

CS 396 Recent Advances in Distributed and Networking Systems

Spring 2007

Instructor: Yuan Xue



Course Information

◆ When and Where

- Tuesday/Thursday 1:10pm-2:25pm,
- 308 [Featheringill Hall](#)

◆ Instructor: Yuan Xue (yuan.xue@vanderbilt.edu)

- Office: 383 Jacobs Hall, Phone: 615-322-2926
- Office hours: Tuesday/Thursday 2:30pm-4pm or by appointment.

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- Office hours: by appointment

◆ Web: <http://vanets.vuse.vanderbilt.edu/~xue/cs396spring07/index.html>

- Basic information
- Paper list

◆ OAK: <http://www.vanderbilt.edu/oak>

- Discussion
- Review



Get to Know The Area of “Distributed and Networking Systems”



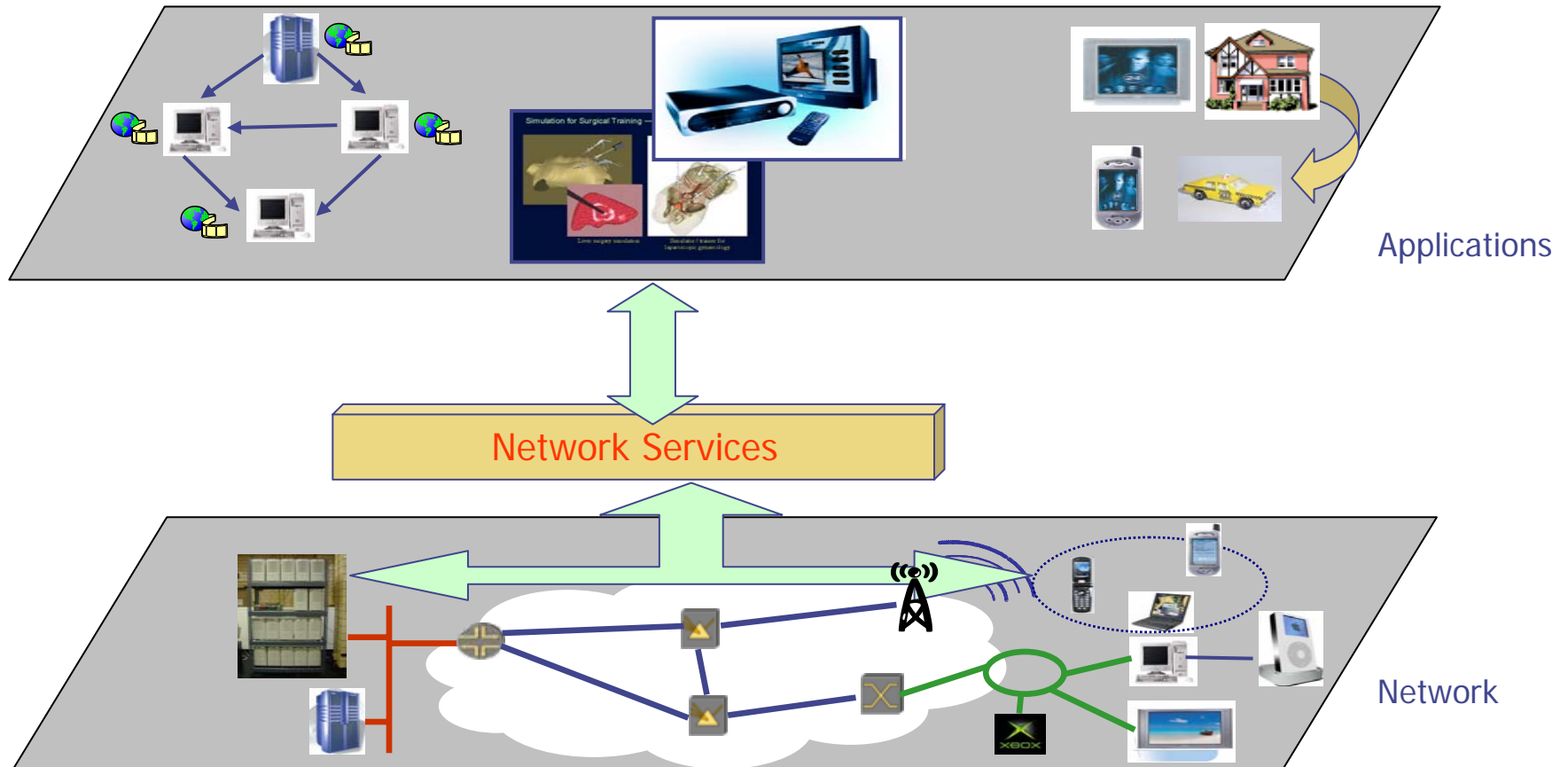
Research Community

- **Data Communication** [SIGCOMM](#)
 - ◆ The ACM Special Interest Group on Data Communication provides a forum for computing professionals involved in the vital field of data communication. SIGCOMM is also a community resource for those interested in network research, network standards, network history, and the educational aspects of networking.
- **Mobility of Systems, Users, Data and Computing** [SIGMOBILE](#)
