Technology Transfer and the Origins of the Commercial Internet. A few stories.

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Starting point

- Many key inventions for the commercial internet came from government-subsidized R&D.

- I wrote a book that examined the creation of the commercial internet. From origins to blossoming.

- One theme of the book: governance of technology transfer made enormous difference.

Today: Four of six (plus) episodes of transfers

- **Internet backbone.** Transfer to private hands, & invent practices for data exchange.
- **TCP/IP.** Transfer to non-for-profit organization the standards body to help evolution of TCP/IP.
- **World-Wide-Web.** Establish organization to help WWW evolve.
- **Browser. T**ransfer of prototype to private firms for commercialization.
- **Webserver software.** Transfer to private firms and not-for-profit organizations.
- **Search engine.** The transfer of that into private hands.

- **Plus scores of routine licensing.** Particularly in frontier fiber optic equipment. (Which the book largely does not discuss.)

- Today we will focus on four episodes (in red).
  - These three come close to your interests, as I understand them.
  - Can discuss the other three if curious.

Governance of technology transfer: themes

- Multiple channels for moving technology. Some planned and some not.
  - Give away assets and/or shareware.
  - License intellectual prop. Exclusive or widely.
  - Knowledge moves with people.
- Private firm actions have Incentives to help own interest, not necessarily to further societal goals.
- Core issue for manager: how to stay consistent w/their mission?
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- Doubly challenging b/c commercial players often have interest in use-cases that did not arise in universities.
  - Universities have limited experience to judge which use-cases had private value.
- History's lesson: Good intentions not enough.
  - Lesson: approach w/humility.

World Wide Web

- Tim Berners-Lee an employee at CERN. Develops hypertext system.
  - Prototypes it at CERN. Given broad discretion.
- Makes available on shareware.
  - Starts to gain interest.
- TBL approaches IETF to get certification & standards endorse.
  - Pushback over ownership. He approaches CERN, who renounces property rights.
- Again, TBL approaches IETF.
  - Runs into “black-holes” of arguments → decides to start own standards organization to help w/growing use.
  - Approaches CERN management, who refuses to house it. Outside their mission.
- MIT becomes home for World Wide Web Consortium in 1994.
- Summary: The most important software of 90s moves to MA b/c IETF fails to certify, & CERN does not view its mission broadly.

The browser

- Browser at NCSA. Funded by NSF.
  - One of many projects. Unimportant initially. A few among hundreds.
  - Linux then Windows → popular.

- Transfer technology with licensing.
  - University faces state pressure to show revenue → moved to own, so could license → Intermediary started licensing → more than 100 licensees → eventually Microsoft → who put all other licensees out of business, except…one firm…
    - Eventually a fight w/MS about $$.

- Transfer technology with people.
  - Ownership/licensing angered lead programmer who graduates → moves to Palo Alto → w/Jim Clark starts Mosaic Communications Company. → sued for copyright (Mosaic) → changed name to Netscape → catalyzed industry.

- Bottom line: licensing seeds competition against a firm founded by the university's own students, who were more effective at catalyzing change.
  - Epilog: One employee, Eric Bina, goes back to university. Others remain angry.

The web server…

- Webserver is necessary to make browser useful. Designer (Eric Bina at NCSA) put webserver on shareware. Adopted widely.
- Netscape started → recruited Eric Bina to be among first employees. He accepted, left university with three days notice.
- University did not/could not find a replacement → webmasters got frustrated → start making their own improvements → combine their efforts after a year → establish Apache Foundation (A "patch"). Becomes leading webserver by beating all proprietary efforts.
- NCSA hires someone a year later, discovers what has happened, and tells NCSA it is pointless, and NCSA wisely gives up.
- Bottom line? Shareware + university neglect → leading webserver software.
  - Would any university action, such as licensing, have made this any better?

The search engine…

- Two graduate students create new algorithm in lab (on NSF funding). Implement a prototype.

- University patents it & tries to license to Valley firms. All say no.
  - Arm-chair QBs: Did the licensing ask for too much money? Did managers at Valley firms not understand what they could have?
  - Did prototype from Berkeley (Inktomi) set misleading example?
  - Was license alone not enough? Did it need inventor & added talent?

- Ironically, the failed licensing motivates students go ABD, start a company.
  - Help from Angel investor, founder of SUN, Andy Bechtolsheim.
  - Years to figure out how to make money.
  - Most profitable startup of the 90s.

- Epilog: Chinese PhD student at Cornell invents similar algorithm & university patents it. (Eventually settles w/Google over competing claims).
  - Concludes he cannot start a business in the US. He goes home and starts Baidu..

Some observations

- Transfers are difficult to govern.
  - Often more than one viable channel for transferring technology.
  - Inconsistent aims: wide diffusion, fast diffusion, or more revenue?
  - Tradeoffs b/w channels non-obvious.
- Governance of transfer plays a big role in the creation of private value.
  - Whether competitive or exclusive..
  - Whether favors established firms.
  - Whether catalyzes change
- Issues inescapable when technologies past prototypes.
  - Once something valuable emerges, private firms take a keen interest.
  - Licensor at information disadvantage.
- Good intentions were not enough.
  - Commercial actors often better informed about use-cases.
  - Policy slow to react to new events.
  - Shareware can be faster than active management of channels.

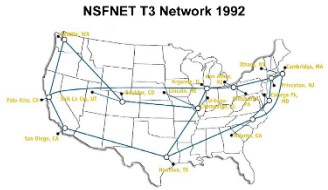
Thank you for your attention

More examples

TCP/IP

- Initial funding at DARPA
  - Establishes practices of sharing information with one another.
- Transfer to NSF
  - Establishes practices of making available information w/o restriction.
  - Similar to voluntary standards.
- Internet Engineering Task Force
  - 1987. For computer scientists.
  - Regular meetings. Governance.
- As the backbone privatizes,
  - IETF places under non-for-profit organization, the Internet Society, like any standard setting organization.
  - DARPA/NSF no longer solely in charge of governance.
- Licensing plays no role in the biggest transfer of all.
- All the academic work becomes available to anyone at no charge.
  - Practices similar to open source communities, initially without the formalism of open source.

Internet backbone



- Giving away assets.
  - IBM (i.e., IBM's lawyers) tried to manipulate the rules so it did not interconnect → become a monopolist on national backbone.
- Did not succeed b/c bad publicity → Congressional action.
- Fall out: Carrier outrage → establish data-exchange (CIX)
  - CIX example → NSF added exchanges to its privatization plan
- Narrow conclusion: Internet would have differed had IBM succeed.
  - Also would have differed had IBM not tried & failed → motivate CIX.
- Narrow conclusion: Saved by "honest policy wonks." See my book.
- Broad observation: Transferring assets a policy mess.
  - Exclusivity is biggest issue.
  - Inherent in the invention of something so valuable, where private firms have obvious interests.