

## COMM 4557 Communication Network Infrastructure

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

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**Please include the “Comm 4557” in the subject line**

Office Hours: Tuesdays 4-5pm + 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. (2018). *Newton's Telecom Dictionary* (31th ed.). New York: Telecom Publishing. (“Newton” in schedule)

All other required readings are available through CARMEN.

**Copyright Disclaimer:** The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## **Policies and Expectations:**

**Class communication:** 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.

**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 three activities without penalty.

**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 date. 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. Problem 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 integrity policy:** 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](http://studentaffairs.osu.edu/resource_csc.asp) and see <http://oaa.osu.edu/coamtensuggestions.html>). *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.

**Academic Misconduct:** It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>

## Course Requirements:

**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 Telcom dictionary. I also encourage you to pursue links on these sites 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. First, **any time before class** you must post a comment or question about the reading for the day. 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 comment 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.**

Second, 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. **Saying that you understood everything is not sufficient.**

Note that **you may not simply repeat a classmate's comment** when making either of these types of posts. If someone has already written what you were planning to write, you must write something else. You may post a different question, or you may reply to the post with a response to, or an elaboration on, the question.

Here's an (intentionally silly) example:

**Student 1:** The author says that red Skittles reflect lower wavelengths than blue Skittles. I understand that wavelengths and colors are related, but what does he mean when he says that the waves are "reflected"

**Student 2:** I had a similar question to @Student 1. I think that we see "reflected" light, but I'm not sure why the two candies don't reflect the same light.

Missed posts cannot be made up, but you can miss up to five without penalty.

**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 to the class. 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.

As with posts, missed in-class exercises cannot be made up. You can, however, miss up to three 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 set has two stages:

(1) In the first stage you are to answer **all** parts to the best of your ability. If there is a question that you do not know how to answer, please seek help from me or a classmate. 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 you 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 full credit for the correction, you must:

- **Leave your original answer.** Please indicate your errors by crossing out the mistake. (~~Like this.~~) Do not delete any part of the original.
- **Describe the problem** with the original answer, explain how your new answer fixes this problem, and indicate which class reading or slide provides the information you need to correct your answer. (In other words, do not just copy the solution set.) If your answer is correct, say this explicitly. If it is correct but differs from my answer, explain why. **Please make any text that you add bold and red.**
- **Correct and explain all your errors**

Here's an (intentionally silly) example:

1. Cookie Monster is ~~green because of all the leafy green vegetables he eats.~~  
**The crossed out text is incorrect. Cookie Monster is blue, not green. Although I don't know why he is this color, it is certainly not because of his healthy eating habits. That monster doesn't eat anything but cookies. Information confirming this correction can be found in Michael Davis's history of Sesame Street, *Street Gang*, in the section that begins "There was a brief period during which Cookie Monster had neither an obsession nor a permanent name."**

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.

**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	10%
Problem sets	25%
Midterm	25%
Final	30%

### **Additional Resources:**

**Student Academic Services** (<http://advising.osu.edu/welcome.shtml>). Arts and Sciences Advising and Academic Services' website provides support for student academic success. Information on advising issues such as tutoring, transfer credits, academic standing, and contact information for Arts and Sciences advisors can be obtained through this website.

**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.

### **Accessibility 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](mailto:slds@osu.edu); 614-292-3307; 098 Baker Hall, 113 W. 12<sup>th</sup> 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.

Date	Topics	Readings	Assignment
T 8/21	Syllabus & Overview		
Th 8/23	Waves	NEWTON: electromagnetic energy – electromagnetic wave (all entries in between) , signal, waveform, wavelength, frequency, hertz, amplitude, phase, sound, sound waves, and <i>any terms in the readings that you don't know</i>  <a href="http://www.youtube.com/watch?v=-oGwFDQNJps">http://www.youtube.com/watch?v=-oGwFDQNJps</a> <a href="http://science.howstuffworks.com/humans-hear-in-space1.htm">http://science.howstuffworks.com/humans-hear-in-space1.htm</a> <a href="http://en.wikipedia.org/wiki/Waveform">http://en.wikipedia.org/wiki/Waveform</a> <a href="http://en.wikipedia.org/wiki/Frequency">http://en.wikipedia.org/wiki/Frequency</a> <a href="http://en.wikipedia.org/wiki/Amplitude">http://en.wikipedia.org/wiki/Amplitude</a> (stop at "Root mean square amplitude")	
T 8/28	Signals	NEWTON: Fourier's theorem, filter (defn 1), signal level, signal decay  <a href="https://en.wikipedia.org/wiki/Audio_filter">https://en.wikipedia.org/wiki/Audio_filter</a> (skip Self-oscillation) <a href="https://youtu.be/JndvN1ngSi4">https://youtu.be/JndvN1ngSi4</a>	
Th 8/30	Modulation	NEWTON: modulation, demodulation, amplitude modulation, frequency modulation, bandwidth (defn #1), noise, signal-to-noise ratio, spectrum,  TELCOM: 11 (at Spectrum) – 18 (before Transmission)  <a href="http://en.wikipedia.org/wiki/Bandwidth_(signal_processing)">http://en.wikipedia.org/wiki/Bandwidth_(signal_processing)</a> (Introduction and overview) <a href="http://en.wikipedia.org/wiki/Modulation">http://en.wikipedia.org/wiki/Modulation</a> (Just introduction, stop at Contents) <a href="http://en.wikipedia.org/wiki/Amplitude_modulation">http://en.wikipedia.org/wiki/Amplitude_modulation</a> (Sections: Intro and History; look at Fig. 1) <a href="http://en.wikipedia.org/wiki/Frequency_modulation">http://en.wikipedia.org/wiki/Frequency_modulation</a> (Sections: Intro and Radio; look at animation)  <i>Optional:</i> <a href="https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet">https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet</a>	

