

Six Centuries of Internetworking

A freshman seminar proposal for Fall 2001

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Summary. In the closing years of the 20th century, the Internet emerged as a critical global infrastructure for sharing information and services. While the changes and impacts brought by the Internet have seemed revolutionary, the Internet is but one more evolutionary step in a progression of technological advances leading to today's interconnected world.

This course explores the development, deployment, and impacts of the Internet and its historical predecessors. In the first half of the course, we survey the history of related global network infrastructures that preceded the Internet, including electricity, telegraph and telephone, and media networks from the invention of the printing press through the radio and television era. These technologies form the foundations of the Internet and serve as metaphors for its development and deployment, and for its impact on society and the way we see the world. The second half of the course explores the evolution of the Internet, the hardware and software technologies behind it, and the people and companies driving its growth. Finally, we discuss the new issues and technical challenges raised by global dependence on our intertwined networks for energy and communications.

Course Goals. This course deals with the Internet and related systems for transmitting information, ideas, and services. It focuses on the *process* rather than the *products* of technological innovation: the course focuses less on the technology itself than on how it came to be and how it might evolve in the future. Thus the course does not assume any specific technical background beyond basic familiarity as a user of the Web, e-mail, telephones, television, etc.

The fundamental goal of the course is to set the Internet in historical context by drawing on examples from the past that are similar in their nature or impacts. This creates an opportunity to learn about the people and forces behind some of the major transforming technologies that have shaped the modern world. The readings tell the stories of critical innovations in an engaging way, in part to motivate study in technical fields and to excite students about the potential of their own creative energy.

The technology stories also serve as a basis for examining the social impacts of technology, public policy issues, dependence of modern societies on large-scale interconnected systems for energy and communications, and the vulnerabilities of those systems. In particular, class discussions examine how these stories support different points of view on the politics of technology: money and intellectual property, ways that societies support or inhibit innovation, the

role of government vs. industry in developing and deploying infrastructure technologies, and the role of these technologies in sustaining or undermining concentrations of wealth and power.

Workload. The course will center on reading and discussion. The instructor will pose questions and present alternative points of view to consider. Students will come prepared to discuss their positions on specific questions and topics, and to support those positions with examples from the readings. The reading list centers on 6-8 books focusing on stories of technological innovation and their impacts, supplemented with reprints of articles from the popular press (e.g., *The Economist*, *Scientific American*, *MIT Technology Review*). Writing assignments include several short, persuasive essays, which will be reviewed in depth and rewritten as necessary, and a longer research paper exploring a specific technology not covered in the assigned readings. There may be one written examination, depending on the level of engagement in the discussions.

Topics. Readings in the later part of the semester trace the development and acceptance of the Internet and its key components, including computers, operating systems, routers and switches, network protocols, the Domain Name Service, Web browsers and servers, and digital security technologies. To gain perspective on these developments, additional readings focus on other technologies that are related to the Internet in some way, either by providing related capabilities at a different period in history, or by establishing essential foundations.

1. *Printing press.* This was the first medium for large-scale information storage, transmission, and distribution.
2. *Chronometer.* The 17th century version of the Global Positioning Sensor (GPS) enabled accurate mapping of the world and reliable transportation of people and goods (and armies) worldwide.
3. *Telegraph.* The creation of the telegraph marks the dawn of electronic communications and the foundation of the phone system and the Internet.
4. *Electricity.* The structure and deployment of the electrical grid parallels the Internet. As essential infrastructure, it faces many of the same issues of coordination, control, and security.
5. *Radio and television.* Broadcasting introduced “content” as a consumer good, an economic model supported by advertising, and the potential for centralized control over information.
6. *Fuel cell.* Micropower is an evolving innovation story that illustrates the evolutionary path to revolutionary technology. Its impact on the electrical grid may be analogous to the invention of the PC in the Internet story. It faces new deployment obstacles because it displaces existing entrenched systems rather than offering fundamental new capabilities, and because widespread use requires a new hydrogen infrastructure.

Discussion topics surrounding these stories include the personalities of the innovators, the conditions that directed their focus on specific problems, the choices they made to develop and promote their inventions, resistance or support of government, the public, and the scientific community, and the process by which the technology was ultimately embraced and refined to “scale up” for deployment as a critical large-scale infrastructure.

Readings. Candidates for the reading list include:

Longitude : The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time by Dava Sobel ; Paperback \$9.56

The Printing Revolution in Early Modern Europe (Canto Series) by Elizabeth L. Eisenstein ; Paperback \$11.16

The Victorian Internet : The Remarkable Story of the Telegraph and the Nineteenth Century's On-Line Pioneers by Tom Standage ; Paperback \$9.60

Rescuing Prometheus, by Thomas P. Hughes ; Paperback, \$12.00

Inventing the Internet (Inside Technology) by Janet Abbate ; Paperback \$16.95

Where Wizards Stay Up Late: The Origins of the Internet By Katie Hafner, Matthew Lyon ; Paperback

Powering the Future: The Ballard Fuel Cell and the Race to Change the World by Tom Koppel ; Paperback \$19.95