Computer Networks
COL 334 / COL 672

Course Instructors

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Course Webpage
https://www.cse.iitd.ac.in/~abhijnan/computer-networks-2021.html

Introductory course on computer networks

- This course provides an introduction to computer networks, with a special focus on the Internet architecture and protocols.
- The course will cover protocols at the Application, Transport, Network, Data link and Physical layers.
- Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, web and email protocols.
- Besides the theoretical foundations, students acquire practical experience through the programming assignments.

Textbooks

- Computer Networking: A Top-Down Approach by Jim Kuorse and Keith Ross.
- Computer Networks: A Systems Approach by Larry Peterson and Bruce Davie.

Evaluation

- Minor Exam (25%)
- Major Exam (30%)
- Programming Assignments (25%)
- Quizzes (15%)
- Class participation (5%)

Audit Criteria: 40% marks and must participate in all assignments

Programming Assignments

- Assignment is to be done and submitted individually.
- Try to meet the deadline. There will be penalties on late submission.
- Institute rules will be followed to discourage copying and defaulters will be penalized accordingly.

Attendance

- At least 80% if you are not auditing.
- No attendance policy for audits

No Cheating

- Fine to *talk* with other students about assignments
  - But only general concepts, not specifics
- General rule: no copying of specifics
  - If you're unsure, then ask.
- Will use automated similarity detection
- *Any cheating (in assignments/quizzes/exams) – Fail (F Grade)*
- *Don't come with excuses later*

What is this course about?

- Networks
  - Road Network – traffic
  - Telephone Network – traditionally build a circuit
  - The Internet
    - Packet data network
  - This course is about the Packet Data Network
  - i.e. the Internet

Goals for the Internet

- Ability to connect many different networks
- Ability to scale to entire world
- Ability to recover from failures
- Basic network technology goals
  - Speed
  - Cost
  - Port-density
  - Reliability
  - Other “features”
    - Quality of service, security, etc..

These are harder and more interesting goals!

(more architectural than engineering)

Architecture vs Engineering

- Architecture:
  - The allocation of functionality and definition of interfaces among elements
- The Internet "architecture" is the decision about *what* tasks get done, and *where*:
  - In the network, or in the hosts
  - Engineering is more about *how* tasks get done
- These architectural decisions play a crucial role in scaling, heterogeneity, robustness, etc…

