EXPLAINING INTERNET CONNECTIVITY: VOLUNTARY INTERCONNECTION AMONG COMMERCIAL INTERNET SERVICE PROVIDERS

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ABSTRACT

The remarkable connectivity of the Internet is often taken for granted. Thousands of competing Internet Service Providers ("ISPs") have voluntarily connected their networks together to form the commercial Internet without the need for government regulation. It is often assumed or argued that "market forces" or "positive network externalities" drove commercial ISPs to interconnect and compete with one another. However, economic models suggest that firms in network industries have, at best, mixed incentives for voluntary interconnection. Moreover, a comparative look at historical examples of competitive and unregulated telecommunications markets (namely the competitive period in early telephony (1894-1921), the pre-Internet online services industry (1979-1994) and the emerging market for Instant Messaging services (1996-present)) also suggest that the first instinct of commercial firms is not to interconnect and compete, but to compete without interconnection or to engage in collusive interconnection (e.g. through merger).

This paper provides a framework by which rival firms' incentives for interconnection in unregulated telecommunications markets may be analyzed and argues that the widespread voluntary interconnection observed among ISPs is anomalous. However, the fact that it is anomalous provides an opportunity to discover or at least eliminate explanations for the remarkable connectivity observed among ISPs through a comparative analysis. The comparative analysis reveals that (1) competitive forces in telecommunications markets will not necessarily drive firms to interconnect their networks voluntarily as there are other options to them, and (2) government actions played an important role in shaping the interconnection behavior competing firms in telecommunications markets. These results have implications for telecommunications policy, and interconnection regulation in particular.

I. INTRODUCTION

An important debate in telecommunications policy is whether the regulation of network interconnection is necessary in competitive telecommunications markets.[1] The prevailing view is that interconnection regulation should only be imposed on dominant firms that have the ability to act anti-competitively by refusing to interconnect.[2] In competitive markets, such regulation is said to be unnecessary as competitive forces drive firms to interconnect voluntarily.[3] The problem with this view is that market structure is taken as an exogenous or "given" factor. In fact, firms in network industries can influence market structure through their decisions whether to interconnect early in the industry.

Others argue that interconnection regulation should extend to a broader class of network operators, irrespective of market power, because network interconnection is invariably better for end users.[4] As communications technologies converge such that multiple kinds of communications services can now be offered over multiple kinds of networks, the government should step in to ensure all of these networks and services interconnect.[5] The problem with this view is that it ignores the risks of regulatory failure. Determining the price and terms for network interconnection that would lead to robust competition and the right incentives for network investment is probably the most complex and difficult task facing telecommunications regulators today.[6] Information asymmetries and the risk of capture all suggest the risk of regulatory failure might be high. Getting this wrong may lead to a worse outcome than leaving interconnection to the market.

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[1] For surveys of the role of network interconnection in modern telecommunications policy, see generally INTERNATIONAL TELECOMMS. UNION, TRENDS IN TELECOMMUNICATIONS REFORM 2000: INTERCONNECTION AND REGULATION (3rd ed. 2000) [hereinafter ITU TRENDS 2000] and ELI M. NOAM, INTERCONNECTING THE NETWORK OF NETWORKS ch.3 (2001).

[2] *Id.* at 10-13 (describing the anti-monopoly rationale for interconnection regulation); ITU TRENDS 2000, *supra* note 1, at 19, 20 (noting that interconnection regulation is generally necessary when one firm is dominant).

[3] NOAM, *supra* note 1, at 15. *See also* PETER HUBER ET AL., FEDERAL TELECOMMUNICATIONS LAW 89 (2nd ed. 1999) ("As competition takes root in the network, the weeds of regulation can and plainly should be extracted.").

[4] ITU TRENDS 2000, *supra* note 1, at 20.

[5] *Id*. at 19. The International Telecommunications Union (ITU) calls this "any-to-any" interconnection.

[6] *Id*. For a good survey of the pricing issues and complex models used in interconnection regulation, see NOAM, *supra* note 1, at ch.4.

Whether we should restrict interconnection regulation to dominant networks or extend it to all networks should depend on what we think firms would do in an unregulated and competitive marketplace. Would they interconnect and compete? Or would they choose other strategies? Only with a good understanding of what the market outcome is likely to be can we then decide whether government intervention can improve upon it. If the market outcome is interconnected competition among rival networks, regulation may add little except costs and the risk of regulatory failure. But if the market is likely to lead to fragmented or non-competitive networks, then regulation or other forms of government intervention might improve on this outcome.

Unfortunately, we do not yet have a good understanding of what firms are likely to do in competitive telecommunications markets. As we shall see, the strategic choices involved are complex. Some economists have tried to model the incentives for network interconnection in telecommunications.[7] But even the most sophisticated models require a level of prescience or knowledge on the part of firms that is wholly unrealistic. Firms are assumed to know about consumer preferences and the possible pay-offs they will receive from choosing or refusing to interconnect.[8] This is rarely true, especially when the industry

[7] For some models of network interconnection developed in the telephone context, see Mark Armstrong, *Network Interconnection in Telecommunications*, 108 ECON. J. 545 (1998), Jean-Jacques Laffont et al., *Network Competition: I. Overview and Nondiscriminatory Pricing*, 29 RAND J. ECON. 1 (1998), Jean-Jacques Laffont et al., *Network Competition: II. Price Discrimination*, 29 RAND J. ECON. 38 (1998), Michael Carter & Julian Wright, *Interconnection in Network Industries*, 14 REV. IND. ORG. 1 (1999) and JEAN-JACQUES LAFFONT & JEAN TIROLE, COMPETITION IN TELECOMMUNICATIONS ch.5 (2000).

For some models in the Internet context, see Paul Milgrom et al., *Competitive Effect of Internet Peering Policies*, *in* THE INTERNET UPHEAVAL 175 (Ingo Vogelsang & Benjamin Compaine eds., 2000), Jacques Cremer et al., *Connectivity in the Commercial Internet*, 48 J. IND. ECON. 433 (2000), Stanley M. Besen et al., *Advances in Routing Technologies and Internet Peering Agreements*, 91 AMER. ECON. REV. 292 (2001), Robin Mason, Compatibility Between Differentiated Firms with Network Effects (Feb. 2001) (unpublished manuscript, on file with author), *available at* http://www.soton.ac.uk/~ram2; Emanuele Giovannetti, *Interconnection, Differentiation and Bottlenecks in the Internet*, 14 INFO. ECON. L. & POL'Y (forthcoming) (2002).

There is also extensive literature on the related question of compatibility choice in network industries. For a survey of this literature, see Michael L. Katz & Carl Shapiro, *Systems Competition and Network Effects*, 8 J. ECON. PERSP. 93 (1994) [hereinafter Katz & Shapiro II]; Richard J. Gilbert, *Symposium on Compatibility: Incentives and Market Structure*, 40 J. IND. ECON. 1 (1992) and other articles in that volume. *See also* Michael L. Katz & Carl Shapiro, *Network Externalities, Competition and Compatibility*, 75 AMER. ECON. REV. 424 (1985) [hereinafter Katz & Shapiro I]; Nicholas Economides & Fredrick Flyer, Compatibility and Market Structure for Network Goods (Nov. 1997) (unpublished manuscript, on file with author), *available at* http://www.stern.nyu.edu/networks/papers.html.

This is just a sample of the economic literature. Network interconnection issues also arise in other contexts, e.g. railroads and electricity.

[8] For example, many of these models rely on the Nash equilibrium to determine the firms' preferred strategies. This game-theoretic solution requires knowledge of the pay-offs from the various

is fairly new. As a result, the models that have been produced are insightful but may not be predictive of actual behavior in specific industries. Nevertheless, economic models can be helpful and reference will be made to them where appropriate.

