

THE DEVELOPMENT OF THE TELEPHONE STANDARD

An Interoperability Case Study

THE DEVELOPMENT OF THE TELEPHONE STANDARD

The early history of US telephony highlights the costs and benefits of interoperability when it is due to the dominance of a single firm. That firm was Alexander Graham Bell's AT&T. The standards AT&T entrenched cut out inefficiencies and reduced calling costs, but also stifled competition and innovation, slowing the development of the industry as a whole.

BEFORE THE STANDARD

Bell was granted a patent for his telephone in 1876 (Coe, 1995). Before long AT&T was the monopoly telephone network and, through its subsidiary Western Electric, the sole legal manufacturer of telephones in the country until 1894. Telephone penetration spread slowly during this initial monopoly period. By 1895, just 4.8 per 1,000 Americans had a phone (Hyman, et al., 1987).

As soon as the last of AT&T's patents expired in 1894, competitors rushed in. By the end of that year, 80 new independent network operators had grabbed 5% of the market. By 1907 non-AT&T firms accounted for 51% of local-network business (Brock, 1981).

During the early stages of competition, AT&T refused to give outside firms access to its long-distance networks. AT&T reckoned the full value it could collect from maintaining a monopoly was greater than the gains it could make from tapping a limited number of extra users. Perhaps surprisingly, most independents did not mind (Mueller, 1997). They did not see AT&T's long-distance lines as important for their subscribers, who were mostly making local calls.

The consequence of having two sets of competing, non-interoperable networks was dual service areas. Someone connected to one network could not call a user of another unless they had two separate phone lines. This costly duplication was a recipe for inefficiency. Businesses would often need separate phones and directories to reach suppliers and customers. Callers had to know which network their contact's phone was connected to. Advertisements listed multiple phone numbers (Brooks, 1975). By 1904, 60% of cities were dual service (Mueller, 1997).

Despite the obvious drawbacks, the lack of interconnection brought some benefits as AT&T and the independents raced to sign up subscribers and expand their networks. The competitive frenzy increased telephone penetration across America (MacDougall, 2005). Prices fell sharply; independents' rates were as much as a half lower than AT&T's. And competition drove innovation: it was independent entrants to the market - not AT&T - that pioneered the use of automatic switching technology to connect customers' telephone lines (Nix & Gabel, 1996).

WHAT LED TO THE STANDARD

By the mid-1920s, however, AT&T had reasserted its leading market position and imposed industry standards (Kavassalis, et al., 1996). The US telephone network was interoperable. Three factors were crucial to this outcome: AT&T's adoption of a 'Universal Service' strategy, enabling regulation and public pressure for a consolidated network.

Universal Service. Faced with a shrinking market share, AT&T did a policy U-turn in 1901 and began interconnecting with independent exchanges as long as they met three conditions: an exchange could not

be in direct competition with any AT&T company exchange; it could use only (AT&T owned) Western Electric telephones; and it had to agree to connect only with AT&T long-distance lines (Brooks, 1975).

From 1907, AT&T relaxed its stance further and began to publicly promote a Universal Service strategy. This led to a surge in networks using AT&T's standards. The percentage of independent telephones interconnected to AT&T networks increased from 14% in 1907 to 67% in 1914 (Mueller, 1997). By that time, fully 89% of independent telephones on non-competing networks were linked up to AT&T. This severely hampered attempts to set up a rival regional and long-distance network, while AT&T's widening reach increased the value of its service to current and prospective subscribers.

Enabling regulation. To avoid antitrust litigation, AT&T agreed with the federal government in 1913 to stop acquiring competing independent exchanges and to interconnect all non-competing exchanges to its long-distance network (Bolter, et al., 1990). The deal was known as the Kingsbury Commitment. The agreement appeared to halt the spread of AT&T's standard, but in practice it did not.

The Kingsbury Commitment was costly for independents because it meant they had to meet AT&T's technical standards. And the ban on acquisitions only briefly slowed AT&T's march to monopoly. As support for dual service competition waned, the Kingsbury Commitment was the only obstacle in the path of acquisitions that the public, state governments and local independent operators all desired (Mueller, 1997).

