Review Materials: Set B

EE122 Fall 2012

1. Lucky you're with AIMD

Consider a generalized version of AIMD, where:

- for every window of data ACKed, the window size increases by a constant A
- when the window size reaches W, a loss occurs, and the window size is multiplied by a constant M < 1

For simplicity, assume that W(1-M) is divisible by A. Thus, the window sizes will cycle through {WM, WM + A, WM + 2A, …, W}. Use RTT to denote the packet round trip time.

1. What is the average throughput (in # of packets)?

2. What proportion of packets is dropped?

3. What is the average throughput, as a function of the drop rate, RTT, A, and M?

2. TCP

Panda has an infinite number of packets to send to Anand. Their point-to-point link has a propagation delay of 4ms, the transmission delay for a data packet is 1ms, and the propagation delay for an ACK packet is 1ms (the path from Anand to Panda is asymmetric). Assume there is no processing delay.

Implementation details:

- Panda is using simple fast retransmission
- during congestion avoidance, CWND += MSS / Int(CWND / MSS)
- the algorithm leaves slow-start when CWND > SSTHRESH (not >=)
- Panda's retransmission timer is 20ms, and is reset whenever new data is ACKed.

Assume that SSTHRESH starts at 10, and that the first transmissions of data packet #5 and #10 are lost. Assume that Anand uses traditional cumulative ACKs.

Determine what Panda's CWND is, and what packet(s) are sent at each time:

Time	Events for Panda	Panda's CWND	Events for Anand
0	Sends D1	1	
1			
2			
3			
4			
5			
6			
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3. Cheating in TCP

It takes a long time to receive an infinite number of packets, so Anand would like to speed things up. For the TCP example above:

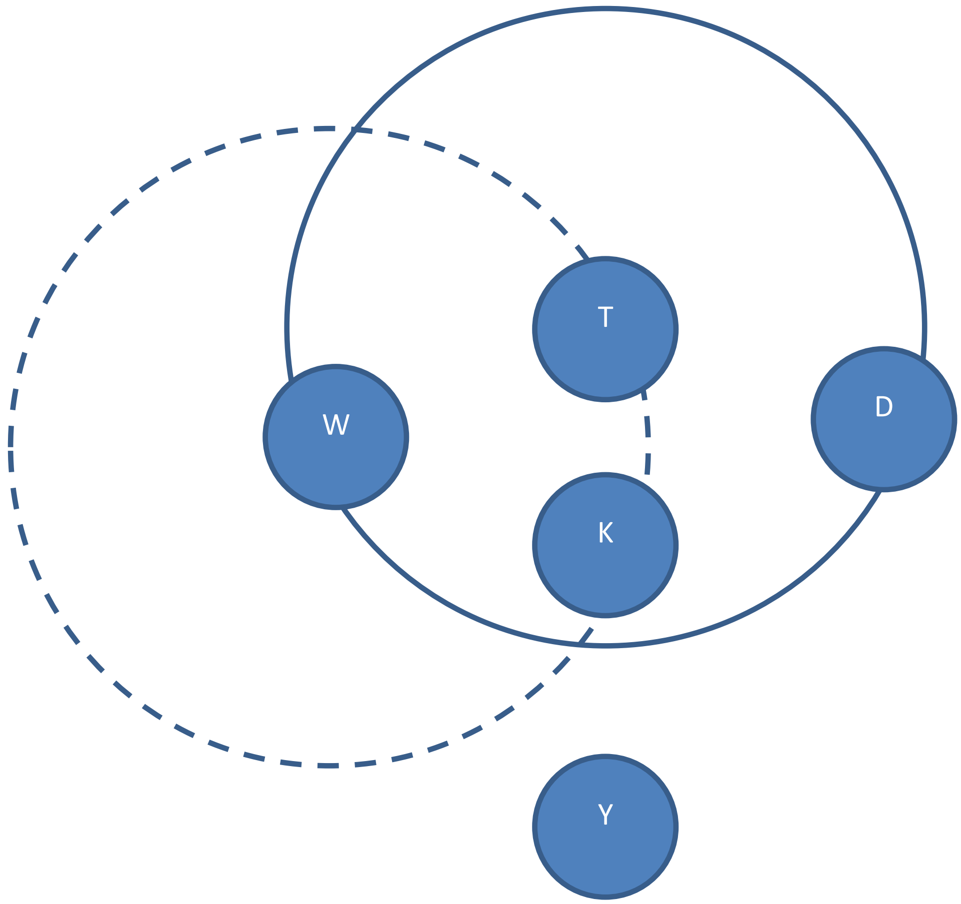
4. What would likely happen if Anand had sent A2 at t = 1?

