
Lecture 1

Introduction

Hui Zhang

**School of Computer Science
Carnegie Mellon University**

15-441 Networking, Fall 2007

<http://www.cs.cmu.edu/~srini/15-441/F07/>

Today's Lecture

- **Course outline and goals.**
- **History and overview**

Course Staff

- **Instructors**

- » Hui Zhang

- <hzhang@cs.cmu.edu> , Wean Hall 7126

- » Srinu Seshan

- <srini+@cs.cmu.edu>, Wean Hall 8113

- **Teaching assistants:**

- » Daniel Spangenberg dspangen@gmail.com

- » Albert Sheu asheu@andrew.cmu.edu

- » One more TA to confirm soon

Course Goals

- **Become familiar with the principles and practice of computer networking**
 - » Protocols, resource sharing
 - » Routing, transport protocols, naming, ...
- **Learn how to write networked applications:**
 - » An IRC server
 - » A peer-to-peer file transfer program
- **Get some understanding about network internals in a hands on way.**
 - » You'll implement a routing protocol for your IRC server
 - » TCP-style congestion control

Course Format

- **~30 lectures**
 - » Cover the “principles and practice”
 - » Readings are posted beforehand
- **4 homework assignments**
- **Mid-term and final.**
- **3 programming projects.**
 - » How to use and build networks / networked applications
 - » Application layer; include key ideas from kernel
 - » Larger, open-ended group projects. *Start early!*

Recitation Sections

- **Key 441 objective**
 - » systems and distributed programming
- **Different from what you've done before!**
 - » Low level (C)
 - » Often designed to run indefinitely. Handle all errors!
 - » Must be secure
 - » Interfaces specified by documented protocols
 - » Concurrency involved (inter and intra-machine)
 - » Must have good test methods
- **Recitations address this**
 - » “A system hackers’ view of software engineering”
 - » *Practical* techniques designed to save you time & pain!

Waiting List

- **Currently 58 people are enrolled, and 28 people are on the waiting list.**
- **If you are enrolled and do not plan to take the course, please drop it within a reasonable amount of time**
- **If you are on the waiting list**
 - » **Please come to lectures for the time being**
 - » **Please sign in for each lecture**
 - » **We expect to sort out waiting list issue within the next couple of weeks**

Administrative Stuff

- **Watch the course web page.**
 - » Handouts, readings, ..
- **Read courses bboards.**
 - » “Announce” for official announcements
 - » “General” for questions/answers
- **Office hours posted on web page.**
- **Course secretary**
 - » Barbara Grandillo, Wean Hall 8018
- **Office hours this week by email / appointment**
 - » Final office hours posted Thursday
- **Books – have people gone to the bookstore? How many copies? *Should* be there...**

Grading

- **Roughly equal weight in projects and testing on course contents.**
- **45% projects**
 - » 10% for Project I, 15% for Project II, 20% for Project III
- **40% exams**
 - » 15% for Midterm, 25% for Final exam
- **15% for homeworks**
- **You need to demonstrate competence in both projects and tests to pass the course. *Don't fail any component.***

Policy on Collaboration

- **Working together is important.**
 - » Discuss course material in general terms
 - » Work together on program debugging, ..
- **Parts *must* be your own work**
 - » Homework, midterm, final
- **Projects: Teams of two**
 - » Collaboration, group project skills
 - » Both students should understand the entire project
- **Web page has details.**

Policy on Late Work and Regrading

- **No assignments with a “short fuse”.**
 - » Homeworks: ~1 week
 - » Projects: ~5 weeks
- **Late work will receive a 10% penalty/day.**
 - » No penalty for a limited number of handins - see web page
 - » No assignment can be more than 2 days late
- **Only exception is documented illness and family emergencies**
- **Start on time!**
 - » Every year some students discover that a 4 week project cannot be completed in a week
- **Requests for regrading must be submitted in writing with course secretary within 2 weeks.**
 - » Regrading will be done by original grader

This Week

- **Intro – what’s this all about?**
- **Applications and Network programming review.**

- **Course outline:**
 - » Low-level (physical, link, circuits, etc.)
 - » Internet core concepts (addressing, routing, DNS)
 - » Advanced topics

- **On to the good stuff...**

History of Computer Networks

- **Communication**
- **Telecommunication**
- **Telecommunication network**
- **Computer network**
- **Convergence network**

Early Communication over Long Distance

- **Between human beings**
- **Letter and messenger**
 - » Information carried by physical objects
 - » Speed limited by transportation means: horse, bird, train, car
 - » Bandwidth? distance? security?
- **Fire**
 - » Early optical communication
 - » Speed of light
 - » Bandwidth? distance? security?