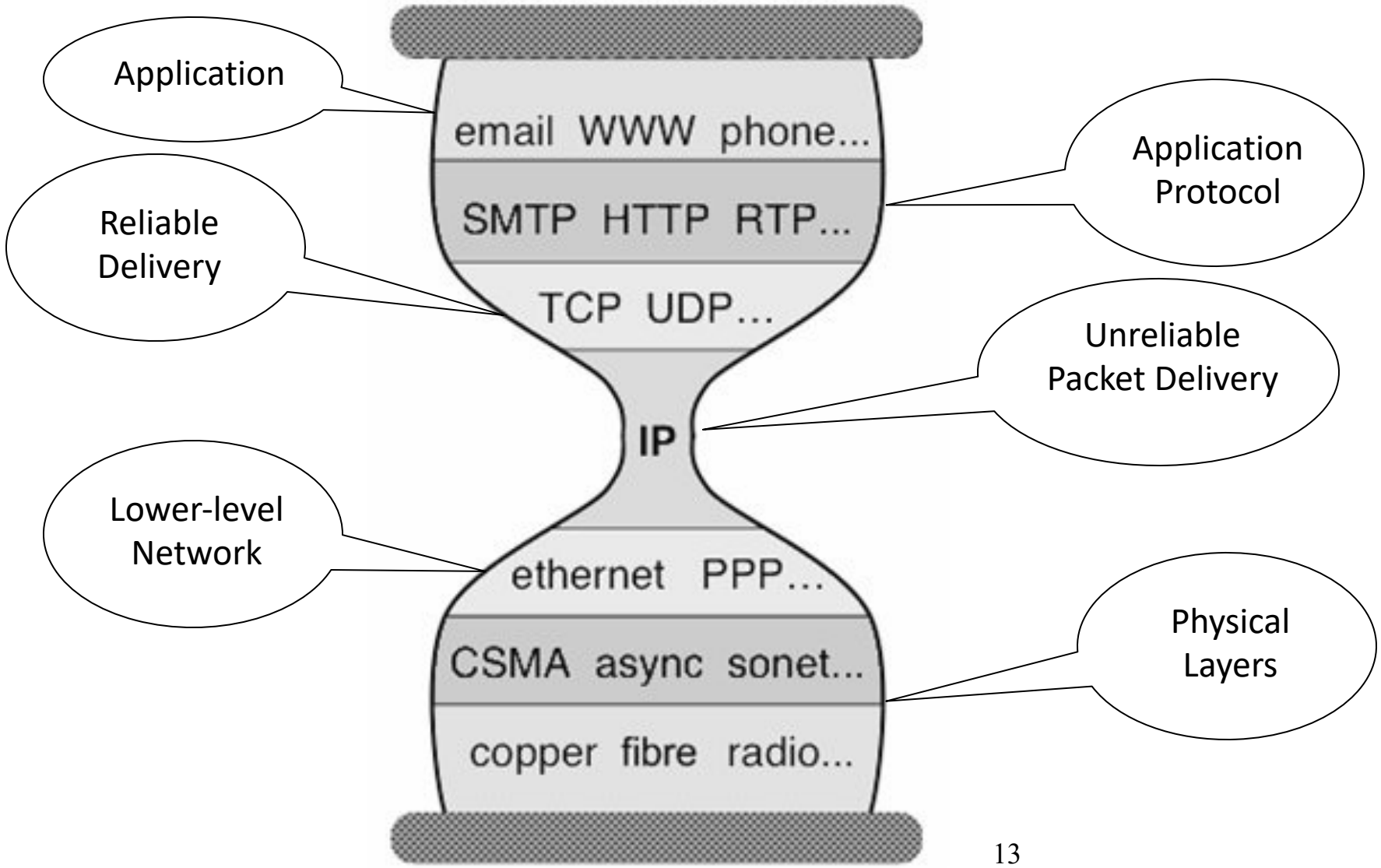
What topics will course cover?

- The core of the Internet “architecture”:
  - IP, DNS, BGP
- Other technologies crucial to the Internet
  - Higher-level protocols: TCP, HTTP.…
  - Crucial lower-level technologies: Ethernet, wireless…
    - These are the two network technologies we will study because they raise interesting questions about shared media
- Won’t cover network topics not crucial to Internet
  - But that doesn’t mean they aren’t interesting
  - E.g., sensornets, low-level encoding, radio technology

Various perspectives on Internet

- Different levels of abstraction
  - Basic concepts versus actual protocols
- Different geographic scales:
  - LAN vs Enterprise vs WAN vs Interdomain
- Different conceptual approaches:
  - Architecture vs Protocol vs Algorithm
- Different aspects of functionality:
  - Different “layers” focus on different tasks

The Internet: an hourglass *with layers*



Basics

- General overview
  - Packet switching, basic design principles
- Idealized view of network
  - Focus on fundamental conceptual questions
  - Ignore all real-world unpleasantness
- Making this vision real
  - IP, TCP, DNS, Web
  - Emphasize concepts, but deal with unpleasant realities

Fundamental conceptual questions

- How can you deliver packets from source to destination?
- How do you build reliable transport on top of an unreliable network?
- How can you federate a set of competing ISPs?
- ….

Internet has had tremendous impact

- Internet changed the way we gather information
  - Web, search engines
- Internet changed the way we relate to each other
  - Email, facebook, twitter
- **Which would you choose?**
  - Computers without the Internet (standalone PCs)
  - Internet without modern computers

The Internet introduced new paradigm

- Completely different from the phone network
- Inventors had to overcome strong technical and commercial resistance to realize their dreams
  - Motivation not for personal gain, but societal benefit!
- A true success story of “thinking differently”
  - Their strong vision kept the design on track
  - Brilliant in conception, sometimes weak in execution

Many challenges remain unsolved

- Security
  - Security of infrastructure
  - Security of users
- Availability
  - Internet is very resilient
  - But availability is not sufficient for critical infrastructures
- Evolution
  - It is too hard to change the Internet architecture

Second half of course: Various topics

- Congestion control
- Advanced topics in routing
- Multicast and QoS
- Security
- Ethernet
- Wireless
- Software-defined networking
- Alternate architectures