ECE 697J – Advanced Topics in Computer Networks

A Course on Network System Design
Fall 2003
Welcome

• Who am I?
  – Tilman Wolf, Assistant Professor in ECE
  – Office: KEB 211C
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  – Come by anytime

• My research interests:
  – Computer networks
  – How to make networks programmable and adaptable to new uses
  – Network processors
  – Network measurements
  – Network and system security
What is a Network?

• Or more specifically: “What is the Internet?”
Answer I

The connection was refused when attempting to contact www.yahoo.com.
Answer II
Answer III

3COM CELLplex 7000 HD Switch
backbone switch with 5 Gbit/s
switch capacity and 4 free slots
current setup:
1 slot card with 16 x 100 Mbit/s ports
1 slot card with 24 x 10 Mbit/s ports

3COM AccessBuilder 4000
8 anal. ports (28.8 kbaud),
8 ISDN ports (64 kbaud)

8 3COM SuperStack LinkBuilder FMS II Hubs
24-port hub
each hub connected with dedicated 10 Mbit/s

Novell-Servers and UNIX-Servers
each connected with dedicated 100 Mbit/s

Multimedia WS / PC / MAC
each connected with dedicated 100 Mbit/s

Power WS / PC / MAC
each connected with dedicated 10 Mbit/s

WS / PC / MAC / Printer
each 24 devices connected on a shared 10 Mbit/s hub

Tilman Wolf
Answer IV

UUNET’s North America Internet network

Tilman Wolf

University of Massachusetts Amherst
What’s the Common Theme?

- Network is a system of interconnected end-systems and routers
- End-systems:
  - Computers/devices that need to communicate
- Interconnection/links:
  - Fiber/wire/radio connections
- Routers:
  - Devices that know how to pass data towards the end-system
- Routers are integral part of the network
- Routers determine the quality/properties of network
  - Functionality
  - Performance
  - Reliability
  - Security
- What will be covered in this course?
What is this Course About?

• Course discusses **network systems** (i.e., routers)
  – Functionality of routers
  – How to implement them efficiently
  – How to expand their functionality for next-generation networks

• This is a broad area – we’ll focus on
  – Data-plane (not control plane, routing protocols, …)
  – Packet-based networks (in particular IP networks)
  – Concepts of router functions (not how to setup a Cisco system)
  – Intel IXP network processor (example of a programmable router)
Syllabus

- Networking basics
- Packet processing (3 lectures)
- Router architectures (2 lectures)
- Switching fabrics
- Novel network applications
- Active and programmable networks
- Design basics of network processors
- Commercial NP architectures
- Design trade-offs in NP architectures
- Intel IXP1200 (4 lectures + 6 lab sessions)
- Network Measurements
- Network Security
- Future trends and new technologies
- Final projects (3 lectures)
Why take this Course?

- Networks are important component of computer systems
- Understanding high-level network protocols is not everything
- Implementation details help understand
  - How things really work
  - Why things break
  - Performance issues
  - Security issues
- Principles are applicable to many systems
- Lab will help you get some hand-on experience
  - Lab is only part of course
- Papers give insight into current research problems
Course Details

• Classes: Tuesdays & Thursdays 2:30-3:45
• Class room: Elab 306
• Grade is composed of
  – 20% Presentation
  – 20% Discussion contribution
  – 20% Lab assignments
  – 40% Final project
• There is not final exam or quizzes
• If you read the book/papers, attend class, and do lab assignments, you’ll probably do well.
Grading

• Presentations
  – Each student will present a paper or book chapter
  – 20–30 minutes PowerPoint presentation
  – Lead discussion for ~10 minutes
  – Grading based on quality of slides and delivery

• Discussion
  – Everybody is expected read book and papers as assigned
  – Discussion in class is important and one of best learning tools
  – Quality and quantity of contributions is considered for grade
  – Class attendance is necessary to make contributions 😊

• Active participation is one main objective of this course
  – Important skill for your professional development
  – Class discussions were the best part of last year’s course

• Three parts:
  – “Traditional Protocol Processing Systems” = router architectures, packet processing details
  – “Network Processor Technology” = NP architectures
  – “Example Network Processor” = Intel IXP1200 architecture

• Classes will follow book
Network Processor Lab

- New lab setup in progress (Marcus 15B)
- Sponsored by Intel
  - PC workstations with IXP1200 network processor
- IXP1200 can be programmed to behave like routers
- Three simple lab assignments
- Also used for final project
Ground Rules

- You are encouraged to participate in class
  - Ask questions
  - Feel free to comment on anything
  - Nobody knows everything – don’t worry that you may something wrong
  - Respect others

- Academic Integrity
  - You should discuss lab assignments with others
  - Don’t copy from others
  - If you do, you will not get any points and may get an overall F

- Let’s have fun!
For next Class

- Get textbook
- Read pages 1-24 (chapters 1-3)
- Recap networking basics