CS685 Network Design and Management

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Description

MET CS 685

Network Design and Management

The course will cover network design and management principles as you work through specific design areas within a Content Delivery Network (CDN). The beginning of the course will be an in-depth understanding of customer network needs and requirements gathering as it relates to today's implementation of a triple play offering, being Voice, Video, and Data services delivered via a CDN to clients connected via a PON. This will be followed by transmission and modulation techniques, including payload structure for Optical and multi-GigaBit Ethernet circuits. Inclusive of Network Management implementation following the FCAPS model.

Course Overview

This course begins with the focus on understanding and performing solid requirements gathering, so that you may accurately specify and detail your requirements while avoiding the inevitable "scope creep" in your network design. An appreciation and understanding of how your network will be used is a key factor before you can even think of designing it. From there you will need to evaluate the technologies available to you, and how best to select them based upon where the needs are in the network, TCP/IP, SONET, GbE, and Wavelength Services will be part of your design, along with an in-depth look at modern architectures using Passive Optic Networks (PON) at the access layer. Proper specification of Switch, Router, and Add/Drop Multiplexer (ADM) equipment will also be incorporated into your design areas. This will also include documented implementation of your selections; IP assignment, VLAN design, Protection Schema, etc.

At the completion of this class, you will have the building blocks as required to design, specify, and implement a modern, large-scale network using the latest technology and devices, while understanding how to secure your network and detail sufficient Operations, administration, Management, Provisioning, (OAM&P) requirements for your Element Management System (EMS).

Learning Objectives

By successfully completing this course, you will be able to do the following:

1. Assess the need for good Network Requirements in order to enable an in-depth network design.
2. Design Content Delivery Network (CDN) capable of handling today's data delivery demands.
3. Choose networking technologies suitable to today's scalable architectural requirements.
4. Design and implement multiple network services in a given architecture.
5. Apply network and security management techniques following the FCAPS model.
6. Evaluate new networking technologies.

Instructor

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Scott Arena is a Master Lecturer in Boston University MET College's Computer Science Department and is currently the department's Networking Curriculum coordinator.

Prior to joining BU full time, Scott spent 38 years in the R&D field of Telecommunications where he worked at AT&T/Lucent Bell Labs, and Verizon Labs. He holds several Patents in the areas of Networking, Fiber Optics, and Security, and has worked on numerous large scale network architectures ranging from the first fiber optic systems deployed in the 1980s to the deployment of the Verizon FiOS network. Prior to joining BU full time, he had been teaching in the CS department part time since 1996.

Materials

There is no formally required text for this course as we will use Technical Papers and Standards Issued specifications and white papers. Sections of various textbooks will be made available throughout the semester as allowed by Boston University Library policies.

Reference Books

Note: in a few of the module lectures, some graphs and content refer to the book “Oppenheimer”.
The referenced book is *Top-Down Network Design*, 3rd Edition, by Priscilla Oppenheimer.

In addition, the following books are for reference only where depicted.

- *Computer Networks*, 6th edition, by Andrew S. Tanenbaum. Pearson Education.
- *Management, Control, and Evolution of IP Networks*, by Guy Pujolle. ISTE.

IEEE Standards – partial listing.

RFC 6632 IETF Network Management

RFC 7276 Operations Administration and Maintenance (OAM)

- IETF overview of Operations, Administration,

and Maintenance (OAM) Tools RFC 1933

Transition from IPv4 to IPv6 (Transition from IPv4 to

IPv6)

RFC 7950 The Yang Data 1.1 Data Model (The Yang 1.1 Data

Model Language, August 2016) RFC 6020 Yang – A Data

Modeling Language for the Network Configuration Protocol

(NETCONF) RFC 6241 Network Configuration Protocol

(NETCONF)

- There are many other RFCs that have been issued to enhance Syslog processing.
- This is the base Syslog, you can find specific RFCs to detail different implementations.

- Toward a Network Telemetry Framework

draft-song-ntf-02 (not official RFC) • RFC

7923 Subscription to Yang Datastores

- Requirements for Subscription to YANG Datastores

Boston University Library Information

Boston University has created a set of videos to help orient you to the online resources at your disposal. An introduction to the series is below:

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All of the videos in the series are available on the Online Library Resources page, which is also accessible from the Campus Bookmarks section of your Online Campus Dashboard. Please feel free to make use of them.

