COMM4557 Communication Networks
Autumn 2016– Last updated 8/22/16

Lecture: 216 Journalism Bldg
                       T/H 12:45 – 2:05

Instructor: Dr. Kelly Garrett
                       3131 Derby Hall
                       garrett.258@osu.edu
                       Please include the "Comm 4557" in the subject line

Office Hours: M 3:00 – 4:00pm + by appointment

Rationale and objectives

How is sound transmitted over the telephone network? How does data flow across the Internet? What is the difference between a telephone call and a Skype call? How and why do Internet technology pose a threat to privacy? These are a few of the questions that you should be able to answer after completing this course. The focus of the class is on developing a basic understanding of telecommunication technologies, from radio broadcasting and the PSTN to streaming audio and encrypted communication. We cover a variety of contemporary telecommunication systems, addressing both what they can do and how they work. We pay particular attention to the similarities and differences between digital and analog technologies.

Specific Learning Objectives:
With these skills, you will be better prepared to

- Read tech news

- Explain technologies to those who are less knowledgeable

- Think critically about key capabilities and limitations of existing and novel telecommunication systems

Required Text:

Newton, Harry with Steve Schoen. (2016). *Newton's Telecom Dictionary* (30th ed.). New York: Telecom Publishing. ("Newton" in schedule)

All other required readings are available through CARMEN.

Policies and Expectations:

Communications: I will post class updates and/or additional materials as announcements on Carmen and/or to your OSU email. Please check Carmen and read your email regularly (at least 2-3 times per week) because you are responsible for this information, just as you are responsible for information in class.

Problem Sets: Problem set due dates are listed in the tentative schedule, below. All assignments must be turned in to Carmen by the start of class on the due you're your answers should be submitted using Carmen's built-in text editor. I do, however, encourage you to prepare your answers in a word processor, and then copy-and-paste them into the text editor. This will make it easier for you to prepare your corrections, which I describe in more detail below. (See Course Requirements, below, for important details about the Problem Sets.

Late Assignments: It is your responsibility to confirm that your assignment has been successfully uploaded to Carmen. Problems sets will not be accepted after the start of class time on the due date.

Challenging a Grade: I am always willing to discuss your grades with you, but I will not do so during class time. To challenge a grade, you must wait 24 hours after the assignment is returned and then email me to make an appointment *within one week* of the assignment being returned to you. When we meet, you must present your concerns in writing and attach the graded paper, exam, or presentation. Please note that a challenge may result in grades being raised or lowered.

Technology: There are a variety of class activities that require that you use a computer. You may use the labs' laptops or your own computer for these activities. This is, however, the only time that you may use these devices. When not engaged in one of these activities, all laptops should be closed. No digital note taking here, please. Furthermore, the **use of cellphones in the classroom is strictly prohibited**. This technology is distracting to you and to your peers. If I see a cellphone in your hand, I will ask you to leave.

Classroom Civility: We want to build a classroom climate that is comfortable for everyone. In a communication class, it is especially important that we (1) display respect for all members of the classroom, including the instructor and students; (2) pay attention to and participate in all class sessions and activities; (3) avoid unnecessary disruption during class time (e.g., having private conversations, reading the newspaper, doing work for other classes, etc.); and (4) avoid racist, sexist, homophobic, or other negative language that may unnecessarily exclude members of our campus and classroom. This is not an exhaustive list of behaviors; rather, they represent the minimal standards that help make the classroom a productive learning environment for all concerned.

Punctuality: Class begins on time every day so that all scheduled discussions and activities can be completed. You are expected to be punctual.

Academic Misconduct: Each student in this course is expected to demonstrate academic integrity and to abide by the *Code of Student Conduct* (http://studentaffairs.osu.edu/resource_csc.asp and see

). *Academic misconduct* includes, but is not limited to, (1) plagiarism (using others' work without citing/crediting them), (2) fabricating information or citations, (3) facilitating acts of dishonesty by others, (4) having unauthorized possession of past exam questions, (5) submitting work previously submitted to another course or work of another person, (6) tampering with the academic work of other students, and (7) cheating on quizzes/exams. Academic misconduct on any assignment will result minimally in receiving a zero on that assignment and may also lead to further disciplinary action. **Penalty for violation of the *Code of Student Conduct* can also be extended to include failure of the course and University disciplinary action.** It is your responsibility to be aware of the rules of academic dishonesty—ignorance is not a defense. ***When in doubt, talk to me.***

Please note that although collaboration is required throughout this course and cooperation is *strongly* encouraged, any work submitted by a student for academic credit must be the student's own work. You are encouraged to study together and to discuss information and concepts covered in lecture with other students. You can give "consulting" help to or receive "consulting" help from such students. However, cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, file exchange, or a hard copy.

