The Web’s Missing Links:
The Search Engine & Portal Industry

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BSSH, Manchester, June 2007

Background of Project
- Software infrastructure chapter – web, email, protocols
- Search and portals (“Web navigation business”)
- Contemporary history, somewhat journalistic
  - Recounting of basic events from secondary sources
  - Focus on interplay between technology and business models

Aims
1. Write analytical history from journalistic sources
2. Situate web with respect to other electronic publishing technologies
   - And earlier Internet story
3. Tie together
   - Web publishing economics
   - Web navigation economics
   - Technical choices built into web design

Social Construction of Technology
Two key concepts established since 1980s
1: Mutual shaping of technologies and society
   - Influence of social factors on technological design choices
2: Power of technological SYSTEMS
   - Combine users, firms, standards, technologies
   - Lock-in effects of dominant systems as “Technological Momentum”

Reconstruction of Technology
- Commercialization of Internet infrastructure
- What happens when an already “shaped” technology gets
  - New uses
  - New “relevant social groups”
  - New cultural meanings
- Thoughts at the back of my mind
  - VHS vs Betamax, QWERTY vs. Dvorak
    - which is the net?

2: Narrative Overview
Web Hosts Growth

Timeline of Developments
- 1991: Web introduced at CERN
- 1993: Mosaic popularizes the Web
- 130 servers to 10,000 in 18 months
- 1993: First web crawlers
- 1994: Yahoo directory service founded
- 1995: AltaVista, Lycos, Excite, Infoseek & OpenText index web
- 1995: Netscape IPO
- 1996: Yahoo, Excite, Lycos & Infoseek IPOs
- 1998: Google, Inc. founded
- 1999: Search firms converge on Portal model
- 2000: Dot com crash signals end of easy money
- 2000: Google starts selling AdWords
- Today: Google dominates search, Yahoo is primary U.S. Portal

Web Directories
- The Web As Its Own Catalog
  - Link directories are special-purpose websites
  - Yahoo is most successful
  - Humans visit lots of websites
  - Find the best ones on a topic
  - Add them with topic code to a simple database
  - Directory listings are batch generated
  - Basically the yellow pages of the Internet
  - Businesses pay for prominent position
  - Firms advertise to reach searchers

Search Engine Model
- Crawlers index the web
  - Technology already developed for ftp sites, gopher headings
  - Keywords entered by users are looked up in index
  - Index & search developed for online services, full text databases like OED
- Hard to do well!
- How to make money?
  - Subscription model fails for Infoseek
  - Standard for online databases like LEXIS
  - Advertising supported
    - Popular keywords sold at a premium from 1995
    - Also sell tech or services to other websites
Portals

- Internet navigation firms add content
  - Both Yahoo (directory)
  - And Excite, Lycos & other search firms
- Theory: add “stickiness” – be more like AOL
  - Good search sends users away quickly
  - Keep them around instead
    - News, Weather & Horoscopes
    - Free email
    - Shopping “malls”
  - They watch more banner advertisements
- But unlike AOL aren’t online services

 AltaVista

Influence of .com Boom

- Portals copy AOL with “strategic partnerships” with doomed startups
  - E.g. “Exclusive CD retailer on Yahoo”
  - Excite@home pays $780 million for online greeting card company
  - Companies valued on number of visitors
- Need rising numbers to justify valuation
  - YHOO stock rises 100 times in 4 years from IPO
  - Lycos (#3 portal) sold for $12.5 billion in 2000

Portals Largely Wiped Out

- Had deemphasized search
  - Full of advertising & paid results
  - Swamped by search engine spam
  - Little investment in improvements
- Crippled when easy money dries up in 2001
- By 2003 Yahoo is only significant non-ISP portal
- AOL and MSN retain online service portals

3: Special Features of the Web
(Let’s open the black box...)
Why Was the Web Special?
- Universal electronic publishing & mail network long predicted
  - But that it would be Internet based was not!
  - Huge sums invested in videotext, cable TV systems, etc.
- Web is the first functional
  - Very large scale
  - Highly distributed (no index or catalog)
  - Hypertext
  - Electronic publishing system
- So, how & why was it different from other electronic publishing systems?
  - And how did this influence the web navigation industry?

