

Revised
Communication Studies Seminar 810
Digital Technologies and the New Media
University of Michigan Fall 2008
Bi-Weekly Wednesdays 4:00-5:30
University Towers Room 222
Prof. W. R. Neuman

This seminar introduces students to the fundamental technical drivers of the digital revolution and the dramatic influence of these developments on the institutions, economics and policy of mass communication. Topics include: the role of the computer and the digital representation of sound, text, images and moving images; media ergonomics, digital networks, optical technologies, the use of the electromagnetic spectrum, recent changes in motion picture, publishing, telecommunications, radio, television and online industries.

The seminar presumes no mathematical or technical background on the part of students; it is an introduction. But the course does focus on the underlying physics and electronics of how things work. The reason for this perspective is straightforward. If as a researcher, media professional, or policymaker one wants to understand what the technology can and cannot do – how far you can push it, what can and cannot be regulated, why some elements are expensive and others cheap, what the media will look like in ten years – one has to understand some of what is going on under the hood.

There is a wonderful scene in the first Star Wars movie -- Obi-wan and Luke are watching the hologram of Princess Leia projected into the air. Sounds like just another new technology? Photons, however, don't do that, and won't do that in the future; they don't float out into the air and then suddenly decide to turn around and come back (quantum physics aside.) Maybe there was supposed to be some reflective medium I didn't notice in that scene. When you know a little more about how things work, you have a better basis for being enthusiastic about new developments when there is good reason and appropriately skeptical about phony photons and other forms of electronic snake oil.

The seminar covers three intertwined topics – 1) how humans respond to sound, light and mediated communication 2) the components of modern media systems such as information storage, computation, transmission and display and 3) network architectures with special attention to the mother of all networks, the Internet.

The course requirement is a term paper on a topic of the student's choosing. It is presumed that students may well have quite different motivation for studying in this area –research, an interest in policy and regulation, the media business, legal issues, design and management of media systems. Accordingly, the term paper assignment is to apply the seminar content to topic in their own field of interest such as information security, personal privacy, community building, entertainment media, copyright or similar issues. Readings will be based on a coursepack.

Topical Outline & Reading Assignments

1. *Sept 10 Introduction to the New Media*

- 1.1. Why Study the Technology?
- 1.2. The Nature of Sound
- 1.3. The Nature of Light
- 1.4. The Physiology of Human Perception
- 1.5. The Behavior of Electrons
- 1.6. Electromagnetic Radiation and Propagation
- 1.7. The Spectrum
- 1.8. The Generic Properties of the New Media
 - Vannevar Bush *As We May Think*
www.theatlantic.com/doc/194507/bush
 - Craig Freudenrich *Light*
science.howstuffworks.com/light.htm
 - Tom Harris *Hearing*
entertainment.howstuffworks.com/hearing.htm
 - Carl Bianco *Vision*
science.howstuffworks.com/eye.htm
 - Marshall Brain *Electricity, Radio and Spectrum*
science.howstuffworks.com/electricity.htm
electronics.howstuffworks.com/radio-spectrum.htm
electronics.howstuffworks.com/radio.htm
 - W. Russell Neuman *The Generic Properties of the New Media*
Ctools

2. *Sept 10 Capturing Sound and Light*

- 2.1. Alphanumeric Systems
- 2.2. Edison's Phonograph
- 2.3. Photographic Fundamentals
- 2.4. Motion Pictures
- 2.5. Television Imaging
- 2.6. Digital Imaging
- 2.7. Enter Digital: Pulse Code Modulation
 - Stephen Littlejohn *Theories of Signs and Language*
 - Marshall Brain *Analog and Digital Recording, Television*
electronics.howstuffworks.com/analog-digital.htm
electronics.howstuffworks.com/cassette.htm
entertainment.howstuffworks.com/tv.htm
 - Charles Woodworth *Photography*
science.howstuffworks.com/film.htm
 - Jeff Tyson *Motion Pictures*
www.howstuffworks.com/movie-projector.htm
 - Karim Nice Gerald Jay Gurevich *Digital Imaging*
electronics.howstuffworks.com/digital-camera.htm
 - Hermann Helgert *Pulse Code Modulation*
www.accessscience.com.proxy.lib.umich.edu, DOI 10.1036/1097-8542.556900

3. **Sept 24 Transmission Technologies**

- 3.1. The Model of Communication
- 3.2. Telegraph
- 3.3. Telephone
- 3.4. AM Radio
- 3.5. FM Radio
- 3.6. Television Transmission
- 3.7. Cable Television
- 3.8. Satellite Broadcasting
- 3.9. Data Communication
- 3.10. Optical Fiber

