
CS4270 and CS8803-DCL: Internet Lab

College of Computing, Georgia Tech

Spring 2014

Course Objectives

The main objective of this course is to offer students **hands-on experience** with networking technologies (routers, switches, hubs), networking protocols (RIP, OSPF, BGP, DHCP, NAT, DNS, TCP, UDP, SNMP, IP multicast), and networking tools (tcpdump, netstat, ping, traceroute).

Additionally, the course covers the main Internet protocols in greater technical depth than a basic networking course. We will also cover a number of state-of-the-art networking topics through recent research papers. The only prerequisite is CS3251 or an equivalent first course in computer networks.

Instructor

[Prof. Constantine Dovrolis](#)

Office: 3346 KACB

Office phone: 5-4205

Office hours: By appointment

Email: constantine@gatech

Teaching assistant

(announced in class)

Table of Contents

- [Course Information](#)
 - [What's New - Important Dates](#)
 - [Textbook](#)
 - [Syllabus - Schedule](#)
 - [Lab exercises](#)
 - [Grading](#)
 - [Course Policies](#)
 - [Miscellanea](#)
-

Course Information

- Lectures: Tue and Thu - 12:05 - 13:25
 - Classroom: ES&T L1175
 - Lab: CCB 104A
 - Prerequisite: CS3251 or equivalent
-

``What's New'' and Important Reminders

- **Please form a team of three students and reserve a certain time slot for the lab by Tuesday January 14.**
-

Textbooks

We will use the following two textbooks. The first (referred to as the "lab manual") describes the lab exercises. The second (referred to as the "textbook") is a recently written textbook that we will be referring to at the lectures (and it is free!).

- The "Lab Manual": [Mastering Networks, An Internet Lab Manual](#), by J. Liebeherr and M. El Zarki, Addison Wesley 2004.
- The "Textbook": [Computer Networking : Principles, Protocols and Practice](#) by O. Bonaventure, 2011.

Other good references:

- The "IBM Textbook": [TCP/IP Tutorial and Technical Overview](#), by A. Rodriguez, J. Gatrell, K. Karas and R. Peschke, IBM 2006 (publicly available on-line).
 - A. Leon Garcia and I. Widjaja, [Communication Networks \(second edition\)](#), 2003
 - J. Kurose and K. Ross, [Computer Networking, A top down approach featuring the Internet](#), 2012
 - W. R. Stevens, [TCP/IP Illustrated, Volume 1: The Protocols](#), 1994.
-

Syllabus - Lectures and lab schedule (subject to minor changes)

- Week-1: *Course overview, review of key networking concepts*
Lecture slides: [Overview of labs](#)
Lecture slides: [TCP/IP networking: an example](#)
Lecture slides: [Review of important networking concepts](#)
Research reading: [The Evolution of Layered Protocol Stacks Leads to an Hourglass-Shaped Architecture](#)
Lab assignment: Visit lab, become familiar with equipment
- Week-2: *Layer-2, LANs and VLANs -- Serialization delay and network bandwidth estimation*

Lecture slides: [Data-link layer protocols](#)

Lecture slides: [ARP](#)

Lecture slides: [VLANs](#)

Lecture slides: [Bandwidth estimation basics](#)

Research reading: [Bandwidth Estimation: Metrics, Measurement Techniques, and Tools](#)

Research reading: [The road to SDN](#)

Lab assignment: Lab-1: Read Introduction from Lab Manual - Become familiar with Wireshark

- Week-3: *Internetworking*

Lecture slides: [IP protocol](#)

Lecture slides: [IP addresses](#)

Lecture slides: [ICMP protocol](#)

Research reading: [Evaluating the benefits of the Locator/Identifier Separation](#)

Research reading: [IPv6 Will Be Deployed Any Day Now](#)

Research reading: [Avoiding traceroute anomalies with Paris traceroute](#)

Lab assignment: Lab-2: Single segment IP networks

- Week-4: *Internet routing architecture - Router architectures*

Lecture slides: [The Internet](#)

Lecture slides: [Router architectures](#)

Research reading: [Internet inter-domain traffic](#)

Research reading: [Ten years in the evolution of the Internet ecosystem](#)

Research reading: [Networking named content](#)

Lab assignment: Lab-3: Static routing

- Week-5: *Intradomain routing: RIP and OSPF*

Lecture slides: [Distance vector routing and RIP](#)

Lecture slides: [Link state routing and OSPF](#)

Research reading: [Path splicing](#)

Lab assignment: Lab-4a: Dynamic routing (RIP-related: Parts 1 through 4)

- Week-6: *Interdomain routing: BGP*

Lecture slides (for both lectures): [Path vector routing and BGP - Policy-based routing](#)

Additional material: [BGP best route selection](#)

Research reading: [BGP routing policies in ISP networks](#)

Research reading: [Pathlet routing](#)

Lab assignment: Lab-4b: Dynamic routing (OSPF-related: Parts 5 and 6)

- Week-7: *Router algorithmics: switch scheduling and packet forwarding algorithms*

Lecture slides: [Packet switching](#) (see also the Wikipedia article for [Clos network](#))

Lecture slides: [IP-lookup algorithms](#)

Research reading: [The iSLIP scheduling algorithm for input-queued switches](#)

Research reading: [Survey and taxonomy of IP lookup algorithms](#)

