CS 528: First Exam (Fall’05)

Answer all six problems. Your answers should be concise – short and to the point, but including the important technical issues. The exam is long, but not difficult – work fast. Suggested time budgets are given with each problem. Clearly state any assumptions. Good luck!

**Problem 1:** (12 points; 9 minutes)
Explain the relationship between **any 3** of the following:
(a) Bloom Filters and Hashing
(b) Hierarchical Routing and Address Aggregation
(c) Bridges and Routers
(d) The end-to-end principle and performance

**Problem 2:** (10 points; 6 minutes) You are deciding on a medium access control protocol for a directly connected local area network (LAN). The choices are a contention protocol similar to Ethernet or a reservation protocol similar to Token Bus (where the station that has the token gets to transmit the next packet).
(a) What Network properties influence your decision, and how?
(b) What application/traffic properties influence your decision and how?

**Problem 3:** (20 points; 12 minutes)
Provide one or two sentence answers **any five** of the following questions:
(a) Give 2 reasons that allow switched networks to scale where directly connected networks cannot.
(b) Give 2 reasons that allow layer 3 switching (routers) to scale beyond layer 2 switching (bridges)
(c) Give 2 examples of how layer 3 switching can better deal with heterogeneous networks than layer 2 switching
(d) Can a hybrid FEC/ARQ scheme be developed? What advantage would it have over just ARQ?
(e) What are two uses for tunneling?
(f) What is the relationship between using either FEC or ARQ (pick one) and shannon’s limit (does it increase it, reduce it or is consistent with it and why)?

**Problem 4:** (18 points; 15 minutes)
(a) Give three examples of the new challenges/requirements for the Internet design as presented in the Bhementhal (E2E vs. a brave a new world) paper
(b) Show how two of them contradict the E2E principle
(c) In your opinion, why weren’t these challanges expected in the original design of the Internet (e.g., as overviewed by the Clark 1988 paper)?
(d) Show how two of the possible technical responses (presented in the same paper) can be used to address one of the challenge you discussed in (b)

Exam paper continued on next page
**Problem 5:** (20 points; 15 minutes)
Consider the following proposal. We are going to try and use an ARQ based algorithm for bulk multicast in place of the digital fountain approach. Multicast is implemented as a tree, with each node in the tree forwarding packets to its children, who in turn forward the packet to their own children recursively until the leaf nodes. Each receiver uses a bloom filter to track which packets were received. Once the multicast is finished, each receiver forwards its bloom filter to its parent in the multicast tree. The parent can multicast missing packets down to its children if it has them (deleting those from the bloom filter) and merge the remaining bloom filters and forward them to its own parent.

(a) What advantage does this approach have over just sending a list of the missing packets?
(b) Would you need a counting bloom filter or a regular bloom filter. Explain your answer.
(c) What are the implications of false positives?
(d) In the simplest case, the intermediate nodes just merge the the bloom filters without checking if they can retransmit packets locally. How is the merge accomplished, and what are the bloom filter sizing considerations in this case vs. the original case?
(e) What advantages/disadvantages does it have relative to the digital fountain approach? Do you think this is a good idea?

**Problem 6:** (20 points; 15 minutes)
The papers that studied the route inflation paper discovered significant inflation relative to the best available routes.

(a) Use examples to show one technical and one non-technical cause for path inflation.
(b) Discuss how you would set up an experiment to study the effect of one of these causes (showing the methodology used by the papers is fine too). What is a possible criticism of this methodology?
(c) Discuss possible solutions to reduce the effect of the two problems
(d) In Paxson’s paper, it was observed that some loops exist on the Internet; discuss a possible reason.