Tom Perera *Telegraphy*

www.chss.montclair.edu/~pererat/pertel.htm

Marshall Brain *Telephony and, Television*

electronics.howstuffworks.com/telephone.htm

electronics.howstuffworks.com/tv.htm

Curt Franklin *Cable Television*

entertainment.howstuffworks.com/cable-tv.htm

Karim Nice and Tom Harris *Satellite Broadcasting*

electronics.howstuffworks.com/satellite-tv.htm/printable

Ray Horak *Fundamentals of Data Communication*

Craig Freudenrich *Optical Fiber*

electronics.howstuffworks.com/fiber-optic.htm

Patrick Parsons, Rob Frieden *How it Works: The Technology*

4. **Sep 24 Storage & Display Technologies**

- 4.1. Paper and Printing
- 4.2. Magnetic Tape
- 4.3. CDs and DVDs
- 4.4. ROM and RAM
- 4.5. Speakers
- 4.6. Cathode Ray Tubes
- 4.7. Plasma, LCDs and DLPs

David Macaulay *Paper and Printing*

Marshall Brain *CDs*

entertainment.howstuffworks.com/cd.htm

Karim Nice *DVDs*

entertainment.howstuffworks.com/dvd.htm

Jeff Tyson *ROM, RAM and LCDs*

computer.howstuffworks.com/rom.htm

computer.howstuffworks.com/ram.htm

electronics.howstuffworks.com/lcd.htm

Tom Harris *Speakers, Plasma Displays*

electronics.howstuffworks.com/speaker.htm

electronics.howstuffworks.com/plasma-display.htm

Craig Freudenrich *DLPs*

electronics.howstuffworks.com/projection-tv.htm

5. **Oct 8 Signals and Systems**

- 5.1. Fourier
- 5.2. Frequency response
- 5.3. Filters
- 5.4. Digital filtering

Zover Karu *Signals and Systems Made Ridiculously Simple*

Marven, Craig and Gillian Ewers *A Simple Approach to Digital Signal Processing.*

6. **Oct 8 Information Theory & Digitization**

- 6.1. Modeling a communications channel (coding, noise, decoding)
- 6.2. Measuring information
- 6.3. Channel capacity: Shannon's theorem
- 6.4. Digitization & Nyquist's theorem
- 6.5. Lossless Source Coding
- 6.6. Predictive Coding
- 6.7. Frequency Domain Coding

Claude Shannon, Warren Weaver *The Mathematical Theory of Communication*

Fred Dretske *Communication Theory*

Colin Cherry *The Mathematical Model of Communication*

7. **Oct 29 Networks**

- 7.1. Circuit Switching
- 7.2. Packet Switching
- 7.3. The ISO Layering Model & the CSTB hourglass
- 7.4. Flow Control/Access control
- 7.5. Latency
- 7.6. Error Detection
- 7.7. Queuing

Frank Defler, Les Freed *How Networks Work*

8. **Oct 29 The Internet**

- 8.1. TCP/IP
- 8.2. Addresses and Domains
- 8.3. Routers
- 8.4. HTTP
- 8.5. Multicast IP
- 8.6. Dynamic Scripting
- 8.7. Email

Preston Gralla *How the Internet Works*

Sharon Gillett Eisner, Mitchell Kapor *The Self-Governing Internet*

Marjorie Blumenthal, David Clark *Rethinking the Design of the Internet*

9. **Oct 29 Wireless Communications**

- 9.1. Cellular systems: First, second, third generation
- 9.2. Wireless data
- 9.3. Spectrum policy, competition & innovation
George Calhoun *The Cellular Idea*
Ray Horak *Wireless Networking*

10. **Nov 5 The Technical Standards Wars**

- 10.1. The Economics of Standards Setting
- 10.2. The Politics of Standards Setting
- 10.3. The Dynamic Process
- 10.4. Standards Institutions
Susanne Schmidt, Raymund Werle *Coordinating Technology*
Joseph Farrell, Garth Saloner *The Economics of Horses, Penguins and Lemmings*

11. **Nov 5 Data Security & Cryptography**

- 11.1. Authentication (Passwords, tokens, biometrics)
- 11.2. Confidentiality (encryption)
- 11.3. Integrity (error correction, digital signatures)
- 11.4. Non-repudiation (digital signatures)
- 11.5. Transposition
- 11.6. One-way function: Hash Functions
- 11.7. Symmetric encryption: Secret Keys
- 11.8. Asymmetric encryption: Public Keys and PKI
- 11.9. Digital Signatures
Chey Cobb *Crptography Basics*
Simpson Garfinkle *Digital Identification Techniques*

12. **Nov 5 Digital Rights Management**

- 12.1. The Legal Tradition of Copyright
- 12.2. The Broadcast Flag
- 12.3. Peer to Peer Challenges
- 12.4. Containment Technologies
- 12.5. Globally Unique Identifiers
Randall Davis et al. *Intellectual Property in the Information Age*