Course Requirements:

Participation is required. While sickness and unexpected emergencies arise from time to time, *regular* absence will hurt your grade. I routinely evaluate participation via in-class activities. *If you are absent on a day when there is an in-class activity, you will not receive credit for it.* It is not possible to make up missed in-class work, but everyone can miss up to four activities without penalty.

Course readings are essential to full participation. Doing the readings and reflecting on what you've read is required for this class. My lectures, our discussions, and the in-class activities all take this for granted. Required readings are listed in the tentative schedule, below. Although some of the readings come from a traditional textbook, we also make extensive use of popular web sites, including HowStuffWorks, Wikipedia, and YouTube. You should read *all* sections of the page or entry, or watch the entire video, unless I indicate otherwise. If you encounter terms you don't understand, please consult Newton's Telcomm dictionary. I also encourage you to pursue links on these site if there are terms or topics that you do not understand or want to know more about.

Please be aware that although I have reviewed these online sources and consider them to be reliable, the content can change and the entries may sometimes contain errors. Cross checking the information you find here with the dictionary and lecture is strongly encouraged.

Discussion posts: There are two types of posts that you are required to make between class sessions. Some time on the day after a class lecture, you must post at least one review question related to the material covered in that lecture. This can take the form of a question that you need help answering, or a question that your classmates could use to test their understanding of the material. To get credit for this post, the question must be clearly connected to the prior lecture and must illustrate your understanding of the larger topic.

Anytime before class you must post at least one question about the reading for the day. The requirements for this question are similar: it can be a question you want help answering, or one that your classmates could answer based on what they read. You may also pose a question about connecting the technology discussed in the reading to current events. Credit is given based on evidence that you have completed and thought about the readings.

Missed posts cannot be made up, but you can miss up to four with no penalty.

Problem sets: The point of the problem sets is to help you learn, not to assess what you've learned. Because of this, grading might be a little different than you are used to so *please read this section carefully!*

Each problem sets has two stages:

(1) In the first stage you are to answer the questions on your own. If there is a question that you do not know how to answer, please ask me for help. You may ask questions at the start of lecture, and I encourage you to come to office hours. If you still do not understand well enough to answer the question, you must explain the parts your do understand, and describe what is confusing you to the best of your ability.

(2) After the submission deadline I will provide a solution set on Carmen. You will then have **one week to correct the answers you submitted in the first stage**. When correcting your assignment, do not just copy the answers provided on the solution set. To get credit for the correction, you must:

- **Leave your original answer.** Please indicate your errors by crossing out the mistake. (~~Like this~~.) Do <u>not</u> delete any part of the original.
- **Describe the problem** with the original answer and <u>explain how the new answer fixes this problem.</u> If your answer is correct, say this explicitly. If it is correct but differs from my answer, explain why.

Each assignment is worth **four point**. (a) You get two points for answering all questions as completely as possible on your first attempt. If you have spoken to me, but are still stuck, then you should answer as much of the question as you can, and explain what

part of the question is tripping you up. (b) You get two more points for correcting your first attempt and explaining all your errors.

In-class exercises. There will be a variety of in-class exercises. Like the problem sets, the goal of these is to help you improve your understanding of the class material. They will also help me to understand what topics are most confusing. Some of the exercises will be completed in small groups, but unless I say otherwise, each individual is expected to turn in their own attempt at documenting the solution. Please be sure to bring paper that you are prepared to turn in and a pen or pencil.

Exams. There will be a midterm and final exam. The midterm will encompass all material covered in the class prior to the exam. The final will be a comprehensive exam, covering all the topics of the course. You should be prepared to answer multiple-choice and short-answer questions on both exams. I will provide more information about the exams later in the semester.

Grading

In-class exercises	10%
Discussion board posts	15%
Problem sets	25%
Midterm	25%
Final	25%

Additional Resources:

Walter E. Dennis Learning Center (http://dennislearningcenter.osu.edu/). This is a free service available to all OSU students, and it has a proven track record of helping students succeed in college. Need a new study strategy? Better time management skills? This is the place to go.