We also have very few real-world examples of unregulated and competitive telecommunications markets to guide our intuitions about firm behavior. There are perhaps only four cases of such markets in U.S. industrial history. They are the early telephone industry (1894-1921), the pre-Internet online services industry (1979-1994), the commercial Internet (1995-present) and the emerging market for Instant Messaging services offered over the Internet (1996-present).[9] These four industries share similar features, such as the presence of positive network externalities, the absence of specific regulation, and a relatively competitive market structure. Of these, the commercial Internet (1995-present) is probably the most prominent and well-known example today. The commercial Internet consists of thousands of Internet Service Providers (ISPs) of varying size and scope.[10] Remarkably, ISPs have voluntarily interconnected their networks through the use of non-exclusive peering and transit agreements, even as they compete vigorously for end-users.[11] On the surface, this appears to support the theory that interconnection regulation will be unnecessary in competitive markets.[12] However, the firms in the other competitive telecommunications markets behaved quite differently.

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strategies available. *See*, *e.g.*, Carter & Wright, *supra* note 7; Mason, *supra* note 7. *See also* Milgrom et al., *supra* note 7, at 187-90.

[9] Another example might be the telegraph industry that preceded early telephony, even though the economics of telegraph service are a little different. Competing telegraph companies also initially refused to interconnect. The telegraph industry followed a similar path to the early telephone industry as it also developed (1) from a period of patent monopoly, (2) to vigorous competition without interconnection, (3) to a period cartel collusion, and ultimately (4) monopoly by Western Union in 1866. *See* GERALD W. BROCK, THE TELECOMMUNICATIONS INDUSTRY: THE DYNAMICS OF INDUSTRY STRUCTURE ch.3 (1981).

[10] *See generally* Daniel C.H. Mah, A Tale of Two Networks: Interconnection in Early Telephony and the Commercial Internet ch.III (2002) (unpublished J.S.D. dissertation, Stanford Law School) (on file with author); Thomas A. Downes & Shane Greenstein, *Do Commercial ISPs Provide UniversalAccess?*, *in* COMPETITION, REGULATION & CONVERGENCE 195 (Sharon E. Gillet & Ingo Vogelsang eds., 1999).

[11] *See generally* Mah, *supra* note 10, ch.III; .MICHAEL KENDE, THE DIGITAL HANDSHAKE: CONNECTING INTERNET BACKBONES (FCC Office of Plans & Policy Working Paper No.32, 2000); COMPUTER SCI. & TELECOMMS. BD., THE INTERNET'S COMING OF AGE 107-124 (2001).

[12] *See*, *e.g.*, NOAM, *supra* note 1, at 67 ("Do [unregulated ISPs] voluntarily provide interconnection to each other? The answer is yes. . . . This is a heartening observation because it provides an empirical data point to the analysis that market forces result in interconnection.")

At the height of competition in the early telephone industry, the Bell System (AT&T) controlled no more than half the market for telephones.[13] Independent telephone companies controlled the remainder. Bell initially refused to interconnect with the Independents, but later employed exclusive sub-licensing agreements to connect with some of them. The Independents also did not always interconnect among themselves. When telephone companies did interconnect, they often agreed not to compete with each other within specified regions and not to connect with other firms. The result was a fragmented telephone industry that persisted until AT&T regained its dominance of the industry and government regulation was introduced.

In the pre-Internet online services industry, firms like CompuServe, Prodigy and America Online offered communications and information services very similar to the services now found on the Internet.[14] In 1994, these firms had 2.6, 1.2 and 1.5 million subscribers respectively.[15] As late as 1994, on the eve of the commercial Internet, Microsoft launched a proprietary online service modeled on the existing services.[16] None of these firms chose to interconnect their systems (at least not initially).[17] They eventually joined the commercial Internet as ISPs, but this did not occur until the emergence of the World Wide Web threatened their businesses.[18]

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[13] *See generally* Mah, *supra* note 10, at ch.II; FEDERAL COMMUNICATIONS COMMISSION, INVESTIGATION OF THE TELEPHONE.INDUSTRY IN THE UNITED STATES (reprint 1974) (1939); GERALD W. BROCK, THE TELECOMMUNICATIONS INDUSTRY: THE DYNAMICS OF INDUSTRY STRUCTURE (1981).

[14] *See generally* CHARLES H. FERGUSON, HIGH STAKES, NO PRISONERS 26-28, 43-44, 46-58, 142-47, 153-55 (1999); Andrew Levison, *Consumer Online Services: Making the Transition from Computer Hobby to Serious Business*, ONLINE, July/Aug, 1995, at 14 [hereinafter Levison I]; Andrew Levison, *The Big Three: Looking for the On-Ramp to the Information Superhighway*, ONLINE, Sept./Oct. 1995, at 54 [hereinafter Levison II]; Aaron J. Levine, A Competitive Analysis of the Online Information Services Industry (1994) (unpublished M.S. paper, Massachusetts Institute of Technology) (on file with author).

[15] Levison II, *supra* note 14, at 58.

[16] KARA SWISHER, AOL.COM 124-28 (1998). Microsoft quickly changed course to incorporate Internet access. *See* Paul M. Eng et al., *Microsoft Plays the Net*, BUSINESS WEEK, Dec. 25, 1995, at 41; FERGUSON, *supra* note 14, at 142-47.

[17] CompuServe did connect its e-mail system to the Internet as early as 1989, but this was a user initiative and not a company offering. Levison II, at 58. Prodigy offered e-mail access to the Internet in 1993, and World Wide Web browsing in January 1995. *Id*. at 58-59. AOL implemented World Wide Web access in 1995. SWISHER, *supra* note 16, 112-14 (1998).

[18] *See*, *e.g.*, Philip Elmer-Dewitt, *Hooked Up to the Max: User-Friendly Internet Threatens Commercial On-line Services Market Share*, TIME, Sept. 26, 1994, at 58; Jack Egan, *Online Goes Big Time: The Commercial Services are Beating the Web by Joining It*, U.S. NEWS & WORLD REP., Nov. 20, 1995, at 104.

In the emerging market for Instant Messaging (IM) services, competing firms have chosen not to interconnect. IM services allow Internet users to send messages to each other in real time. Originally, this involved only text messaging, but companies have recently added voice and video chat features. AOL Time Warner (which controls AOL Instant Messenger and ICQ), Yahoo! and Microsoft each have a substantial IM user base,[19] but they have not linked their services together to enable users of one service to communicate directly with the users of other services. Several major IM firms (including Yahoo! and Microsoft) have created a trade group called *IMUnified* to address interconnection and compatibility issues, but neither Yahoo! or Microsoft have actually interconnected their systems to date.[20] Importantly, AOL Time Warner, the leading IM firm, did not join this group. Instead, it is (very slowly) developing its own standards for interoperability. AOL Time Warner has also blocked third-party attempts to unilaterally connect with their systems.[21] Its behavior in this regard has attracted some regulatory attention.[22]

Viewed in this broader historical context, the behavior of firms in the commercial Internet is the exception rather than the rule. The evidence suggests that firms in competitive telecommunications markets will not necessarily choose to interconnect. And even if they did, they would not necessarily choose to compete once interconnected. Other competitive strategies are clearly available. What then induced competing ISPs to interconnect and

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[19] *See* Jim Hu, *AOL's Lead in Instant Messaging Arena Dwindles*, CNET NEWS.COM, Nov. 16, 2000, *at* http://news.com.com/2100-1023-248700.html?legacy=cnet (last visited Apr. 28, 2002) (reporting that AOL/ICQ had about 30 million registered IM users in the U.S. compared with 10.6 million for Yahoo! and 10.3 million for Microsoft. *Compare* Louise Rosen, *Why IM Matters So Much*, UPSIDE TODAY, Sept. 19, 2000, *at* http://www.upside.com/texis/mvm/print-it?id=39c289380&t=1(last visited Apr. 28, 2002) (reporting that AOL and its subsidiary ICQ had over 130 million registered users worldwide, compared with Microsoft's 18 million users).

[20] *See* http://www.imunified.org (last visited Apr. 28, 2002). There may be reason to doubt the bona fides of the *IMUnified* group. It published a rudimentary interoperability standard in 2000 but neither Microsoft nor Yahoo! have implemented it. The timing of their announced "standard" suggests that it was intended to pressure antitrust authorities to deny or impose conditions on the proposed merger of AOL and Time Warner. Nothing of note has happened since the merger was approved and the group's website contains nothing more than an old press release. Louise Rosen, *IM Unified Develops IM Interoperability Standard*, UPSIDE TODAY, Sept. 1, 2000, *at* http://www.upside.com/texis/mvm/story?id=39affca00 (last visited Apr. 28, 2002); *Messaging Standard Agreed Upon – Mostly*, USA TODAY, July 26, 2000, *at* http://www.usatoday/life/cyber/tech/review/crh340.htm (last visited Apr. 28, 2002).