T 9/4	Transmission Basics	<p>NEWTON: frequency division multiplexing, radio, signal converter, frequency band, diffraction, spectrum congestion, spectrum designation of frequency, spectrum management, propagation delay</p> <p>TELECOM: 1 - 11 (before Spectrum), 23 (first paragraph of multiplexing), 26 (just FDM)</p> <p><a href="http://en.wikipedia.org/wiki/Multiplexing">http://en.wikipedia.org/wiki/Multiplexing</a> (introduction and frequency-division multiplexing)</p> <p><a href="http://electronics.howstuffworks.com/radio-spectrum.htm">http://electronics.howstuffworks.com/radio-spectrum.htm</a> (first three pages of entry)</p> <p><a href="http://www.fcc.gov/dashboard/">http://www.fcc.gov/dashboard/</a> (select "Search by Name", select your phone carrier from the dropdown labeled "Select Spectrum Holder by Common Name")</p> <p><i>Optional:</i> <a href="https://youtu.be/r-shNhpBkhs">https://youtu.be/r-shNhpBkhs</a> (recommended by student in prior class)</p>	Problem set 1
Th 9/6	Digital basics	<p>NEWTON: analog, analog transmission, digital, digital signal, digital transmission, binary number system, binary, bit</p> <p>TELECOM: 18 - 23 (including Table 1.1)</p> <p><a href="http://computer.howstuffworks.com/bytes.htm">http://computer.howstuffworks.com/bytes.htm</a> (first four pages of entry)</p> <p><a href="http://electronics.howstuffworks.com/analog-digital.htm">http://electronics.howstuffworks.com/analog-digital.htm</a> (first five pages of entry)</p> <p>Optional binary practice: <a href="http://games.penjee.com/binary-numbers-game/">http://games.penjee.com/binary-numbers-game/</a></p>	
T 9/11	Digital Representation	<p>NEWTON: ASCII, PCM, encoding, sampling, sampling frequency, sampling rate, quantization, Nyquist Theorem, codec, bit rate</p> <p>TELECOM: 160-161 (Coding schemes: ASCII...)</p> <p><a href="https://www.tutorialspoint.com/digital_communication/digital_communication_pulse_code_modulation.htm">https://www.tutorialspoint.com/digital_communication/digital_communication_pulse_code_modulation.htm</a></p> <p>Video: What is PCM? <a href="https://youtu.be/YJmUKNTBa8s?t=6s">https://youtu.be/YJmUKNTBa8s?t=6s</a> IMPORTANT: You can stop at 2m15s</p>	Problem set 1 corrections & Problem set 2