5. What would likely happen if Anand had sent A2 at t = 1, and A3 at t = 2?

6. What would likely happen if Anand had sent A6 at t = 14?

4. Wireless Etiquette

The following hosts are on the same wireless channel. Each host has the same receive/transmit radius (radii shown for two hosts).



Initially, there is no communication.

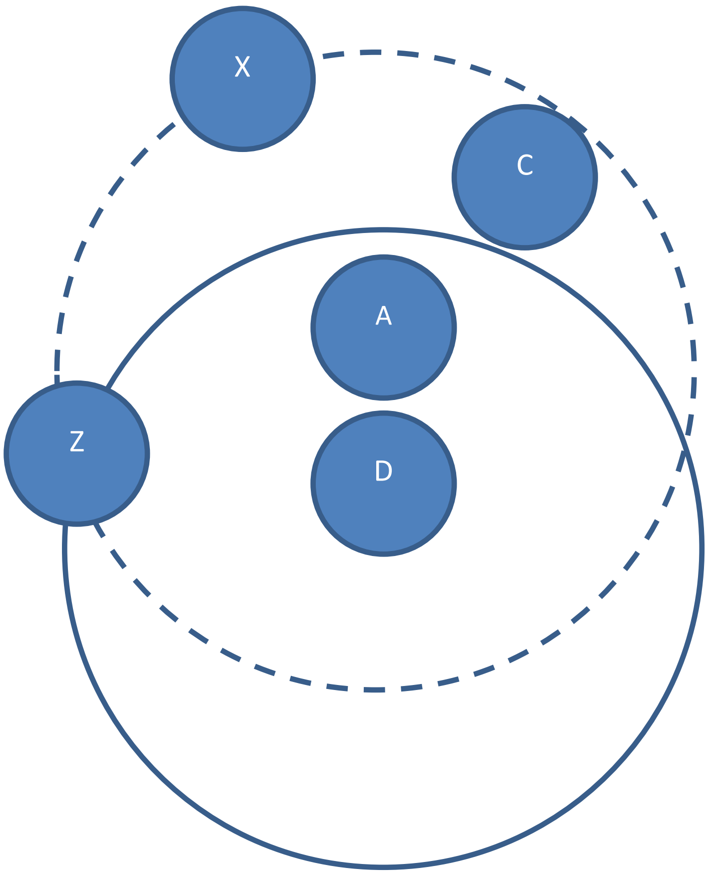
7. Taylor (T), who uses the classic MACA protocol (RTS-CTS-DATA-ACK), wishes to send data to W, and sends an RTS to W. Which hosts hear the RTS? Which hosts are allowed to send?

8. W sends a CTS to Taylor. Which hosts hear the CTS? Which hosts are allowed to send?

9. Upon receiving the CTS, Taylor starts sending DATA to W. Kanye (K), having overheard the CTS, decides to ignore the protocol and immediately transmit. What happens?

10. What would have happened if Kanye had started transmitting before Taylor did?

Now consider the following, similar scenario:



11. Cruz (C), who is using the simplified 802.11 protocol (carrier sense + RTS/CTS), completes the RTS/CTS handshake with X, and starts sending DATA. Arnold (A) ignores the CTS he heard from X, and begins sending DATA to Z. What happens?

