# Csci 5221 Foundations of Advanced Networking

## Spring 2007 Final Essay

### Due Friday 5pm April 27

Please read the following two papers:

**P1:** "A Measurement Study on the Impact of Routing Events on End-to-End Internet Path Performance" by F. Wang et al, and

**P2:** "R-BGP: Staying Connected in a Connected World" by N. Kushman et al

(If necessary, you may want to consult the references cited by the papers.)

Please write an essay or "paper" (maximum 6 pages) in the form of a "workshop" or "conference" paper, in which you will answer the following questions. Your essay or "article" should not simply consist of a "laundry list" of answers to the individual questions. In other words, consider the following questions as a "reminder" to yourself of what key questions you need to address in your "paper." Your "paper" should be appropriately structured with the answers to the following questions "embedded" in your "paper." A possible outline for your "paper" might consist of the following components: title and author, a very short abstract, introduction, clearly defined problem statements, succinct description of R-BGP and your proposed improvements, a brief but clearly stated "action plan" for designing and implementing your proposed improvements, evaluation you may plan to carry out, etc.

1. Based on your reading of [P1] and [P2], argue in your own words why it is important to understand the impact of routing failures on end-to-end Internet path performance, and why it is important to mitigate the impact of routing failures.

2. In your own words, define what are *fail over*, *recovery* and *fail down* routing events, and briefly discuss their (expected) impact on end-to-end path performance.

3. Based on the results and findings of [P1], in your own words summarize the "root causes" for packet losses (in particular, loss bursts) that are induced by routing events.

4. Compared with intra-domain routing protocols such as OSPF, what are the major challenges and difficulties in performing resilient and fast rerouting using BGP?

5. The paper [P2] proposes an enhancement to the current BGP for performing resilient "backup" routing under routing failures. In your own words, please clearly state the design assumptions and constraints of R-BGP, and summarize the main ideas and schemes of R-BGP (the three mechanisms highlighted in the paper). Also briefly discuss pros and cons (or other potential issues) of the proposed scheme. (For instance, consider the example in Fig.5(b) in [P2], during the "convergence period" after link between Bob and MIT fails and before AT&T switches its path to Sprint and advertises to Joe, traffic from Joe to MIT in fact traverses through its customer Bob, then to Bob's provider, AT&T. If Bob (or even AT&T) has installed appropriate source address filters along the data paths to ensure policy compliance, would traffic from Joe to MIT be carried through Bob to MIT?)

6. After reading the papers (P1) and (P2), identify a research problem that needs to be further investigated. Briefly describe how you would like to address the problem. In other words, come up with a *short* research plan with the problem statements, the research methodology/approaches you would like to employ to solve the problem. In your research plan, please briefly argue why the problem is important, and how you believe the proposed methodology/approaches would likely help you solve the problem

   For instance, one research problem is to address the issue outlined above in Fig. 5(b). Where does the issue lie here? In other words, why can't Joe switches its route to MIT via Bob immediately to AT&T when it learns the withdrawal from Bob?

   Another research problem could be to incorporate/integrate BGP failover/rerouting with IGP fast rerouting within an ISP. For example, consider the example in Fig.7 in [P1]. When the link to the Beacon fails, within ISP1, RR2 will continue to send packets destined to the Beacon to e1 before it learns the withdrawal of the route to the Beach from e1 (via i-BGP) and switches its route to e2. Can we design a fast reroute scheme such that, when e1 learns of the route failure to the Beacon,

would automatically reroute traffic to RR1 which then forwards to e2 instead? Similarly, within ISP3, once the egress router to ISP1 (which is also connected to RR4) learns the withdrawal of the route to Beacon from ISP1, it will automatically reroute traffic to RR4 which then reroutes to RR5.