Before we start - Background



About the course

- > Terminology and concepts
- Broad and deeper topics
- Combines theory and practice

Your professor

- Principal Consultant at Riverbed Technology
- Academic and professional experience
 - Telecommunication
 - Modeling and simulation
 - Network optimization
 - Statistical and analytical analysis of networks and applications

Students

Prior learning or related experience in telecommunication and networking?

Course Introduction



Instructor: Dragan Hrnjez

Email: <u>dhrnjez@gmu.edu</u>

Location: remote/off-site

Office Hours

Dedicated virtual office hours via Zoom on Tuesdays between 6:30 PM to 7:10 PM (Please schedule office hour no later then 24 hours in advance). Alternate arrangements can be made. We will discuss these in our first meet up.

Recommended Books:

- There are no required books for this course. The following books are optional (used during previous semesters):
 - <u>Carrier Grade Voice Over IP, Third Edition; McGraw-Hill Education; Richard Swale and Daniel Collins</u>
 - Voice Over IP Fundamentals; Cisco Press; Davidson, Peters, Gracely, Bhatia, Kalidindi, Mukherjee; 2nd Edition; July 2006
 - ◆ IP Telephony: Deploying VoIP Protocols and IMS Infrastructure; John Wiley & Sons Ltd.; Oliver Hersent; 2011
 - ◆ RTP: Audio and Video for the Internet; Addison Wesley; Colin Perkins; June 2003
- Communication, content delivery and assignments:
 - Blackboard portal for asynchronous class-related activities
 - Website at http://mason.gmu.edu/~dhrnjez (user id: tcom631, pass: voiceIP)
 - Synchronous Zooom sessions
 - Additional materials will be distributed on an ongoing basis

Virtual Classroom Requirements



- ◆ To access the technologies used in this workshop, you will need Adobe Reader and Adobe Flash Player (latest version). If your computer doesn't already have this software and/or you are prompted for this download, you can go to the Adobe website and download this software
- You will need a web cam or an integrated laptop camera in case you want to present yourself to the class. I will have one and you will be able to see me
- You will also need a working headset with a microphone to listen to synchronous and synchronous sessions and to work on your lab requirements
- We will be utilizing Zoom for a synchronous meet-ups. To ensure that you're able to access the Zoom room, please make sure your device meets Zoom's system requirements

Assignments and Grading Policy



Midterm

- Option 1: in-class, closed-book/closed-notes, MC/TF questions, simple problems and essay questions
- Option 2: remote and timed, MC/TF questions, simple problems
- > The decision will be made during next few weeks
- Labs (We will have 3 labs and the facilitation for these will be determined during the semester.)
 - > We will discuss and explain lab activities in more details later
 - All three lab reports need to be turned in no later then Dec 11th 2018

Grading*		
Midterm	12%	
Labs	12%	
Homewoks	12%	
Discusion boards	6%	
Project	34%	
Final exam	24%	

*Final grade determined by a weighted average

Homeworks

- Several homework assignments throughout the semester
- Due the following week after they are assigned
- Return hard or softcopy in a single file with the student name visible in the file name

Discussion boards

- > Throughout the semester we will have few discussion boards.
- > These are mandatory and they will be graded based on involvement and effort.

Project

- > Assigned second week and is due last week of semester
- > This is a group project (3-4 students)
- Final Exam (take home last week of the semester)
 - Comprehensive
 - MC/TF questions, more complex engineering problems and essay questions

Grades		
Α	90 or above	
Α-	87 to 89	
B+	83 to 86	
В	80 to 82	
B-	77 to 79	
C+	73 to 76	
С	70 to 72	
C-	67 to 69	

