Internet Protocols
ECSE-6600

http://www.pde.rpi.edu/
Or
http://www.ecse.rpi.edu/Homepages/shivkuma/

Shivkumar Kalyanaraman
Rensselaer Polytechnic Institute
shivkuma@ecse.rpi.edu
Overview

- Introductions: course description & calendar
- Answers to frequently asked questions
- Prerequisites
- Informal Quiz
Who’s Who

- **Instructor:** Shiv Kalyanaraman; kalyas@rpi.edu,
  - Room: JEC 6042, Phone: x8979
- **Course secretary:** (on-campus)
  - Jeanne Denue-Grady; denuej@rpi.edu,
  - Room: JEC 6049 ; Phone: x6313
- **PDE/RSVP Point-of-contact:**
  - Kari Lewick; lewick@rpi.edu, CII 4011; x2347
- **Production/Videostream Point-of-contact:**
  - Don Bazley: bazlyd@rpi.edu, x2421
- **WebCT Lectures Unavailable etc:**
  - Nadine Thompson, thompn@rpi.edu, x8501
- **TAs:**
  - Karthikeya Chandrayena
  - Satish Raghunath
  - Adnan El-Nasan
Networking Courses @RPI

- **CANOS**
- **CCN**
  - Network Programming (CS)
  - Internet Protocols
  - Network Modeling
  - Experimental Networking (Lab Course)
  - Network Operations (CS)

  **Mobile & Wireless Networking**

  "Topics Courses"

  - "Core Networking Sequence"

"Core Networking Sequence"

- Network Programming (CS)
- CCN
- Network Modeling
- Experimental Networking (Lab Course)
- Network Operations (CS)
Course Description Highlights

- **Syllabus:**
  - Core protocols: Transport (TCP, UDP), IP, Routing, Addressing/Naming ...
  - Advanced topics: Multicasting, Security, Next-generation IP, Better-than-best-effort Internet, High-Speed Routers, IP Telephony ...

- **Goals:**
  - Breadth of topics
  - Depth in core areas, and key advanced topics
  - Insights into design and implementation
  - Preparation for possible research/advanced development in networking
Course Description Highlights (Continued)

- Lectures: problem-solution approach
- Informal quizzes: Every two weeks
- Remote students should download latest class material from WebCT for each class
- WebCT bulletin board: Post your questions!
- WebCT: Grades, papers, RFCs, Internet drafts…

- 2 Labs: Hands-on TCP and IP {20 pts}
- 4 Homeworks: {20 pts}
- 1 Research Case Study: {10 pts}
- 3 exams: 15 pts, 15 pts, 20 pts: {50 pts}
Prerequisites

- Required \textit{(no exceptions)}:
  - ESCE-4670 Computer Communication Networks or equivalent
  - \textbf{VERY GOOD} C programming knowledge

- Desirable:
  - Operating Systems
  - Computer Architecture (ECSE-4730 or equivalent)

- If you \textbf{do not have the required prerequisites}, you \textbf{must drop the course} and take it later (next year).
Prerequisites

- Protocol Layers: ISO/OSI reference model
- Physical Layer: Coding, Manchester
- Transmission Media: UTP, Cat 5
- Data Communication: Asynchronous vs synchronous, Baud, bit, and Hz, Half-Duplex vs Full-duplex, Modulation/Demodulation
- Packet Transmissions: Framing, Bit stuffing, byte stuffing
- Flow Control: On-Off, Window
- Error Detection: Parity, Checksum, Cyclic Redundancy Check
Prerequisites (Continued)

- Error Recovery: Start and Stop, Go back $n$, Selective Reject
- LANs: Aloha, CSMA/CD, Ethernet, IEEE 802.3, Token Ring/IEEE 802.5, FDDI
- Addressing: Unicast/multicast, Local/Global
- LAN wiring: 10Base5, 10Base2, 10Base-T, 100Base-TX,
- E-LANs: Hubs, Bridges, Routers, Switches
- Routing: Distance Vector vs Link State, Spanning tree, source routing
- Transport layer: multiplexing, reliability, congestion control, introduction to TCP and UDP
- Basics of probability and queuing theory
Still trying to get into the course?

