Week 8: CC and the Network Layer

CSCI 4431/6431 Computer Networks

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Today

- Finish Chapter 3: **congestion control**
- Start Chapter 4: the **network layer**, data plane vs. control plane, **longest prefix match**
- **Worksheet** intermixed with lecture
- **Lab 2**: reliable data transfer in code

Housekeeping

- **Project 1 implementation** due **Tue 10/20, 11:59 PM**
- **Next week, 10/21:** interoperability session in class. Your code meets your partner group's
- Reflection due **10/25** - done individually
- Discord and office hours for questions

Congestion Control

Slides: https://gaia.cs.umass.edu/kurose_ross/ppt-9e/Chapter_3_v9.0.pptx

Chapter 3 - Slides 108 - 123: Congestion and AIMD

- **Congestion**: too many senders, too fast, for the *network*. Delay climbs, retransmissions waste capacity
- TCP is **end-to-end**: infer congestion from loss and delay (vs. network-assisted ECN)
- **AIMD**: +1 MSS every RTT; halve on 3 duplicate ACKs; back to 1 MSS on a timeout
- Worksheet: Q1 part 1

The sawtooth: TCP is always probing for bandwidth.

Chapter 3 - Slides 124 - 128: cwnd and slow start

- `LastByteSent − LastByteAcked ≤ cwnd`, so **rate ≈ cwnd / RTT**
- **Slow start**: begin at 1 MSS, **double every RTT** until **ssthresh** (half of cwnd at the last loss), then go linear
- Worksheet: Q1 parts 2 - 5

Each returning ACK lets new bytes out. The ACKs clock the sender.

The Network Layer

Data Plane

Slides: https://gaia.cs.umass.edu/kurose_ross/ppt-9e/Chapter_4_v9.0.pptx

Chapter 4 - Slides 3 - 12: Forwarding vs. routing

- **Forwarding** (data plane): one router, input link → output link, via the forwarding table
- **Routing** (control plane): network-wide, computes what goes in the tables. Per-router algorithms or an **SDN** controller
- Service model: **best effort**. No guarantee of delivery, order, timing or bandwidth
- Router internals (slides 14 - 16, 23 - 41): watch **4.2a** and **4.2b**

Forwarding is getting through one interchange. Routing is planning the trip.

Chapter 4 - Slides 17 - 22: Longest prefix match

- Forwarding table maps overlapping address **ranges** to output links
- Use the **longest** prefix that matches. Done in hardware (TCAM), one lookup per cycle
- Worksheet: Q2

Break

5 minutes. Get ready for Lab 2.

Lab 2

Reliable data transfer: build it, break it, fix it

Accept the assignment at go.gwu.edu/csnetworks

The next 60 minutes

	Do	Min
Given	Run rdt1.0, watch it fail on a bad channel	5
Build	Write rdt2.0 in `rdt2.py`: ACK, NAK, stop-and-wait	20
Break	Corrupt the replies too. What did your protocol do?	10
Fix	`rdt21.py` has two defects. Find and fix them	10

`python3 check.py` scores you. `python3 test.py <protocol> <channel>` shows the packets.

Submitting

```
git tag submit/1
git push origin submit/1
```

- New tag each time: `submit/2`, `submit/3`
- Answer the three questions in `answers.md`
- Not done in class? Finish **Fix** before **Friday**

Wrap up and Homework

- **Project 1 implementation** due **Tue 10/20, 11:59 PM**
- Before 10/21, watch 4.3a and 4.3b: IP
- Also watch 4.2a and 4.2b: router internals.
- **Next week:** IP addressing and Project 1 interoperability testing

Chapter 4 Resources

Video	When Covered
4.1 Network Layer	Week 8
4.2 Inside a Router, pt 1, pt 2	Pt1 partly in class, rest **video only**
4.3 IP, pt 1	Week 9
4.3 IP, pt 2	Week 9, but NAT and IPv6 are **video only**
4.4 Generalized Forwarding	Week 12, with SDN
4.5 Middleboxes	Week 12 **Video only**

Slides · Practice problems · Playlist