As Boston University students, you have full access to the BU Library. From any computer, you can gain access to anything at the library that is electronically formatted. To connect to the library, use the link http://www.bu.edu/library. You may use the library's content whether you are connected

through your online course or not, by confirming your status as a BU community member using your Kerberos password.

Once in the library system, you can use the links under “Resources” and “Collections” to find databases, eJournals, and eBooks, as well as search the library by subject. Some other useful links follow:

Go to Collections to access eBooks and eJournals directly.

If you have questions about library resources, go to Ask A Librarian to email the library or use the live-chat feature.

To locate course eReserves, go to Reserves.

Please note that you are not to post attachments of the required or other readings in the water cooler or other areas of the course, as it is an infringement on copyright laws and department policy. All students have access to the library system and will need to develop research skills that include how to find articles through library systems and databases.

Free Tutoring Service

Free online tutoring services by Tutor.com are available to BU online students for the duration of their eligible online course. Tutor.com is a web-based service that provides an online writing lab and access to on-demand and scheduled tutoring sessions for writing, math, business, coding languages, and other subjects. Students can submit a question to a tutor, submit a paper for feedback about writing and grammar, or schedule a live session with a tutor.

You can log in directly to Tutor.com from Blackboard Online Campus by clicking the link in the left-hand navigation

menu within your online course. All activity in the Tutor.com classroom is recorded for learner review and quality control. Transcripts will be available afterward in My Account under My Locker in your Tutor.com account.

Please Note

Tutor.com services may be used only for current Boston University online courses and career services. Use of this service for purposes other than current coursework or career services may result in deactivation of your Tutor.com account.

Study Guide

Module 1 Study Guide and Deliverables

Topics: Identifying Customer Needs and Goals; Requirements Gathering Phase and Approach

Assignments: Concepts Assignment 1 and Discussion 1 - ***Refer to Calendar for Due Dates***

Assessments: Quiz 1 ***Refer to Calendar for Due Dates***

Module 2 Study Guide and Deliverables

Topic: Logical Network Design

Assignments: Concepts Assignment 2 and Discussion 2 - ***Refer to Calendar for Due Dates***

Assessments: Quiz 2 ***Refer to Calendar for Due Dates***

Module 3 Study Guide and Deliverables

Topic: Selecting Technologies

Assignments: Concepts Assignment 3, Lab 1, and Discussion 3 - ***Refer to Calendar for Due Dates***

Assessments: Quiz 3 ***Refer to Calendar for Due Dates***

Module 4 Study Guide and Deliverables

Topic: Physical Layer Service and Selection

Assignments: Concepts Assignment 4 and Discussion 4 - ***Refer to Calendar for Due Dates***

Assessments: Quiz 4 ***Refer to Calendar for Due Dates***

Module 5 Study Guide and Deliverables

Topic: Network Management

Assignments: Concepts Assignment 5 and Discussion 5 - ***Refer to Calendar for Due Dates***

Assessments: Quiz 5 - ***Refer to Calendar for Due Dates { if assigned }***

Module 6 Study Guide and Deliverables

Topic: Network Performance

Assignments: Concepts Assignment 6 and Discussion 6 - Refer to Calendar for Due Dates

Assessments: Quiz 6 - ***Refer to Calendar for Due Dates { if assigned }***

Grading Information

The final grade for the course will be determined as follows:

Discussion/Participation	5%
Area Design	20%
Five Quizzes	25%
Concepts Assignments:	10%
Labs	20%
Final Exam:	20%
Total	**100%**

Discussion/Participation

- In weekly discussion forums, you will be given a topic and you have by Thursday at 6:00 AM ET to post your original post.
- Then by Saturday at 6:00 AM ET of the same week you need to comment to a minimum of Three (3) peer postings. Your peer postings should be in dialogue form, not just a single sentence in order for full credit.
- To keep conversations going, respond to questions asked and feedback offered by your classmates or your instructor on your own post, by Sunday, at 6:00 AM ET.
- Access at “Class Discussion” on the left-hand course menu. •

No discussion or postings will be accepted late for credit.

Quizzes

There is one graded quiz for each of the first five modules—no quiz in Module 6.