Telegraph: Communication Using Electrons

- **Between human beings**
- **Major milestones:**
 - » 1827: Ohm's Law
 - » 1837: "workable" telegraph invented by Samuel Morse
 - » 1838: demonstration over 10 miles at 10 w.p.m
 - » 1844: Capitol Hill to Baltimore
 - » 1851: Western Union founded
 - » 1868: transatlantic cable laid
 - » 1985: last telegraph circuit closed down
- **Other important dates**
 - » 1869: transcontinental railway
 - » 1876: Alexander Bell invented telephone

Telegraph Engineering

- **Technical issues**
 - » How to encode information?
 - » How to feed/input information to the system?
 - » How to output information?
 - » How to improve the distance?
 - » How to improve the speed?
- **Common issues faced by all telecommunication systems**

Telephony

- **Interactive telecommunication between people**
- **Analog voice vs. digital information**
 - » Transmitter/receiver continuously contact with electronic circuit
 - » Electric current varies with acoustic pressure

Analog/Continuous Signal

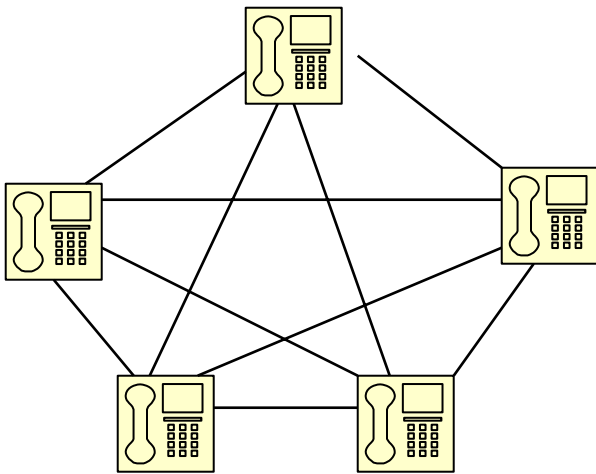


Digital/Discrete Signal

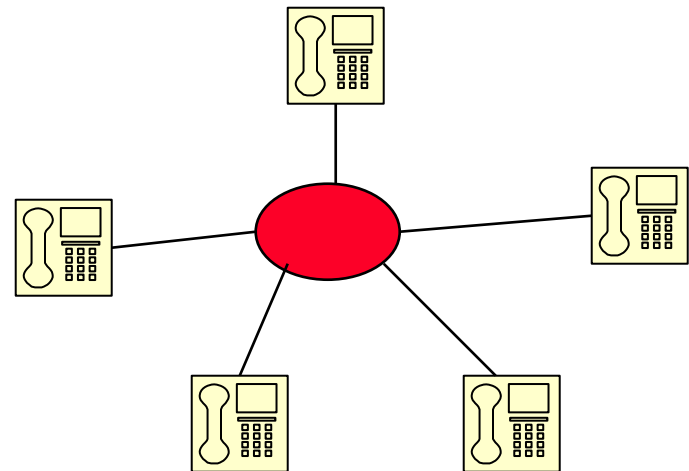


Telephony Milestones

- **1876: Alaxendar Bell invented telephone**
- **1878: Public switches installed at New Haven and San Francisco, public switched telephone network is born**
 - People can talk without being on the same wire !

