# King Fahd University of Petroleum & Minerals
# Computer Engineering Dept

COE 541 – Performance and Analysis of LANs

Term 031

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# Projects Objectives

- Introduce the concept of network evaluation through analytic and/or simulation techniques
    - Literature surveys are not required nor accepted as part of these projects
- Students should appreciate the complexities involved in modeling and evaluating a network
    - Building of traffic models
    - Good understanding of the statistical models used
    - Modeling of service policies, and
    - Collecting required performance figures

# Projects Objectives (2)

- Students should become familiar with at least one simulation/evaluation vehicle
  - It is left to the student to weigh different alternatives and make the final decision
  - One should learn from his own project as well as the projects of other teams about the suitability of a particular tool for particular problem

# List of Projects (1)

| No. | Topic |
|---|---|
| 1 | Analysis and simulation of basic service disciples for a polling system |
| 2 | Simulation and evaluation of an Integrated Services IEEE802.11 network |
| 3 | Simulation and evaluation of IEEE802.11 network support for real-time services |
| 4 | TCP/IP window and slow-start study over wireless channels |
| 5 | Sliding window protocols (Go-back-N and Selective-Reject) analysis and simulation |
| 6 | Queuing system calculator/simulator |
| 7 | Analysis and simulation of an m-terminal polling system where gated-limited service discipline is utilized |

# Projects (2)

- Other reasonable proposals not listed above are also acceptable. Those should be submitted for approval by **Wednesday October 1st, 2003**

- All projects involve:
  - Writing a SIMULATION/EMULATION code and collecting results
  - Presentation detailing: design, execution, and results

# Projects (3)

- By Sunday October 5th, 2003 – groups 2 students are assigned to projects – FCFS
  - You can use email to reserve your project if still available
  - Requirements/deliverables as well as marking are all scaled in proportion to the number of members in the team

- Deliverables:
  - Simulation code/package that can be demonstrated in class – on a floppy or CD
  - Presentation material detailing code design, algorithms, GUI (if included), and all required results
  - Talk to instructor for detailed list of required results

# Projects (4)

- Projects are worked on progressively or incrementally – check the time-line for projects
- A GUI is not always required – but it is always a bonus if it is not required

# Time Line

- Sunday Sept 28th, 2003: Introduction of Projects
- Sunday October 5th, 2003: Team/Project Assignment Finalized
- Sunday October 19th, 2003: Preliminary proposal and methodology
  - Algorithm and methodology – proposal and evaluation of optio
  - Weight 2%
- Sunday November 30th, 2003
  - Draft presentation material
  - preliminary simulation results
  - Weight 6%
- Sunday Dec 23rd, 2003
  - Final presentation material
  - Weight 7%
- Sunday Dec 30th, 2003: Start of Presentations and Evaluatio
  - Weight 10%

2% +

6% +

7% +

10%

→ 25%

# COE 541 Grading Policy

Old

| | | |
|---|---|---|
| Class Homework/Quizzes/Participation | 30% | (Includes pop quizzes) |
| Major Exam | 20% | (Dec 2nd, 2003 – 6:30-8:30 pm) |
| Term Paper/Project | 20% | |
| Final Exam | 30% | Scheduled by the registrar |

Proposed

| | | |
|---|---|---|
| Class Homework/Quizzes/Participation | 20% | (Includes pop quizzes) |
| Major Exam | 25% | (Dec 2nd, 2003 – 6:30-8:30 pm) |
| Term Paper/Project | 25% | |
| Final Exam | 30% | Scheduled by the registrar |

**Are all free on Tuesday Dec 2nd, 2003 from 7:45 till 8:30 pm?**
**Backup exam date: Thursday Dec 4th, 2003 6:30-8:30 pm**

# Deliverables

- All teams will be responsible for delivering:
  - Final presentation material – power point

two week before the final presentations date on December 28th

- Soft and hardcopies of intermediate reports and draft presentations should also be delivered on the specified due dates
- Students should submit the final source code as well as the final binary code on a floppy or compact disk

# Choosing a Project

- Please think thoroughly and consider your background and programming skills when you make your choice of project as well as the platform to be used
- Once you make you choice, please send it by email, as choices are reserved on a FCFS basis
- The list of available projects will be updated as preferences are received

# More Information

- Projects are “sketched” in the next few slides
- Please contact the instructor for further details on the tasks involved and expected results

# Description of Projects

1. Analysis and simulation of basic service disciples for a polling system

- Assume a network comprised of one central server and N (variable) terminals. The server uses a basic service disciple such as exhaustive, gated, and the /- limited schemes to service the N terminals.
- Arrival process – Bernoulli and more detailed models (correlated arrivals for example)
- Write a simple simulation code to evaluate each of these service schemes in terms of buffer occupancy, delay, and utilization
- Compare with analytic results in the literature
- A GUI component is a bonus

