no information about it.

8. routing
    1. the best route for communication between two points in the network is re-evaluated periodically, taking into account the current traffic in the network and any faults such as broken connections or routers

9. RIP algorithm
    1. ☐ *Periodically, and whenever the local routing table changes*, send the table (in a summary form) to all accessible neighbours.
    2. *When a table is received from a neighbouring router,*

Pseudo-code for RIP routing algorithm

Send: Each *t* seconds or when *Tl* changes, send *Tl* on each non-faulty outgoing link.

Receive: Whenever a routing table *Tr* is received on link *n*:
```
for all rows Rr in Tr {
    if (Rr.link ≠ n) {
        Rr.cost = Rr.cost + 1;
        Rr.link = n;
        if (Rr.destination is not in Tl) add Rr to Tl;    // add new destination to Tl
        else for all rows Rl in Tl {
            if (Rr.destination = Rl.destination and
                (Rr.cost < Rl.cost or Rl.link = n)) Rl = Rr;
                // Rr.cost < Rl.cost : remote node has better route
                // Rl.link = n : remote node is more authoritative
        }
    }
}
```

TCP & UDP Comparison

| Characteristic	UDP	TCP
General	Simple, high speed, low functionality wrapper that interfaces with IP	Full-featured protocol to reliably communicate data with another application across IP.
Connection	Connectionless, no setup	Connection-oriented; setup prior to transmission
Interface to Application	Discrete message based	Stream based
Reliability and ACK	No reliability guaranteed, best effort delivery without acknowledgement	Reliable, all messages acknowledged
Retransmissions	None. Application must detect if needed	All lost data retransmitted automatically
Flow control	None	Flow control on both ends (sliding window)
Overhead	Low	Low, but not as low as UDP
Speed	Very high	High, but not as high as UDP
Data quantity	Single datagram - up to 65K bytes	Small to very large (gigabytes)
Applicability	Speed matters more than completeness. Small discrete messages. **Multicast or broadcast**	Data must be received reliably, in order.

10.

Some Common Application Protocols

Protocol	Name	Purpose
HTTP	Hypertext Transfer Protocol	Browser to server, web app to web service, etc.
HTTPS	HTTP Secure	Secure HTTP
DHCP	Dynamic Host Configuration Protocol	Server assigns IP address to a host
DNS	Domain Name System	Map domain name to IP address
RTP/RTCP	Real-time Transport Protocol / Real-time Transport Control Protocol	Delivers audio and video streams / statistics and control information about RTP stream
LDAP	Lightweight Directory Access Protocol	Querying and modifying directory services information
POP	Post Office Protocol	Retrieve email from a server
IMAP	Internet Message Access Protocol	Retrieve email from a server
SMTP	Simple Mail Transfer Protocol	Send mail from client to server, and send mail to/from server to server
SSH	Secure Shell	Terminal-type (shell) access to remote computers

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11.

IP packet layout

header

| | | | IP address of source | IP address of destination | | | data |

up to 64 kilobytes
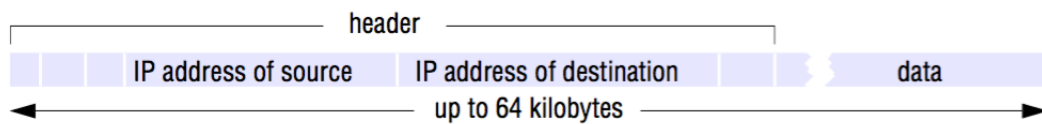
12.

Subnet Addressing

- Subnetting allows an organization to break their address space into smaller networks.

Network Prefix	Host Number

Network Prefix	Subnet Number	Host Number

13.