13. **Dec 3 Wrap Up & Review of Projects**

Resource Readings

- Abbate, Janet (1999). Inventing the Internet. Cambridge: MIT Press.
- Abe, George (2000). Residential Broadband. Indianapolis IN: Cisco Press.
- Besen, Stanley M. and Garth Saloner (1989). The Economics of Telecommunications Standards. Changing the Rules: Technological Change, International Competition and Regulation in Communications. R. W. Crandall and K. Flamm. Washington DC: The Brookings Institution: 177-220.
- Blumenthal, Marjorie and Davis Clark (2001). Rethinking the Design of the Internet: The End-to-End Arguments vs. the Brave New World. Communications Policy in Transition: The Internet and Beyond. B. M. Compaine and S. Greenstein. Cambridge, Massachusetts: MIT Press: 91-140.
- Bolt, Richard A. (1984). The Human Interface: Where People and Computers Meet. Belmont, CA: Lifetime Learning Publications.
- Brain, Marshall (2001). How Stuff Works. New York: Wiley.
- Brinkley, Joel (1997). Defining Vision: The Battle for the Future of Television. New York: Harcourt Brace.
- Calhoun, George (1988). Digital Cellular Radio. Norwood MA: Artech House.
- Calhoun, George (1992). Wireless Access and the Local Telephone Network. Norwood MA: Artech House.
- Cannon, Don L. and Gerald Luecke (1980). Understanding Communications Systems. Dallas, TX: Texas Instruments Learning Center.
- Carne, E. Bryan (1984). Modern Telecommunication. New York: Plenum Press.
- Cherry, Colin (1980). On Human Communication: A Review, a Survey, and a Criticism. Cambridge: MIT.
- Clark, David D. (1999). Implications of Local Loop Technology for Future Industry Structure. Competition, Regulation, and Convergence: Current Trends in Telecommunications Policy Research. S. E. Gillett and I. Vogelsang. Mahwah NJ: Erlbaum: 283-296.
- Cobb, Chey (2004). Cryptography for Dummies. New York: Wiley.
- Cone, Robert J. and Patricia L. Barnes-Svarney (1998). How the New Technology Works : A Guide to High-Tech Concepts. Phoenix AZ: Oryx Press.

- Covell, Andy (2000). Digital Convergence. Newport RI: Aegis.
- Crane, Rhonda (1979). The Politics of International Standards: France and the Color TV War. Norwood NJ: Ablex.
- Curtin, Dennis P., et al., Eds. (1998). Information Technology : The Breaking Wave. New York: Richard Irwin.
- Derfler, Frank J., Jr and Les Freed (1998). How Networks Work. Indianapolis, Indiana: Que.
- Dertouzos, Michael (1997). What Will Be: How the New Information Marketplace Will Change Our Lives. San Francisco: Harper.
- Dordick, Herbert S. (1986). Understanding Telecommunications. New York: McGraw Hill.
- Dretske, Fred I (1981). Knowledge and the Flow of Information. Cambridge: MIT Press.
- Foster, Ian and Carl Kesselman, Eds. (1999). The Grid: Blueprint for a New Computing Infrastructure. San Francisco: Morgan Kaufmann.
- Fountain, Henry (2001). The New York Times Circuits: How Electronic Things Work. New York: St Martins Press.
- Garfinkel, Simson and Gene Spafford (1997). Web Security and Commerce. Cambridge: O'Reilly.
- Gilder, George (2000). Telecosm : How Infinite Bandwidth Will Revolutionize Our World. New York: Free Press.
- Gillett, Sharon Eisner and Mitchell Kapur (1997). The Self-Governing Internet: Coordination by Design. Coordinating the Internet. B. Kahin and J. H. Keller. Cambridge: MIT Press: 3-38.
- Gralla, Preston (1999). How the Internet Works. New York: Que.
- Hershey, John (2002). Cryptography Demystified. New York: McGraw Hill.
- Horak, Ray (1997). Communication Systems & Networks: Voice, Data and Broadband Technologies. New York: M&T Books.
- Hubel, David H. (1995). Eye, Brain, and Vision. New York: W H Freeman.
- Kahin, Brian and James H. Keller, Eds. (1997). Coordinating the Internet. Cambridge: MIT Press.
- Karu, Zover. Z. (1995). Signals and Systems Made Ridiculously Simple. New York: Zizi Press.