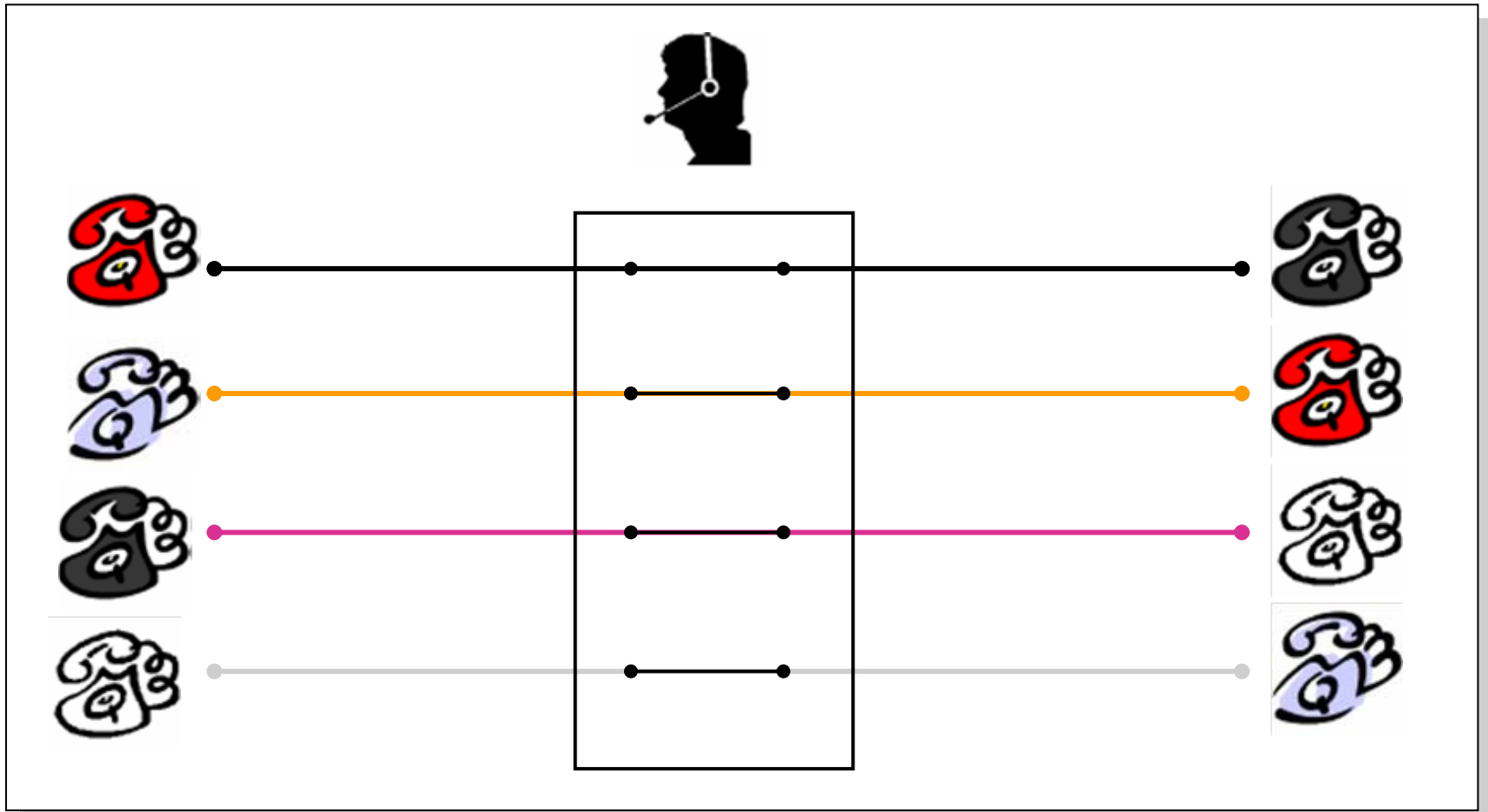


Without Switch



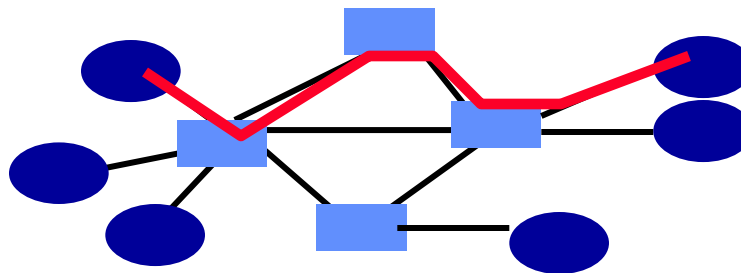
With Switch

Back in the Old Days...



