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Universal Access and Its Asymmetries

The Untold Story of the Last 200 Years

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TELEPHONY

In 1900, *Scientific American* reported a curious telephone line in use between Anderson, Pendleton, and Ingalls in Indiana. Intriguingly, it used the top wires of rows of barbwire fences, with gaps bridged with galvanized wires. Yet it provided reasonably good connections: "The line, it seems, is not an experiment, but it is in active daily operation with four regular subscribers, and it gives a service which our correspondent assures us compares well with the lines of regular companies" (*Scientific American* 1900, 196). C. Alley, the creator/owner of this fourteen-mile line, claimed that it was the only barbwire-based line in existence (*Scientific American* 1900). In reality, Mr. Alley's line was not the only one, but it was the first to come to the notice of *Scientific American*, whose prestige lent it cachet. For instance, two years earlier, in the *New York Times*, a two-paragraph article "Fences for telephone lines," reporting on plans of farmers of Washington Valley in northern New Jersey, said that "they had heard of a primitive line that is in use in the southern part of the State, and intend building one of their own if it be found practicable" (*New York Times* 1898, 4). Further, two years after the *Scientific American* report, another article in the *New York Times*, a reprint of a story in the *Butte Inter Mountain*, situated the creation of a barbwire-based line in Montana this way:

Fort Benton's latest effort is a barbed-wire wire communication. Being by instinct and association cow people, they resented the genesis of the barbed wire, and

when it was discovered that it was one of the evils that came with the railroad and threw the cowpuncher, the bull-train, and the river streamer out of the game, they decided to take a material view of the situation, and the result is that they are preparing to have a telephone exchange which will take in every ranch from the Missouri River north to the Canadian line and south to the Highwood Mountains. (*New York Times* 1902d, 18)

Soon the practice spread, often inspired by the *Scientific American* report, in Colorado, Iowa, Kansas, Nebraska, New Mexico, Minnesota, Ohio, Pennsylvania, South Dakota, and other states (Kline 2000).¹

Such lines were the butt of urban jokes. Ironically, even the independent telephone companies, formed to serve rural areas neglected by the Bell Telephone Company, made fun of barbwire-based lines, calling them “squirrel lines.” Their industry publication *Telephony* reprinted local newspaper reports of such lines in its humor section (Kline 2000).

Whether or not barbwire-based lines were a joke is a matter of perspective, as we will see.

EXPANSION OF TELEPHONY

In May 1877, the Bell Telephone Company entered the market, offering to lease a set of two telephones for \$40 per year for business use and \$29 for nonbusiness use (Brock 1981).²

Sensing a competitive threat to its profitable intracity telegraph service, Western Union Telegraph Company entered the telephone business in December 1877, even though its legal standing vis-à-vis Bell’s patents was tenuous. Western Union’s entry set off an expansionary dynamic, with both companies rushing to enter new markets to secure first-mover advantage. Further, since the value of a network grows with the number of subscribers, both set about expanding their new networks as soon as possible (Gabel 1969).³ But then, in November 1879, Western Union sold its telephone networks to Bell in a complex deal, exiting the telephone business under the pressure of patent infringement lawsuits and fear of a hostile takeover of its core business—the telegraph (Brock 1981; Hochfelder 2002).

After the exit of Western Union, Bell had a patent monopoly until 1894, when its key patents expired. Yet, Bell continued to set up service in all “desirable” locations⁴ to forestall competition on the expiration of its

key patents, as its 1880 annual report explains: “With a thorough occupation of the principal cities and towns . . . the danger of competition with our business from newcomers seems small” (Brock 1981, 103).

At the end of 1877, when Western Union entered the market as a competitor, the US had 9,000 telephones. At the end of 1879, when Western Union exited the telephone business, the number had reached 31,000 (Bureau of the Census 1976). Even as a monopoly, Bell continued its network expansion, tripling the number of telephones between 1880 and 1884, and then doubling them between 1884 and 1893 (Fischer 1987). At the end of 1894, when Bell’s key patents expired, the US had 285,000 telephones (Bureau of the Census 1976).⁵

INEQUITIES AND INEQUITIES THAT MATTER

Bell’s strategy had a blind spot—a limited conception of what constituted desirable locations. At the end of its patent monopoly, half of its telephones were in cities with over 50,000 people, aggregating to 18 percent of the US population. On the other hand, only 6 percent of its telephones were in communities with fewer than 10,000 people, aggregating to 71 percent of the US population (MacDougall 2004). In effect, the development of telephony thus far was largely an urban affair.

Bell ignored rural communities, seeing no economic benefit in serving them. In its estimation, not only was the cost of laying rural lines prohibitive, but rural people’s telephony needs were limited. When it came to the social benefits of rural telephony, Bell executives belittled them as “the sentimental side of the question” (MacDougall 2004, 129). In general, for Bell, the very notion of rural telephone service was a “lost ball in tall grass” (Blalock 1940, 466).

While Bell was steadfast in its stance that urban-rural inequity did not matter, rural dwellers felt otherwise. “Farmers were, in fact, an ‘ornery’ lot. Many of them demanded this technology when its vendors said it was inappropriate for them” (Fischer 1987, 16). Bell routinely turned down petitions from small communities, with a response that a critic characterized as: “No, your town is too insignificant for us to consider” (MacDougall 2004, 127).

In this way, Bell’s policies created a “reservoir of unsatisfied demand” (Brock 1981, 107). In the period prior to the expiration of Bell’s controlling

patents in 1894, farmers created jerry-rigged telephone networks that were illegal or of doubtful legality (Atwood 1984; Fischer 1987). In response, Bell expended its energies suing these “wildcats” as opposed to expanding its service; in the process, it infuriated people in unserved areas with what they saw as “dog-in-the-manger policies” (MacDougall 2004, 127).