- Lewin, Leonard, Ed. (1984). Telecommunications: An Interdisciplinary Text. Dedham, MA: Artech.
- Macaulay, David (1998). The New Way Things Work. Boston: Houghton Mifflin.
- Marven, Craig and Gillian Ewers (1996). A Simple Approach to Digital Signal Processing. New York: Wiley.
- Maxwell, Kim (1999). Residential Broadband. New York: Wiley.
- McKnight, Lee W. and Joseph P. Bailey, Eds. (1997). Internet Economics. Cambridge: MIT Press.
- Messerschmitt, David G. (2000). Understanding Networked Applications. New York: Morgan Kaufmann.
- Mirabito, Michael M. A. (1994). The New Communications Technologies, 2nd Edition. Boston: Butterworth-Heinemann.
- Monaco, James (1981). How to Read a Film: The Art, Technology, History, and Theory of Film and Media. New York: Oxford University Press.
- Morris, Charles (1946). Signs, Language and Behavior. New York: Prentice-Hall.
- Mukherjee, Biswanath (1997). Optical Communication Networks. New York: McGraw Hill.
- National Research Council (1994). Realizing the Information Future: The Internet and Beyond. Washington, D.C.: National Academy Press.
- National Research Council (1996). Cryptography's Role in Securing the Information Society. Washington, DC: National Academy Press.
- National Research Council (1999). The Digital Dilemma: Intellectual Property in the Information Age. Washington, DC: National Academy Press.
- Negroponte, Nicholas (1995). Being Digital. New York: Knopf.
- Neuman, W. Russell (1991). The Future of the Mass Audience. New York: Cambridge University Press.
- Neuman, W. Russell, Lee McKnight and Richard Jay Solomon (1997). The Gordian Knot: Political Gridlock on the Information Highway. Cambridge: MIT Press.
- Norris, Mark (2000). Communications Technology Explained. New York: Wiley.
- Office of Technology Assessment, Ed. (1992). Global Standards: Building Blocks for the Future. Washington DC: U. S. Congress Office of Technology Assessment.

- Ogden, Charles K. and Ivor A. Richards (1923). The Meaning of Meaning. Orlando: Harcourt Brace.
- Packer, Randall and Ken Jordan, Eds. (2001). Multimedia: From Wagner to Virtual Reality. New York: W.W. Norton & Company, Inc.
- Parsons, Patrick R. and Robert M. Frieden (1998). The Cable and Satellite Television Industries. Needham Heights MA: Allyn & Bacon.
- Partridge, Craig (1994). Gigabit Networking. Reading MA: Addison-Wesley.
- Pelton, Joseph (1997). Overview of Satellite Communication. Encyclopedia of Telecommunications, Vol. 13. F. E. Froehlich and A. Kent: Dekker: 151-179.
- Pierce, John R. and A. Michael Noll (1990). Signals: The Science of Communication. New York: Scientific American Library.
- Pierce, John R. and Edward C. Posner (1980). Introduction to Communication Science and Systems. New York: Plenum Press.
- Postel, Jon and Joe Touch (1999). Network Infrastructure. The Grid: Blueprint for a New Computing Infrastructure. I. Foster and C. Kesselman. San Francisco: Morgan Kaufmann: 533-567.
- Reed, David P. (1992). Residential Fiber Optic Networks: An Engineering and Economic Analysis. Norwood MA: Artech House.
- Rob, Peter and Carlos Coronel (2002). Database Systems: Design, Implementation, & Management. Boston, Massachusetts: Course Technology.
- Rogers, Everett M. (1986). Communication Technology: The New Media in Society. New York: The Free Press.
- Russell, Travis (1995). Signaling System #7. New York: McGraw-Hill.
- Sapir, Edward (1921). Language: An Introduction to the Study of Speech. New York: Harvest.
- Schiffman, Harvey Richard (1982). Sensation and Perception: An Integrated Approach. New York: John Wiley & Sons.
- Schmidt, Susanne K. and Raymund Werle (1998). Coordinating Technology: Studies in the International Standardization of Telecommunications. Cambridge: MIT Press.
- Shannon, Claude E. and Warren Weaver (1963). The Mathematical Theory of Communication. Urbana: University of Illinois.
- Swain, Phillip (2000). The Future of Interactive Television: TV.Com. New York: TV Books.

Techo, Robert (1980). Data Communications. New York: Plenum.

Wallenstein, Gerd (1990). Setting Global Telecommunications Standards: The Stakes, The Players and the Process. Boston: Artech House.

Wayner, Peter (2002). Disappearing Cryptography: Information Hiding: Steganography & Watermarking. San Francisco, California: Morgan Kaufmann Publishers.

White, Ron (1998). How the Internet Works. New York: Que.

Winston, Brian (1998). Media Technology and Society : A History : From the Telegraph to the Internet. New York: Routledge.

Wright, Michael and Mukul Patel (2000). Scientific American How Things Work Today: How Things Work Today. New York: Crown.