Today’s Class

- **Search wars: Amazon’s A9 site**
  - Features of the site: inside book, search history

- **Short papers**
  - Online news revenue models

- **Linux and open source**
  - Goldman report
  - Open source and software industry structure

- **Reminders**
  - Short paper #5 handed due Tuesday 27th
  - Final project presentations 5/4, papers 5/11
Online News Advertising

- Need to consider advertising goals, appropriateness to venue and to method
  - Branding, direct marketing
  - Specificity of user goals, of content
    - More specific fits direct marketing better
  - Accurate knowledge of demographic

- Problem of measuring ad effectiveness
  - Better for direct marketing, using measures such as CTR and conversion rate
  - Less clear what these mean for branding
    - When reasonable to expect click
Online News Revenue Trends

- Increased use of contextual ads
  - Placed by news organizations on search engines
    - E.g., BBC building US presence
  - Placed by news customers on own sites
    - E.g., recent WSJ, CNN, ESPN deals with Overture

- Paid access to historical articles
  - Reverse-time versioning (digital goods)

- Effects of driving traffic vs. losing control
  - News aggregators like GoogleNews (NYT, WSJ)
Revenue Recommendations

- Being big enough for own bidders
  - Problem of intermediary such as Google or Yahoo between site and advertisers
  - Branding issues with AdSense
  - Need critical mass of bidders to work
    - News sites going on their own
    - Services targeted at news only

- Opportunities for new categories of keywords
  - Not just search terms or article content
    - News category, byline, sentiment, ...
Rise of Linux

- Goldman Sachs report
  - Linux on Intel likely to emerge as dominant platform in corporate data centers
    - Replacing proprietary Unix systems
      - Sun Solaris, HP UX, IBM AIX
    - Limiting growth of Windows server systems
  - Linux has evolved into “enterprise class” operating system
    - Not just for low-end “edge” servers such as file, print, Web, email
  - Significant consequences for both IT vendors and IT departments
Broader Open Source Context

- Open source is changing IT industry competitive structure
  - Making certain lines of business less attractive and others more attractive
  - Too big to ignore, demands a response from many industry players

- A potential new model for digital goods more broadly – “artists guilds”
  - Much of the reward comes from recognition rather than financial remuneration
    • But where do companies and people get paid?
Linux Value Proposition

- Enables use of lower-cost Intel based (IA) server hardware with Unix-like OS
  - Previous choice of Windows on IA hardware vs. vendor-specific Unix and hardware bundle
- Enables use of many hardware vendors
  - Linux runs on IA servers from Dell, IBM, HP, etc. as well as variety of non-IA servers
  - Previous choice of vendor-specific solution resulted in “lock in”
    - Switching cost to change applications to new OS
- Relatively easy to port to Linux from Unix
Linux Provides Common Platform

- Sun Solaris on Sparc
- IBM AIX on AS-400
- ...
- MS Windows on IA

- Applications need only support Linux API’s and not different vendor-specific Unix API’s
Server Market, pre-Linux

- Unix system vendors
  - Bundled proprietary version of Unix and proprietary hardware
    - Sun, IBM, HP
  - Infrastructure software from same or other vendors
    - Databases, middleware, app servers
  - Applications software from ISV’s

- Windows server hardware vendors
  - Operating system, infrastructure and much application software from Microsoft
  - IA (mainly x86) hardware from Dell, HP, IBM, ...
Linux Meeting Business Needs

- Open source phenomenon created new opportunities for customers
  - Drove commercial adoption
- Open source creating new options for customers
  - Destabilizing vendor lock-ins
  - When feasible
    - Type of software
    - What kind of value?
    - Can companies guide this strategically?
- Linux a late not early arrival in OS market
Linux Server Market

- **System vendors**
  - Linux bundled with IA hardware
    - IBM, HP, Dell
  - Linux on other hardware
    - IBM mainframes, zSeries
    - To some degree HP

- **Linux vendors**
  - Several companies, RedHat dominant

- **Two enterprise extensions, not (yet) fully standardized**
  - RedHat, United Linux consortium
Linux Vendors

- No proprietary software advantage
  - Open source, widely available
- Possibility of proprietary extensions
  - But likely to alienate open source community
  - Counteracts significant customer benefit of Linux which is standardization
- Main value is in certification and support
  - Certifying that certain versions of Linux perform up to particular standards
    - With various commonly used application and infrastructure software
  - Cataloging and providing easy patches/updates
Effects on Software Vendors

- Types of software vendors
  - OS
  - Infrastructure
    - E.g., databases, Web servers, app servers
  - Applications
    - E.g., productivity tools, HR/payroll

- Remaining OS vendors
  - Microsoft, fighting Linux
  - HP and IBM, “maintenance” of proprietary Unix
  - Sun and Apple, selling bundled custom hardware and OS
Overall Server Marketplace