Web Navigation Business
- Unlike earlier electronic publishing, the web has no search or index built in
  - Makes publishing very easy, retrieving very hard
  - Hypertext seen as alternative to searching and indexing
- Unlike earlier electronic publishing systems
  - Navigation and indexing content is a separate business from publishing content
  - Creates huge business opportunity for web directory & search

The Early Web
- Leverages existing Internet technologies
  - TCP/IP, FTP, news, Gopher, SGML, SMTP etc
  - New elements: HTML, HTTP, URL
- Simple design
  - Elegantly tackles immediate needs
- Fundamental problems ignored
  - Searching
  - Hyperlink issues
- Follows cultural traditions of Internet

Layering of Protocols

<table>
<thead>
<tr>
<th>FTP Client (File transfer)</th>
<th>Mail client (Mail transfer)</th>
<th>Web browser (HTTP)</th>
<th>Many others….</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTP</td>
<td>SMTP</td>
<td>HTTP</td>
<td>Video, chat, news, P2P, instant messaging</td>
</tr>
</tbody>
</table>

Socket API
TCP/IP
(also DNS shared by applications)

Construction of Internet Technologies (1970s-80s)
- Closed, homogenous, small academic population
  - Results: Rely on social mechanisms for security, elimination of troublemakers
- Practical, working network
  - Rather have it next week than perfect
- Non-commercial
  - No mechanisms to bill for use of resources
- Support for many machine types
  - Compatibility through standards, not code

Construction of Internet Technologies II
- Decentralized and international
  - Easy to connect new machines, sub-domains
- Many different communication mechanisms
  - TCP/IP works over many media
- Connects computers to each other
  - Peer to Peer - any machine can be client or server
- Created for experimentation and research, not one specific task
  - Separation of application protocols from network mechanisms
Berners-Lee’s Limited Resources

- Computer specialist at CERN
- Supporting the real science...
- Web justified as useful tool for CERN
- By 1994, CERN gave 20 man years of effort over 5 years
- Mostly from interns and post docs
- Initial appeal of web as integrator of existing content
- FTP, news, Gopher, telnet
- Contrast with major electronic publishing projects – Xanadu, Time Warner, etc.
  - No hypertext, information retrieval or database specialists involved
  - No grants awarded
  - No top management approval

Difficult Problems Ignored

1. From Hypertext Research
   - Maintaining links in distributed system
   - State of the art: 2 way, versioned, typed links

2. From Information Retrieval & Databases
   - Standards for metadata
     - (date, author, keywords)
   - Searching distributed databases

Difficult Problems Ignored

3. From Online Services (& Xanadu)
   - Charging for microtransactions
   - Reimbursing content providers

As A Result of Problems Ignored

- Web server is very simple
  - HTTP just delivers requested file
- Web has no catalog (central or federated)
- Links decay rapidly
- There is no clear way to make money from web publishing

The Need for Web Navigation

- Web servers very easy to set up, so people do
  - No license, fees, or permissions needed
  - No need for specialist cataloging skills
  - Add one small service to an existing computer
- As a result of same characteristics information is very hard to find
- Search firms need (unlike TBL team)
  - Great algorithms
  - Big computers
  - Ph.D. specialists
  - Venture capital

4: The Triumph of Google
Google
- Seizes a neglected search market
  - Highest quality search results
  - Lowest profile advertising (from 2000)
  - Simplest user interface
- Two big innovations
  - PageRank algorithm
    - Priority for pages widely cited by widely cited pages
  - Pay-per-click advertising with price set by auction algorithm on keyword

Internet Publishing Models
- No support for payment for content
  - Micropayment hyped but flops
  - Web publishing model shifts fundamentally from AOL era
- Users resist subscription services
  - Economic foundation for web publishing comes from advertising, not readers
  - Economies of scale favor big firms
  - Key argument for portals

Pay Per Click Ad Model
- First used by Overture, Google copies
  - Traditional: $X per thousand page views
  - New: $Y per person who clicks on an ad
- Easy to add Google ads to a website
  - Revenues split with website operator
  - Selection algorithm includes several factors
    - Site content
    - Amount bid & frequency of clicks
- Changes economics of web publishing
  - Smaller sites can cover costs, make money

Current Situation
- Google booms
  - Adds new services
  - Keeps things simple
  - Offers APIs for maps, etc.
  - Broadens ad-syndication business
- Yahoo stumbles
  - Realizes importance of search, launches own engine
  - So far unable to match Google’s effective ad targeting
    - Despite hyped “Panama” project

Open Questions
- How would one ideally tackle the topic?
  - Is it too soon to write this history?
  - Where are the users?
  - Is this a new industry or continuation of yellow pages, etc.
- What to do with academic side of story?
  - Lycos: CMU
  - Yahoo, Google, Excite: Stanford
  - Open Text: Waterloo

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