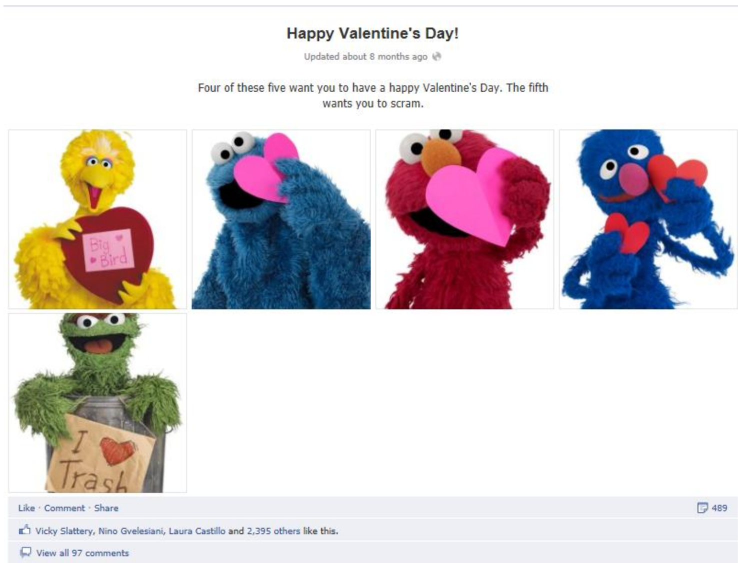
12. Suppose Cruz hadn't started transmitting, and that instead Arnold had been continuously transmitting DATA for the previous two hours. When should Cruz send?

13. Arnold's twin, Danny, also ignores RTS/CTS and carrier sense, and hence Arnold and Danny are both sending to Z. What happens?

5. HTTP

We would like to download all the thumbnails from one of the TA's list of "Top Ten Sesame Street Photo Albums". This involves the following steps:

- download a master index page, of size I. This page contains links to ten album pages.
- download the album pages, each of size A. Each album page contains five photos.



An example of an album page.

- download the photos (thumbnails), each of size P.

We can't start downloading the album pages before we finish downloading the entire master index page. We can't start downloading the images from album *i* before we finish downloading album page *i* (but we don't need to wait for album page *j*).

Assumptions **(read these carefully!)**:

- the transmission delay for any one album page is larger than an RTT
- every photo is larger than any one album page
- HTTP request packets, TCP SYNs and ACKs are negligibly small
- the connections can each achieve throughput T (but if there are multiple connections they must share the throughput)

- we don’t need to wait for the HTTP responses to be acknowledged, nor for TCP connections to terminate

- the only files we need to download are those explicitly stated above in steps i-iii (i.e., the total size of the HTTP responses is [I + 10(A + 5P)])

- all files are hosted on the same web server

For each of the following scenarios, calculate the **minimum** total time to download the pages and photos.

14. Sequential requests with non-persistent TCP connections:

    _____ x RTTs + _____ x I/T + _____ x A/T + _____ x P/T

15. Concurrent with non-persistent TCP connections

    Additional assumptions:

    - all album pages are requested concurrently

    - TCP connections are not opened pre-emptively (e.g., we do not open a TCP connection for use with the album pages, until we are ready to make a HTTP request)

    _____ x RTTs + _____ x I/T + _____ x A/T + _____ x P/T

16. Sequential with a single persistent TCP connection

    _____ x RTTs + _____ x I/T + _____ x A/T + _____ x P/T

17. Pipelined within a single persistent TCP connection

    _____ x RTTs + _____ x I/T + _____ x A/T + _____ x P/T

6. You Down with BGP?

The domains A, B, C, … , Z are fully interconnected (i.e., they each have a direct link to all other domains), and use BGP. We do not know their selection or export policies, which can be **arbitrary**. We do know that, in the steady state, the following routes have been exported:

- ABCDEF
- LMNOP
- PQ
- and some others that we don't know about.

Indicate whether, in the steady state, the following route advertisements:

- are **guaranteed** to be exported regardless of the choice of selection or export policies
- are **guaranteed** to be exported **if standard** policies are used, but not necessarily true in general
- are **not guaranteed** to be exported, even if standard policies are used

1. ABCDE

2. ABCDEFG

3. BCDE

4. BCDEF

5. LMNOPQ