[21] *See*, *e.g.*, Lisa M. Bowman, *AOL Blocks Instant Messaging Start-up*, CNET NEWS.COM, Jan. 30, 2002, *at* http://news.com.com/2100-1023-826625.html (last visited Apr. 28, 2002); Jim Hu, *AOL Blocks Another Instant Messaging Rival*, CNET NEWS.COM, Jun. 12, 2000, *at* http://news.com.com/2100-1023-241743.html (last visited Apr. 28, 2002).

[22] *See* Time Warner, Inc., 16 F.C.C.R. 6547 (2001) (Applications for Consent to Transfer Control of Licenses) (imposing limited IM interoperability conditions on the merger of AOL and Time Warner).

compete in the absence of regulation? Why did firms in the other industries choose different strategies?

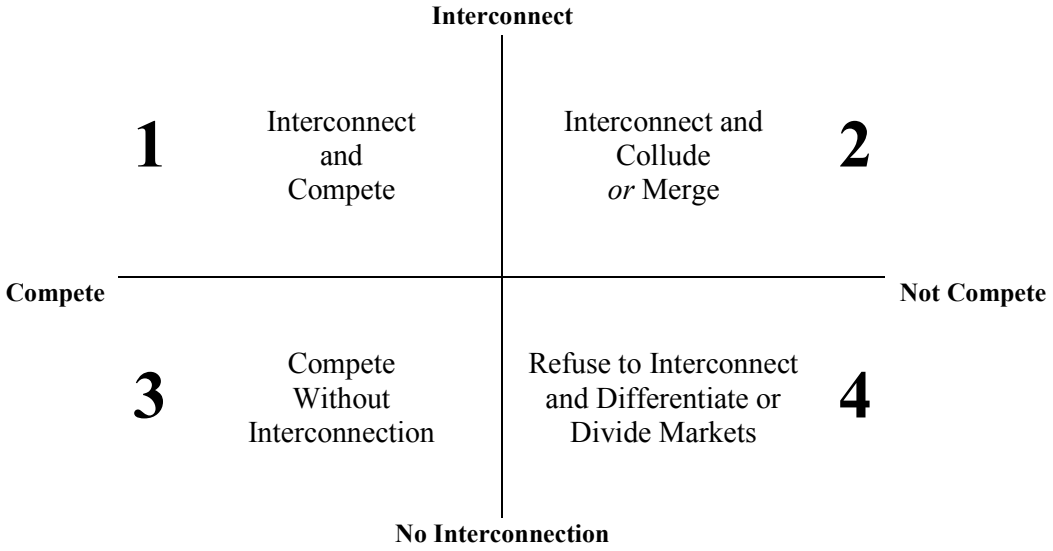
II. INTERCONNECTION AND ITS ALTERNATIVES

To appreciate how the strategies of firms differed in the commercial Internet and other competitive telecommunications markets, we must first consider the range of choices open to a firm. Two broad dimensions of strategic choice are (a) whether or not to interconnect, and (b) whether or not to compete.[23] This yields the four strategies mapped in Figure 1.1. Of course, firms could also pursue partial interconnection and partial competition strategies. Partial interconnection might occur where firms only agree to deliver certain traffic between their networks. Partial competition might occur if firms can only imperfectly differentiate their products. For simplicity, I have included only the four polar possibilities in the diagram. Nevertheless, in my view, Figure 1.1 still captures some important elements of interconnection choice. Most existing economic models only consider a choice between quadrants 1 and 3 (i.e. to compete with or without interconnection).[24] The matrix in Figure 1.1 provides a richer framework for understanding and comparing firm behavior across early telephony and the commercial Internet.

[23] The first dimension of choice is familiar. However, the second dimension – whether to compete – requires some explanation. A decision by two firms to interconnect without competing is very similar to a merger of the firms. Network interconnection can therefore be understood as a partial integration of the two firms, with the degree of competition after interconnection representing the extent of integration (less competition, greater integration, and vice versa).

[24] One exception is the model developed by Carter & Wright, *supra* note 7, which explicitly includes collusive interconnection as a possible strategy of firms. *Compare*, *e.g.*, Stanley M. Besen & Joseph Farrell, *Choosing How to Compete: Strategies and Tactics in Standardization*, 8 J. ECON. PERSP. 117, 119-21, fig.1 (1994) (modeling only the choice between network competition with and without compatibility (i.e. interconnection)).

Figure 1.1 – Interconnection Strategies



First, firms might choose to "interconnect and compete" (quadrant 1 in Figure 1.1). Network interconnection creates value for the customers of each firm by expanding the total number of communication possibilities between users. A combined network with *2n* users is generally much more valuable than two separate networks of *n* users each.[25] This increase in value may also expand demand as new users find it more valuable to join the larger network. Provided each firm can capture some of the value created by interconnection to cover the costs of interconnection, their revenues and profits may increase. However, this may not be true if the firms compete on price after they interconnect. Because interconnected networks can no longer differentiate themselves based on the number of people on each network, price competition between the firms might be quite intense. This may dissipate the potential for increased profits.[26] But if firms can avoid intense price competition by differentiating themselves post-interconnection to serve different user populations, this might still be a

[25] Using Metcalfe's law as a rough guide, we can estimate the value of the network to be proportional to the square of the number of users (for large *n*). See HARRY NEWTON, NEWTON'S TELECOM DICTIONARY 532 (16th ed. 2000). *But cf.* G.M. Peter Swann, *The Functional Form of Network Effects*, 14 INFO. ECON. & POL'Y (forthcoming 2002) (on file with author) (suggesting that (a) the network benefits received by an individual user may differ depending on the identity of other users and whether the individual is an early adopter, a median adopter or a late adopter, and (b) network benefits may diminish for existing users as even more users join the network). Swann argues that the relationship between network size and individuals' valuations of the network may be an S-shaped curve. *Id*. (manuscript at pp.7-9).

[26] *See*, *e.g.*, Mason, *supra* note 7, at 1-2; Besen & Farrell, *supra* note 24, at 121.

profitable strategy.[27] "Interconnect and compete" appears to be the pre-dominant strategy of ISPs in the commercial Internet.

Second, firms might do better to interconnect and not compete (quadrant 2 in Figure 1.1). This could be achieved through a collusive interconnection agreement or by the merger of the firms involved.[28] A collusive arrangement can ensure that the interconnected firms avoid price competition after interconnection by, for example, putting a floor on retail prices (through the interconnection price) or by expressly limiting direct competition (e.g. by allocating territories to each company). This ensures that each firm can capture more of the value created by interconnection. A merger, of course, fully integrates the two firms and allows the merged entity to capture the full value of interconnection. These strategies are not anti-competitive if the firms involved do not singly or collectively wield market power. As long as other firms exist to compete effectively with the integrated firms, consumers may not be worse off. However, these tactics (especially merger) can significantly improve the market position of the firms involved by creating a firm with a larger installed base of customers relative to other firms. When combined with, for instance, the "compete without interconnection" strategy, it could magnify network externalities and create a "tipping effect" (see below). Bell employed these tactics post-1907 as it aggressively acquired competitors while selectively entering into exclusive interconnection agreements (called sublicenses) with certain Independents and refusing to connect with others. Bell's sublicenses typically included an agreement by the parties not to compete with each other.[29] Independent telephone companies in this era also employed the same terms in their interconnection agreements (albeit with less success).

Alternatively, firms might choose to compete without interconnection (quadrant 3 in Figure 1.1). A firm might believe that it can capture the entire market by competing in this

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[27] *See* Mason, *supra* note 7, at 1-2. Differentiating after interconnection represents a partial move towards quadrant 2 in Figure 1.1.

[28] *See*, *e.g.*, Carter & Wright, *supra* note 7, *passim* (showing how collusive interconnection, under various scenarios, would be the profit-maximizing strategy for telecommunications firms). For a contrary view on the likelihood of collusive price setting through interconnection agreements, see LAFFONT & TIROLE, *supra* note 1, at 187-207.

