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:

<table>
<thead>
<tr>
<th>APPLICATION GATEWAY</th>
<th>ARP</th>
<th>ASYMMETRIC</th>
<th>ASYNCHRONOUS</th>
<th>ATM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTENUATION</td>
<td>BANDWIDTH</td>
<td>bps</td>
<td>BRIDGE</td>
<td>BURSTY TRAFFIC</td>
</tr>
<tr>
<td>CAPACITY OF A LINK</td>
<td>COAXIAL CABLE</td>
<td>CONGESTION</td>
<td>CONNECTION-ORIENTED</td>
<td>CONNECTIONLESS</td>
</tr>
<tr>
<td>CRC</td>
<td>DATAGRAM</td>
<td>DECRYPTION</td>
<td>DHCP</td>
<td>DISTORTION</td>
</tr>
<tr>
<td>DISTRIBUTED</td>
<td>DNS</td>
<td>EFFECTIVE THROUGHPUT</td>
<td>ENCAPSULATION</td>
<td>ENCODING</td>
</tr>
<tr>
<td>ENCRYPTION</td>
<td>END-TO-END</td>
<td>ERROR CORRECTING</td>
<td>ERROR DETECTING</td>
<td>FDM</td>
</tr>
<tr>
<td>FIBER</td>
<td>FIREWALL</td>
<td>FLOW CONTROL</td>
<td>FORWARDING</td>
<td>FRAME</td>
</tr>
<tr>
<td>GEO SATELLITE</td>
<td>GUIDED MEDIA</td>
<td>HANDSHAKING</td>
<td>HTTP</td>
<td>HTTPS</td>
</tr>
<tr>
<td>ICMP</td>
<td>IMAP</td>
<td>IN-BAND</td>
<td>INFRARED</td>
<td>IP</td>
</tr>
<tr>
<td>IP DATAGRAM</td>
<td>IPv4</td>
<td>IPv4 ADDRESS</td>
<td>IPv6</td>
<td>LAN</td>
</tr>
<tr>
<td>LATENCY</td>
<td>LEO SATELLITE</td>
<td>LINK-TO-LINK</td>
<td>MAC ADDRESS</td>
<td>MEDIA</td>
</tr>
<tr>
<td>MODEM</td>
<td>MTU</td>
<td>MULTIPLEXING</td>
<td>NAT</td>
<td>NIC</td>
</tr>
<tr>
<td>OSI MODEL</td>
<td>PAN</td>
<td>PEERING FOR ISPs</td>
<td>PEER PROTOCOLS</td>
<td>PING</td>
</tr>
<tr>
<td>POP</td>
<td>PORT</td>
<td>PROCESSING DELAY</td>
<td>PROPAGATION DELAY</td>
<td>PROTOCOL</td>
</tr>
<tr>
<td>PROTOCOL LAYER</td>
<td>QoS</td>
<td>QUEUEING DELAY</td>
<td>REAL-TIME TRAFFIC</td>
<td>REASSEMBLY</td>
</tr>
<tr>
<td>REPEATER</td>
<td>RJ-45 CONNECTOR</td>
<td>ROUTER</td>
<td>ROUTING ALGORITHM</td>
<td>RTT</td>
</tr>
<tr>
<td>SEGMENTATION</td>
<td>SINE WAVE</td>
<td>SLIDING WINDOW</td>
<td>SMTP</td>
<td>SOCKET</td>
</tr>
<tr>
<td>SYMMETRIC</td>
<td>SYNCHRONOUS</td>
<td>TCP</td>
<td>TDM</td>
<td>THROUGHPUT</td>
</tr>
<tr>
<td>TOPOLOGY</td>
<td>TRACEROUTE</td>
<td>TRANSMISSION DELAY</td>
<td>TUNNELING</td>
<td>TWISTED PAIR</td>
</tr>
<tr>
<td>UDP</td>
<td>UNGUIDED MEDIA</td>
<td>VIRTUAL CIRCUIT</td>
<td>VoIP</td>
<td>WAN</td>
</tr>
</tbody>
</table>
II. NETWORK PERFORMANCE EVALUATION (20 POINTS)

In this section, you will be 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:


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