Systems, Networks, and Webs:
History and Theory of Infrastructure

This course offers historical, comparative, and theoretical perspectives on the evolution of major infrastructures from the 19th century to the present. We will focus especially on information infrastructures: the Internet, the World Wide Web, and scientific cyberinfrastructures.

To set the stage, we will compare their historical trajectories with those of older transportation, electric power, and communication infrastructures. For example, transportation infrastructures face their most difficult challenges at the interface between different transport modes, as in ports (where shipping connects with trucking and rail) and airports (where air transit connects with automobile, truck, bus, subway, train, and pedestrian modes). These intermodal problems in transport networks find significant parallels in information infrastructures. For example, data conversion (from analog to digital, or from one digital format to another) creates difficult problems for system designers and users; connecting networks built on different standards motivated early Internet research.

The course looks at how infrastructures form, how they change, and how they shape (and are shaped by) social systems. A major focus will be the role of standards (e.g. railroad track gauge, alternating current voltages, TCP/IP, HTTP, HTML) and standard-setting bodies in creating "ground rules" for infrastructure development. Concepts such as "technological momentum" (the tendency of large technical systems to become increasingly resistant to change), "load factor" (maximizing the use of available system capacity), and "interdependence" (among components and between connected infrastructures) will be explored. We will try to articulate the differences between systems, networks, and webs (or internetworks) as both technological and social phenomena.

Prerequisites: none.

Requirements and assignments

This course is “front-loaded” with reading that will prepare you for four weeks of research and writing at the end of the course. Please budget your time carefully.

Students in the masters-level version of the course (541) have a different set of requirements from doctoral-level (741) students.
Requirements for all students

- **Class participation** (20 percent of course grade). This is a discussion seminar, so you are expected to participate actively in all class discussions. This requirement includes at least one in-class presentation of course readings. (Depending on the number of students in the course, you may be asked to do two or more presentations.) Presentations are not graded separately, but their quality is taken into account as part of the class participation grade. See “Presentation Guidelines” and “How to Give an Academic Talk” (CTools). Attendance at all classes is expected.

- **Group/pair project.** Working in groups of two to four, students will create case studies comparing the development of two dissimilar infrastructures. This project should be based on your term paper research.

  The project will culminate in 2 products:

  1. A class presentation, delivered during one of the last three class sessions (10 percent of course grade).

  2. A medium-length paper (2500-3500 words for pairs, 3000-4000 words for triples) OR a website (or other new media product) including the same amount of text. While this paper should be considerably different from the term paper — focusing on comparative analysis — you need not research an entirely different topic. Due in class April 20 (25 percent of course grade). NO LATE PROJECTS.

Additional requirements for 541 students:

- A **1200-1600 word “think piece”** (10 percent of course grade). Due in class Feb. 16.

- **Term research paper** (35 percent of course grade). A 3000-4000 word paper on an infrastructure issue of your choice. This can be a traditional paper, or a hypermedia project (must include the same amount of text). 541 students may use course texts as the primary basis for this project, but must conduct at least some additional research as well (guideline: at least five additional high-quality sources). The assignment has three parts.

  (a) A 400-500 word prospectus, clearly describing your topic, your approach, and the sources you plan to use, is due March 2.

  (b) An extended prospectus (1000-2000 words), further elaborating your topic and showing evidence of additional research, is due March 23.

  (c) A final version, thoroughly revised and proofread, is due by midnight on Thursday, April 23. NO LATE PROJECTS.

Additional requirements for 741 (doctoral) students:

- **Additional required readings** (see schedule).

- A **2000-3000 word essay** on theories of infrastructure development (20 percent of course grade). Due in class February 16.

- **Term research paper** (35 percent of course grade). A 4000-5000 word paper on an infrastructure issue of your choice. This can be a traditional paper or a new media project.
In addition to course readings, 741 students must conduct substantial independent research (at least fifteen additional high-quality sources). Use of original historical sources is encouraged, but not required. The assignment has three parts.

(a) A 500-word prospectus, clearly describing your topic, your approach, and the sources you plan to use, is due March 2.

(b) A extended prospectus (minimum 1500-2500 words), further elaborating your topic and showing evidence of research, is due March 23.

(c) A final version, thoroughly proofread, is due by midnight on Thursday, April 23. NO LATE PROJECTS.

**Required Texts (books available at Shaman Drum):**


Articles and web-based readings on CTools
Copies of all course books are on 4-hour reserve at the Shapiro Library desk.

Plagiarism policy:

Plagiarism is the use of another person’s words or ideas without attribution. In professional settings generally, plagiarism is an extremely serious matter. Professors, journalists, and other information professionals can (and regularly do) lose their jobs for this offense.