- Do you have the pre-requisites?
- Please submit course add form to course secretary: Jeanne, JEC 6049 by tomorrow (Fri, Jan 18th), noon time (12 pm).
- Depending upon the number of people who drop the class, space available, TA resources available, we will add more students.
  - Decisions to be emailed to you by Jeanne.
  - Make sure you mention your email address to her.
Answers to FAQ's

- Lot of paper readings in the class (due every homework) + research case study (writing skills)
- Labs require advanced C programming skills
- Informal quizzes given periodically

- All homeworks/labs etc due at the beginning of the class indicated on the course calendar
  - Up to one late submission: no penalty
  - Beyond that 10% penalty: only if submitted before solutions are posted.

- All quizzes are open-book and extremely time limited.
  - Quizzes consist of design qns, numerical, multiple-choice (true-false), and short answer questions.
Informal Quiz: Prerequisites

T  F (True or False)

☐  ☐ Datalink refers to the 3rd layer in the ISO/OSI reference model

☐  ☐ If peak rate = 10 Mbps, Avg rate = 2 Mbps and Service rate = 4 Mbps, multiplexing gain = 2.

☐  ☐ An even parity bit value for the 8-bit string 01101010 is 0.

☐  ☐ Packet forwarding is a control-plane function and routing is a data-plane function.

☐  ☐ Bridges and switches in Ethernet allow separation of collision domains, and reduce the degree of sharing of the physical media.

☐  ☐ Finding path from one node to another in a large network is a transport layer function.

☐  ☐ It is impossible to send 3000 bits/second through a wire which has a bandwidth of 1000 Hz.

☐  ☐ Randomness (in service and arrival) is what causes queuing at buffers.

☐  ☐ Little’s law which relates expected queuing delay E(T) and expected # in the system E(n) is applicable only to M/M/1 queues.

☐  ☐ Little’s law also holds for instantaneous (as opposed to average) queuing delay and instantaneous number in the system.
Informal Quiz (Continued)

- Bit stuffing is used so that framing characters do not occur in the frame payload.
- CRC is based upon the idea that it is highly unlikely for an uncorrupted packet to be perfectly divisible by the CRC polynomial.
- Random access MAC protocols tend to perform very well at low loads in terms of channel multiplexing; but suffer from high delay at high loads.
- “Taking turns” or token-based protocols like token-ring offer a best of both partitioning and random access worlds.
- For long delay paths, on-off flow control is better than window flow control.
- Ethernet uses a CSMA/CD access method.
- The packets sent in a connection-oriented network are called datagrams.
- The distance-vector protocol involves checking neighbors’ distance vectors and updating its own distance vector.
- Address structure is required to recognize whether the destination is one-hop or multiple-hops away.
Informal Quiz: Solutions

T  F (True or False)

- √ Datalink refers to the 3rd layer in the ISO/OSI reference model
- √ If peak rate = 10 Mbps, Avg rate = 2 Mbps and Service rate = 4 Mbps, multiplexing gain = 2.
- √ An even parity bit value for the 8-bit string 01101010 is 0.
- √ Packet forwarding is a control-plane function and routing is a data-plane function.
- √ Bridges and switches in Ethernet allow separation of collision domains, and reduce the degree of sharing of the physical media.
- √ Finding path from one node to another in a large network is a transport layer function.
- √ It is impossible to send 3000 bits/second through a wire which has a bandwidth of 1000 Hz.
- √ Randomness (in service and arrival) is what causes queuing at buffers.
- √ Little’s law which relates expected queuing delay E(T) and expected # in the system E(n) is applicable only to M/M/1 queues.
- √ Little’s law also holds for instantaneous (as opposed to average) queuing delay and instantaneous number in the system.
Informal Quiz Solutions...

√ □ Bit stuffing is used so that framing characters do not occur in the frame payload.
√ □ CRC is based upon the idea that it is highly unlikely for an uncorrupted packet to be perfectly divisible by the CRC polynomial.
√ □ Random access MAC protocols tend to perform very well at low loads in terms of channel multiplexing; but suffer from high delay at high loads.
√ □ “Taking turns” or token-based protocols like token-ring offer a best of both partitioning and random access worlds.
□ √ For long delay paths, on-off flow control is better than window flow control.
√ □ Ethernet uses a CSMA/CD access method.
□ √ The packets sent in a connection-oriented network are called datagrams.
√ □ The distance-vector protocol involves checking neighbors’ distance vectors and updating its own distance vector.
√ □ Address structure is required to recognize whether the destination is one-hop or multiple-hops away.