 - ◆ The purpose of ACM SIGMOBILE is to promote research and development by bringing together researchers and practitioners and fostering interest in the mobility of systems, users, data, and computing. SIGMOBILE addresses the above spectrum of topics, sharing one common theme - mobility. The group's technical scope reflects the emerging symbiosis of portable computers and wireless networks, addressing the convergence of mobility, computing and information organization, its access, services, management, related technologies, and mobile user services, alongside more "classical" topics in wireless and mobile networking.
- **Operating Systems** [SIGOPS](#)
 - ◆ The ACM Special Interest Group on Operating Systems addresses a broad spectrum of issues associated with computing systems research and development, focused on operating systems but also including distributed systems and middleware.
- **Measurement and Evaluation** [SIGMETRICS](#)
 - ◆ The ACM Special Interest Group on Measurement and Evaluation fosters research in performance analysis techniques as well as the advanced and innovative use of known methods and tools, seeking a balance between theoretical, methodological, and practical issues. Members' interests include advancing the state-of-the-art, as well as applying new performance evaluation tools and techniques in practice.
- Also SIGSOFT , SIGSAC, SIGBED, SIGMM,



Research Scope

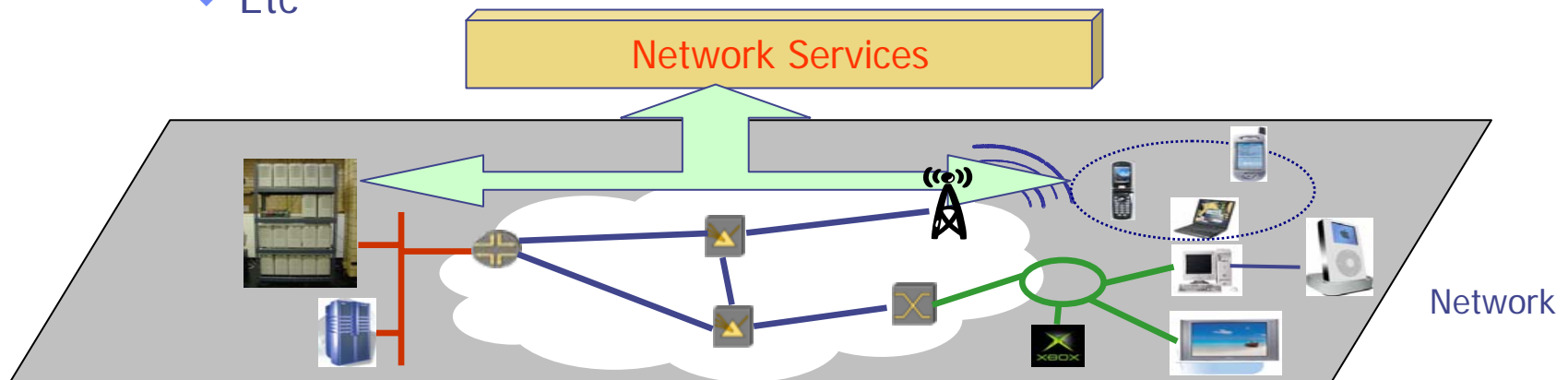
◆ Networked and Distributed Services and Applications