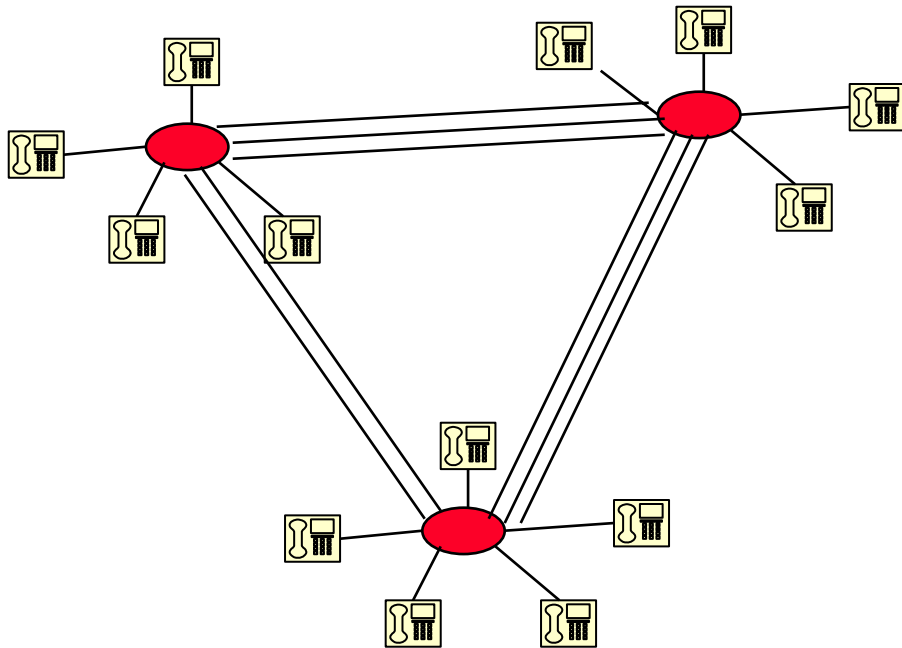
Circuit Switching

- **Source first establishes a connection (circuit) to the destination**
 - » Each switch along the way stores info about connection (and possibly allocates resources)
- **Source sends the data over the circuit**
 - » No need to include the destination address with the data since the switches know the path
- **The connection is explicitly torn down**

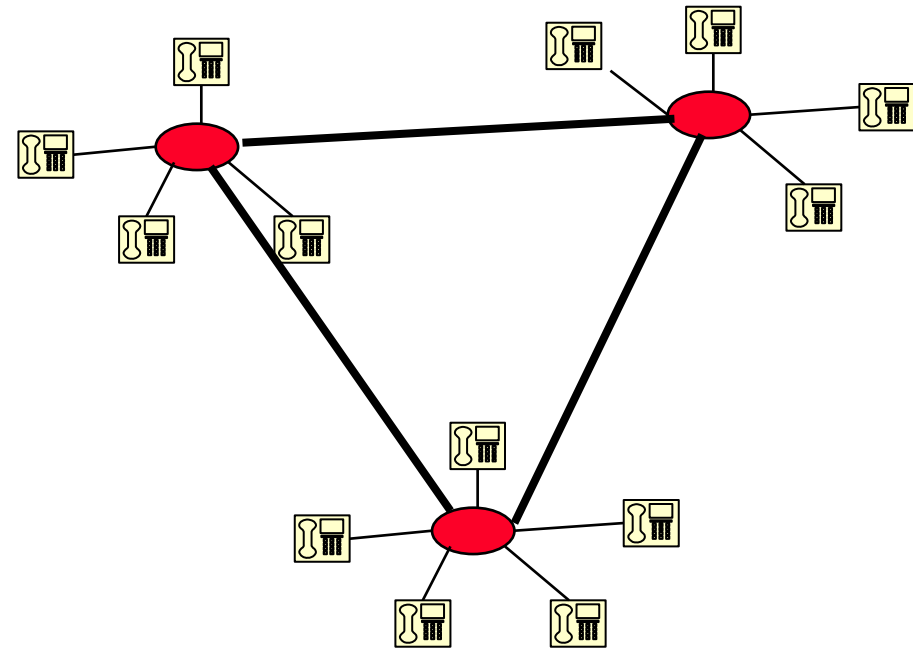


Telephony Milestones

- 1937: Multiplexing introduced for inter-city calls



Without Multiplexing



With Multiplexing

Telephony Milestones

- **1878: First telephone directory; white house line**
- **1881: Insulated, balanced twisted pair as local loop**
- **1885: AT&T formed**
- **1892: First automatic commercial telephone switch**
- **1903: 3 million telephones in U.S.**
- **1915: First transcontinental telephone line**
- **1927: First commercial transatlantic commercial service**

Telephony Milestones

- **1939: Pulse Code Modulation (PCM) invented**
- **1948: Transistor invented by Bell scientists**
- **1951: Direct dialing for long-distance demonstrated**
- **1963: Digital transmission introduced**
- **1965 1ESS central office switch introduced**
 - » **Stored Program Control (computerized)**
- **1976 4ESS: first digital electronic switch**
- **1982 Bell System split into ATT and 7 RBOCs**
- **1983 First fiber-optic cable in ATT long distance network**
- **1989 SONET standard published by CCITT**
- **1999 Last 4ESS switch installed in ATT network**

Summary

- **Communication long before computer**
- **Evolutions of modern communication and computer intertwined**
- **Important concepts**
 - » **Switching**
 - » **Multiplexing**
 - » **Analog vs. digital**

Data or Computer Networks

- **Networks designed for computers to computers or devices**
 - » vs. communication between human beings
- **Digital information**
 - » vs. analog voice