

Name:

CS461, Final
Spring 2004
May 19, 2004

Pledge:

Directions:

- Please answer each question in the space provided. The amount of space should be sufficient for a correct answer. If you need more space, please use the backs of pages, and make a note to that effect. If you run out of space, exam books are provided at the front of the room.
- This exam is closed-book, closed-notes, and is covered by the Honor Code. Please write and sign the pledge after you finish your exam.
- There are a total of five sections, with the number of points for each shown by the question. While it is not the intent for the exam to be a race, spending too much time on a single question may preclude finishing the exam. Budget your time wisely.
- To be fair, I will try to avoid answering content-related questions during the exam, unless it's to correct a mistake on my part.
- If you feel that a question **requires** additional assumptions or information to answer, please state them. Your guiding principle should be *Occam's razor*, which loosely translated states that you should allow as few assumptions as necessary to explain the situation.
- Unless otherwise stated/implied, assume a C-like language running on a Unix-like operating system.
- Please first read over the entire exam and then begin to answer questions. I will wait outside the exam room for the first 5 minutes, and then will be available in my office (room 322).
- Please write legibly and bring your exams to my office as you finish.

1. True or False (10 pts) For each statement, write “true” if the statement is true, or “false” if the statement is false. If you believe the statement does not have a clear answer, give whichever choice is more appropriate and explain why.

- DiffServ requires more state than RSVP.
- BLAST-like protocols are not appropriate for shared wide-area networks.
- Consistent Hashing is a common technique for building peer-to-peer systems.
- IP-over-IP uses more space than MPLS
- Head-of-line blocking is prevalent in input-buffered systems

2. Short Answer (20 pts) Answer each item *well* in no more than 4 sentences.

- Some Remote Procedure Call (RPC) systems do not tag data other than arrays. Explain its benefit over a tag-based approach.

- Explain why an RPC system may want to tag data anyway.

3. TCP (20 points)

- Describe the slow start phase, including its rationale and what its start and stop conditions.

- Describe fast retransmit.

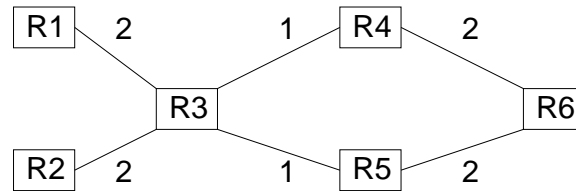
Draw a TCP timeline without fast retransmit. Draw one with fast retransmit and indicate the changes. Show (and mark) all salient features, not just fast retransmit.

4. Replication and Quorums (15pts)

Assume a quorum approach with version numbers. State the conditions necessary for correct operation.

Give two **correct** yet significantly different quorum schemes. For each scheme, describe a workload for which it is a much better match, and describe what kinds of failure properties it has.

5. Routing and Policies (20pts)



Consider the figure above, where a set of routers are connected via a set of links. The links have a bandwidth indicated by the number near each link. Assume R6 is a stub (will not pass traffic), while all others allow transit.

- How does a BGP-based system underutilize this topology? Give an example.

- Assume that MPLS is introduced on all routers. Can you achieve better link utilization, and if so, how? Give an example that achieves this.

Assume that instead of MPLS, special load balancing software is added to R3. When it receives a packet destined for R6, it will choose either the top path or the bottom path, based on whichever one has fewer packets queued in the output queue.

- Is there any scenario where this approach provides better utilization than MPLS, and if so, describe it.

- Are there any drawbacks to this scheme compared with MPLS, and if so, explain them.