The results for your quiz will be released as soon as possible after the quiz closes. When the quizzes are released, you will be able to see your scores only. This is to protect the integrity of the quizzes applicable to future course running. Quizzes will be open for a minimum of five (5) days in which you must select an opportune time for you to dedicate seventy (70) minutes. Once a quiz is started, it cannot be paused, therefore you need to select ample time during the window.

Due to the availability of the Quizzes with a five-day window, No Quizzes

will be accepted late for credit. Attempt the quiz at “Assessments” on the

left-hand course menu.

Concepts Assignments

As we progress through the semester, you will complete concepts assignments that help you solidify the concepts you have read in the assigned readings, modules and online lectures. They must NOT be simply cut and paste from the class text or any other resources. Due to the required timing of the assignments, NO late assignment will be accepted for credit.

Submit at “Assignments” on the left-hand course menu.

Labs

There will be two labs in the course focusing on Network Management. These will be independent labs that use the Cisco DevNet Platform (sandbox) that allows users to experiment for free with several exemplary techniques. We will perform a lab focusing in the Yang and NetConf models, as well as Streaming Telemetry to see the methodology behind these models. These are independent labs and do not need to be performed in any specific order. The Cisco DevNet Platform is free and you can set it up in your own windows environment.

Area Design

The Area Design will be a focus of all of the applicable concepts in a CDN, due to the voluminous amount of effort required for a complete design, you will select a focus area such as the Origin, Cache Sites or PON network as your focal area. Whereby you will be responsible for designing what equipment and network areas are in scope/applicable for your selection.

Final Exam

There will be a proctored Final Exam by your instructor or presentation of your final team project on the last evening of the course.

Lateness

We recognize that emergencies and unexpected but significant extensions in work hours occur in professional and personal lives. If one occurs that prevents your completion of a course item by a deadline, please make this plain to your instructor. This must be done well in advance of the deadline (unless it is an emergency that makes this impossible, of course), and should be accompanied by particulars that back it up. Additional documentation may be requested. If this is permitted at the discretion of the instructor, a minimum of Twenty points will otherwise be deducted for late submissions on a per day basis: we want to be fair to everyone in this process, including the vast majority of you who sacrifice so much to submit your homework on time in this demanding schedule.

Academic Conduct Policy

Please visit Metropolitan College's website for the full text of the department's *Academic Conduct Code*.

A Definition of Plagiarism

> “The academic counterpart of the bank embezzler and of the manufacturer who mislabels products is the plagiarist: the student or scholar who leads readers to believe that what they are reading is the original work of the writer when it is not. If it could be assumed that the distinction between plagiarism and honest use of sources is perfectly clear in everyone’s mind, there would be no need for the explanation that follows; merely the warning with which this definition concludes would be enough. But it is apparent that sometimes people of goodwill draw the suspicion of guilt upon themselves (and, indeed, are guilty) simply because they are not aware of the illegitimacy of certain kinds of “borrowing” and of the procedures for correct identification of materials other than those gained through independent research and reflection.”
>
> “The spectrum is a wide one. At one end there is a word-for-word copying of another’s writing without enclosing the copied passage in quotation marks and identifying it in a footnote, both of which are necessary. (This includes, of course, the copying of all or any part of another student’s paper.) It hardly seems possible that anyone of college age or more could do that without clear intent to deceive. At the other end there is the almost casual slipping in of a particularly apt term which one has come across in reading and which so aptly expresses one’s opinion that one is tempted to make it personal property.”
>
> “Between these poles there are degrees and degrees, but they may be roughly placed in two groups. Close to outright and blatant deceit- but more the result, perhaps, of laziness than of bad intent-is the patching together of random jottings made in the course of reading, generally without careful identification of their source, and then woven into the text, so that the result is a mosaic of other people’s ideas and words, the writer’s sole contribution being the cement to hold the pieces together. Indicative of more effort and, for that reason, somewhat closer to honest, though still dishonest, is the paraphrase, and abbreviated (and often skillfully prepared) restatement of someone else’s analysis or conclusion, without acknowledgment that another person’s text has been the basis for the recapitulation.”

The paragraphs above are from H. Martin and R. Ohmann, *The Logic and Rhetoric of Exposition, Revised Edition.*

Academic Conduct Code

I. **Philosophy of Discipline**

The objective of Boston University in enforcing academic rules is to promote a community atmosphere in which learning can best take place. Such an atmosphere can be maintained only so long as every student believes that his or her academic competence is being judged fairly and that he or she will not be put at a disadvantage because of someone else's dishonesty. Penalties should be carefully determined so as to be no more and no less than required to maintain the desired atmosphere. In defining violations of this code, the intent is to protect the integrity of the educational process.