All writing assignments for this course must be your own, original work, written in your own words. You may incorporate excerpts from publications by other authors, but they must be clearly marked as quotations and properly attributed. You may obtain copy editing assistance, and you may discuss your ideas with others, but all substantive writing and ideas must be your own or else be explicitly attributed to another, using a citation sufficiently detailed for someone else to easily locate your source. Bare URLs are insufficient as citations.

It is your responsibility to understand exactly what plagiarism is and how to avoid it. All cases of plagiarism will be officially reported and dealt with according to Rackham policies. There will be no warnings, no second chances, no opportunity to rewrite; all plagiarism cases will be immediately reported to SI's Dean of Academic Affairs. Consequences can range from failing the assignment (a grade of zero) or failing the course to expulsion from the University. For additional information about plagiarism, see the "Academic and Professional Integrity Policy Statement" in the SI Master's Student Handbook, the Rackham pamphlet on Academic Integrity, and the Plagiarism document from the UM Libraries. Sweetland Writing Center has special help on plagiarism for international students.

Instructor:

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Course Schedule


**741 required/541 recommended:**


Jan. 19 — **MLK Day: class will not meet, but please read the items below**


**741 required/541 recommended:**


Jan. 26 — **Gateways**


Tineke Egyedi, "Infrastructure Flexibility created by Standardised Gateways: The Cases of XML and the ISO Container," *Knowledge, Technology & Policy* 14, no. 3, 41-54 (CTools)


**741 required/541 recommended:**


Feb. 2 — **Information Infrastructures**

may decide to spend less time on some chapters than on others, but everyone should read chapters 1-2, 6-7, and 9 carefully.

741 required/541 recommended:


Feb. 9 — Cities as Infrastructure

Stephen Graham and Simon Marvin, Splintering Urbanism (New York: Routledge, 2001). Read the Prologue and Chapters 1-5, focusing on chapters 1-3. Also read the table of contents, the lists of tables and figures, and the page of quotations just before the Prologue (but skip the acknowledgements).


Feb. 16 — The Internet


Janet Abbate, Inventing the Internet (Cambridge, MA: MIT Press, 1999)

741 required/541 recommended:

Jorge Luis Borges, "The Garden of Forking Paths" (short story, 1941). Full text at courses.essex.ac.uk/lt/lt204/forking_paths.htm, interesting hypertext adaptation and commentary at www.geocities.com/papanagnou/cover.htm

Recommended (all):

Rhonda Hauben, Netizens: On the History and Impact of Usenet and the Internet. A quirky, but interesting history of the early Internet (including especially its interaction with the history of Unix). The book exists in a print edition, but it is also available online at www.columbia.edu/~rh120/

— 541: “think piece” due in class —

— 741: Essay due in class —

Feb. 23 — NO CLASS (Winter break)

Mar. 2 — Hypertext and the World Wide Web


Vannevar Bush, "As We May Think," *Atlantic Monthly* 176: 7 (1945), 101-08 (CTools)


Explore the CERN (European Laboratory for Particle Physics) web site on CERN and the history of the WWW. See especially the original proposal documents. www.cern.ch/Public/ACHIEVEMENTS/web.html


**741 required/541 recommended:**

Tineke M. Egyedi and Ruben van Wendel de Joode, "Standards and Coordination in Open Source Software," *IEEE 3rd Conference on Standardization and Innovation in Information Technology* (2003), 85-97 (CTools)

— *Term paper prospectus due (541 and 741) —*

Mar. 9 — **The Internet as Infrastructure**


Graham and Marvin, *Splintering Urbanism*, pp. 219-248, 251-256

— *Choose group/pair project partners —

Mar. 16 — **Information Infrastructure in the Developing World**


Castells, *The Internet Galaxy*, chapter 9

Graham and Marvin, *Splintering Urbanism*, Chapter 7

Visit the website of the *Negotiating the Net* book project, www.cidcm.umd.edu/ntn/. Read the “Continent” study (last column on the right). Also choose and read at least two of the country studies. Note that these are drafts; the finished book (2006) is available.

**Recommended (all):**

Graham and Marvin, *Splintering Urbanism*, Conclusion and Postscript
Mar. 23 — Cyberinfrastructure for the Sciences


Visit the website of the NSF Office of Cyberinfrastructure, www.nsf.gov/dir/index.jsp?org=OCI. Choose and read at least one of the “CI+X” reports (on cyberinfrastructure in various sciences), www.nsf.gov/od/oci/reports.jsp


Mar. 30 — Project Presentations

April 6 — Project Presentations

April 13 — Project Presentations

April 20 — Conclusion

— Group/pair project paper due in class. NO LATE PROJECTS —

Thursday, April 23 — Final draft of term project due

Turn in on CTools and in my faculty mailbox (paper)

— NO LATE PROJECTS —