[29] *See* Mah, *supra* 10, at 41-43. See, for example, *Pacific Tel. & Tel. Co. v. Anderson*, 196 F. 699 (D.E.D. Washington 1912) and *Cumberland Tel. & Tel. Co. v. State ex rel. Attorney-General*, 100 Miss. 102 (1911), in which the courts upheld Bell's sublicensing contracts. Compare the inconsistent treatment of the Independents' exclusive connection contracts in *United States Tel. Co. v. Central Union Tel. Co.*, 202 F. 66 70-75 (6th Cir. 1913) (declaring such contracts void) and *Home Tel. Co. v. Sarcoxie Light & Tel. Co.*, 236 Mo. 114 (1911).

manner.[30] The presence of network externalities creates the potential for a "tipping effect" whereby all consumers converge on the network that gains an initial lead in market share.[31] The value of a network is dependent on the number of users on the network. This is true for both existing and prospective users of the network. So, if one network (the larger network) gains an early lead in the number of users, it becomes more attractive to prospective users. Prospective users are therefore more likely to select the larger network. This in turn increases the advantage of the larger network over its rivals. Eventually, the larger network might have such a large advantage over its rivals that the latter cannot compete. At this point, the market is said to have "tipped" in favor of the larger network. Thus, the potential rewards of this strategy may be quite large as the "winner" of the competitive battle ends up with a monopoly. However, the path to monopoly can be quite expensive. When multiple firms pursue this strategy, competition for early market share can be very intense as each firm does its best to recruit customers to join its network rather than the networks of its rivals.[32] This would typically involve both heavy marketing and low prices to attract customers. It is also a risky strategy because the "losers" in the competitive battle end up with nothing. It may also take a long time for the "winner" to recoup its marketing expenses and lost revenues from low prices.[33] This was the Bell System's main competitive strategy before 1907. It was also the dominant strategy of the pre-Internet online services firms and is the current strategy for firms in the IM services market (especially AOL Time Warner, the leading IM service provider).

Finally, firms may decide to differentiate their services so as to avoid the "winner takes all outcomes" of competition without interconnection (quadrant 4 in Figure 1.1). An extreme example of this strategy was when Western Union and the Bell System settled their patent dispute over the telephone in 1879.[34] Western Union was then the dominant telegraph company while Bell was still a new company in the telephone field. Bell sued Western

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[30] *See*, *e.g.*, Besen & Farrell, *supra* note 24, at 118-21, 122-24; Katz & Shapiro II, *supra* note 7, at 107.

[31] Katz & Shapiro II, *supra* note 7, at 105.

[32] *Id*. at 105; Besen & Farrell, *supra* note 30, at 122-24.

[33] The "winner" would enjoy some barriers to entry because of its large network of users. As a result, it may be able to charge supra-competitive prices to recover the costs of acquiring monopoly. However, the monopoly status of the firm may attract government intervention (e.g. in the form of antitrust action or interconnection obligations), which in turn would limit its ability to recover such costs and make monopoly profits.

[34] *See* Mah, *supra* note 10, at 17; BROCK, 13, at 95-99.

Union for entering the telephone business in violation of Bell's patents. The parties settled their dispute by agreeing to divide the telephone and telegraph markets. Western Union conceded the telephone market to Bell in return for Bell staying out of the telegraph business and other financial consideration. Arguably, the same strategy was employed in the early cable television industry. Cable companies could have entered the telephone business using the coaxial cables they used to transmit video signals. Initially, they chose not to do so to avoid direct competition with AT&T. Only recently have cable companies used their networks to deliver telephone and other telecommunications services.[35]

It is highly unlikely that individual firms would know *ex ante* which of these four strategies would be the most profitable. It follows that firms could choose *any* of these strategies in a competitive market, depending on their market position, expectations and preferences. In fact, firms could select different strategies in different situations and in their dealings with different rivals.[36] The choice of strategy becomes even more complicated when more than two firms are involved. The pay-offs (or losses) from particular strategies may well depend on what choices other firms make. In addition, interconnection requires the agreement of the firms involved. Firms could fail to reach agreement on the terms of interconnection (e.g. over how to divide-up the gains from interconnection) even if both would benefit from interconnection.

From a public policy perspective, governments (and consumers) would probably prefer firms to choose the "interconnect and compete" strategy most of the time.[37] Interconnection ensures that consumers enjoy the benefits of network externalities while competition constrains the pricing and other behavior of firms. But there is no intrinsic reason why firms would choose this strategy when other strategies might offer greater rewards. The historical evidence is consistent with this. Firms in competitive

[35] This pattern of events was also dictated by regulation as U.S. telecommunications policy generally disfavored competition in local telephone markets until the passage of the Telecommunications Act of 1996. *See* 110 Stat. 56 (1996). The decision of cable companies not to offer telephone service can therefore also be seen as a regulatory strategy. However, it is interesting that cable companies did not push for liberalization of local telephone markets as MCI did for long-distance markets in the early 1970s.

[36] See, in the context of non-physical networks, Besen & Farrell, *supra* note 24, at 121 ("There is no general answer to the question of whether firms will prefer competition for the potentially enormous prizes under inter-technology competition, or the more conventional competition that occurs when there are common standards. Indeed, the same firms may choose different strategies in different situations.")

[37] "Interconnect and collude" or "mergers" would be tolerated to the extent that they produced efficiencies from integration and provided other firms existed to discipline the colluding or merging firms.

telecommunications markets (other than the commercial Internet) did choose other strategies. However, the fact that commercial ISPs chose "interconnect and compete" as their main strategy is a convenient anomaly. It provides an excellent opportunity to discover, through a comparative analysis, the factors that caused ISPs to behave this way when history suggests that competing firms in similar markets tended to prefer other strategies.

III. ELIMINATING EXPLANATIONS THROUGH COMPARISON

A comparative look at early telephony, the pre-Internet online services industry, the IM services market, and the commercial Internet should immediately eliminate (or at least seriously weaken) certain common explanations or assumptions about connectivity on the Internet. Logically, a particular variable cannot be a strong explanation for differences between the industries if it is the same in each of them.

1. Positive Network Externalities

A number of writers have suggested that the presence of positive network externalities explains universal connectivity on the Internet. In an early work on Internet interconnection, Bailey opined that "[p]erhaps the dominant economic force driving firms to desire interconnection is positive network externalities. . . . The Internet is an excellent example of a network in which positive network externalities drive the economics."[38] More recently, Noam expressed a similar (albeit tentative) view: "Do [ISPs] voluntarily provide interconnection to each other? The answer is yes. They do so because of the inherent advantages to their members in having a larger number of network participants. These are the network externalities discussed earlier."[39] In the context of the cable "open access" debate, Speta argued that cable companies would rationally open their broadband networks to competing ISPs because of indirect network externalities.[40]

Neither Bailey nor Noam explain how positive network externalities affect firms' incentives to interconnect in much detail. In fact, economic models of incentives for interconnection suggest that firms are likely to have mixed incentives to interconnect

[38] Joseph P. Bailey, *The Economics of Internet Interconnection Agreements*, *in* INTERNET ECONOMICS 155, 158 (Lee W. McKnight & Joseph P. Bailey eds., 1997).

[39] NOAM, *supra* note 1, at 67 (2001).

[40] James B. Speta, *Handicapping the Race for the Last Mile? A Critique of Open Access Rules for Broadband Systems*, 17 YALE J. ON REG. 39, 76-88 (2000).

depending on their perceptions and expectations about consumer preferences and the firms' actual or likely market position.[41] Obviously, such perceptions and expectations can also change over time. A comparative look at historical examples of competitive telecommunications markets confirms that firms will not necessarily interconnect simply because positive network externalities are present. They might interconnect and compete, as ISPs have done in the commercial Internet, but they also have other options. The behavior of firms in early telephony, the pre-Internet online services industry and the emerging market for Instant Messaging (IM) services suggest that the first instinct of commercial firms is not to "interconnect and compete." The empirical analysis here suggests that the mere presence of positive network externalities is not necessarily enough to induce firms to voluntarily interconnect and compete. The behavior observed in the commercial Internet is unusual in this respect.