II. **Academic Misconduct**

Academic misconduct is conduct by which a student misrepresents his or her academic accomplishments, or impedes other students' opportunities of being judged fairly for their academic work. Knowingly allowing others to represent your work as their own is as serious an offense as submitting another's work as your own.

III. **Violations of this Code**

Violations of this code comprise attempts to be dishonest or deceptive in the performance of academic work in or out of the classroom, alterations of academic records, alterations of official data on paper or electronic resumes, or unauthorized collaboration with another student or students.

Violations include, but are not limited to:

A. **Cheating on examination**. Any attempt by a student to alter his or her performance on an examination in violation of that examination's stated or commonly understood ground rules.

B. **Plagiarism.** Representing the work of another as one's own. Plagiarism includes but is not limited to the following: copying the answers of another student on an examination, copying or restating the work or ideas of another person or persons in any oral or written work (printed or electronic) without citing the appropriate source, and collaborating with someone else in an academic endeavor without acknowledging his or her contribution. Plagiarism can consist of acts of commission-appropriating the words or ideas of another-or omission failing to acknowledge/document/credit the source or creator of words or ideas (see below for a detailed definition of plagiarism). It also includes colluding with someone else in an academic endeavor without acknowledging his or her contribution, using audio or video footage that comes from another source (including work done by another student) without permission and acknowledgement of that source.

C. **Misrepresentation or falsification of data** presented for surveys, experiments, reports, etc., which includes but is not limited to: citing authors that do not exist; citing interviews that never took place, or field work that was not completed.

D. **Theft of an examination**. Stealing or otherwise discovering and/or making known to others the contents of an examination that has not yet been administered.

E. **Unauthorized communication during examinations**. Any unauthorized communication may be considered prima facie evidence of cheating.

F. **Knowingly allowing another student to represent your work as his or her own**. This includes providing a copy of your paper or laboratory report to another student without the explicit permission of the instructor(s).

G. **Forgery, alteration, or knowing misuse of graded examinations, quizzes, grade lists, or official records of documents**, including but not limited to transcripts from any institution, letters of recommendation, degree certificates, examinations, quizzes, or other work after submission.

H. **Theft or destruction of examinations or papers** after submission.

I. **Submitting the same work in more than one course** without the consent of instructors.

J. **Altering or destroying another student's work or records**, altering records of any kind, removing materials from libraries or offices without consent, or in any way interfering with the work of others so as to impede their academic performance.

K. **Violation of the rules governing teamwork**. Unless the instructor of a course otherwise specifically provides instructions to the contrary, the following rules apply to teamwork: 1. No team member shall intentionally restrict or inhibit another team member's access to team meetings, team work-in-progress, or other team activities without the express authorization of the instructor. 2. All team members shall be held responsible for the content of all teamwork submitted for evaluation as if each team member had individually submitted the entire work product of their team as their own work.

L. **Failure to sit in a specifically assigned seat during examinations.**

M. **Conduct in a professional field assignment that violates the policies and regulations of the host school or agency.**

N. **Conduct in violation of public law occurring outside the University that directly affects the academic and professional status of the student, after civil authorities have imposed sanctions.**

O. **Attempting improperly to influence the award of any credit, grade, or honor.**

P. **Intentionally making false statements to the Academic Conduct Committee or intentionally presenting false information to the Committee.**

Q. **Failure to comply with the sanctions imposed under the authority of this code.**

Who's Who: Roles and Responsibilities

You will meet many BU people in this course and program. Some of these people you will meet online, and some you will communicate with by email and telephone. There are many people behind the scenes, too, including instructional designers, faculty who assist with course preparation, and video and animation specialists.
Although you will not normally encounter the following people in your online course, they are central to the program. You may receive emails or phone calls from them, and you should feel free to contact them.

Your Computer Science Department Online Program Coordinator, Michelle Younger. Michelle administers the academic aspects of the program, including admissions and registration. You can ask her questions about the program, registration, course offerings, graduation, or any other program- related topic. She can be reached at metcsol@bu.edu or (617) 353-2566.

