

Broadband network structure and natural monopoly

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Overview

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- Public BB provision
- Joint production
- Cable and scaling
- BB cost structure
- Usage costs in BB
- Finland v Sweden
- Network structure
- Peculiarities of BB
- A word on wireless
- State management
- The telegraph
- World cables in the 1920s
- Conclusion

This paper is motivated largely by an attempt to understand how natural monopoly arguments would be different for broadband than for cable TV.

Further, the role of special characteristics of broadband content delivery are considered.

R.D. Atkinson. Role of Competition in a National Broadband Policy. J. on Telecomm. & High Tech. L., 7:1, 2009.

X. Wen. Market Dominance by China's Public Utility Enterprises. Antitrust LJ, 75:151, 2008.

Public BB provision

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The rationale for public intervention comprises two thrusts:

- natural monopoly as an argument for the efficiency of a single provider, to be regulated by the authorities; and
- welfare arguments for the subsidy of access by large groups of consumers that might otherwise be left behind by development.

We consider the first point although it will in general also imply subsidies.

A. Picot and C. Wernick. The role of government in broadband access. *Telecommunications Policy*, 31(10-11):660–674, 2007.

T.W. Hazlett. The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's "Big Joke": An Essay on Airwave Allocation Policy. *Harvard Journal of Law & Technology*, 14:335–767, 2001.

Joint production

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There are economies of joint production whenever

$$C(q^S) + C(q^T) \geq C(q^{S \cup T}) \quad \text{whenever} \quad S \cap T = \emptyset \quad (1)$$

for all demand levels, where $C(q^U)$ is the cost of supplying the demand of a subset $U \subseteq \{1, \dots, N\}$ of the consumers.

Under these circumstances, the arrangement of a single supplier for all consumers has no disadvantage over many suppliers.

Note that 3^N inequalities must be satisfied.

G.R. Faulhaber. Cross-subsidization: pricing in public enterprises. *The American Economic Review*, 65(5):966–977, 1975.

Cable and scaling

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The service is essentially unidirectional, the cost of joining two separate networks, providing the same content, is quite low.

Suppose disjoint subsets A and B of consumers are each served by a separate cable network. Each network will have its infrastructure as well as distribution equipment and administrative overheads. The joining of the network serving A to the network serving B could consist of any connection from B that delivers the content to a suitable point on the defunct network for A . The cost of splicing the connection to the existing network for B would be minimal and require no substantial redesign of the network for B , provided the networks are not (say) on different continents or planets.

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Faulhaber and Hogendorn (2000) point out that the cost structure in broadband provision arise in three ways:

1. cost per unit of actual usage;
2. a cost per actual user; and
3. a cost per potential user.

The cost (1) arises in broadband and cable television networks in a similar way and (2) is similar but (3) is zero for cable television and significant for BB.

Network effects also exist in BB networks but are quite hard to estimate.

G.R. Faulhaber and C. Hogendorn. The market structure of broadband telecommunications. *The Journal of Industrial Economics*, 48(3):305–329, 2000.

Usage costs in BB

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Joining of networks serving subsets A and B of consumers is not quite as simple where broadband access is concerned.

Adding customers A to the old network for B can result in entire network for B having to be upgraded to provide upstream capacity for A .

Cable television supplies (with the exception of pay-per-view and similar services) the full range of content to every premise.

Broadband networks do not deliver “the Internet” to every premise, but rather just *access* to the Internet. BB access cannot be duplicated locally. Demand matters!

Louis Plissonneau, Jean-Laurent Costeux, and Patrick Brown. Analysis of Peer-to-Peer traffic on ADSL. In *Passive and Active Network Measurement*, pages 69–82. 2005.

Finland v Sweden

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Sweden pursued an interventionist strategy, with the state building a national backbone network as well as subsidising other infrastructure.

Heikki et alii (2008) report that Finland achieved levels of broadband availability similar to Sweden's without public investment in infrastructure.

Can the Finnish model work elsewhere?

E. Heikki, L. Frank, and H. Timo. Does strategy matter? A comparison of broadband rollout policies in Finland and Sweden. *Telecommunications Policy*, 32(6):412–421, 2008.

Network structure

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Structure of the Internet has been the subject of enthusiastic research, including on economic incentives in file sharing and other applications.

Because of

- NAT and
- virtualisation

it is extremely difficult to build a node-to-node picture of the Internet.

J. Kleinberg and P. Raghavan. Some results of Christos Papadimitriou on internet structure, network routing, and web information. *Computer Science Review*, 3(2):119–125, 2009.

W. Willinger, D. Alderson, and J.C. Doyle. Mathematics and the internet: A source of enormous confusion and great potential. *Notices of the American Mathematical Society*, 56(5):586–599, 2009.

Peculiarities of BB

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The BB network is not like a traditional telecommunications network.

- There is no obvious natural limit on the traffic.
- Communication is not necessarily between fixed points on the network.
- Traffic is highly heterogeneous.

All of the above imply complex issues of planning and pricing.

G. Goth. New Internet Economics Might Not Make It to the Edge. IEEE Internet Computing, pages 7–9, 2010.

R. Cooper and G. Madden. Internet network externalities. International Journal of Management and Network Economics, 1(1):21–43, 2008.

D.E. Marcus and D. Elixmann. Regulatory Approaches to Next Generation Networks (NGNs): An International Comparison. Communications and Strategies, 69, 2008.