Th 9/13	Digital Representation, part 2	<p>NEWTON: pixel, bit depth, raster graphics, bitmap, vector images, aliasing ,aliasing noise</p> <p>TELECOM: 390-396 (stop before Television Standards)</p> <p><a href="http://preservationtutorial.library.cornell.edu/intro/intro-01.html">http://preservationtutorial.library.cornell.edu/intro/intro-01.html</a> (Link is to "1. Basic Terminology" section, 8 pages in all)</p> <p><a href="https://en.wikipedia.org/wiki/Raster_graphics">https://en.wikipedia.org/wiki/Raster_graphics</a> <a href="https://en.wikipedia.org/wiki/Vector_graphics">https://en.wikipedia.org/wiki/Vector_graphics</a> <a href="http://www.wfu.edu/~matthews/misc/DigPhotog/alias/">http://www.wfu.edu/~matthews/misc/DigPhotog/alias/</a></p> <p>Optional video about storing bitmapped images: <a href="https://www.youtube.com/watch?v=1LZWCSKj45g">https://www.youtube.com/watch?v=1LZWCSKj45g</a></p>	
T 9/18	Compression & Brief intro to Cryptography	<p>NEWTON: compression, compression algorithm, compression artifacts, encryption, encryption key, cipher, non-repudiation</p> <p>TELECOM: 375 (at Encryption) - 381</p> <p><a href="http://computer.howstuffworks.com/file-compression.htm">http://computer.howstuffworks.com/file-compression.htm</a> <a href="http://computer.howstuffworks.com/encryption.htm">http://computer.howstuffworks.com/encryption.htm</a> (first four pages of entry)</p>	<p>Problem set 2 corrections &amp; Problem set 3</p>
Th 9/20	Cryptography	<p>NEWTON: public key encryption, challenge-response, RSA (defn 2)</p> <p><a href="http://youtu.be/EPXiYOa71c">http://youtu.be/EPXiYOa71c</a></p>	
T 9/25	Wrap up cryptography	<p><i>Recommended, but optional:</i> For other cryptography videos from the Khan Academy, see: <a href="https://www.khanacademy.org/math/applied-math/cryptography">https://www.khanacademy.org/math/applied-math/cryptography</a></p> <p>And if you want to know more about the math behind it <a href="http://youtu.be/IY8BXNFgnyI">http://youtu.be/IY8BXNFgnyI</a> <a href="http://youtu.be/cJvoiOLuutQ">http://youtu.be/cJvoiOLuutQ</a></p>	
Th 9/27	Digital data transmission	<p>NEWTON: Parity, parity bit, Time Division Multiplexing, network, LAN, host, hub, router, Ethernet, WiFi, WiFi access point</p> <p>TELECOM: 26-27 (TDM), 164, 173-177 (stop at LAN Transport Techniques), 182-184 (stop at Shared Versus Switched), 215 - 219 (Packet-Switched Networks)</p> <p><a href="http://en.wikipedia.org/wiki/Multiplexing">http://en.wikipedia.org/wiki/Multiplexing</a> (time-division multiplexing only)</p>	<p>Problem set 3 corrections &amp; Problem set 4</p>

T 10/2	Digital network performance	NEWTON: propagation delay, latency, cache (def. 2), streaming, streaming media	
Th 10/4	Review & exam prep	Wrap up unfinished topics Review for midterm	Problem set 4 corrections & Problem set 5
<b>T 10/9</b>	<b>Midterm</b>		
Th 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  <a href="http://computer.howstuffworks.com/cable-modem.htm">http://computer.howstuffworks.com/cable-modem.htm</a> (All) <a href="http://electronics.howstuffworks.com/dsl.htm">http://electronics.howstuffworks.com/dsl.htm</a> (Pages 1-2) <a href="http://computer.howstuffworks.com/fiber-to-the-home.htm">http://computer.howstuffworks.com/fiber-to-the-home.htm</a> (Pages 1-2, 4)	
10/16	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 10/18	The Internet: IP	TELECOM: 245 - 256 (Stop at TCP)  <a href="http://computer.howstuffworks.com/internet-infrastructure.htm">http://computer.howstuffworks.com/internet-infrastructure.htm</a> (All) <a href="http://en.wikipedia.org/wiki/Internet_Protocol">http://en.wikipedia.org/wiki/Internet_Protocol</a> (stop before "Version history")  <i>Recommended:</i> Newton - Internet, protocol, IP (def. 1), Internet address	
T 10/23	The Internet: TCP, UDP	TELECOM: 256 - 257 (TCP and UDP)  <a href="http://en.wikipedia.org/wiki/Transmission_Control_Protocol">http://en.wikipedia.org/wiki/Transmission_Control_Protocol</a> (introduction, historical origin, network function, and all subsections of data transfer) <a href="http://en.wikipedia.org/wiki/User_Datagram_Protocol">http://en.wikipedia.org/wiki/User_Datagram_Protocol</a> (just introduction) <a href="http://compnetworking.about.com/od/networkprotocols/l/a071200b.htm">http://compnetworking.about.com/od/networkprotocols/l/a071200b.htm</a>  <i>Recommended:</i> Newton - TCP/IP, TCP (def. 1), UDP, firewall	Problem set 6 corrections

