Final Examination, CSL 858

May 7, 2007

Duration: 2 hours

Maximum Marks: 60

1. *(20 marks)* Answer the following in brief.

   (a) What property of CDMA makes it suitable for military applications?

   (b) Does Slotted-ALOHA outperform ALOHA in terms of total throughput? Why?

   (c) What is "p-persistence" in the context of MAC protocols?

   (d) Quote from a Vicomsoft page: "Network Address Translation (NAT) automatically provides firewall-style protection without any special set-up." Do you agree? Why? Does this NATural (pun intended) firewall protect from computer viruses?

   (e) Explain one way BGP can be used to send Spam emails stealthily.

   (f) How do "route-reflectors" improve the scalability of BGP?

   (g) How does virtual-output-queuing reduce head-of-line blocking in routers?

   (h) State any two uses of MPLS in IP networks.

   (i) What does "additive-increase multiplicative-decrease" refer to in the context of TCP? What is its main purpose?

   (j) The throughput of TCP-Reno flows have an "RTT-bias". Explain.

2. *(12 marks)* Answer the following in brief.

   (a) Compare WiMax and WiFi technology in terms of wireless range, throughput, and quality-of-service.

   (b) State any two security issues related to Passive Optical Networks (PON).

   (c) What is "Trace Anonymization"? What are some of its uses?

   (d) Name any two cooperative signaling methods and briefly describe how they work.

   (e) Explain the difference between the time-of-arrival (ToA) and time-difference of arrival (TDoA) localization schemes.

   (f) Give any one advantage of on-demand (reactive) routing protocols for ad hoc networks over pro-active routing protocols.

3. *(12 marks)* We are given an IP network in which the bandwidth-delay product (that is the product of maximum possible throughput and round-trip-time over typical end-to-end paths) is of the order of gigabytes. In other words, it is a high-speed network. The routers in this network use first-in-first-out (FIFO) packet scheduling and drop-tail queuing mechanisms.

   We want to support two types of applications in this network:

   - Real-time applications that have low delay-jitter requirements (e.g. voice-over-IP).
   - Best-effort applications that do not have strict delay requirements (e.g. FTP).

   Design a window-based end-to-end congestion-control protocol for the best-effort applications which

   - can utilize the large bandwidth of the network and
   - does not harm the performance of the real-time applications.

   You may use (or modify) any TCP protocol we discussed in class. Your answer must include the following.

   (a) Clearly indicate how you would increase and decrease the congestion window in your protocol.

   (b) Explain how your protocol meets the requirements mentioned above.

   (c) Is your protocol compatible with TCP-Reno? Why?

   (d) Will your protocol perform well on wireless links with a high packet loss rate due to channel errors? Why?

4. *(6 marks)* Consider Figure 1.

   (a) How many routes to 132.14.0.0/16 could AS-1's BGP speakers receive?

   (b) Suppose AS-1 and AS-2 adopt the policy that outbound traffic is routed to the closest link (in terms of hops) to the destination's AS, thus minimizing their own cost. What paths will traffic from host C to host D and from host D to host C take?

   (c) What could AS-1 do to have the C→D traffic use the link r1-r8? What could AS-1 do to have the C→D traffic pass through AS-3?

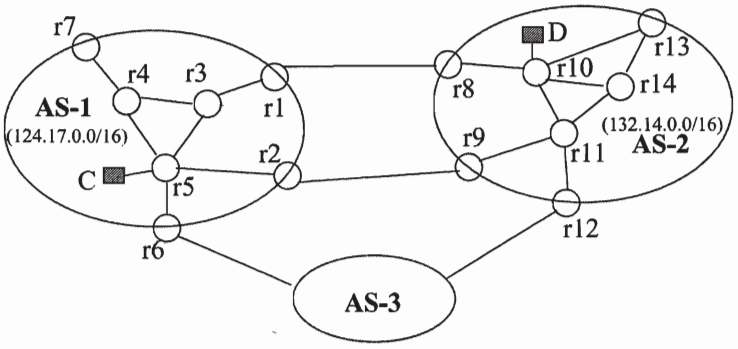

Figure 1: Routing Topology

5. *(10 marks)* A wireless LAN consisting of one base-station and n users (Figure 2) employs 802.11 as its MAC protocol. The base-station is connected to a server through a high-speed link. Assume that all nodes transmit and receive data over the wireless channel at the same bit-rate R.

   Suppose m users are transmitting data to the server through the base-station and the remaining $n - m$ users are receiving data from the server through the base-station. Assume that the MAC layer of all users uploading data to the server are continuously back-logged with data to transmit. Similarly, the MAC layer at base-station is always back-logged with data destined for each of the users downloading data from the server.

   Assume that the MAC protocol is fair, that is it gives each node contending for the channel an equal opportunity to access it. In answering the following, state any assumptions you make.

   (a) Compute the per-user throughput obtained by the users downloading data and those uploading data. What does this tell us about the per-user fairness of 802.11 in WLANs?

   (b) *Briefly* describe how you would modify the MAC protocol at the base-station so that all users obtain about the same throughput.

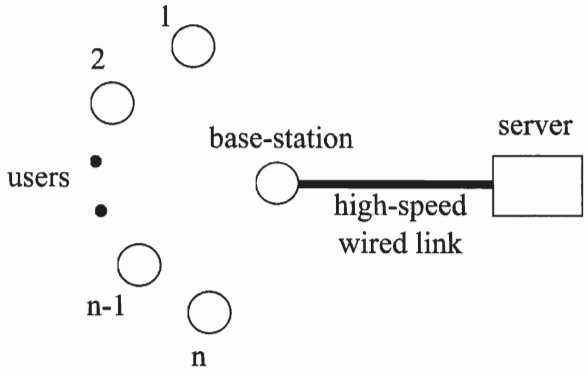

Figure 2: Wireless LAN