EECS 428

Computer Networks II

2006 Spring Semester

Dungeon-and-Dragon Project

There is no grading for episode 1.

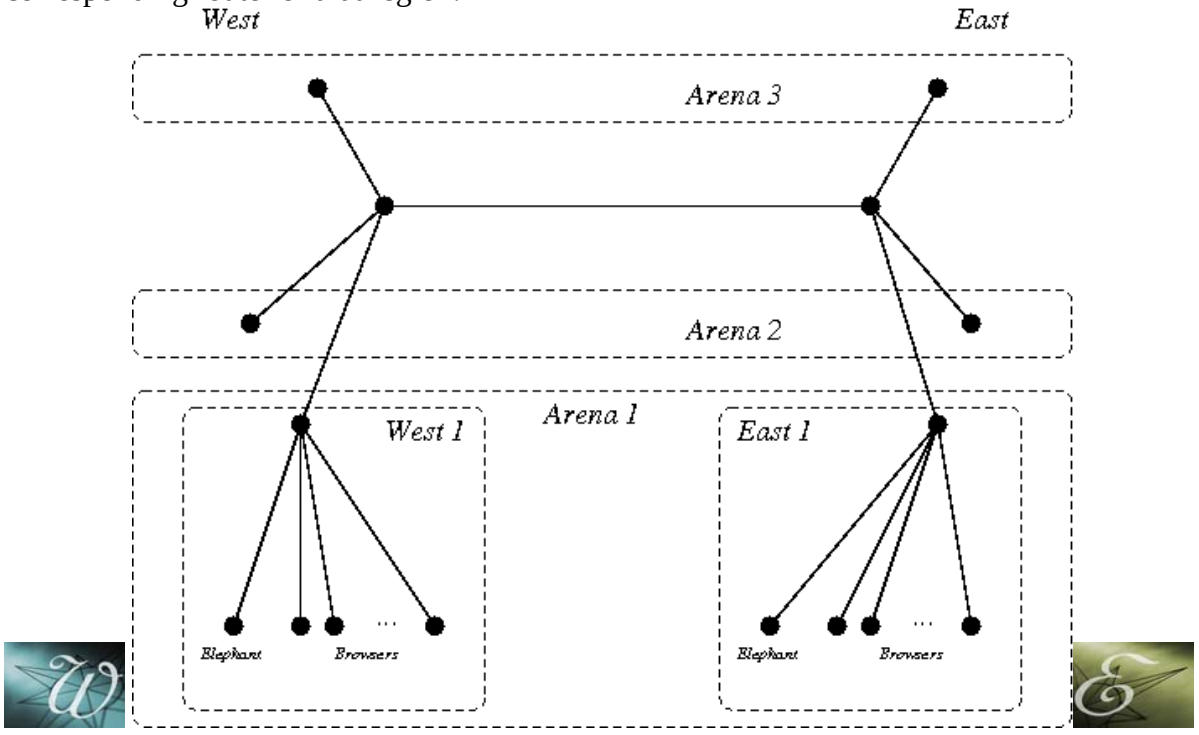
The Dungeon-and-Dragon project is graded at the end of the course depending on your final achievement.

Episode 1 – The Phantom Simulator

Due February 3

In the first episode, you will learn the basic tool to survive in your networking adventure: the ns2 network simulator. To use ns2, go to the JCC UNIX Lab. If you want a newer version of ns2, you can download it from `http://www.isi.edu/nsnam/ns/`. The manual, tutorial, examples, test cases, mailing list, help, and other wizardry are available at the same URI.

Environment. Once you have acquired the ns2 simulator, you will use it to build the main environment of this project (figure). The central link is a wide-area backbone link connected to three areas, which I will call "arenas". Each arena is further subdivided into an East and a West "region". Each region of each arena contains a router that is connected to the corresponding end-point of the central link: the western router of the first arena is connected to the western router of the central link; the eastern router of the first arena is connected to the eastern router of the central link, and so on. Each region of each arena contains $2n+1$ other nodes, all linked to the corresponding router of that region.



Here's the definition of the parameters of this network. The bandwidth of the central link is 10Mbps (an ancient Ethernet) and its latency is 20ms. The bandwidth from the region routers to the central link is 100Mbps and their latencies are 10ms (arena 1), 50 ms (arena 2), and 200ms (arena 3). The buffers on all of the output cards contain 512 packets. All packets are 1500B (including headers). All TCP senders use Sack, have a clock granularity of 10ms, and an advertised window of 256 packets. All TCP receivers use Sack with delayed acknowledgments and a 50ms time-out.

Characters. The environment is populated by a few beings. They will attempt to communicate with each other. Some are friendly but some are mean: watch out!

The Browsers. The Browser family are your average Internet folks, thrown in a world of sorcery and intrigue. The Browsers generate Pareto traffic with shape equal to 1.5 and minimum transfer size of 8KB. Their access link is a DSL line (300kbps, 50ms).

The Elephants. The Elephant family uses the Internet to download vast amounts of pictures and movies. The Elephants are located in the East and attempt to download from the West. Their access to the backbone is a 1Gbps, 1ms link (Gigabit Ethernet). Each Elephant generates one 400MB download. The Elephant in the first arena starts at time 5s, the Elephant in the second arena starts at time 6s, and the Elephant in the third arena starts at time 7s.

Our brave fellows wish to communicate, but will they be able to survive the network? More importantly, will they be able to survive each other? (Play dramatic music here.)

Initial placement. When our adventure begins, the players are placed in the following way:

- One Elephant is placed on a node in the eastern region of each arena, and will attempt to download from a node placed in the West on the same arena.
- n=10 Browsers are placed on a node in each region of each arena, and will attempt to download for a node placed on the other region of the same arena.

Therefore, each region contains 22 nodes: a router, an Elephant (source or sink), 10 Browser sources, and 10 Browser sinks.

Square 1. The first steps of the adventure are:

1. Implement the simulation scenario in ns2.
2. Make sure that your simulation script is correct by inspecting it, by examining nam animations, and by going through the ns output traces. (*Warning*: ns has a steep learning curve and this step is more difficult than you think it is.)
3. Measure the times it takes to each Elephant to transfer its file. Are there significant differences?
4. Explain your answer. Your explanations should be based on concrete facts, and you are encouraged to use summary statistics or charts or both along with a written explanation. In particular, the three Elephants have three different round-trip times (RTT). If the download time is the same, how did some of the Elephants overcome the longer RTT? If the download time is different, is the RTT gap sufficient to explain the throughput difference?

Episode 1. Hand in by email to `vl@case.edu` your ns script and your answers to questions 2 and 3 in PDF. Do not use blank spaces in your file names.

Ultimate objectives. Keep in mind the ultimate semester-long objectives: your grade depends on these more than on anything you achieve for Episode 1!
The ultimate objectives of this multi-episode project will be that, at the end of the semester,

- A problem with large bandwidth-delay product (BDP) link has been identified, verified, and satisfactorily explained.
- A possible solution has been proposed and validated on simulations.

Episode 1 is the first step toward these ultimate objectives in that it should highlight a problem in high BDP networks for Elephant flows. In the next assignments, you will be required to understand the origin and causes of this behavior and to examine a proposed fix to the problem. The final grade will depend on the correctness of your statements, on whether your investigation centers on a really unexpected, important, or bothersome Internet behavior, and (most important of all) on how satisfactory your explanation is.

Best of luck and May the Force be with you!