Research Scope

◆ Network and Network Services

- Wireline Network
 - ◆ LAN
 - ◆ Internet
- Wireless Networks
 - ◆ Cellular Network
 - ◆ Wireless LAN
 - ◆ Wireless Mesh Network
 - ◆ Mobile Wireless Ad hoc Network
 - ◆ Wireless Sensor Networks
 - ◆ Etc



Research Scope

◆ Distributed Systems and Applications

- Web services
- File/Storage systems (google file system)
- Content distribution
- Peer-to-peer systems
- VoIP (skype)
- Video-on-demand/IPTV
- And many others...

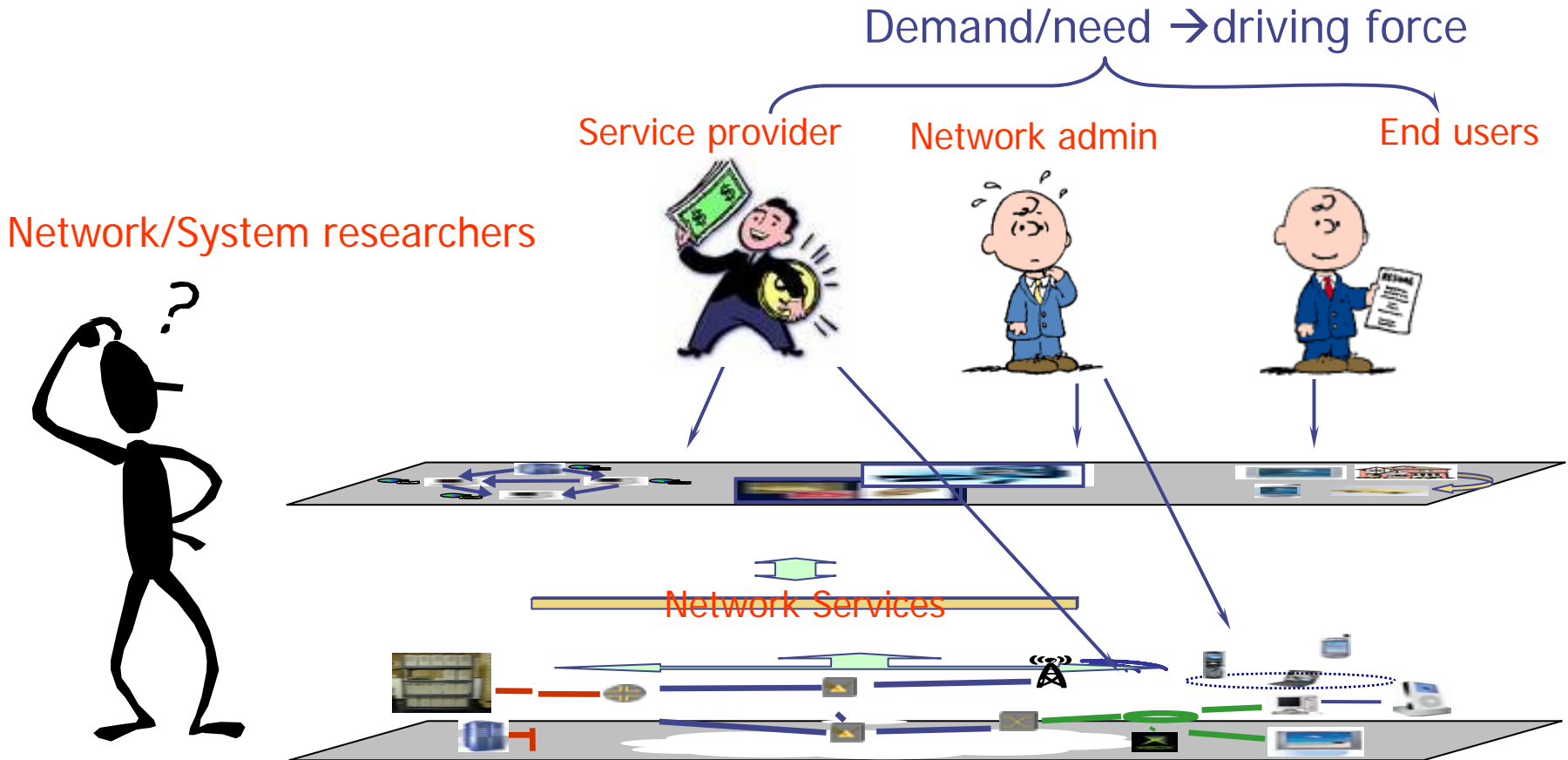
Related issues

- Search engine
- Multimedia Transformation



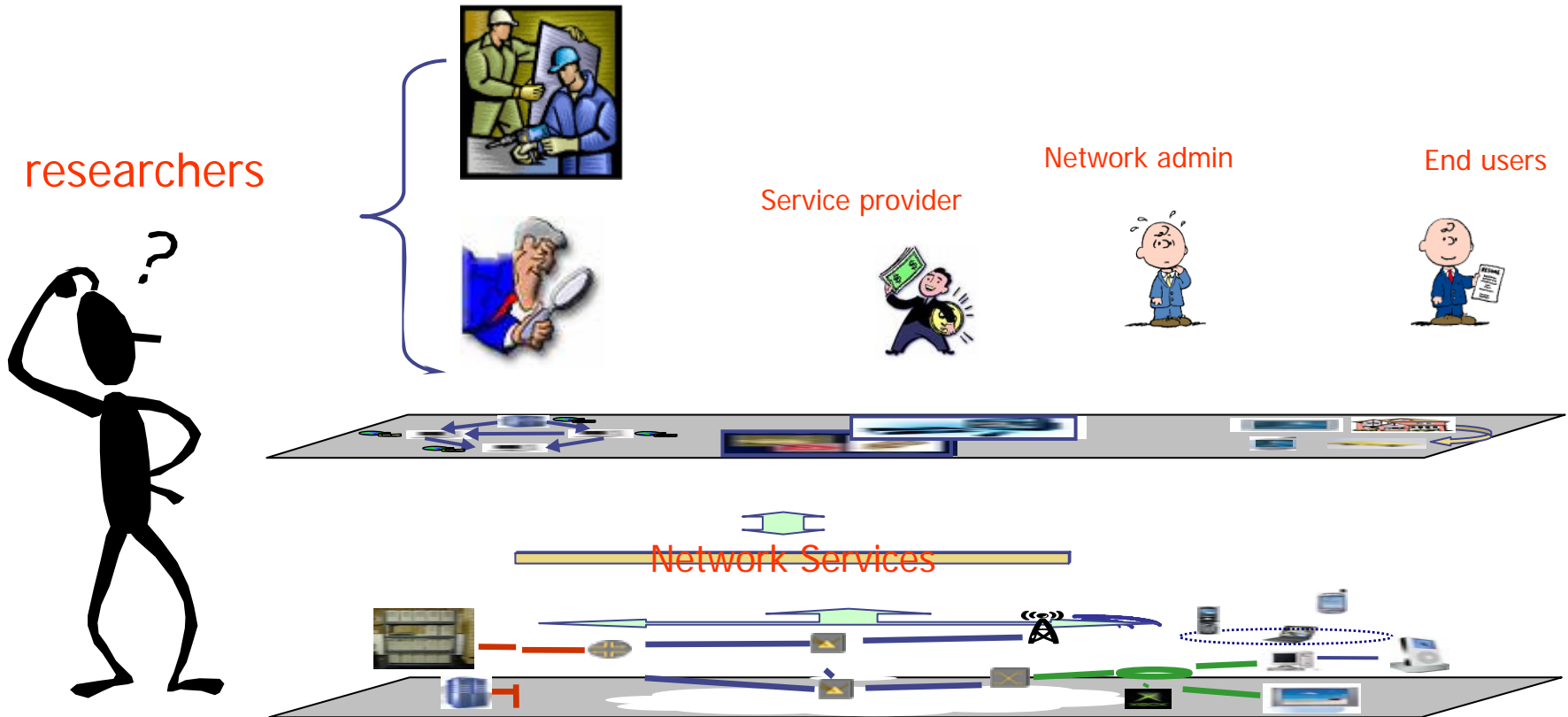
Research Issues

- ◆ What are the problems/issues?
- ◆ Where/how do we find them?



Research Issues

- ◆ Different types of researchers → different styles of research



Research Issues

◆ What are the problems/issues?