Th 10/25	The Internet: DNS, Firewalls	<p>NEWTON: DNS , firewall, proxy server</p> <p>TELECOM: 280 (DNS) - 285 (stop at Evolution of the POP Architecture)</p> <p><a href="http://www.iana.org/gtld/gtld.htm">http://www.iana.org/gtld/gtld.htm</a>  <a href="http://www.whois.com/whois/osu.edu">http://www.whois.com/whois/osu.edu</a>  <a href="http://en.wikipedia.org/wiki/Firewall_(computing)">http://en.wikipedia.org/wiki/Firewall_(computing)</a>  (Introduction, Types: network layer &amp; Application layer)</p>	
T 10/30	The Web: HTTP, HTML, and more (if there's time)	<p>NEWTON: HTTP, HTTP referer, HTML, HTML tag, HTML 5.0, XML, XML attributes, XML element, cascading style sheets</p> <p><a href="http://en.wikipedia.org/wiki/Http">http://en.wikipedia.org/wiki/Http</a> (Introduction, technical overview, and example session)  <a href="http://www.perlfect.com/articles/http.shtml">http://www.perlfect.com/articles/http.shtml</a>  <a href="http://computer.howstuffworks.com/javascript.htm">http://computer.howstuffworks.com/javascript.htm</a></p>	Problem set 7
Th 11/1	Advanced Web: Cookies & Query parameters	<p>NEWTON: URL, URL shortening service, cookie, cookie file</p> <p><a href="http://computer.howstuffworks.com/cookie.htm">http://computer.howstuffworks.com/cookie.htm</a>  (all pages)  <a href="https://en.wikipedia.org/wiki/Query_string">https://en.wikipedia.org/wiki/Query_string</a></p>	
T 11/6	TLS & Email	<p>NEWTON: SSL, TLS (defn 2), HTTPS, all entries beginning "email", IMAP, POP3, spoofing (first paragraph), phishing</p> <p><a href="https://en.wikipedia.org/wiki/Transport_Layer_Security">https://en.wikipedia.org/wiki/Transport_Layer_Security</a>  (introduction and description)  <a href="http://www.howtogeek.com/56002/htg-explains-how-does-email-work/">http://www.howtogeek.com/56002/htg-explains-how-does-email-work/</a></p>	
Th 11/8	Telephony:	<p>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)</p> <p>TELECOM: 334 (start at SIP) - 339 (stop at ENUM)</p> <p><a href="http://electronics.howstuffworks.com/telephone.htm">http://electronics.howstuffworks.com/telephone.htm</a>  (including video)  <a href="http://en.wikipedia.org/wiki/Local_exchange_carrier">http://en.wikipedia.org/wiki/Local_exchange_carrier</a>  <a href="http://electronics.howstuffworks.com/ip-telephony.htm">http://electronics.howstuffworks.com/ip-telephony.htm</a>  <a href="http://en.wikipedia.org/wiki/Session_Initiation_Protocol">http://en.wikipedia.org/wiki/Session_Initiation_Protocol</a>  (Introduction, history, protocol operation)</p>	

T 11/13	Mobile Telephony	NEWTON: cell phone, cellphone range, ESN (defn 2), SIM card, GSM, MTSO, roaming  TELECOM: 580-1	Problem set 7 corrections & Problem set 8
Th 11/15	Mobile Standards	NEWTON: 3G, 4G, 5G  <a href="https://en.wikipedia.org/wiki/5G">https://en.wikipedia.org/wiki/5G</a> <a href="https://www.tomsguide.com/us/5g-networking-faq,news-20629.html">https://www.tomsguide.com/us/5g-networking-faq,news-20629.html</a>	
T 11/20	Privacy & Surveillance	<a href="https://www.privacyrights.org/online-privacy-using-internet-safely">https://www.privacyrights.org/online-privacy-using-internet-safely</a> <a href="https://mashable.com/2016/08/11/webcam-texas-hack/#6EK0UDEGk5qc">https://mashable.com/2016/08/11/webcam-texas-hack/#6EK0UDEGk5qc</a> <a href="http://www.usnews.com/news/articles/2015/08/25/the-illusion-of-online-privacy">http://www.usnews.com/news/articles/2015/08/25/the-illusion-of-online-privacy</a>	Problem set 8 corrections & Problem set 9
Th 11/22	No class	Enjoy the break	
T 11/27	Malware	NEWTON: malware, virus, worm (defn 2), Trojan horse, ransomware, adware, black hats  <a href="https://en.wikipedia.org/wiki/Malware">https://en.wikipedia.org/wiki/Malware</a> <a href="https://www.consumer.ftc.gov/articles/0011-malware">https://www.consumer.ftc.gov/articles/0011-malware</a>	
Th 11/29	Case study	TBD	Problem set 9 correction
T 12/4	Review & exam prep	Wrap up unfinished topics Review for midterm	
<b>T 12/11 2:00p      Final exam *** Note the date and time ***</b>			