Lab assignment: Lab-4c: Dynamic routing (BGP-related: Part 7)

- Week-8: *Transport protocols: UDP and TCP*

Lecture slides: [Transport protocols - part 1](#)

Research reading: [The power of explicit congestion control](#)

Research reading: [Bandwidth estimation: metrics, measurement methods and tools](#)

- Week-9: *TCP flow, error and congestion control*

Lecture slides: [Transport protocols - part 2](#)

Lecture slides: [Transport protocols - part 3](#)

Lecture slides: [Read the first 3 sections to understand mostly the Bandwidth-Delay Product \(BDP\) concept.](#)

Research reading: [CUBIC: A new TCP-friendly high-speed TCP variant](#)

Lab assignment: Lab-5a: Transport protocols

- Week-10: *LAN switching, bridges and VLANs*

Lecture slides: [LAN switching](#)

Research reading: [The cost of a cloud: research problems in data center networks](#)

Lab assignment: Lab-5b: Transport protocols

- Week-12: *The Domain Name System (DNS)*

Lecture slides: [The DNS system and protocol](#)

Lecture slides: [DNS-based server selection](#)

Lecture slides: [Anycast routing for DNS root servers](#)

Research reading: [DONAR: Decentralized server selection for cloud services](#)

Research reading: [An overview of DNS-based server selections in content distribution networks](#)

Lab assignment: Lab-6: LAN switching

- Week-11: *DHCP and NATs*

Lecture slides: [DHCP](#)

Lecture slides: [Network address translation](#)

Lecture slides: [NAT traversal](#)

Research reading: [On Dominant Characteristics of Residential Broadband Internet Traffic](#)

Research reading: [Understanding Block-level Address Usage in the Visible Internet](#)

Lab assignment: Lab-8: DNS

- Week-13: *The Simple Network Management Protocol (SNMP)*

Lecture slides: [SNMP and network management](#)

Research reading: [Virtual Routers on the Move: Live Router Migration as a Network Management Primitive](#)

Lab assignment: Lab-7: NAT and DHCP

- Week-14: *IP Multicast*

Lecture slides: [IP multicast](#)

Lab assignment: Lab-9: SNMP

- Week-15: *Network Security*

Research reading: [Hardware-based malware detection](#)

Research reading: [Spamming Botnets: Signatures and Characteristics](#)

Lab assignment: Lab-10: Multicasting

Lab exercises: rules, schedule and notes

The lab exercises are described in the Lab Manual. Each exercise has a "prelab" section that you will need to study before doing the lab.

Also, each exercise has a number a questions that you will answer during the lab session. A report (in electronic form) that includes your answers is due **one week after your group was assigned to complete that lab exercise**. Your report should focus on qualitative facts and explanations; you do not need to submit lengthy traces and raw data.

The lab exercises, and the lab reports, will be done by **groups of THREE students**.

Each group will have access to the lab for a specific day of the week, either in the "morning time slot" (until 2pm) or in the "evening time slot" (after 3pm). The lab will be open in the weekends in case you need some extra time. **Each group will pick a time slot on the class of Tuesday, January 14 (make sure that you attend that class).**

It is very important that you clean up the lab after your time slot. Additionally, you should unplug all network cables and return them to the cable box, undo any changes you made in host or router configuration files, and report any potential problems with the equipment to the instructor (and to the next group).

You should NOT leave data files saved on the PCs. You need to leave the machines in a ``clean state".

The same goes for routers. ROM-monitor mode recovery is not fun, so make sure that you do NOT save the router configurations.

Shutting down PCs: Do NOT just switch off the power of the PCs. It makes the routers unhappy and the PCs will sometimes fail to boot. In the router case, the 'reset' command will get them started normally. The PCs should work after a power cycle.

Unfortunately, the PCI eth1 cards often come out of their sockets in the PCs. If a card all of a sudden stops showing up in the output of 'lspci', it is likely that the card has come out of its socket. In that case please notify the TA as soon as possible. We need to unlock that PC and reposition the card.

Grading

- *Lab reports:* 30%
- *Midterm exam:* 30%
- *Final exam:* 30%
- *Class presentation:* 10%

Miscellanea

- [Textbook web page](#)
 - [Lecture slides](#)
 - [A tutorial for IOS and Cisco router configuration](#)
 - [Specific notes \(mostly troubleshooting\) for each lab exercise](#)
 - [A sample midterm exam](#)
-

Course Policies

- All work for this class, except the lab exercises and reports, is to be done individually. You are strongly urged to familiarize yourselves with the [GT Student Honor Code](#) rules. Specifically, the following is not allowed:
 1. Copying, with or without modification, someone else's work when this work is not meant to be publicly accessible (e.g., a classmate's program or solution).
 2. Submission of material that is wholly or substantially identical to that created or published by another person or persons, without adequate credit notations indicating authorship (plagiarism).
 - You are encouraged to discuss problems and papers with others as long as this does not involve copying of code or solutions. Any public material that you use (open-source software, help from a text, or substantial help from a friend, etc...) should be acknowledged explicitly in anything you submit to us. If you have any doubt about whether something is legal or not please do check with the class Instructor or the TA.
 - Absolutely no late homeworks, assignments, or projects will be accepted. The deadline for each homework/assignment/project will be specified at the corresponding handout.
-