Speta's argument can be met in a similar way. Even if some broadband Internet content applications are characterized by strong indirect network externalities, it is not clear why this would make cable companies more willing to allow unaffiliated ISPs non-discriminatory access to their network. In essence, Speta's argument is that cable companies have no incentive to prevent unaffiliated ISPs from connecting to their network because it would be more profitable for them to give their broadband customers access to a wide variety of content. But, this is not necessarily so. Under certain conditions (e.g. if the cable company owns very popular content), it may be profitable to limit the conduits on which content is distributed or limit the content distributed over the company's network.[42] Moreover, a look at the pre-Internet online services industry, which offered information services similar to those now found on the Internet, should make us doubt Speta's argument based on indirect network externalities. These same indirect externalities were present in the earlier industry, yet the firms in these industries operated for many years without voluntary interconnection.[43] And, as Lemley & Lessig have delicately pointed out, Speta's arguments

[41] *See*, *e.g.*, Katz & Shapiro I, *supra* note 7, at 437-39; Mason, *supra* note 7; Economides & Flyer, *supra* note 7.

[42] *See* Daniel L. Rubinfeld & Hal J. Singer, *Open Access to Broadband Networks: A Case Study of the AOL Time Warner Merger*, 16 BERKELEY TECH. L.J. 631 (2001); Daniel L. Rubinfeld & Hal J. Singer, *Vertical Foreclosure in Broadband Access?*, 49 J. IND. ECON. 299 (2001).

[43] Speta argues that firms in the pre-Internet online services industry eventually did interconnect through the Internet because of indirect network externalities generated by the breadth of content on the Internet. Speta, *supra* note 40, at 86. However, such externalities do not explain why the commercial online services did not do so much earlier. The TCP/IP protocols were publicly available in the mid-1970s

suffers from a "large prediction problem"[44] as cable companies have not in fact moved quickly to provide "open access," except under legal obligation or regulatory pressure.

Arguably, positive network externalities (of the direct kind) were much stronger in the commercial Internet than in early telephony. People today generally value widespread communications capability more than when the telephone was first invented. People at the end of the nineteenth century generally had smaller and more local social (and therefore calling) circles. This might be considered an explanation for the observed differences in interconnection behavior between the two industries. Certainly, the smaller calling circles in early telephony enabled the Independents to compete (at least for a while) without interconnection with the Bell System. But, this characteristic of telephone demand changed over time, which enabled Bell to take advantage of its superior long-distance network. We can also compare the commercial Internet to the online services and IM services industries, which are much nearer in time. The fact that people today are more inclined to demand widespread connectivity did not induce voluntary interconnection in those industries. This suggests that the *size* of the positive network externalities will not necessarily dictate the choice of interconnection strategy.

2. "Competition" or "Market Forces"

Another common explanation for Internet connectivity (often advanced together with the network externalities argument) is "competition" or "market forces." In other words, some believe that competition or market forces would drive firms to voluntarily interconnect. For example, after noting that voluntary interconnection is a feature of the Internet, Noam says, "This is a heartening observation because it provides an empirical data point to the analysis that market forces result in interconnection."[45] In a similar vein, Oxman has lauded the Commission's policy of "unregulating" the Internet. He argued that Commission actions

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and adopted widely by the ARPANET community in the early 1980s. If indirect network externalities were as strong as Speta suggests, why did the online services choose to compete without interconnection until the eve of the commercial Internet? Arguably, content providers migrated to the Internet because the online firms were charging too much to distribute their content to a smaller audience and it was this that forced the online firms to provide access to the Internet. In other words, it was not consumer demand for variety that drove interconnection, but the availability of a cheaper and better distribution platform for content providers.

[44] Mark A. Lemley & Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 UCLA L. REV. 925, 948 (2001).

[45] NOAM, *supra* note 1, at 67.

to keep traditional common carrier regulation from infecting the Internet has allowed competitive forces to drive the spectacular growth (and, by implication, connectivity) of the Internet.[46] This belief in the role of market forces in the Internet is also implicit in § 230(a)(4) of the Communications Act of 1934, which states that the "Internet . . . has flourished, to the benefit of all Americans, with a minimum of government regulation."[47]

Our comparative analysis of early telephony and the commercial Internet suggests that competition or market forces cannot be relied upon to produce universal connectivity in telecommunications markets. A look at the other competitive telecommunications markets confirms this. Commercial firms can choose (and have chosen) different strategies in competitive settings in the past. The terms of interconnection are also important here. Connecting firms can affect the degree of competition between them (and other firms) after interconnection through the interconnection agreement, as the early telephone companies did with their exclusive connection contracts and agreements not to compete.

Arguably, there was much more direct competition among ISPs than between Bell and the Independents. While competition between a Bell subsidiary and an Independent firm occurred in some 1200 locations in early telephony, the most competitive ISP markets involve ten or more competing firms.[48] Bell also controlled the long-distance market, whereas the Internet backbone market is more competitive. In fact, a common view among telephone historians is that Bell eventually used its control of the long-distance market to dominate local markets as well. The fact that AT&T had an effective monopoly over long-distance service may have influenced its incentives to interconnect. However, control of a "bottleneck" facility is also not necessarily determinative of firms' decisions to interconnect. Again, a look at the pre-Internet online services industry is instructive. None of the firms controlled a key "bottleneck" resource, yet firms like CompuServe and Prodigy chose not to interconnect.

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[46] JASON OXMAN, THE FCC AND THE UNREGULATION OF THE INTERNET 6 (FCC Office of Plans & Policy Working Paper No.31, 1999) ("The FCC has taken numerous steps . . . to permit competitive forces, not government regulation, to drive the success of [the data services] industry. . . . [T]he success of the Internet today is, in part, a direct result of those policies.")

[47] Communications Act of 1934 § 230(a)(4), 47 U.S.C. § 230(a)(4).

[48] This might change as Internet users migrate to broadband access, which is most often provided by ISPs affiliated with the incumbent cable or local telephone company.

3. Other Incomplete Explanations

Lemley and McGowan, both legal scholars, propose two other explanations for Internet connectivity.[49] First, they observe that the Internet mostly "piggybacks" on the existing (and regulated) telephone infrastructure and no one can be said to have "built" the physical infrastructure.[50] Second, they point out that the Internet operates on a set of non-proprietary protocols (TCP/IP) readily available to all.[51] According to them, "[a]nyone who uses the standard to transmit data from her computer is 'on' the Internet; anyone who does not use the standard is not."[52] Oxman makes similar claims that the growth and success of the Internet can be attributed to the "openness" of both the underlying telecommunications infrastructure and the TCP/IP protocols.[53]

It is not immediately obvious why either factor is directly relevant to firms' decisions to interconnect. Whether an ISP decides to construct its own network or to lease capacity from a telephone company does not appear to have any direct bearing on its choice of interconnection strategy. Perhaps, the fact that access to the telephone network is available at cheap, sometimes regulated prices affects the ease of entry into the ISP market, which may then affect firms' profit expectations and, thus, indirectly their willingness to interconnect. However, the rapid pace of competitive entry in both early telephony and the commercial Internet suggests that entry barriers in both industries were fairly low.[54] In any event, a comparison of the commercial Internet with the earlier online services industry suggests that the fact that the Internet is a "piggyback" network does not dictate the choice of interconnection strategy. As noted earlier, firms like CompuServe, Prodigy and AOL chose to operate proprietary systems that were not interconnected, even though their services were also offered over the telephone network. Analogously, IM services can be viewed as a "piggyback" communications network constructed on top of the Internet. Competing firms in this industry have also resisted interconnection and interoperability.

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[49] Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CALIF. L. REV. 479, 551-62 (1998).

[50] *Id*. at 552.

[51] *Id*.

[52] *Id*.

[53] OXMAN, *supra* note 46, at 5-6.

[54] Entry barriers in early telephony were a little higher because of the need to obtain a local franchise to begin operation as a telephone company. Such barriers also increased over time as governments accepted the idea of telephone service as a natural monopoly.

