Syllabus for Advancement to Candidacy Exam in the area of Computer Networks

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Main Topics

- The ISO/OSI network architecture reference model
  - The advantage of layered architecture
  - Physical layer, data link layer, network layer, transport layer, session layer, presentation layer, application layer
  - Differences between networking devices: hub, repeater, switch, bridge, router, gateway
  - Differences between data units: data frame, datagram, packet, segment, message
  - Differences between connections, and which layer offers which kind of connections: connection-oriented, connection-less
  - Differences between networking services: peer-to-peer, end-to-end, point-to-point, hop-by-hop

- Current Internet architecture based on TCP/IP (questions can be based on the protocol operations)
  - Data framing: error detection (CRC), error correction (Hamming code)
  - Ethernet, MPLS, Token Ring, ATM, (VLAN), frame relay
  - IP, AAL, IPv6
  - TCP, UDP
  - RTP, RTCP
  - SMTP, IMAP, SNMP, HTTP, FTP, TELNET
  - DNS
    - Records and meanings of certain types: A - address record, NS - DNS name server name, CNAME - canonical name record for an alias, MX - mail server name record.

- Network control protocols:
  - DHCP, ARP, ICMP
  - Multicast: IGMP, PIM-SM, PIM-DM
  - Differences between ALOHA, Slotted-ALOHA, CSMA, CSMA/CA, CSMA/CD
  - Basic flow control protocols: sliding window, go-back-N, selective repeat
  - TCP flow control algorithm: maximum segment size (MSS), send window, receive window
  - TCP congestion control algorithm: congestion window, slow-start, additive increase multiplicative decrease (AIMD)
  - Routing scaling: hierarchical routing, autonomous systems, IGP, EGP
  - The basic routing algorithms: distance vector -- Bellman-Ford, link state -- Dijkstra's, path vector
• The representative protocols based on the above algorithms: DV-RIP, LS-OSPF, PV-BGP

• Network designs:
  o The relationship CSMA/CD data frame length and the network segment length
  o Quality of service: IntServ, DiffServ differences, MPLS
  o IPv6 improvement over IP: address space, ease of allocation, autoconfiguration, mobility support (type 2 routing header)
  o Network addressing: interface, MAC address, IP address, port, URL
  o NAT - network address translation

• Advanced topics:
  o Mobility
  o Queuing

Recommended readings:
• J. Kurose, K. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Addison-Wesley, '00
• Richard Stevens, TCP/IP Illustrated, Vol.1, Addison-Wesley, '94.

Sample Curriculum:
• CS 200: Seminar in Research
• CS 260: Fundamentals of the Design and Analysis of Algorithm
• CS 250A: Computer Systems Architecture
• CS 241: Advanced Compiler Construction
• CS 230: Distributed Computer Systems
• CS 232: Computer Networks
• At least four other courses relevant to the student’s research (e.g., CS 233-237)