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()
  - Signal: what is a signal? Which conditions will generate signals? What can a process do with a signal?
- 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_DGAM, 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
    - 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
- Other Remote Access Technologies in text-based system.

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
- Web-based email. What are the differences of accessing incoming emails through UAs and web-based manner?
- 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
  - The web access model
- URL
  - Structure
  - Used for different services
- HTML
  - Static vs. dynamic
  - CGI
- HTTP
  - Features
  - Transaction
  - Main Methods
  - Performance enhancement of HTTP 1.1
  - Cookie: function, four components for cookie supporting, example
  - Proxy server
  - Conditional get

SNMP

- Terminologies: SNMP, MIB, SMI, RMON
- Definition, goals and functional areas of network management
- Different network management architectures and their pros and cons
- 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,
- RMON: Purpose, probe

Real-time Services

- Real-time services
  - Isochronous services and QoS requirements
  - Jitter compensation via playback buffer
- RTP/RTCP
  - Functions of RTP/RTCP, relationship between RTP and RTCP
  - Definitions: end system, translator, mixer, monitor
  - RTP features, SSRC vs. CSRC
  - RTCP features, relationship of RTCP port number with RTP port number
- Multimedia signaling protocols
  - H.323
    - Function, H.323 protocol stack (Just understanding H.323 is a set of protocols)
    - components
  - SIP
    - Function
    - Architecture and components
    - SIP methods(INVITE, ACK, BYE), SIP header (Just understanding the similar definition manner with HTTP), SIP URL

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
- Linux and vi commands
- Signal() system call and its functions

- 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
- TFTP packet format
- Typical communication procedure of TFTP
- Anonymous FTP
- NFS
- URI, URN
- HTTP status code
- SNMP history
- SNMP message format
- RMON configuration
- New Trends Of Network Management
- RTCP packet types
- H.323 and SIP call procedure
- 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
SIP	TCP/UDP	5060 (can be ignored)

Sample questions

Question 1: Select the best choice. (single-choice, each 1 mark, total 30)

( ) 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) About RTCP and RTP, which of the following statements is true?

A) RTP provides flow control and congestion control for RTCP

B) Both RTP and RTCP are based on TCP

C) Both RTP and RTCP use a well-known port number

D) None of the above

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 blank with a suitable term. (Each 1 mark, total 10)

1) _____ provides mapping between Domain name and IP address.
Domain name system or DNS

2) _____ protocol can be used to assign IP address dynamically.
Dynamic Host Configuration Protocol or DHCP

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

Choices:

A) Sender
B) From
C) GetbulkRequest
D) GetNextRequest
E) ASCII
F) Base64
G) Cookies
H) resource records
I) mixer
J) translator

1) In the mail message, the header indicates the real message sender is _____A_____.

2) The SNMP command be used to get a block of data from the MIB of an agent is_____
C_____.

3) In SMTP, the encoding scheme used to encode user name and password is_____F_____.

4) In WWW application, which is used to record a user's status to access a web site?_____
G_____.

5) In real-time applications, the intermediate device which may change the SSRC(Synchronization SouRCe Identifier) carried in RTP packets is _____I_____.

Question 5

Define the 5 functions of Network Management. Describe the pros and cons of using a centralized architecture for network management.

[5 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 creat 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]