The fact that TCP/IP is a non-proprietary protocol also appears to be irrelevant. A comparative analysis is not needed to see why. Internet connectivity requires more than just the common adoption of the TCP/IP protocols. Both physical and logical interconnections must also be established.[55] Physical interconnection depends on the willingness of the networks involved to actually connect their networks. Logical interconnection involves programming each network's routers to recognize the other network and to deliver data packets correctly. A firm cannot become an ISP unilaterally by adopting the TCP/IP protocols. Cooperation with other ISPs is required, which gives existing firms the opportunity to deny interconnection with new entrants. The non-proprietary nature of these protocols therefore has little bearing on firms' incentives to interconnect.

IV. IDENTIFYING EXPLANATIONS THROUGH COMPARISON

So why did commercial ISPs choose to "interconnect and compete," while firms in other competitive telecommunications markets preferred other strategies? The comparative process is less helpful in finding explanations, but focussing on the differences between the commercial Internet and the other industries should suggest factors that may have affected or influenced competing firms' choice of competitive interconnection strategy.

1. The Role of Government

An important difference between the commercial Internet and other telecommunications industries was the role played by government in the evolution of each industry.

Generally, the federal and state governments at the beginning of the twentieth century believed that telephone service was a natural monopoly. They acted accordingly. Save for the minor restraints contained in the Kingsbury Commitment, Bell was allowed to acquire Independent companies and to sublicense on non-competitive terms. State regulatory commissions used mandatory interconnection laws to solve the problem of subscriber fragmentation rather than to preserve or sustain competition. The Kingsbury Commitment itself was hardly pro-competitive in effect, even though it was supposed to be an informal settlement of a potential antitrust suit against Bell.

[55] *See* COMPUTER SCI. AND TELECOMMS. BD., *supra* note 11, at 112-15.

In contrast, competition in telecommunications is the new policy paradigm at the end of the twentieth century. As a result, the steps taken by the National Science Foundation (NSF) when it privatized the Internet were generally much more pro-competitive. As Abbate recounts, the NSF envisioned a competitive Internet backbone market not unlike the competitive long-distance telephony market that had been created after the AT&T divestiture.[56] The Network Access Points (NAPs) that the NSF created were inspired in part by the Commercial Internet Exchange (CIX) that early commercial ISPs had set up to connect their networks. The use of NAPs reduced considerably the coordination costs involved in connecting multiple ISPs. A competitive ISP market was the goal of privatization from the outset.

Importantly, when the NSF decided to turn over the Internet to commercial providers, the largest community of Internet users was the academic institutions funded by the federal government and the federal government itself. The federal government was therefore vitally interested in ensuring that its various agencies and dependencies remained interconnected after privatization. As a large buyer, it was also in its interest to ensure that Internet connectivity was competitively supplied. The NSF's privatization process reflected these concerns. Its subsidies for regional networks and educational institutions to connect to the Internet were predicated on "interregional connectivity" across all of the NAPs. ISPs therefore had incentives to meet these connectivity requirements in order to compete for the business of the largest known users of the Internet at the time. The federal government also increased its general spending on Internet connections during this period.[57]

In effect, the federal government acted as the "sponsor" of the commercial Internet. In the context of competing technologies with network externalities, Katz and Shapiro have developed a model to show that a technology sponsored by a firm willing to make investments in its adoption (e.g. through penetration pricing) would dominate unsponsored technologies.[58] Firms with property rights over the network good (e.g. intellectual property

[56] JANET ABBATE, INVENTING THE INTERNET 199, 239 n.16 (suggesting that the NSF's privatization plan was inspired in part by the competitive long-distance telephony market that emerged after the break-up of AT&T).

[57] U.S. GENERAL ACCOUNTING OFFICE, INTERNET AND ELECTRONIC DIAL-UP BULLETIN BOARDS 23-24 app.III (1997) (showing that Internet expenditures by a sample of 42 federal departments and agencies tripled between 1994 and 1996).

[58] *See* Michael L. Katz & Carl Shapiro, *Technology Adoption in the Presence of Network Externalities*, 94 J. POL. ECON. 822 (1986).

rights or ownership of the network) may be willing to make such investments because such rights would allow them to capture in a later period the value created by technology adoption in the earlier period. But a network sponsor need not be the network "owner." Large customers or communities of users could serve a similar function. As Katz and Shapiro acknowledge, "large buyers are natural candidates to *be* the network sponsor."[59] This is especially so if the large customer has much to gain from inducing others to join the sponsored network. The initial connectivity among ISPs can therefore be seen as a variation of the "sponsored network" story told by Katz & Shapiro with the federal government playing the role of sponsor-buyer. In this case, the network sponsor was more interested in ensuring competition and maximum connectivity than profits.

No similarly large sponsor-customer existed in early telephony or the other telecommunications industries to drive competition with interconnection. This is an important difference that goes a long way towards explaining why commercial ISPs *initially* chose to interconnect with one another. It is a less powerful explanation for why ISPs continued to connect voluntarily as the government's financial influence over the Internet waned and commercial interests began to dominate. But, once ISPs were interconnected, it probably became very difficult for any one firm to start a separate network in competition with the Internet. However, after a certain amount of entry in the market, established ISPs might decide to refuse interconnection with new entrants in order to reduce competitive pressures within their chosen markets. There is little evidence that this has occurred. The number of ISPs in the market grew quickly between 1995 and 2001.[60] This could only occur if the new entrants could find established ISPs willing to interconnect. In the last year or so, the number of ISPs has begun to decline as a result of consolidation among smaller ISPs and as the Internet stock bubble burst.[61] The top-level IBPs have refused to peer for free with some ISPs, but they still readily connect with anyone willing to pay for transit. Moreover, transit prices have fallen over time, which does not suggest that the top-level IBPs are attempting to reduce entry in downstream access markets. However, their refusal to peer for

[59] Katz & Shapiro II, *supra* note 7, at 102.

[60] Todd Judd Erikson, *Introduction to the Directory of Internet Service Providers*, BOARDWATCH MAG.'S DIRECTORY OF INTERNET SERVICE PROVIDERS, 13TH ED., Spring 2001, at 4 (showing the number of ISPs listed in their directory increasing from 1447 in February 1996 to 7463 in April 2000, before declining to 7288 in March 2001).

[61] *Id*.

free except with IBPs that meet stringent peering criteria does suggest that they are trying to restrict entry in the top-level backbone market.

2. The Terms of Interconnection

Another difference in the two industries was the interconnection agreements used by firms in each industry. The only relevant comparison here is between the commercial Internet and the early telephone industry, as these are the only industries that featured interconnection agreements. Interconnection agreements in the early telephone industry tended to retard universal connectivity through its use of exclusive terms. While such agreements were often broken, the exclusivity arrangements nonetheless acted as a brake on the emergence of a unified telephone system. In contrast, bilateral interconnection agreements in the commercial Internet generally have not precluded ISPs from entering into interconnection agreements with third parties. ISPs often have multiple peering agreements and even ISPs that rely on transit arrangements "multi-home" by purchasing connectivity from more than one backbone provider.

Also, interconnection agreements in early telephony often ended competition between the connecting parties. This was a feature of Bell sublicenses and Independent connection contracts. Interconnection in early telephony was therefore often associated with the "interconnect and collude" or merger strategy identified in Chapter I. In contrast, peering and transit agreements in the Internet (as far as we can tell) assume that the firms may indeed compete with one another in downstream access markets (and perhaps also in transit markets) once interconnected. Thus, ISP interconnection agreements reflected more of an "interconnect and compete" strategy than in early telephony.

3. The Influence of "Culture"

However, the different terms of interconnection beg the question. Why did ISPs choose such non-restrictive and pro-competitive interconnection agreements in the first place? Did they believe this was the most profitable course? Perhaps, but it would have been difficult for the pioneers to predict *ex ante* their best strategy. In retrospect, the ISP business has not been spectacularly profitable, probably because of the extent of competition at both the backbone and access levels. Even leading ISPs like WorldCom and AOL Time Warner

have experienced decline in revenues in recent times due in part to the general downturn in Internet markets. Some well known ISP brands (like EarthLink) have yet to turn an operating profit.