A word on wireless

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“Most of us grew up in an era where voice telephony was strictly from wires in the ground and television purely over the air and now live in a world where the opposite is the case.”

Nicholas Negroponte

Wireless BB will always be very good for providing access as a last-mile or middle-mile technology. How it can be deployed to provide acceptable capacity is a question involving backhaul and spectrum management issues.

Sebastian Max, Erik Weiss, Guido R. Hiertz, and Bernhard Walke. Capacity bounds of deployment concepts for wireless mesh networks. *Perform. Eval.*, 66(3-5):272–286, 2009.

State management



The telegraph

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Kielbowicz (2009) cites WS Jevons in 1867 writing on state management being advantageous where

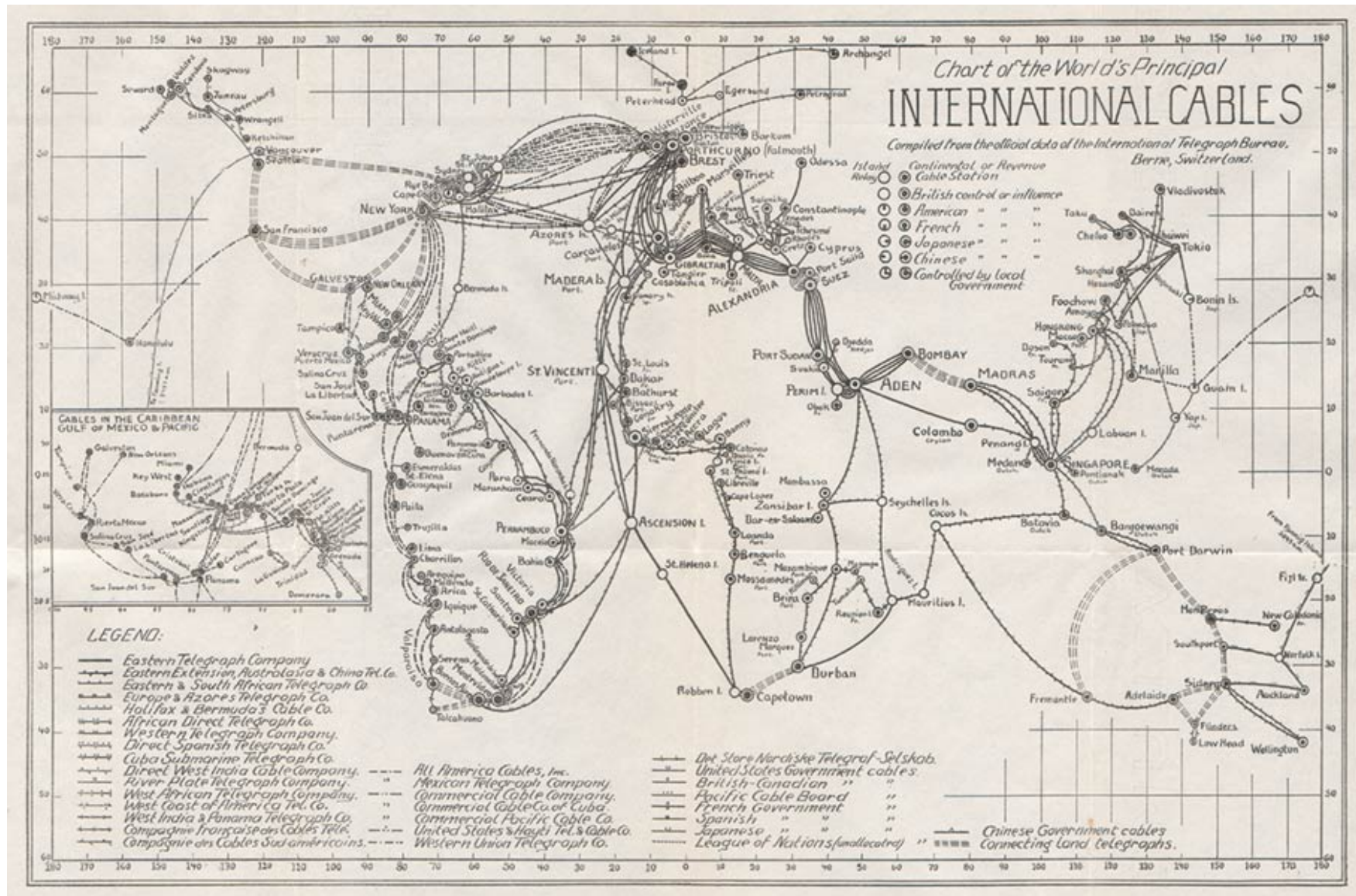
1. economies of joint production exist;
2. operations are routine;
3. public scrutiny is easy; and
4. little capital is involved.

Jevons supposed then that a

“telegraph system appears to me to possess the characteristics which favour unity and State management almost . . . as the Post Office.”

R. B Kielbowicz, AT&T's Antigovernment Lesson-Drawing in the Political Economy of Networks, 1905-20, *History of Political Economy*, 41(4):673–708, 2009.

World cables in the 1920s



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The case for a natural monopoly in BB provision seems quite weak.

Many network applications that seem socially desirable (HD video consultations with remote patients etc.) are really advanced traditional point-to-point telecommunications services and can only coincidentally be provided through BB.

Kua haere au!