Accommodations for Students with Disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Tentative Course Schedule
NEWTON refers to *Newton's Telcomm Dictionary*, which is required for this class
TELCOM refers to excerpts from Goleniewski's *Telecommunication Essentials*, posted on Carmen.
Links should

Date	Topics	Readings	Assignment
T 8/23	Syllabus & Overview		
Th 8/25	Waves	NEWTON: electromagnetic energy – electromagnetic wave (all entries in between) , signal, waveform, wavelength, frequency, hertz, amplitude, phase, sound, sound waves, and *any terms in the readings that you don't know* http://www.youtube.com/watch?v=-oGwFDQNJps http://science.howstuffworks.com/humans-hear-in-space1.htm http://en.wikipedia.org/wiki/Waveform http://en.wikipedia.org/wiki/Frequency http://en.wikipedia.org/wiki/Amplitude (stop at "Root mean square amplitude)	
T 8/30	Signals	NEWTON: Fourier's theorem, filter (defn 1), signal level, signal decay https://en.wikipedia.org/wiki/Audio_filter	
Th 9/1	Modulation	NEWTON: modulation, demodulation, amplitude modulation, frequency modulation, bandwidth (defn #1), noise, signal-to-noise ratio TELECOM: 11 (at Spectrum) – 18 (before Transmission) http://en.wikipedia.org/wiki/Modulation (Just introduction, stop at Contents) http://en.wikipedia.org/wiki/Amplitude_modulation (Sections: Intro and History; look at Fig. 1) http://en.wikipedia.org/wiki/Frequency_modulation (Sections: Intro and Radio; look at animation) http://en.wikipedia.org/wiki/Bandwidth_(signal_processing) (Introduction and overview)	

T 9/6	Transmission Basics	NEWTON: frequency division multiplexing, radio, signal converter, frequency band, diffraction, spectrum, spectrum congestion, spectrum designation of frequency, spectrum management, propagation delay TELECOM: 1 - 11 (before Spectrum), 23 (first paragraph of multiplexing), 26 (just FDM) http://en.wikipedia.org/wiki/Multiplexing (introduction and frequency-division multiplexing) http://electronics.howstuffworks.com/radio-spectrum.htm (first three pages of entry) http://www.fcc.gov/dashboard/ (select "Search by Name", select your phone carrier from the dropdown labeled "Select Spectrum Holder by Common Name")	Problem set 1
Th 9/8	Digital basics	NEWTON: analog, analog transmission, digital, digital signal, digital transmission, binary number system, binary, bit TELECOM: 18 - 23 (including Table 1.1) http://computer.howstuffworks.com/bytes.htm (first four pages of entry) http://electronics.howstuffworks.com/analog-digital.htm (first five pages of entry)	
T 9/13	Digital Representation	NEWTON: ASCII, PCM, encoding, sampling, sampling frequency, sampling rate, quantization, Nyquist Theorem, codec, bit rate TELCOM: 160-162 (before Transmission modes) http://www.library.cornell.edu/preservation/tutorial/intro/intro-01.html (Link is to "1. Basic Terminology" section, 8 pages in all)	Problem set 1 corrections & Problem set 2
Th 9/15	Digital Representation, part 2	NEWTON: pixel, bit depth, raster graphics, bitmap, vector images, aliasing ,aliasing noise TELECOM: 390-396 (before Television Standards) https://en.wikipedia.org/wiki/Raster_graphics https://en.wikipedia.org/wiki/Vector_graphics http://www.wfu.edu/~matthews/misc/DigPhotog/alias/	

T 9/20	Compression & Cryptography	NEWTON: compression, compression algorithm, compression artifacts, encryption, encryption key, cipher, non-repudiation TELECOM: 375 (at Encryption) - 381 http://computer.howstuffworks.com/file-compression.htm http://computer.howstuffworks.com/encryption.htm (first four pages of entry)	Problem set 2 corrections & Problem set 3
Th 9/22	Cryptography, part 2	NEWTON: public key encryption, challenge-response, RSA (defn 2) http://youtu.be/EPXilYOa71c *Recommended, but optional:* For other cryptography videos from the Khan Academy, see: https://www.khanacademy.org/math/applied-math/cryptography And if you want to know more about the math behind it http://youtu.be/IY8BXNFgnyI http://youtu.be/cJvoi0LuutQ	
T 9/27	Digital data transmission	NEWTON: Parity, parity bit, Time Division Multiplexing, network, LAN, host, hub, router, Ethernet, WiFi, WiFi access point TELECOM: 26-27 (TDM), 164, 173-177 (stop at LAN Transport Techniques), 182-184 (stop at Shared Versus Switched), 215 - 219 (Packet-Switched Networks) http://en.wikipedia.org/wiki/Multiplexing (time-division multiplexing only)	Problem set 3 corrections & Problem set 4
Th 9/29	Digital network performance	NEWTON: propagation delay, latency, cache (def. 2), streaming, streaming media	
T 10/4	Review & exam prep	Wrap up unfinished topics Review for midterm	Problem set 4 corrections & Problem set 5
Th 10/6		**Midterm**	