The NSF's financial incentives for interconnection (described above) also do not explain the form of interconnection agreements adopted by commercial ISPs. The NSF did not prescribe the terms of interconnection agreements. Instead, free peering was already the default interconnection arrangement among early commercial ISPs at the CIX. Something else motivated these choices.

A possible explanation is "culture." Some have noted that the early ISP industry was characterized by a cooperative culture. A number ISP pioneers were commercial offshoots of regional academic networks funded by the NSF. While they were commercially minded, their business outlook was not exactly the same as, say, Bill Gates of Microsoft. Their experience as managers of NSF networks probably included close cooperation with other network operators and the sharing of relevant expertise and know-how. Early ISP pioneers also had a "libertarian" streak that favored self-organization over government control. [62] These shared experiences among, for example, the CIX founding members may have led to the use of free peering agreements. The attitude of CIX members can be contrasted with the approach of ANS. While ANS was also an NSF contractor, its principals included IBM and MCI, which probably gave ANS a more commercial outlook. As noted in Chapter III, ANS proposed to charge all other ISPs interconnection fees for connection to its backbone network. It eventually capitulated and joined the CIX as a non-paying member, but only after pressure from Congress and the Internet community. As it turned out, the CIX itself wielded bargaining power. The CIX members were later able to force ANS to join CIX as a full fee-paying member by disconnecting it from the CIX router in October 1993.

In contrast, company leaders in the early AT&T (pre-1907) initially favored aggressive competition to eliminate their rivals (either by driving them out of business or acquiring them once weakened). As a result, they steadfastly refused to interconnect with Independents even when experiments with sublicensing in Bell's southern territories proved

[62] *See*, *e.g.*, Roy Rosenzweig, *Wizards, Bureaucrats, Warriors, and Hackers*, 103 AMER. HIST. REV. 1530, 1550-51 (1998) (arguing that "the Internet of the 1990s may be the perfect synthesis of the anti-hierarchical cultural revolution of the 1960s and the anti-statist political revolution of the 1980s.")

its effectiveness in expanding Bell's influence and control of the industry without sacrificing profits through competition without interconnection. AT&T managers pre-1907 were probably influenced by their experience under patent monopoly, which may have imparted a sense of entitlement.[63] The change in AT&T's strategy after 1907 coincided with the assumption of control by the Morgan banking interests within AT&T. Morgan and his associates wielded substantial (if not dominant) financial power during this time. J.P. Morgan had earlier intervened in the distressed railroad industry to avoid ruinous competition among three major railroads.[64] His goals in the railroad industry were to restore profitability and to control the market through consolidation and/or "harmonious relations" among competitors.[65] Market control and profitability were also Morgan's goals when it took control of AT&T. It is perhaps not surprising then that mergers and the use of sublicense contracts to lessen competition with Independents became a common feature of AT&T strategy after 1907.

There are some problems with the cultural explanation for the different strategic preferences of commercial ISPs today and the Bell System in early telephony. First, "culture" is difficult to define. Once defined, the persons who share this "culture" may be difficult to identify. And then, the link between the shared "culture" and the observed behavior must be established. But it is at least plausible to suppose that the strategic preferences of firm managers will be affected by their past experiences and dealings with competitors and collaborators. The influence of cultural factors may be particularly strong under conditions of uncertainty, as would be the case in a new industry in which the profitability of different strategies is hard to predict *ex ante*. There is at least some evidence of a shared "culture" or common experience among ISP pioneers, especially at the CIX, that

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[63] *See* KENNETH LIPARTITO, THE BELL SYSTEM AND REGIONAL BUSINESS: THE TELEPHONE IN THE SOUTH, 1877-1920, at 136 (1989) (observing that AT&T management before 1907 "refused to relinquish their belief in an uncompromised competitive victory for the Bell System. . . . Holding to his older, imperious view, managers of the parent organization at first refused to permit non-Bell companies to use Bell equipment on their lines.") AT&T's failure to preempt competitive entry through pricing when its initial patents expired can also be explained by the experiences of AT&T management during the patent monopoly. *See* Joan Nix & David Gabel, 53 J. ECON. HIST. 377, 384 (1993) (arguing that AT&T chose patent litigation over limit pricing to deter entry "in large part because of the success the firm had with this approach prior to 1894.")

[64] See LEWIS COREY, THE HOUSE OF MORGAN chs.XV and XVI (1930) (describing the demoralized state of the railroad industry in the 1870s and 1880s, and J.P. Morgan's reorganization of the industry). For a more sympathetic view of Morgan's involvement, see EDWIN P. HOYT, JR. THE HOUSE OF MORGAN ch.6 (1966).

[65] *See* COREY, *supra* note 64, at 157 (summarizing Morgan's methods).

led them to choose non-exclusive interconnection arrangements like free peering. Moreover, this "culture" was quite different from both other business leaders of today and the business leaders within AT&T in early telephony.

Even if the effect of cultural differences can be firmly established, this factor could only explain *initial* connectivity. Any shared culture among early ISPs has been diluted by rapid entry by new entrants and established firms, as well as by consolidation. It is very unlikely that all of the firms that followed the CIX pioneers into the ISP market shared the same experiences or values. Telephone companies, who are no strangers to the strategic use of interconnection, now own the major Internet backbones. The Internet has become increasingly commercial and profit-oriented, which explains the restrictions on free peering imposed by IBPs and the cable companies' resistance to "open access." From a policy point of view, therefore, we cannot rely on "culture" to ensure continued connectivity in the Internet.

4. Service Differentiation

One factor that might have sustained Internet connectivity (and sustained new entry in the ISP market following privatization) is the ability of service providers to differentiate their services. Internet access markets can vary significantly. Different customers have different networking requirements in terms of technology, bandwidth requirements and ancillary services like web-design and hosting. This allows ISPs to differentiate themselves so as to serve different user populations. This makes ISPs more like complementors rather than competitors.

The ability of firms to differentiate their services tends to increase the incentives for interconnection. This is because service differentiation reduces direct substitutability and thus price competition between the connecting firms. At the same time, interconnection eliminates customer base (or network size) as a dimension of competition. In theory, competition may be softened and profits increased by network interconnection if service differentiation is possible.[66] To see this, assume that there are two kinds of customers – residential users and business users. Residential users have preferences for ease of use and

[66] Giovannetti, *supra* note 7 (manuscript at pp.2-3); Mason, *supra* note 7; Economides & Flyer, *supra* note 7.

can tolerate lower bandwidth and delays in transmission. They also have a relatively small budget for such services. Business users have large bandwidth requirements and need high quality, reliable connections to the Internet. They may also need help with web-design and hosting services. They also have a larger budget and higher willingness to pay. The costs for serving these two user populations are also likely to be different. Promotional costs for residential markets may be higher than for business markets, while the reverse may be true of the networking costs. Suppose also that there are only two ISPs. The ISPs could agree to interconnect and then differentiate themselves so as to focus on serving different users. For example, a backbone provider that focuses on serving business customers might agree to connect with a consumer-focused ISP. Both benefit from interconnection, but otherwise do not compete directly for the same customers. This enables them to avoid price competition and to each capture some of the benefits of interconnection.

Interconnection with differentiable service offerings is therefore more like an "interconnect and collude" strategy rather than an "interconnect and compete" strategy – it is a strategy involving interconnection and partial competition. This is because service differentiation may be imperfect. As a result, price competition is not completely eliminated between the firms. For example, AOL caters more towards residential users that like an interface with lots of help and guidance. Some of the smaller ISPs offer a no-frills interface for the technically inclined residential users that dislike AOL's "excessive" user-friendliness. There are probably also some users who are indifferent to the amount of help provided by the ISP through the user interface. For this group, price remains the distinguishing factor between the ISPs. Depending on the size of this group, price competition may not be eliminated completely.

The problem is that this strategy might ultimately fail. Internet interconnection agreements generally do not require one or another firm to restrict themselves to particular customers. If serving one user population is more profitable than serving another, there will be a temptation for the interconnected firms to enter the profitable segments of the market rather than the less profitable ones. So, if serving residential users is less profitable than serving content providers or businesses, then one might expect consumer-focused ISPs to expand into the business or content provider markets to improve their revenues. EarthLink,

for example, has expanded into business Internet services. Similarly, AOL Time Warner obtains revenues from affiliated content providers.

