

Key Points for the Review

Network Basics

- What is internet and Internet?
- Does WWW equal to Internet?
- What are the major components of Internet?
- What is protocol? Typical protocols of network layer, transport layer and application layer
- What are the two important design concepts of Internet?
- Terms for network devices and examples: node, host node, link, network component
- Terms for network performance parameters: bandwidth (bps, Bps), throughput, delay (latency), jitter, error rate (PLR, BER, FER, PER)
- Network types according to the switching function in the network
- Different channel access technologies: multi-access and point-to-point
- Network types according to the range of the network: LAN, MAN, WAN, PAN (range, channel access technology, examples of them)
- Network types according to the user of the network: public network and private network
- Layered architecture: ISO/OSI 7 layer model, TCP/IP model, Revisory Model, relationship between them, devices at different layers

Network Programming Basics

- Basic concepts
 - Process: what is a process? Does process equal to program? PID, PPID, special processes, fork(), exec()
 - file descriptor: what is a file descriptor? Special file descriptors, Related system calls and their functions: open(), read(), write(), lseek(), ignore dup() and fcntl()
- IP Addresses
 - The IP address definition in Linux system
 - Big-endian and little-endian byte order, host byte order and network byte order, byte order conversion functions: htonl(), ntohl(), htons(), ntohs()
- DNS
 - Function of DNS
 - Host entry structure defined in Linux system
 - System calls retrieving host entries from DNS: gethostbyname(), gethostbyaddr()
- Connection
 - What is a connection? How to identify an endpoint of a connection? How to identify a connection?
 - Well-known port numbers used for some typical applications (DHCP, DNS, TELNET,

TFTP, FTP, SMTP, POP3, HTTP, SNMP)

- Sockets interface
 - What is a socket? What is the sockets descriptor?
 - Internet-specific socket address and Generic socket address, how do we use them in the system calls such as connect(), bind(), and accept()?
 - Different sockets interface types: SOCK_STREAM, SOCK_DGRAM, SOCK_RAW, other two can be ignored.
 - System calls used in sockets programming (掌握函数的功能以及在示例程序/实验程序里的应用)
 - Socket operation:
 - Byte order operation:
 - Address formats conversion:
 - Socket option: (can be ignored)
 - Name and address operation:
- Basic flows of TCP/UDP based sockets API

DHCP

- DHCP overview: Basic function, relationship between BOOTP and DHCP, DHCP client, DHCP server, DHCP Relay, DHCP lease, Phases of IP assignment with DHCP
- DHCP message format
- STD and MSC of DHCP Address acquisition
- STD and MSC of Early lease termination in DHCP
- STD and MSC of Lease renewal in DHCP
- Basic address acquisition procedure through DHCP relay

DNS

- Basic functions of DNS, nowadays status of DNS
- Hierarchical structure of domain namespace
- Important terms
 - Domain / domain name / FQDN
 - Domain namespace, zone
 - Resource Record
 - Name server / primary server / secondary server / caching server
 - Resolver
 - Query / response
 - Standard query / inverse query / pointer query
 - recursive resolution / iterative resolution
- Communication model between user program, resolver and name server. How does DNS work together with the user programs (e.g. TELNET, FTP, HTTP, SMTP) ?

- Procedure of the recursive resolution and iterative resolution
- What are the mechanisms in DNS that are possible to improve the querying efficiency?
- The ideas of inverse query and pointer query. The comparison between them.
- DNS Message Format
- Types of Resource Record (only the ones highlighted using red color in the lecture notes)

TELNET

- What is TELNET and telnet?
- What are the advantages of the idea of option negotiation in TELNET?
- NVT
 - What is NVT? What are its functions?
 - NVT operations
- TELNET control functions: IAC, DO, DONT, WILL, WONT
- TELNET options example: echo mode, binary transmission, line mode vs. character mode, character set, terminal type
- Understand the TELNET session through examples

TFTP/FTP

- TFTP features
- Transfer mode of TFTP
- Retransmission defined in original TFTP protocol, the SAS (Sorcerer's Apprentice Syndrome) problem and how to fix it
- FTP features
- FTP model
- FTP basic control commands and replies, user commands
- FTP Control Connection & Data Connection
- FTP Active and Passive Mode. The corresponding sample MSCs of the two modes.

EMAIL

- Email system
 - Components of email system
 - Basic functions of email system
 - Terms: UA, Mail Server, MTA
 - Email address
- Message Format
 - Header, blank line, body
- SMTP

- Basic model
- Basic commands and replies
- POP
 - Basic model
 - Basic commands and replies
- IMAP
 - Features of IMAP
 - Comparison of POP and IMAP
- Message formats
 - RFC 5322: main headers
 - MIME: New headers and main content types
- What are the limitations of SMTP? How is MIME used to offset the limitations of SMTP?