Accordingly, the federal government agreed to make exceptions to the commitment as long as AT&T's acquisitions were in dual service areas and AT&T sold off another local network to an independent (Brock, 1981). The impact of what one critic has called a "*lax and malleable regulatory regime*" was striking (Weiman & Levin, 1994). By 1924, AT&T had snapped up 223 of the 234 independent telephone companies (Lloyd, 2010). Once again it dominated the industry and had succeeded in imposing its private technological standard.

Social pressure. Underlying the regulation that enabled AT&T's universal service was growing public pressure for interoperability. AT&T did most of the early lobbying for a unified service itself. AT&T companies orchestrated media campaigns to sway public opinion to view the industry as a natural monopoly while highlighting the damaging effects of dual service (Weiman & Levin, 1994).

HOW THE STANDARD CHANGED OUTCOMES

Sixty percent of American cities had competing networks in 1904, but by the mid-1920s dual service had been eliminated. Users now required only a single telephone and paid a single rate. As well as saving money they enjoyed increased network effects as they were able to call all those with telephones in their city and further afield. Interoperability magnified the benefits of telephony, including greater societal integration, quicker communication for businesses and reduced transaction costs.

AT&T's standardisation ideology, which put the priority on stability, reliability and uniformity, was seen by some as crucial in helping the company tackle the complexity entailed by rapid expansion of the telephone service. Between 1920 and 1938, the number of telephones on AT&T networks jumped from 7.7 million to more than 19 million (Russell, 2014).

But the effect of AT&T's imposed standard on innovation was mixed. AT&T shunned radical or disruptive innovations in favour of incremental change. This meant it was late adopting a number of key technologies, setting back the development of the industry as a whole. For example, it was cheaper and

more efficient to use machines rather than humans to connect calls, but AT&T did not incorporate automatic switching into its standards until 1919, more than 20 years after independent operators started to make the change (Russell, 2014).

AT&T also severely restricted the use of non-AT&T approved telephones or third-party equipment, effectively prohibiting external innovation in network devices. When regulators overturned these de-facto bans in 1968 and 1975, competition and innovation in downstream markets blossomed (Wu, 2007). People were able to buy telephones with an array of different features. Mass consumer versions of the fax machine were developed. Most importantly, the way was cleared for the rapid development of the modem and the early internet (Oxman, 1999). It is entirely possible that these innovations could have seen the light of day earlier but for AT&T's iron grip.

Nevertheless, AT&T's control of industry standards allowed it to keep improving interoperability. The time needed to connect a transcontinental call dropped from 14 minutes in 1920 to 1 minute by 1950. Direct distance dialing became commonplace from 1960. By 1970, a three-minute transcontinental call cost \$1.35, down from \$16.50 in 1920 (Abler, 1977).

CONCLUSION

The early US telephone networks provide a compelling case study in the pros and cons of interoperability. There are a number of key takeaways.

First, there are sometimes limited commercial incentives for interoperability. In the early years of competition, AT&T and most independent entrants opposed both vertical and horizontal interconnection. By not interconnecting, both sides could appropriate the full value of their respective networks, and both thought they could win the competition for new users.

Second, while a lack of interoperability can cause duplication, it can also yield significant gains for society. Competing firms had strong incentives to expand their networks, minimise costs and innovate.

Third, a supportive regulatory environment helped AT&T to impose a common interoperable standard. AT&T may not have achieved its goal of Universal Service without accompanying enabling regulation and social pressure. The implementation of antitrust law from 1913 onwards encouraged AT&T companies to acquire independents as a means to eliminate dual service. This lax regulatory regime helped AT&T impose its standards and achieve monopoly status.

Fourth, achieving interoperability through the dominance of a single firm can have harmful effects. AT&T invested heavily and enhanced its services, but it used its dominance to restrict innovations that threatened its power. This may have delayed the development of early internet technology. A dominant firm may also seek to leverage its market position to push into related markets.