→ Classical and emerging issues

- Functionality
- Performance/QoS
 - ◆ Throughput
 - ◆ Delay, delay jitter
 - ◆ Etc.
- Reliability/availability
 - ◆ Reliability
 - ◆ Availability
 - ◆ Disruption/churn
 - ◆ Dependability
- Security, Privacy
- ...

- 
- Improvement, Optimization
 - Assurance, Guarantee

Research Issues

◆ How do we find them?

- User study
- Measurement/Observation
 - ◆ Intuitive to find existing problems
- Theoretical Analysis
 - ◆ Powerful in predicting future issues
 - ◆ CSMA/CD
 - ◆ Scalability issue of ad hoc network

◆ Where do we find them?

- Examining network entities



Research Subjects

- ◆ Where do we put our hands on?
- ◆ Layers in The Network Stack
 - Application/Session
 - ◆ QoS management, network management
 - Transport
 - ◆ Congestion control, reliable delivery
 - Network
 - ◆ Routing, traffic engineering
- ◆ Wireless Network
 - MAC/Link
 - Location
 - Topology Control/Power Control
 - Power Management
 - ...
- ◆ Distributed Systems
 - Process Scheduling
 - Memory Management
 - File Management
 - ...



Research Method and Approach

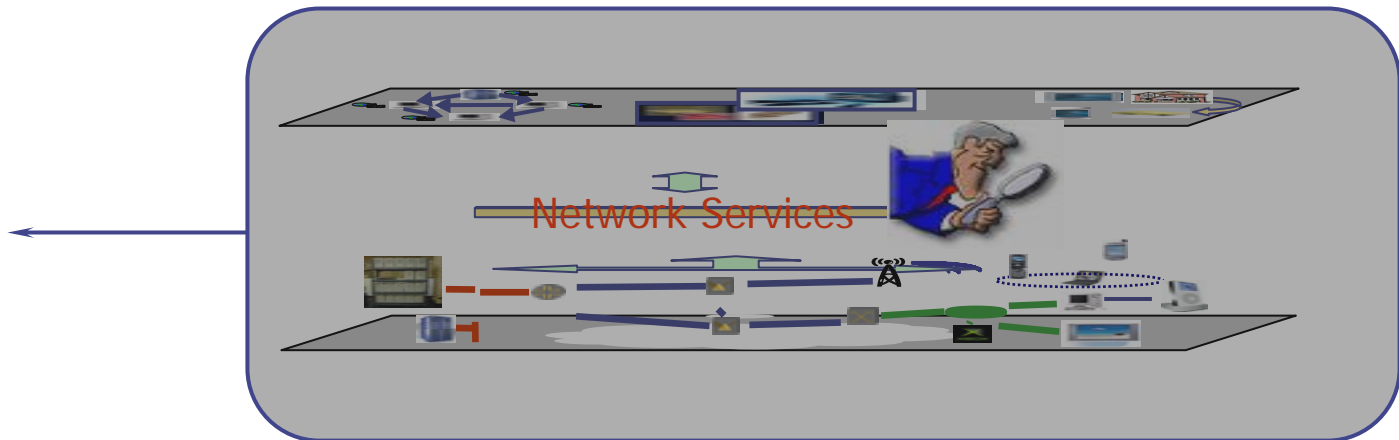
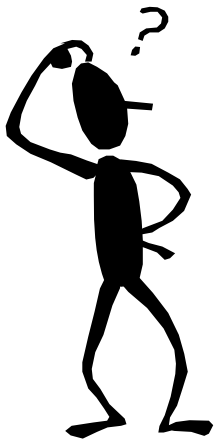
- ◆ How could we solve these problems?
- ◆ How could we show our solution is
 - Functional, valid, reasonable
 - Good, better than others (existing ones), best
- ◆ Two Major Approaches
 - Analytical
 - ◆ “We can prove...”
 - ◆ Cons: strong assumptions, ideal models
 - Experimental
 - ◆ “We can show in the following environments that...”
 - ◆ Cons: what about other environments?
 - ◆ Experimental platforms
 - Simulation (ns-2), emulation (Emulab/ISISlab, DETER), experiment (PlanetLab)