T 10/11	Connecting to the Internet	NEWTON: broadband, cable modem, ADSL, fiber, fiber to the curb, fiber to the most economical point, FTTP TELECOM: 388 - 390 (stop at Digital Video), 529 http://computer.howstuffworks.com/cable-modem.htm (All) http://electronics.howstuffworks.com/dsl.htm (Pages 1-2) http://computer.howstuffworks.com/fiber-to-the-home.htm (Pages 1-2, 4)	
Th 10/13	No class	Autumn Break	
T 10/18	Internet Protocol stack	NEWTON: protocol, protocol stack, OSI reference model, OSI standards TELECOM: 165 (OSI Reference Model) - 171, 264 - 269 (before Addressing Schemes)	Problem set 5 corrections & Problem set 6
Th 10/20	The Internet: IP	TELECOM: 245 - 256 (Stop at TCP) http://computer.howstuffworks.com/internet-infrastructure.htm (All) http://en.wikipedia.org/wiki/Internet_Protocol (stop before "Version history") *Recommended*: Newton - Internet, protocol, IP (def. 1), Internet address	
T 10/25	The Internet: TCP, UDP	TELECOM: 256 - 257 (TCP and UDP) http://en.wikipedia.org/wiki/Transmission_Control_Protocol (introduction, historical origin, network function, and all subsections of data transfer) http://en.wikipedia.org/wiki/User_Datagram_Protocol (just introduction) http://compnetworking.about.com/od/networkprotocols/l/aa071200b.htm *Recommended*: Newton - TCP/IP, TCP (def. 1), UDP, firewall	Problem set 6 corrections
Th 10/27	The Internet: DNS, Firewalls	NEWTON: DNS TELECOM: 280 (DNS) - 285 (stop at Evolution of the POP Architecture) http://www.iana.org/gtld/gtld.htm http://www.whois.com/whois/osu.edu http://en.wikipedia.org/wiki/Firewall_(computing) (Introduction, Types: network layer & Application layer)	

T 11/1	The Web: HTTP, HTML, and more	NEWTON: HTTP, HTTP referer, HTML, HTML tag, HTML 5.0, XML, XML attributes, XML element, cascading style sheets http://en.wikipedia.org/wiki/Http (Introduction, technical overview, and example session) http://www.perlfect.com/articles/http.shtml http://computer.howstuffworks.com/javascript.htm	Problem set 7
Th 11/3	Advanced Web: Cookies & TLS	NEWTON: URL, URL shortening service, cookie, cookie file, SSL, TLS (defn 2), HTTPS http://computer.howstuffworks.com/cookie.htm (all pages) https://en.wikipedia.org/wiki/Transport_Layer_Security (introduction)	
T 11/8	Email	NEWTON: all entries beginning "email", IMAP, POP3, spoofing (first paragraph), phishing http://www.howtogeek.com/56002/htg-explains-how-does-email-work/	Problem set 7 corrections & Problem set 8
Th 11/10	Telephony:	NEWTON: telephony, PSTN, POTS, circuit, circuit switching, circuit switched network, LEC (defn 1), IXC, point of presence, signaling (not "**Signaling** System 7"), Captain Crunch, voice over IP, SIP (defn 3) TELECOM: 334 (start at SIP) - 339 (stop at ENUM) http://electronics.howstuffworks.com/telephone.htm (including video) http://en.wikipedia.org/wiki/Local_exchange_carrier http://electronics.howstuffworks.com/ip-telephony.htm http://en.wikipedia.org/wiki/Session_Initiation_Protocol (Introduction, history, protocol operation)	
T 11/15	Mobile Telephony	NEWTON: cell phone, cellphone range, ESN (defn 2), SIM card, GSM, MTSO, 3G, 4G, 5G TELECOM: 580-1	
Th 11/17	Privacy & Surveillance	https://www.privacyrights.org/online-privacy-using-internet-safely http://mashable.com/2016/08/11/webcam-texas-hack/#P.erfPVuNgqq http://www.usnews.com/news/articles/2015/08/25/the-illusion-of-online-privacy	Problem set 8 corrections & Problem set 9

T 11/22	Malware	NEWTON: malware, virus, worm (defn 2), Trojan horse, ransomware, adware, black hats https://en.wikipedia.org/wiki/Malware https://www.consumer.ftc.gov/articles/0011-malware	
Th 11/24	No class	Thanksgiving break	
T 11/29		Case studies	Problem set 9 correction
Th 12/1		Case studies	
T 12/6	Course Review	Overview of course goals and topics; discussion of scenario for final exam	
T 12/13 2:00p		**Final exam *** Note the date and time *** **	