Fifth, interoperability could have been achieved in other ways, but these also had drawbacks. One option considered during the early 1900s was mandated interconnection. However, this was almost always rejected by both sets of networks, the courts and users. Mandated interconnection might have led to subscribers converging towards a single network at the local level, effectively ending local competition. Furthermore, vertical interoperability would have removed the incentive for independent entrants to develop their own short-haul networks, which was key in increasing network coverage.

RELEVANCE TO TODAY'S SOCIAL MESSAGING NETWORKS

Parallels can be drawn between this case study and current debates over modern social messaging networks, such as WhatsApp or Snapchat. These networks are not interoperable. As with early telephone markets, this has spurred firms to compete aggressively for users by trying to boost the coverage of their networks and launching innovative services. While interoperability between these messaging apps may yield greater network effects, it could also lead to less product differentiation and reduce incentives to innovate.

The incentive to interoperate may be stronger for new messaging entrants because they would instantly be able to tap into the networks of the big established firms. These incumbents would have comparatively little to gain from interoperability. They would give up the benefits of network effects accrued in building up their customer base but would get little in return from accessing the smaller networks of new entrants. But there are two big differences from the early days of telephony. First, the cost of subscribing to multiple messaging networks is close to zero. Dual telephone service, by contrast, called for expensive duplicated equipment. Second, modern messaging applications are more differentiated such that users may prefer multiple applications for their different social groups (business, family or friends etc).

REFERENCES

- Abler, R., 1977. The telephone and the evolution of the American metropolitan system . In: I. d. S. Pool, ed. *The Social Impact of the Telephone*. s.l.:MIT Press, pp. 318-341.
- Bolter, W., McConnaughey, J. & Kelsey, F., 1990. *Telecommunications Policy for the 1990s and Beyond*. s.l.:ME Sharpe.
- Brock, G. W., 1981. *The telecommunications industry: The dynamics of market structure*. No. 151 ed. Cambridge, Mass: Harvard University Press.
- Brooks, J., 1975. *Telephone: The First Hundred Years*. New York: Harper and Row.
- Coe, L., 1995. *The telephone and its several inventors: A history*. s.l.:McFarland.
- Hyman, L., Toole, R. & Avellis, R., 1987. The New Telecommunications Industry: Evolution and Organisation. *Public Utilities Reports and Merrill Lynch*.
- Kavassalis, P., Solomon, J. & Benghozi, P., 1996. Open standards and interoperability: new learning models for electronic communications. *Revue d'économie industrielle*, 75(1), pp. 163-185.
- Lloyd, M., 2010. *Prologue to a farce: Communication and democracy in America*. s.l.:University of Illinois Press.

MacDougall, R., 2005. The People's Telephone: The Politics of Telephony in the United States and Canada, 1876-1926. *Enterprise & Society*, 6(4), pp. 581-587.

Mueller, M., 1997. *Universal Service: Competition, interconnection, and monopoly in the making of the American telephone system*. s.l.:American Enterprise Institute.

Nix, J. & Gabel, D., 1996. The introduction of automatic switching into the Bell system: market versus institutional influences. *Journal of Economic Issues*, 30(3), pp. 737-753.

Oxman, J., 1999. *The FCC and the Unregulation of the Internet*. Washington: Office of Plans and Policy, Federal Communications Commission.

Russell, A. L., 2014. *Open standards and the digital age*. s.l.:Cambridge University Press.

Weiman, D. F. & Levin, R. C., 1994. Preying for Monopoly? The Case of Southern Bell Telephone Company, 1894-1912. *Journal of Political Economy*, 102(1), pp. 103-126.

Wu, T., 2007. Wireless Carterfone. *International Journal of Communication*, Volume 1, pp. 389-425.

Frontier Economics Ltd is a member of the Frontier Economics network, which consists of two separate companies based in Europe (Frontier Economics Ltd) and Australia (Frontier Economics Pty Ltd). Both companies are independently owned, and legal commitments entered into by one company do not impose any obligations on the other company in the network. All views expressed in this document are the views of Frontier Economics Ltd.