CS573 Advanced Wide Area Networks

Syllabus

Instructor: Alan Wu

Objectives:
The sophistication of data communications and computer networks is growing rapidly. New technologies, standards, and systems are emerging each day to meet the requirements of new applications. It is essential for computer engineers and technical professionals to develop a solid foundation as well as state-of-the-art expertise in data communications and computer networks in order to face these challenges.

This course provides an in-depth understanding of the advanced wide area network technologies, the software implementation of the protocols, as well as the emerging technologies and standards of tomorrow.

Upon completion of this 3-credit course, you will learn:
- Layered network architectures, OSI Reference Model, and TCP/IP Protocol suite
- Protocols such as HDLC that control the transmission of data over a communications links as well as Internet access
- Different switching technologies such as circuit switching and packet switching
- Connection-oriented and connectionless networking concepts and the difference between virtual circuit and datagram packet switching networks
- What is the difference between X.25 and Frame Relay for WAN deployment
- What is the ATM technology and how it provides high speed backbone WAN services
- How messages are routed across packet switched networks and what the routing algorithms are
- What causes congestion in a network and how to control and solve network congestion problems
- The latest internetworking technologies including bridges/switches, routers, Internet Protocol (IP), and routing algorithms for the Internet
- What is the next generation IP (IPv6) and why is it needed
- How does TCP work and what are the problems of TCP over high speed networks
- Quality of Service (QoS) and resource allocation
- What are the higher layer protocols and applications such as email, file transfer, and multimedia systems

Methodology and Course Format:
Classes will be held in lecturing format including class discussions. Visual aid will be used for the presentation. A minimum of 30 contact hours is required for the semester. Some class materials are put on a Web site for you to access. This Web site is setup at URL http://briefcase.yahoo.com/rivernh at this time. I need your Yahoo ID to allow you to access the files. You need to get a Yahoo ID. It’s free.

Evaluation:
Midterm Exam ----------------------------------------------------------------------------------------------- 25%
Final Exam --------------------------------------------------------------------------------------------------- 35%
Projects/Research Papers/Study Reports/Assignments---------------------------------------------------------- 35%
Exam on Research Papers/Assignments ------------------------------------------------------------------------ 5%
Total -------------------------------------------------------------------------------------------------------- 100%

Textbook:

References:
Partial List of Excellent Reference Sources for Classes and Assignments:

- IEEE Communications Magazine (technical journal)
- IEEE Journal on Selected Areas in Communications (technical journal)
- IEEE Networks (technical journal)
- IEEE Spectrum (technical journal)
- IEEE Transactions on Communications (technical journal)
- Computer Communications (technical journal)
- Bell System Technical Journal (technical journal)
- Light wave, The Journal of Fiber Optics (technical journal)
- Telecommunications (trade magazine -- OK for technical reference)
- Byte (trade magazine -- OK for technical reference)
- Network World (weekly newspaper -- not for technical reference)

Course Requirements:

Students are required to pass all exams and complete all assignments. Exams will be based on the textbooks, lecture material, and handouts. All exams will be comprehensive (questions and answers), closed book and closed notes, and will be conducted in-class. See "Assignments" for detailed assignment requirements. Grades for all exams and assignments will not be determined by curves. Letter grades submitted to the Registrar's Office will be based on the Rivier College grading system. The conversion from numerical grade to letter grade will be based on the following table:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Honor Points</th>
<th>Numerical Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.0</td>
<td>92 - 100</td>
</tr>
<tr>
<td>AB</td>
<td>3.5</td>
<td>84 - 91</td>
</tr>
<tr>
<td>B</td>
<td>3.0</td>
<td>76 - 83</td>
</tr>
<tr>
<td>BC</td>
<td>2.5</td>
<td>68 - 75</td>
</tr>
<tr>
<td>C</td>
<td>2.0</td>
<td>60 - 67</td>
</tr>
<tr>
<td>F</td>
<td>0.0</td>
<td>Below 60</td>
</tr>
</tbody>
</table>

Assignment:

The potential topics for your report/paper are listed as follows:
- Routing protocols for packet switching network, frame relay, and ATM network
- Flow and congestion control for packet switching network, frame relay, and ATM network
- Compare Frame Relay to ATM technology
- ATM technology for backbone WAN deployment
- Compare IP over SONET to IP over ATM (over SONET)
- Next generation Internet and QoS
- MultiProtocol Label Switching (MPLS) technology and QoS
- Wireless communication technologies and mobile IP
- TCP performance issues and improvement techniques such as window scaling, RTTM, PAWS, and selective acknowledgment
- Optical networking technologies and routing
- Compare voice over IP and voice over ATM
- A Topic of your own selection (may be related to your work but must be related to the material of this course)

The paper should consist of about 12 typed pages (single space with font size 12) plus illustrations, bibliography, and appendices (if necessary). A minimum of eight technical articles and/or books must be used as sources for your paper. Thirty percent of your reference material should be technical articles published within two years. The quality of references is an important part in deciding what grade you will get. Other universities may have similar topics assigned to their students as research paper assignments. Your paper will be rejected if these papers are used as your references.

You must submit a one-page outline and discuss it with me before you start writing the paper or start your project. If you need advice regarding the topic to select, the format of the paper, the contents of the paper, or reference material, you should discuss it with me. Discussing the same with classmates is also encouraged. The outline discussion process is very important, because, only through this process, I may help you to organize your paper, advise you on the contents of the paper, advise you on where to find references, and guide you to the right direction. Since training you to do
independent research is one of the reasons for this assignment, you need to try your own effort first before you ask for any help.

There is no special format for the outline. Since you need to show me how your paper will be organized and what will be discussed in your paper, it will be easier for you to format your outline similar to the table of contents of a book. The outline will include the title of the paper, number of sections in the paper, the subtitle for each section, a few lines describing what will be discussed in each section, and references found so far to be used for writing your paper.

Since this is a research paper written by you, you must understand everything you write in the paper. Since we don’t have time for every one of you to present your paper to the class and subject to my oral test, there will be a written test to your paper. The written test will be taken at the same time with your final exam.

**Class Schedule:**

<table>
<thead>
<tr>
<th>SESSION</th>
<th>DATE</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/19</td>
<td>Computer Network Architectures and Layered Protocols</td>
</tr>
<tr>
<td>2</td>
<td>1/26</td>
<td>Data Link Control Protocols and Internet Access Protocols</td>
</tr>
<tr>
<td>3</td>
<td>2/2</td>
<td>Switching Techniques, Packet Switching Networks, and X.25</td>
</tr>
<tr>
<td>4</td>
<td>2/9</td>
<td>Frame Relay and ATM</td>
</tr>
<tr>
<td>2/16</td>
<td></td>
<td>No Class. Study for Midterm Exam</td>
</tr>
<tr>
<td>5</td>
<td>2/23</td>
<td>Midterm Exam (25%), Routing Algorithms Flow and Congestion Control</td>
</tr>
<tr>
<td>3/2</td>
<td></td>
<td>No Class. Winter Vacation</td>
</tr>
<tr>
<td>3/9</td>
<td></td>
<td>No Class. Search and Read References to Prepare Assignment Outline</td>
</tr>
<tr>
<td>6</td>
<td>3/16</td>
<td>Assignment Outline Due, Internetworking, Bridges, Routers, and Internet Protocol (IP)</td>
</tr>
<tr>
<td>3/23</td>
<td></td>
<td>More on Internet Protocol and IPv6</td>
</tr>
<tr>
<td>3/30</td>
<td></td>
<td>No Class. Easter Holiday</td>
</tr>
<tr>
<td>8</td>
<td>4/6</td>
<td>Transport Protocols and TCP</td>
</tr>
<tr>
<td>4/13</td>
<td></td>
<td>No Class. Write Research Paper Assignment</td>
</tr>
<tr>
<td>9</td>
<td>4/20</td>
<td>Assignment Due (35%), QoS and Resource Allocation, Higher Layer Protocols</td>
</tr>
<tr>
<td>4/27</td>
<td></td>
<td>No Class. Study for Final Exam and Research Paper Written Test</td>
</tr>
<tr>
<td>10</td>
<td>5/4</td>
<td>Final Exam (35%) and Research Paper Written Test (5%)</td>
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Notes:
1. Class will meet for 3 hours each session for a total of 10 sessions (30 contact hours)
2. Reading Assignment is assigned each week. Students are required to read related topics in the textbook before each class.