Research Method and Approach

◆ Different Views and Models

- Black box vs. white box

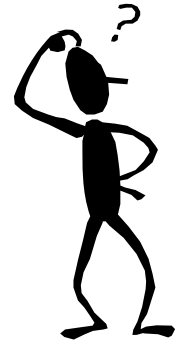
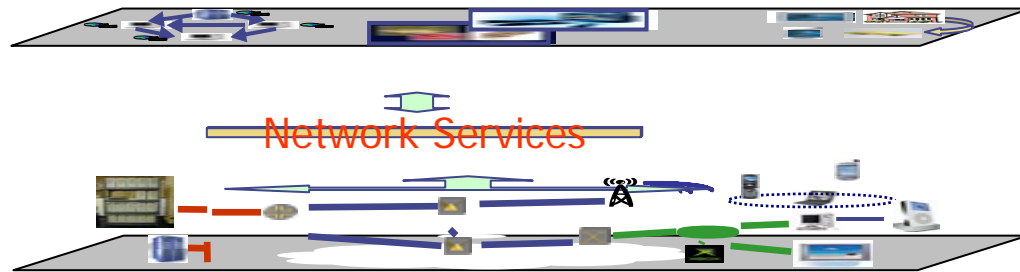
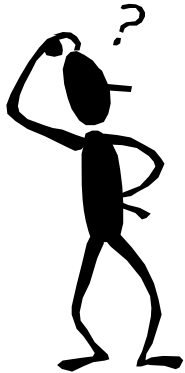


Research Method and Approach

◆ Different Thinking and Questions

How can I control/improve...

What is the behavior of ...



Where Do I Find The Existing Research Results in This Area?



Publications

◆ Conferences

- ACM (usually small, single track conferences)
 - ◆ SIGCOMM: Sigcomm
 - ◆ SIGMOBILE: Mobicom, Mobihoc, Mobisys, Sensys
 - ◆ SIGOPS: SOSP/OSDI, NSDI, PODC, Middleware
 - ◆ SIGMETRICS: Sigmetrics
- IEEE (usually large, multi track conferences)
 - ◆ INFOCOM, ICNP, ICDCS, IWQoS
 - ◆ SECON, ICC, Globecom, MASS, etc...
- USENIX
 - ◆ USENIX, OSDI, NSDI, Middleware, HotOS, WWW



Publications

◆ Journals

- IEEE/ACM Transactions on Networking (ToN)
- IEEE Transactions on Computers
- IEEE Transactions on Parallel and Distributed Computing (TPDS)
- IEEE Transactions on Mobile Computing (TMC)
- IEEE Transactions on Wireless Communication
- IEEE Transactions on ...
- IEEE Journal on Selected Areas in Communications (JSAC)
- ACM Transactions on Computer Systems
- ACM Transactions on ...
- Wireless Networks
- MONET, CCR, MCCR, etc ...



