Computer Networking Comprehensive Exam

Study Guide

The CECS Master of Science Comprehensive Exam in Computer Networking is designed to test fundamental knowledge of the field of Computer Networking. Test questions will focus on major themes and concepts. The topics covered will include both undergraduate and graduate level material. Questions asked will focus on high-level concepts rather than picky details. Questions will be designed to determine the scope and depth of your understanding, not your ability to memorize minutia. For example, a question would be more likely to read, "What information must be included in the header field when a packet is transmitted across a packet-switched network? Why is each type of information necessary?" rather than "Draw and label the format of an Ethernet packet."

Two hours are allotted for the exam. You are strongly encouraged to thoroughly prepare for the test. You should carefully read each question before answering, and answer clearly and concisely. Be sure your handwriting is legible. You should bring multiple pencils and a non-programmable calculator to the exam. Cell phones will not be allowed.

The exam will be composed of the following three sections:

I. DEFINING NETWORK TERMINOLOGY (20 POINTS)

In this section, you will be asked to define general networking terms or concepts. If asked to define the term, you should do so precisely and concisely in 1-2 sentences. You may also be asked to identify definitions from a given list. The terms or concepts will be taken from the following list:

APPLICATION GATEWAY	ARP	ASYMMETRIC	ASYNCHRONOUS	ATM
ATTENUATION	BANDWIDTH	bps	BRIDGE	BURSTY TRAFFIC
CAPACITY OF A LINK	COAXIAL CABLE	CONGESTION	CONNECTION-ORIENTED	CONNECTIONLESS
CRC	DATAGRAM	DECRYPTION	DHCP	DISTORTION
DISTRIBUTED	DNS	EFFECTIVE THROUGHPUT	ENCAPSULATION	ENCODING
ENCRYPTION	END-TO-END	ERROR CORRECTING	ERROR DETECTING	FDM
FIBER	FIREWALL	FLOW CONTROL	FORWARDING	FRAME
GEO SATELLITE	GUIDED MEDIA	HANDSHAKING	HTTP	HTTPS
ICMP	IMAP	IN-BAND	INFRARED	IP
IP DATAGRAM	IPv4	IPv4 ADDRESS	IPv6	LAN
LATENCY	LEO SATELLITE	LINK-TO-LINK	MAC ADDRESS	MEDIA
MODEM	MTU	MULTIPLEXING	NAT	NIC
OSI MODEL	PAN	PEERING FOR ISPs	PEER PROTOCOLS	PING
POP	PORT	PROCESSING DELAY	PROPAGATION DELAY	PROTOCOL
PROTOCOL LAYER	QoS	QUEUEING DELAY	REAL-TIME TRAFFIC	REASSEMBLY
REPEATER	RJ-45 CONNECTOR	ROUTER	ROUTING ALGORITHM	RTT
SEGMENTATION	SINE WAVE	SLIDING WINDOW	SMTP	SOCKET
SYMMETRIC	SYNCHRONOUS	TCP	TDM	THROUGHPUT
TOPOLOGY	TRACEROUTE	TRANSMISSION DELAY	TUNNELING	TWISTED PAIR
UDP	UNGUIDED MEDIA	VIRTUAL CIRCUIT	VoIP	WAN

II. NETWORK PERFORMANCE EVALUATION (20 POINTS)

In this section, you will asked to calculate the performance of a given network. You will be provided with all of the information needed to perform the calculation. The network you are analyzing could be packet-switched, circuit-switched, or use time division multiplexing. You should be able to use the following simple concepts to determine the specified network performance:

- Calculation of propagation delay
- Calculation of transmit time of packet
- Packetization of data (creating packets and packetization delay)
- Queueing delays at routers and switches
- Processing delay
- Store-and-Forward delays for packet networks (queueing + processing)
- TDM slots and delays
- One-way Latency versus RTT
- Call set-up/tear-down in Packet-Switched Networks

III. GENERAL NETWORK CONCEPTS AND THEMES (60 POINTS)

In this section, you will be asked to answer three out of four possible questions. Each question will have multiple parts. Part of your task in this section will be selecting which three questions you wish to have graded.

The questions asked will be taken from one of the following core areas of Computer Networking:

Networking Theory and Design

- TCP/IP versus OSI Protocol Stack
- IPv4 versus IPv6
- Client/Server versus Peer-to-Peer Paradigms
- Quality of Service Concerns
- End-to-End versus Link-to-Link Strategies
- Internet Infrastructure and Organization
- Repeaters/Bridges/Routers
- Packet- vs. Circuit-Switching

Physical Layer

- Transmission Media
- Analog versus Digital Transmission
- Encoding
- Bandwidth, propagation delay, etc.

Data Link Layer

- MAC Protocols
- Error detection/correction
- Framing
- Multiplexing
- NICs
- ARP

Network Layer

- IP
- IP Datagrams
- Subnetting and Subnet Masks
- Fragmentation and Reassembly
- Routing Algorithms
- Forwarding
- DHCP, NAT, and CIDR
- ICMP
- Tunneling

Transport Layer

- TCP versus UDP
- Flow Control versus Congestion Control
- Reliable Data Transport, Sliding Window, and AIMD
- TCP 3-way Handshake

Application Layer

- DNS, HTTP, SMTP, MIME, IMAP, POP, FTP (at a basic level)

Network Security

- Encryption/decryption
- Symmetric versus Asymmetric
- Firewalls
- Application Gateways
- Data Confidentiality, Data Integrity, Data Authentication, Non-repudiation

LAN Design

- Topology, Media, and MAC Selection
- Ethernet (IEEE 802.3)
- WiFi (IEEE 802.11)

SUGGESTED REFERENCES

A current computer networking textbook is essential. Recommended texts include:

- **Computer Networking: A Top Down Approach Featuring the Internet (5th Edition)**, by Jim Kurose and Keith Ross, Addison Wesley, (2009).

- **Computer Networks and Internets (5th Edition)**, by Douglas E. Comer, Prentice Hall (2009).

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