# Description of Projects

2. Simulation and evaluation of an Integrated Services IEEE802.11 network

- Assume an IEEE802.11 wireless LAN setting with one access point and N (variable) terminals on the ground. The terminals belong to two classes – real-time and non-real-time terminal. It is required to model the collision-based and collision-free multiple access schemes supported by the LAN to support the non real-time and the real-time traffic streams, respectively.
- Write a simple simulation code to model these two access schemes.
- For a given arrival process of traffic (may start with simple Bernoulli models) evaluate the performance of the LAN in terms of terminal throughput, network throughput, and traffic delay (for each type)
- A GUI component is a bonus

# Description of Projects

3. Simulation and evaluation of  IEEE802.11 network support for real-time services

- Assume an IEEE802.11 wireless LAN setting with one access point and N (variable) terminals on the ground. The terminals generate real-time traffic such as voice and utilize the polling mechanism to transport this traffic.
- Write a code to simulate such network. Produce results such as terminal throughput, network throughput, average delay for payloads, drop rate, etc.
- A GUI component is a bonus

Contact me for references

# Description of Projects

4. TCP/IP window and slow-start study over wireless channels

- Assume two nodes are communicating using TCP/IP. The TCP initializes a transmission window and starts sending sequenced segments. The window size increases as the session progresses increasing the utilization of the link. When congestion is occurring (lost segments or their acknowledgments) the TCP reduces the window size to reduce outgoing traffic. This leads to lower utilization of the link. After some time of no data loss, TCP increases the window size again to increase the link utilization and so on.
- For wireless links, packets may be lost due to errors and not necessarily due to congestion and buffer overflow.
- Write a simulation code that emulates this process. Determine the actual parameters used in current TCP/IP based transport. For a given arrival process of segments at the source nodes, and a given error model on the wireless link, find the average throughput of the wireless link and the average segment delay

# Description of Projects

5. Capacity Evaluation For UMTS Integrated-Service Network - Design and simulation - 2
   - The study should includes but not limited to:
     - An overall view of the procedures and functionalities within UMTS network for transmission voice and of packet data
     - A description of these channels
     - For a given specific simple scenario (one BTS and multiple mobile terminal) write a code to simulate and evaluate the performance of such a network
     - The references used for this study
   - Deliverable:
     - Report – including the source/binary code
     - Presentation
   - Where to start:

# Description of Projects

6. Queuing system calculator/simulator

- The project involves writing a code to simulate a c server (c >=1) queueing system and producing queue statistics for a given degree of confidence
- The calculator should accept a wide range of arrival and service processes (at least the classical ones)
- Comparison with analytic results should be performed where applicable
- A GUI is also required to facilitate user interface

# Description of Projects

7. Analysis and simulation of an m-terminal polling system where gated-limited service discipline is utilized

- Assume a network of m terminals and one central server. The service implements a gated-limited service discipline.
- It is required to write a code to simulate the service for some arrival/service-time processes.
- The code should also include the ability to prioritize buffers (changing service order).
- A GUI component is a plus

# Example of a Simple Queueing Code

```
%
% Simulation of an M/G/c queue
%
% Blocked Calls are queued
%
%
% System Clock:      T[], t
% No of Servers:     C
% no of arrivals:    N
% mean arrival rate: L
% mean service time: S
% Arrival vector:    A
% Service times:     M
% Waiting times:     W
%
N = 50000;
C = 1;
L = 1/2;      % L customers per time unit
%
%
% generating Poisson Arrivals with interarrival
% times of average (1/L) time units
%
AA= -(1/L) * log(rand(1,N));
A = cumsum(AA);
%
% Generating the exponential service times with
% mean of S time units
%
S = 1;
M = - S * log(rand(1,N));
```

```
%
%
t = 0;
T = zeros(1,C)+[0:1e-10:(C-1)*1e-10];
W = zeros(1,N);
U = zeros(1,C+1);
Queued = 0;


for i=1:N
    [t,k] = min(T);     % find what server to use
    c = sum(T < A(i));  % how many are ideal
    U(c+1) = U(c+1) + 1;% increment utilization
     vector
    if (T(k) > A(i))    % The arriving customer
     was waiting
       W(i) = T(k) - A(i); % Record the waiting
     time
       T(k) = T(k) + M(i); % Advance system clock
       Queued = Queued + 1;% increment Queued
     counter
    else % The server is free
       T(k) = A(i)+M(i);% advance system clock.
       W(i) = 0;        % the customer did not
     wait
    end
end

ProbQ = Queued/N;
AvgW  = mean(W);
U = U/N;
```

# Example of a Simple Queueing Code (2)

- Event Driven Simulation
  - System clock moved as events occur
- Arrival process – vector A
  - Instants in time when arrivals occur
- C – channels vector
  - Instants in time when service completes