Identifying “Recent Advance”

◆ Results from Recent Top Conferences

- “Recent”: 2003-2006
- “Top”: acceptance ratio (<25%)
 - ◆ Sigcomm, Sigmetrics, Mobicom, SOSP/OSDI, NSDI, MobiHoc
 - ◆ Infocom, ICDCS, ICNP, IWQoS, Mobisys, Sensys, Middleware
- “Hot”
 - ◆ Hot-OS, Hot-Net, workshops on hot topics
- Papers, Panels, Keynote Speeches, Tutorials, etc.



Findings

- ◆ New Results on Classical Topics
 - Wireline Network/Internet
 - ◆ Routing/IP multicast/Traffic Engineering
 - ◆ Congestion Control
 - Wireless Network and Mobile Computing (all conferences)
 - ◆ Rate Control
 - ◆ MAC
 - Security
- ◆ Hot Issues
 - Reliability/Failure management
 - Disruption/Churning
- ◆ Popular Research Method/Approach
 - Trace Analysis
 - Optimization
 - ...
- ◆ Emerging Applications and Infrastructure
 - Content Distribution Network
 - ◆ Drafting Behind Akamai
 - ◆ Planet Scale Software updates
 - Overlay Broadcasting Systems
 - Voice over IP
 - ◆ Quantifying Skype User Satisfaction



Objectives of This Class

- ◆ Latest Development in This Area
 - New Results on Classical Issues
 - **New Issues**
 - **Popular Research Methods/Approaches**
 - Emerging Applications
- ◆ General research capability
 - Foster research perspectives
 - Improve presentation skills
 - Improve writing skills
- ◆ Goal
 - Identify your research style
 - Learn some research methods
 - Pick several issues that interest you



Topic Organization

◆ Organize by Research Method

- Measurement
- Model and Analysis
- Optimization and management
- Experiment

- Wireless mesh network/campus network
- Component-based service network
- Peer-to-peer file system
- Overlay streaming system

◆ Focus on Two Hot Issues

- Reliability, Disruption, Failure Management
- Cooperation, Reputation, Incentives

◆ Introduce Several Systems

- Peer-to-peer system and overlay network
- Wireless Mesh Network
- VoIP (Skype)
- Google File System
- Content Distribution Network

Not focus on Security, Network Management, Sensor Network, Operating Systems



Course Component

◆ Class

- Instructor's Lectures
- Students' Presentations

◆ Assignment and Grading

- Participate 10%
 - ◆ Guided Group-based Discussion
- Presentation 10%
- Review 10%
 - ◆ Review after class discussion;
 - ◆ Summary of the paper, the discussion results, and your own comments.
 - ◆ Posted onto OAK;
- Project 70%
 - ◆ Related to your own research



Presentation

- ◆ Why
 - Understand the topic
 - Improve presentation skills
- ◆ Assignment
 - One paper per student
 - 40 min talk
- ◆ Grading
 - ◆ Good overview of the background
 - ◆ Well motivate the problem
 - ◆ Explain the intuition behind solution
 - ◆ Clearly present the solution
 - ◆ Insightful Comment
- ◆ Timeline
 - Sign-up for presentation by **Jan 30**
 - Send slides to instructor for comments at least **TWO** days before presentation
- ◆ All presentation slides will be posted to OAK system



Review

◆ Why

- Understand the topic
- Improve writing skills
- Foster critical thinking
- Practice paper review, an important service to community

◆ Assignment

- Two reviews for one session
- Five-six reviews in total for one student

◆ Grading

- Good summary of the paper and discussion
- Insightful comment

◆ Post Review to OAK system



Project

- ◆ Grading (70% in total)
 - Background survey 20%
 - Design report 20%
 - Final report with results (Simulation, Experiment, Proof, Demo) 20%
 - Presentation/Poster 10%
- ◆ Timeline
 - Design report: about 5 pages (03/27/07)
 - Final report: about 10 pages (04/19/07)
- ◆ Topics
 - Any topic related with distributed and networking systems
 - Related to your research
 - Approval from the instructor
- ◆ Individual or Team (no more than three students)
- ◆ Discussions with the instructor are strongly encouraged.