- Four paradigms
  - Linux new, likely to adversely affect others

Proprietary Unix
- Sun
- HP
- IBM

Windows on IA
- Dell
- HP
- IBM

Linux on IA
- Dell
- HP
- IBM

Linux on non-IA
- HP
- IBM
Server Vendor Strategies

- Complete solution vendors (IBM, HP) embracing Linux
  - HW, OS, infrastructure SW, consulting, support
  - Somewhat cannibalizing own proprietary Unix
  - IBM most aggressive
    - Linux competency center, 250 engineers

- Box vendors (Dell) embracing Linux
  - Largely as alternative to Windows
    - Mainly lower end servers

- Proprietary Unix vendors (Sun) trying to limit Linux to edge servers – success?
Microsoft Response

- Initially tried discrediting Linux
  - Ballmer dismissed at 1998 trade show
  - 1999 “Linux Myths” web site
    - Questioned performance and reliability
    - Cancerous because OS licenses limit IP rights
    - Has proven relatively ineffective
- Widely cited and posted memo from David Stutz when he left Microsoft
  - Innovate rather than getting defensive
  - OSS threatens eroding economic value of software
OS Vendor Market

- HP and IBM exploiting Linux to
  - Cut own costs
  - Provide better cross-platform support to customers
  - Focus on overall solutions with hardware, software and consulting

- Apple and Sun continuing their standard model of bundled proprietary system
  - Sun much less successful because of head-on Linux competition in core market

- Microsoft having mixed server success
What Should OS Vendors Do?

- HP/IBM model is apparently having success
- Microsoft does not need the server OS market though they are working hard on growing it
  - Important for all their (server) applications which run only on Windows
- Sun has only a server business
- Should Apple (and Microsoft) worry about a desktop open source OS?
Evolution of Linux

- Initial deployments have largely been in “edge” servers: Web, print, etc.
  - Less mission critical, more drive to lower cost
  - Mainly displacing vendor-specific Unix+HW
  - Also affecting growth of Windows servers
  - Dell large beneficiary
    - Lowest cost large provider of IA servers
- Starting to see deployments in data center
  - Core, mission critical servers
  - Still substantial drive to lower cost
  - Still in early adopters stage
Infrastructure and Applications

- Most applications do not depend solely on API’s in OS
  - Use infrastructure software to provide additional functions
    - App servers: e.g., BEA WebLogic, IBM WebSphere, Apache Tomcat
    - Database servers: e.g., Oracle, MS SQL server
    - Storage managers: e.g., Veritas

- Both infrastructure and application software must be converted to Linux
  - Main infrastructure vendors have or are doing
    - Initial cost but longer term benefits for them
Infrastructure Software

- Infrastructure software needs to run on Linux for applications to do so
  - Applications usually also depend on OS directly as well
    - Not always case, e.g., J2EE app servers are supposed to hide OS from applications

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Application
Infrastructure
Linux
Hardware
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Effects of Linux on IT Industry

- Big winners and losers in hardware
  - Who, why
  - Could winners do better helping Linux (more)

- Big winners and losers in OS software
  - Who, why
  - OS as cost vs. revenue

- Effect on computer services business
  - IT consultants, flexibility

- Effect on other software vendors
  - Infrastructure software, application software
Needs of Data Centers

- **Reliability**
  - Frequency and duration of unavailability
    - Downtime usually costs company much more than additional preventive expenditures
    - Often seek “five nines” – 99.999% uptime
      - About 5 minutes total downtime per year

- **Security**
  - Can affect reliability, e.g., virus, DOS
  - Need to protect data from unauthorized use or manipulation

- **Manageability**
  - Administration and troubleshooting of systems
Trends in Data Centers

- Increasing focus on total cost (TCO)
  - E.g., consolidation of servers, reduced excess capacity

- Within constraints of reliability, security and manageability
  - IA hardware attractive alternative to proprietary Unix system hardware
  - But Windows often not attractive as OS
    - Perceived as less reliable
    - Not generally easy to port from dominant Linux environment
  - Linux at least being actively considered
Linux in Data Center Early Adopters

- Many of the “new economy” service providers
  - Tend to have technology savvy staff
  - Often building new systems from ground up
- Google, Yahoo (Inktomi), Amazon, VeriSign, E*Trade, but also CNN
  - Several have moved from vendor proprietary Unix systems
  - Some have documented large savings
    - E.g., Amazon estimated 25% reduction in data center costs in SEC filings
Other Open Source Projects

- Technology-focused infrastructure software
  - Broad base of technical users with skills and desire to contribute
    - Operating systems (Linux and GNU)
    - Web and application servers (Apache/Tomcat)
    - Databases (MySQL, Postgres)
    - Security (Snort)
    - Storage

- Less domain-specific application software
  - Business process critical
  - User bases do not have technical skills or motivation
Infrastructure Software Market

- Linux has had substantial effect on OS market
  - Support from large firms like IBM important for mainstream adoption
- Open source email and Internet infrastructure predates many commercial solutions
- What other infrastructure software likely to move to open source
  - E.g., Databases
    - What necessary from business perspective