

## Networking Area Examination

This exam consists of 9 questions. Please answer exactly **six** of them. Typed answers are preferred, but don't spend a lot of time typesetting equations, etc. — hand-written equations are fine.

If you have questions during the exam, please contact Mostafa Ammar [ammar@cc.gatech.edu](mailto:ammar@cc.gatech.edu), (404) 894-3292 (office), (770) 493-4592 (home).

1.
  - (a) For a multicast Video-on-Demand (VoD) service explain the important performance measures that can be used to judge the service.
  - (b) We are interested in the following two basic approaches for a multicast video-on-demand service:
    - i. Staggered Continuous Multicast of a video: Where a video is multicast on  $K$  channels by repeating the video in its entirety on each channel and staggering the start times of the video in each channel by  $1/K$  of the video length.
    - ii. Using Skyscraper Broadcasting.  
In what sense is Skyscraper Broadcasting better than staggered continuous multicast and at what expense.
2. Consider the following statement: “An Ack-based Reliable Multicast Protocol is not feasible because it will suffer from Ack implosion.”
  - (a) What is Ack implosion?
  - (b) Is this statement correct?
  - (c) Describe at least two schemes that help address the Ack implosion problem.
3. Traffic Shaping and Policing are important components of a QoS architecture. Answer the following:
  - (a) What is the difference between Traffic Shaping and Traffic Policing?
  - (b) Why are these two functions important? You can discuss this by showing how the two functions fit within a QoS architecture.
  - (c) Show how a Token Bucket with Leaky Bucket Control (TBLB) can be used for each of these two functions. Make sure to explain the traffic specification associated with the use of a TBLB.
4.
  - (a) Explain how Network and Port Address Translation (NAT and Pat) work.
  - (b) It is sometimes said that the need for a larger address space (as is provided by IPv6) is obviated by the significant use of NAT and PAT. Do you believe this to be true? Why or why not?
5. Suppose you wanted to generate transit-stub topologies to use in a simulation study. Explain the criteria you would apply in choosing the parameters for the generation.
6. Suppose you wanted to modify web client/server interaction so that a request could come from one machine and the response could go to another. Design a modification that will support this, with as little change to the current client/server operation as possible. Explain the main features of your design, including how the server and clients must be modified (if needed).

7. This question concerns active networking.

- Give an example of an application that derives benefit from active networking, even if active nodes are not universally deployed. Explain.
- Give an example of an application that requires universal deployment of active networking to derive the majority of the benefit. Explain.

8. Suppose you wanted to impose access control so that only authorized senders could send to a particular multicast group. Assume the use of PIM-SM routing, and describe an access control scheme. Give a critical analysis of the strengths and weaknesses of your design.

Describe how you would extend this for inter-domain multicast using MSDP (Multicast Source Discovery Protocol). Note: If you don't know what MSDP is you may need to look it up in the IETF drafts.

9. A queuing system has the following properties:

- Customers arrive in pairs but only when the system is empty. Customers are served one at a time.
  - If the system is empty at time  $t$ , the probability that a pair of customers arrives during  $(t, t + \delta t)$  is  $\lambda\delta t + o(\delta t)$ .
  - If the system is non-empty at time  $t$ , the probability that a customer completes service in  $(t, t + \delta t)$  is  $\mu\delta t + o(\delta t)$ .
- (a) Write down the differential-difference equations for  $P_k(t) = \text{Prob}[k \text{ customers in system at time } t]$ . Either give a complete derivation or a plausible explanation.
- (b) Determine  $P_k = \lim_{t \rightarrow \infty} P_k(t)$  for  $k = 0, 1$ , and  $2$ .