Broadband AND OPTICAL NetworkING
ECSE-6660

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

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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) Melissa Reardon; reardm@rpi.edu, Room: JEC 6049; Phone: x6313
- **PDE/RSVP Point-of-contact**: Kari Lewick; lewick@rpi.edu, CII 4011; x2347
- **Production/Videostream/WebCT Point-of-contact**: John Hughes: hughej2@pde.rpi.edu, x2421
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Networking Courses @RPI

- Network Programming (CS)
- CANOS
- CCN
- Mobile & Wireless Networking
- Broadband & Optical Networking
- “Topics Courses”
- Internet Protocols
- Network Modeling
- “Core Networking Sequence”
- Experimental Networking (Lab Course)
- Network Operations (CS)
Course Description Highlights

- This course will develop fundamental concepts, protocols & architectures of broadband and optical networking.
- Broadband networking driven by the imminent convergence of telephony (voice), Internet (data), cable (video), and wireless networks.
- Fundamental ideas in telephone, networking, cable systems, wireless
- Convergence architectures: B-ISDN, ATM, Frame Relay, Internet
Course Description Highlights

- Issues:
  - High-speed switching & router-design,
  - Quality of service (QoS) building blocks and architectures
  - Traffic engineering (MPLS, ATM, frame-relay),
  - Fiber optical communications,
  - Optical networking concepts,
  - Protection/restoration/survivability,
  - Optical link layers (SONET, WDM)
Course Description Highlights

- LANs/MANs/Last-Mile:
  - Gigabit Ethernet,
  - 802.11a/b and community/hot-spot networks
  - Cable-modem, DSL principles and economics
  - Free-space-optical network
  - Multihop/3G wireless data, smart antennas, OFDM
- The course will involve substantial reading and a term project to help student synthesize the variety of concepts and appreciate the broad techno-economic challenges.
## Format and Grading

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- Homework: 4
- Projects: 1
- Exams: 2

- Homework: 25%
- Term Project: 15%
- Exams: 60%

- Access to Email and the World Wide Web required for course communications and materials.
  - Download class material from WebCT for each class
  - **WebCT bulletin board**: Post your questions!
  - **WebCT**: Grades, papers, homework dropbox etc
- Lots of reading & critical thinking involved! (credit given in homeworks)
Prerequisites

- **Required** (*no exceptions*):
  - Computer Communication Networks (ECSE-4670)
  - Probability for Engineering Applications (ECSE-4500)
  - Suggested complementary course: Internet Protocols (ECSE-6600)

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

- If you **do not have the required prerequisites**, you **must drop the course** and take it later.
Textbooks

REQUIRED:


• Rajiv Ramaswami, Kumar Sivarajan, *Optical Networks: A Practical Perspective (Second Edition)*, 2001
REFERENCE Textbooks


Answers to FAQ's

- Lot of paper readings in the class (due every homework) + research case study (writing skills)
- Informal quizzes given occasionally to complement homeworks. These are not graded.

- All homeworks due at the beginning of the class indicated on the course calendar
  - Up to one late submission: no penalty
  - Beyond that 20% penalty: only if submitted before solutions are posted (max one week grace period)

- All quizzes are open-book and extremely time limited.
  - Quizzes consist of design qns, numerical, 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.