Differentiation may also not improve profitability after interconnection if there are many ISPs (i.e. more than two). Nothing stops one ISP from interconnecting with many complementary ISPs. This means that even though any pair of ISPs may be intending to interconnect and then differentiate their services, the result of multiple firms doing so may still be many competing ISPs in each complementary market segment.

In any event, it was more difficult for early telephone companies to differentiate their services. Business and residential customers did have different needs, but basic telephone service was essentially the same no matter which firm provided it. Bell enjoyed some quality advantages, especially at the long-distance level, but Independents often enjoyed a cost (and price) advantage as a result of lower quality. Also, the skills needed and the costs of providing a telephone to a business versus a residential user were probably not very different. The business user might want more telephones and may use the service more intensively, but the technology used to serve each group of users was fairly similar. For these reasons, interconnection between rivals without some form of collusion that eliminated competition would have led to intense price competition. This might have been good for telephone users, but not so for the firms involved. The preference of telephone companies to "compete without interconnection" and to "interconnect and collude" may be explained by their inability to differentiate their service offerings except through express agreement.

5. Lock-in

As noted earlier, once ISPs were interconnected, it became very difficult for any one firm (or set of firms) to break away. A firm (or the set of firms) would have to be dominant, with a substantial majority of all Internet users on its (or their) network before it (or they) could profitably disconnect other ISPs (whether one at a time or all at once). The fear that WorldCom would reach this critical size persuaded U.S. and European regulators to block its proposed merger with Sprint and to impose conditions on its merger with MCI. This suggests that non-dominant ISPs, having chosen initially to interconnect, are now "locked-in" and cannot easily disconnect from other ISPs.

What caused such lock-in? Network externalities obviously play a role. A non-dominant firm that disconnected from the Internet is likely to find its customers deserting to the ISPs that have remained interconnected. Consumers probably would not stand for the loss of the network benefits associated with being attached to the larger Internet. ISPs might also be locked-in because of the threat of regulation and antitrust enforcement. While the FCC has steadfastly acted to keep the Internet free of traditional common carrier regulation, it may revise its interpretation of the Communications Act to require ISPs to interconnect if the Internet threatens to fragment. Similarly, antitrust authorities may step in if a dominant ISP acts anti-competitively by refusing lesser ISPs access to its network.

Capital markets may be a third source of lock-in in the commercial Internet. This involves looking past the incentives of the firm at the incentives of firm managers and inside investors. During the Internet boom, public capital markets lavishly funded anything associated with the Internet. Internet-related ventures enjoyed a much lower cost of capital than non-Internet-related ones, irrespective of profitability. The capital markets exhibited an "irrational exuberance"[67] for such ventures. This behavior of the capital markets probably influenced the managers and backers of Internet companies, including ISPs. The effect of network interconnection on profitability did not matter as long as capital markets were willing to make funding available to Internet ventures irrespective of the expected returns. Easy connectivity served the interests of managers and inside investors as long as they could extract such funds provided by the capital markets before they corrected themselves. On this view, the remarkable connectivity among commercial ISPs may have been the result of firm managers and inside investors behaving rationally in response to (somewhat perverse) incentives created by the capital markets. This can be contrasted with the influence of capital markets in the early telephone industry. J.P. Morgan (the principal Bell financier after 1907) was very much interested in ensuring that AT&T controlled the telephone market, albeit without sacrificing profitability. Morgan's influence over Bell's sublicensing policies has already been mentioned. Morgan also manipulated capital markets to ensure that AT&T had

[67] *See*, *e.g.*, ROBERT J. SHILLER, IRRATIONAL EXUBERANCE 19-21 (2000) (explaining how the public's adoration of the Internet, among other factors, helped to precipitate the unjustifiably high stock prices in the late 1990s). The term "irrational exuberance" is actually from a speech given by the Chairman of the U.S. Federal Reserve, Alan Greenspan, in December 1996. *See* Alan Greenspan, The Challenge of Central Banking in a Democratic Society, Remarks by Chairman Alan Greenspan at the Annual Dinner and Francis Boyer Lecture of the American Enterprise Institute for Public Policy Research (Dec. 5, 1996), *at* http://www.federalreserve.gov/boarddocs/speeches/1996/19961205.htm.

superior access to capital, which increased Bell's bargaining power when negotiating merger or sublicensing agreements with the Independent.

V. IMPLICATIONS FOR TELECOMMUNICATIONS POLICY AND REGULATION

This paper has shown that firms in competitive telecommunications markets would not necessarily choose to interconnect and compete in the absence of regulation. Other strategies are available. Historically, firms in such markets have preferred the other strategies. The "interconnect and compete" strategy was only prevalent among firms in one industry – the commercial Internet. Moreover, a close analysis of what happened in the Internet suggests that firms chose this strategy not because of positive network externalities or competition, but mainly because of certain government actions taken early in the life of the industry. Cultural factors also played a role in determining the form of early interconnection agreements among ISPs, which in turn influenced later arrangements.

Two policy implications are immediately apparent. First, governments should not blindly trust in market forces to drive interconnection in telecommunications markets. Government intervention may be necessary even in competitive markets to ensure that consumers benefit from interconnection. Firms might refuse interconnection and thus deprive end users of the benefits of network externalities. Alternatively, firms might interconnect but then extract most or all of the extra value created by interconnection through collusive agreements. This is the bad news. Second, governments can take steps short of direct regulation to induce firms to interconnect and compete. The role of the U.S. government as the "sponsor" of the Internet played a large role in determining the conduct of ISPs in the commercial Internet, as did the structure of NAPs created by the NSF upon the privatization of the Internet. In turn, antitrust scrutiny after privatization has preserved ISP connectivity and competition. This is the good news – governments may be able to take subtle steps to improve on the market outcome without getting involved in the complex task of interconnection price setting.

However, many of the lessons from the Internet's privatization can only be applied early in a commercial development of a telecommunications market. As a result, these lessons may be most valuable in the context of telecommunications market liberalization.

Perhaps the best way to introduce competition into telecommunications is not to privatize the incumbent and to create a regulator, as has been the practice. The government may use its status as a large customer to induce entry by multiple carriers. Using the Internet's privatization as a template, a government might split its telecommunications needs evenly among multiple firms. As a condition of these government contracts, the firms must build networks and interconnect with each other. They would also be allowed and encouraged to compete for non-government users. The government-owned network would remain in public ownership, but its role as a market participant would gradually be phased out and replaced by private providers. In fact, the government might even maintain high prices for access to the incumbent network and high retail prices to induce competitive entry and bypass of the government network (i.e. use the incumbent's prices as a "cap" for competitive entrants).[68] Once competing and interconnected private providers are established, the incumbent government network could then be retired or sold. Antitrust enforcement would then be used to ensure no firm develops a dominant position in the market. All of this assumes, of course, that (1) the government is a substantial consumer of telecommunications services and (2) is willing and able to commit to this course of action.

Unfortunately, most significant economies around the world have already privatized their telecommunications sectors and are now grappling with the regulation of a privately owned yet still dominant incumbent. For political reasons, governments may also favor privatizations over the method of liberalization suggested here. Privatizations bring in money for government while the suggested method requires increased spending. As a result, it may be too late or too impractical to apply these lessons for telecommunications market liberalization in the real world.

VI. CONCLUSION

Interconnection in telecommunications will continue to be an important and difficult problem facing policymakers and regulators. But like many difficult problems, the solutions are not simple and cannot be neatly summarized. The best we can do is to keep searching for answers. This paper has attempted to lay down a better analytical and empirical foundation for understanding the incentives of firms to interconnect and compete in telecommunications

[68] Phased price reductions on the government-owned service could also be used as a tool for encouraging efficiency.

markets. In general, the market outcome cannot be relied upon to generate the greatest benefits for end users. Governments can intervene usefully to improve on the market outcome. This is precisely what the U.S. government did for the early commercial Internet, despite a persistent myth that the Internet developed because of non-intervention by government. The challenge ahead is to translate the lessons from this study into positive policy prescriptions grounded in a specific social, political and economic context.