Your Computer Science Department Program Manager, Crystal Kelley. Crystal is responsible for administering most aspects of the Computer Science Department. You can reach Crystal at kelleycr@bu.edu or (617) 353-2566.

Professor Guanglan Zhang, Computer Science Department Chairman. You can reach Professor Zhang at guanglan@bu.edu or at 617-358-5688.

Professor Lou T. Chitkushev, Associate Dean for Academic Affairs, Metropolitan College. Dr. Chitkushev is responsible for the academic programs of Metropolitan College. Contact Professor Chitkushev with any issues that you feel have not been addressed adequately. The customary issue- escalation sequence after your course facilitator and course faculty is Professor Zhang, and then Professor Chitkushev.

Professor Tanya Zlateva, Metropolitan College Dean. Dr. Zlateva is responsible for the quality of all the academic programs at Boston University Metropolitan College.

Disability and Access Services

In accordance with University policy, every effort will be made to accommodate students with respect to speech, hearing, vision, or other disabilities. Any student who may need an accommodation for a documented disability should contact Disability and Access Services at 617-353-3658 or at access@bu.edu for review and approval of accommodation requests.

Once a student receives their accommodation letter, they must send it to their instructor and/or facilitator each semester. They must also send a copy to their Faculty & Student Support Administrator, who may need to update the course settings to ensure accommodations are in place. Accommodations cannot be implemented if the student does not send their letter.

All Boston University students are required to follow academic and behavioral conduct codes. Failure to comply with these conduct codes may result in disciplinary action.

Registration Information and Important Dates

View the drop dates for your course.

Withdraw or drop your course.

- If you are dropping down to zero credits for a semester, please contact your college or academic department.
- **Nonparticipation in your online course does not constitute a withdrawal from the class.**
- If you are unable to drop yourself on MyBU Student Portal, please contact your college or academic department.
- Online courses will open to students in Blackboard on the first day of the term.
- Online courses close to students three weeks after the last day of the term. Please plan to download and save any assignments or material you'd like to keep by that date.

Technical Support

Help Desk

Boston University IT Help Desk can be reached via email (ithelp@bu.edu), phone (617-353-4357) or by filling out the support form on their website. For IT Help Desk hours of operation, visit the contact page. If you are contacting IT outside of business hours, you will receive a response the following day. Visit the BU Information Services & Technology (IS&T) news page for announcements and system-wide alerts.

Technology Requirements and Resources

To successfully view all content in your course, it is important that your computer setup meets the necessary minimum technical requirements. Certain courses with specific functionality or educational tools may require additional technical requirements, these details can be found on the Course Resources or Materials page in the Syllabus.

System Requirements

- Access to reliable, high-speed internet: Check your internet connection speeds • Learning Management System (Blackboard): System Requirements
- Synchronous live classroom sessions (Zoom): System requirements for Windows, macOS, and Linux • Courses with proctored exams (ProctorU): System requirements for Windows, macOS
- Two-factor authentication service for BU applications: Duo Security

Downloads

- Recommended web browsers: Mozilla Firefox or Google Chrome Synchronous live classroom sessions (Zoom): Zoom download center
- Courses with proctored exams (ProctorU): Desktop or laptop computer with Guardian browser
- Two-factor authentication service for BU applications (Duo Security): optional Duo Mobile download for iOS or Duo Mobile download for Android

Recommended Hardware

- Desktop or laptop computer recommended for best experience, some course functionality including proctored exams are not compatible with phones or tablets
- Headset with built-in microphone for high quality audio during live classroom sessions
- Webcam (required for proctored exams)
- Working computer speakers (required for proctored exams)

Clearing Your Browser Cache

It is recommended that users periodically clear their browser cache to ensure they are viewing the most current course content. Completing this step often resolves login issues and problems viewing course materials.

Proctored Exams

Courses with proctored exams will have a ProctorU link in the left-hand course navigation. This link will not appear until scheduling opens. The BU Virtual Assessment Administrator will notify you when it is time to schedule your exam. Details on ProctorU's technical requirements and how to schedule your exam are in the Proctored Exam Information module on the course homepage. The Assessment Administrator can be reached at pexams@bu.edu.

ProctorU support is available 24/7 via phone (855-772-8678), email support@proctoru.com), or 'live chat' when logged in to the ProctorU dashboard.