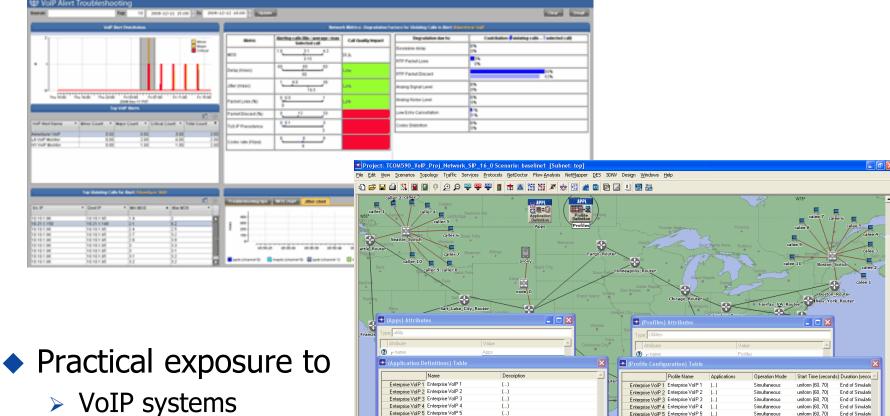
Labs



- X-Lite/Kapanga softphones and Asterisk Softswitch Labs
- Riverbed\OPNET Modeling and Simulation Labs
- You will need a working headset with microphone for virtual/asynchronous sessions, labs and potentially projects
 - Reasonably Priced Headsets (you don't need to by these if you already have one; make sure the connector is right for your system and environment)
 - https://www.amazon.com/Cyber-Acoustics-headphone-microphone-AC-204/dp/B0055CR9M0/ref=sr_1_7?s=wireless&ie=UTF8&qid=1535389690&sr=1-7&keywords=headsets+with+microphone&refinements=p_36%3A2491155011
 - https://www.staples.com/v7-noise-canceling-stereo-headset-over-the-head-black-ha212-2np/product_IM15RU601?cid=PS:GooglePLAs:IM15RU601&ci_src=17588969&ci_sku=IM15RU601&KPID=IM15RU601 &gclid=CjwKCAjwm_P5BRAhEiwAwRzSO4tjkD5YF55K7dm2Ymj3OwZgRGF9WQK5eUMZZ5reTEEJN0FKCE19mBoCgSsQA vD_BwE
 - https://www.amazon.com/MuveAcoustics-Drive-Wired-Earbud-Headphones/dp/B01N79G14B/ref=sr_1_1_sspa?crid=1J45QAQUH5ZDS&dchild=1&keywords=earbuds+with+micropho ne&qid=1597844611&s=electronics&sprefix=erabuds+%2Celectronics%2C159&sr=1-1spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzU0QyNkdEOUQ0ODI0JmVuY3J5cHRIZElkPUEwODc3NDU0M1 VZRjgzOUxUREozUyZlbmNyeXB0ZWRBZElkPUEwMzU1NjY5MUU0MIBUMDJBTkk3NSZ3aWRnZXROYW1lPXNwX2F0ZiZhY 3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=
- These lab activities will be conducted remotely, either by running the software on your personal computer or by using virtual machines within the prebuilt environment. We will use VPN to interconnect these systems together. The software for labs will also be installed throughout ENGR building in case we have to use it.
- More about lab capabilities to come within next few weeks.

Group Projects





Enterprise VolP 6 Enterprise VolP 6

Enterprise VolP 7 Enterprise VolP 7

Enterprise VolP 8 Enterprise VolP 8

Enterprise VolP 9 Enterprise VolP 9

Enterprise VoIP 6 Enterprise VoIP 6

Enterprise VoIP 7 Enterprise VoIP 7

Enterprise VoIP 8 Enterprise VoIP 8

Enterprise VoIP 9 Enterprise VoIP 9

Enterprise VolP 10 Enterprise VolP 10 (

Simultaneous

Simultaneous

Simultaneous

Simultaneous

uniform (60, 70)

uniform (60, 70)

uniform (60, 70)

uniform (60, 70)

End of Simulation

End of Simulation

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- - VoIP systems
 - VoIP engineering proce
 - Modeling and design
 - > Industry trends

Group Projects – use cases











Course Outline - Comprehensive VoIPMASON

Topics	Book Readings
Introduction to Voice and Voice Transmission Technologies: Voice characteristics, digitalization and encoding. Traditional circuit switched equipment and networks used in telephony. Signaling basics. Potential use-cases for VoIP deployments (benefits/challenges). Enterprise/Campus and Commercial Telephony. Typical VoIP Connection Strategies.	Voice Over IP Fundamentals: Chapter 1, Chapter 2, Chapter 3 (not required)
Concept of Transporting Voice over Packet Switched Network: Internet Protocol (IP) introduction. Real time protocols: RTP, RTCP, RTSP, SCTP, UDP-Lite/Liter - packet formats, functionality and features. Real-time media synchronization.	Carrier Grade: Transporting Voice by Using IP Voice Over IP Fundamental: Chapter 6 RTP: Audio and Video for the Internet
Voice over IP Decomposition: Human voice and coding techniques, compression. Factors that affect VoIP quality: delay, jitter, packet loss, echo. Performance and quality metrics for VoIP: MOS, R-Factor, PESQ. VoIP performance measurement and monitoring tools.	Carrier Grade: Speech-Coding Techniq. Voice Over IP Fundamentals Chapter 7 RTP: Audio and Video for the Internet
Intro to VoIP signaling protocols: Overview. SIP signaling protocol: format and inter-workings.	Carrier Grade: The Session Initiation Protocol Voice Over IP Fundamentals: Chapter 11 IP Telephony: Chapter 2
H.323 Signaling Protocol: Architecture, format and inter-workings.	Carrier Grade: H.323 Voice Over IP Fundamentals: Chapter 12 IP Telephony: Chapter 3
SS7 Signaling Protocol: Architecture, format and inter-workings (H.323, SIP and ISUP (SS7) signaling protocols).	Carrier Grade: VoIP and SS7 Voice Over IP Fundamentals: Chapter 4

Course Outline - Comprehensive VoIPMASON

Topics	Book Readings
The Softswitch Architecture: Interoperability of different signaling protocols (H.323, SIP, SS7) using Softswitches, Applications of Softswitches in a carrier grade VoIP environment. (SS7 signaling over IP-based networks). VoIP — PSTN migration and integration strategies.	Carrier Grade: Distributed Gateways and the Softswitch Architecture Voice Over IP Fundamentals: Chapter 14 IP Telephony: Chapter 4
Voice over IP Network Planning and Design: Traffic analysis and forecasting (advanced), numbering and dial plans, number routing, vendor selection criteria for LAN and WAN deployments. E.911, CALEA.	Lecture notes and supplemental reading
VoIP Quality and QoS: A thorough explanation of QoS components, protocols and trade-offs. RSVP, Diffserv, MPLS and 801.2q protocols are covered in details in terms packet format, features and functions and their pros and cons. format, features and functions and their pros and cons.	Carrier Grade: quality of Service Voice Over IP Fundamentals: Chapter 8
VoIP Security: Requirements, technologies and NAT/Firewall considerations. VoIP encryption analysis.	Carrier Grade: Interconnecting VoIP Networks Voice Over IP Fundamentals:
	Chapter 10 IP Telephony: Chapter 6
NextGen VoIP: VoIP Mobility. VoIP Equipment: Adapters, soft phones, WiFi phones, mobile phones. Collaboration and presence. Billing and Mediation. VoiceXML. IP Multimedia Subsystem (IMS).	Pats in Voice Over IP Fundamentals: Chapter 15 Chapter 16