WWW

- WWW components
 - Client/browser
 - Web server
- URL
 - Structure
 - Used for different services
- HTML
 - Static vs. dynamic
 - CGI
- HTTP
 - Features
 - Transaction
 - Main Methods: GET, PUT, POST, others can be ignored
 - Performance enhancement of HTTP 1.1
 - Cookie: function, four components for cookie supporting, example
 - Proxy server
 - Conditional get

SNMP

- Terminologies: SNMP, MIB, SMI
- Definition, goals and functional areas of network management
- SNMP features
- SNMP model and components
- SNMP framework
 - SMI and ASN.1 (Functions and relations only)

- MIB hierarchy naming
- SNMP protocol: traps/polling, SNMP commands

You can ignore the following contents

- How do machines communicate with one another on the Internet?
- The history of Internet
- Ways to connect to the Internet
- vi commands
- signal
- Some useful information about learning a protocol
- Detailed RFC number about each protocol
- Multicast address allocation in DHCP
- Security Problems in DHCP
- data path from the user's keyboard to the remote system
- other remote access technologies
- TFTP packet format
- Typical communication procedure of TFTP
- Anonymous FTP
- NFS
- The web access model
- URI, URN
- HTTP status code
- Different network management architectures and their pros and cons
- SNMP history
- SNMP message format
- RMON
- New Trends Of Network Management
- DNS for IPv6
- ASN.1

Summary of the protocols

Protocol	Transport layer protocol	Well-known port
DHCP	UDP	Server:67; Client:68
DNS	Mostly UDP, sometimes TCP	53
Telnet	TCP	23
TFTP	UDP	69
FTP	TCP	Control connection: 21 Data connection in active mode: 20

SMTP	TCP	25
POP3	TCP	110
HTTP	TCP	80
SNMP	UDP	Get/set: 161 Trap: 162

Sample questions

Question 1: Select the best choice. (single-choice, each 1 mark, total 20)

- () 1) In a FTP session, when the user types in the user command “put”, the control command is sent from to
- A) PUT, server, client
B) PUT, client, server
C) STOR, client, server
D) STOR, server, client
- () 2) When defining the value of a socket address variable in the program, the structure should be used.
- A) struct sockaddr
B) struct sockaddr_in
C) both A and B
D) none of A and B
- () 3) In the following resource record types, is to map an IP address to a system name.
- A) MX
B) A
C) CNAME
D) PTR

Question 2: True/False selection. (Write T in the blank if you think the statement is true, write F if it is false. Each blank 1 mark, total 20 marks)

- (**F**) 1) For a program, there must be one and only one process running in the operating system.
- (**T**) 2) The server in a telnet application uses well-known port number 23.

- (**T**) 3) In a TFTP application, all the DATA packets have 512 bytes except the last one.

Question 3: Fill in the blanks with a suitable term. (each 1 marks, total 20)

- 1) _____ **Delay** _____ is an expression of how much time it takes for a packet of data to get from one designated point to another.
- 2) Every process has unique _____ **process ID** _____.

Question 4: Find a correct match among the choices and the questions. (each 2 marks, total 10)

Choices:

- A) DHCP
- B) DNS
- C) SNMP
- D) TELNET
- E) HTTP
- F) SMTP
- G) FTP
- H) POP3
- I) IMAP
- J) TFTP

- 1) _____ **B** _____ protocol is not bound to a single type of applications, but a supporting protocol for various applications.
- 2) In _____ **D** _____, command and data are multiplexed over the same connection, and special character is used to differentiate command and data.
- 3) _____ **G** _____ may set up more than one connection simultaneously between a client and a server.
- 4) _____ **H** _____ supports download-and-delete requirements for access to remote mailboxes.
- 5) In _____ **E** _____, PUT method is used to store specified document under the supplied URL.

Question 5

List the 4 components of the SNMP model and explain briefly the function of each

component. Explain the 2 ways to deliver management information.

[6 Marks]

Question 6

About the following program, please answer question a) and b).

a) Please fill in the blanks in PART I of the following program to create a file “*myfile.out*” and the content of this file is:

ABCDEFGHIJ0123456789

b) What is the output of this program? What is the content of *myfile.out* after this program is executed?

```
#include <unistd.h>
#include <sys/types.h>
#include <stdio.h>
#include <fcntl.h>
int main(void){
    int fd;
    char buf1[]="0123456789";
    char buf2[]="ABCDEFGHIJ ";
    char buf[5];
    /***** PART I *****/
    if ((fd = open(_____(1)_____) =
    (2) _____) ;
        printf("Error in opening.\n");
    write( _____(3)_____);
    write(_____(4)_____);

    /***** PART II *****/
    lseek(fd, 5, SEEK_SET);
    read(fd, buf, 5);
    write(1, buf, 5);
    lseek(fd, 10, SEEK_SET);
    write(fd, buf, 5);
}
```

[6 marks]