Clearly, the inequity mattered to rural people, as they took great trouble to ask for service or create telephone connectivity themselves.

BOTTOM-UP INITIATIVES COMPEL ACTION

The proponents broke the stalemate not by way of argument, but action.

After June 1894, upon the expiration of Bell’s patents, bottom-up entrepreneurial activity saw unbridled flourishing with the emergence of independents—telephone companies independent of Bell. Broadly, they were either profit-motivated entrepreneurial enterprises or cooperative endeavors such as subscriber-owned mutuals and farmer cooperatives. The entrepreneurs were after a “share of the boodle” that Bell had long monopolized (Brooks 1976, 104). For them, rural areas represented virgin markets, in contrast to urban areas where Bell was dominant. Cooperatives, on the other hand, were self-help endeavors.

By the end of the year, independents were serving 15,000 phones—about 5 percent of the total market; and they grew, reaching market shares of 19 percent in 1897 and 44 percent in 1902 (Brock 1981). With the rising threat of independents, Bell was forced to begin serving rural areas. The ensuing competition fueled network growth, with a ninefold increase in number of telephones per capita between 1893 and 1902, eclipsing the twofold increase in the previous nine years (Fischer 1987). In 1902, the total number of telephones in the US reached 2,371,000 (Bureau of the Census 1976).

Around the turn of the century, the independents also started making inroads in urban areas, and now towns often had companies competing for their business. In 1905, Iowa alone had 147 towns with two or more competing companies. Since the competitors’ networks were not interconnected, businesses had to subscribe and advertise “both phones,” given that residential customers typically subscribed to only one telephone service. Consequently, telephone networks often developed along class

lines; for example, in Minneapolis, the older Bell network served the elite, while the newer Tri-State Telephone Company brought new subscribers of lesser means into the fold with its lower rates (Brooks 1976).⁶

By 1907, the independents had captured a 49 percent market share, when the total number of telephones in the US was 6,119,000 (Brock 1981; Bureau of the Census 1976). To stem this tide, Bell's division head, Thomas Doolittle, and president, Theodore Vail, strategically deployed long-distance telephony. Even though long-distance telephony was still technologically embryonic and had a doubtful future, both on technical and commercial grounds, the company started interlinking the Bell telephone networks, which were local in scope, into a national system. Against the doubters within his own company, Vail argued: "I take it that it is extremely important that we should control the whole toll-line system of intercommunication throughout the country. This system is destined, in my opinion, to be very much more important in the future . . . We need not fear the opposition in a single place, provided we control the means of communication with other places" (Brock 1981, 118). This system building strategy paid off big time in the long term.

However, in the short term, this move did not affect the independents, as the traffic was almost entirely local. Furthermore, the telegraph was ubiquitous and economical. Contrary to Bell's expectations, regional calling within a 100-mile radius turned out to be the arena of decisive competition. A local telephone company could increase the value of its service by interconnecting with telephone companies in nearby areas, expanding the calling universe of its subscribers. The independents started making such interconnections among themselves, while Bell focused on building out its national long-distance network. Later, Bell, realizing its mistake, entered this arena in a concerted way. The company's systematic approach secured a decided advantage over the loosely coordinated and piecemeal approach of the independents. Moreover, it started enticing susceptible independents into interconnection arrangements as sublicensees. Other independents called out sublicensees as sellouts to the "octopus"—their epithet for Bell, which also had many tentacles, metaphorically speaking, with its extensive economic and political reach. But for the sublicensees, such arrangements were a way out of a tough competitive situation and a lifeline for economic survival, especially when Bell offered

to vacate the area where it was in competition with them (Mueller 1997). Gradually, Bell secured a dominant position region by region, and later its national long-distance network made its overall system unassailable.⁷

Around the same time, Vail started talking about universal service in Bell's annual reports, starting with the 1907 one. In this way, Bell's celebrated slogan—"One system, one policy, universal service"—appeared in the 1909 annual report (Mueller 1993). Vail meant something very different by "universal service" than what we understand it to be today. He was clearly not calling for service for everyone, as he was against rural telephone service. Instead, he was advocating for a unified system, operated by one entity, that allowed any subscriber to talk to any other one, which was not possible at the time because of lack of interconnection among competing networks. Basically, Vail was making a case for a Bell takeover of the industry to "unify the service," seeking the government's permission to acquire independents in spite of antitrust laws (Mueller 1997).

At first, the government's response vacillated between impedance and acceptance. Gradually, however, it became decidedly opposed to Bell's acquisition of the independents. Its threat of antitrust action led to the Kingsbury Commitment of 1913, in which Bell agreed to stop acquiring independents and also to interconnect with them. This saved the independents, but it also reduced them to appendages of a Bell-centric, integrated system (Barnett and Carroll 1993; Brock 1981).⁸ At that point, the US had a total of 9,543,000 telephones (Bureau of the Census 1976). Subsequently, in the interwar years, the network grew gradually. In 1945, the US had a total of 27,867,000 telephones and 46.2 percent of households had service (Bureau of the Census 1976).⁹

SYSTEM-BASED EXPANSION OF UNIVERSAL SERVICE

By 1965, under the Bell-centric, integrated system framework, the number of telephones in the US had reached a total of 93,656,000; and 84.6 percent of households had service (Bureau of the Census 1976). Thereafter, the regulators started making deliberate use of intrasystem cross-subsidies—the transfer of monies from profitable long-distance service to subsidized local residential services—to achieve universalization of the network, and with that, the dynamic of network expansion changed.

The discussion on cross-subsidies started in the 1920s, but only in 1947 did the Federal Communications Commission (FCC) put in place a mechanism for enabling it—namely, the *Separations Manual*.¹⁰ The manual laid out the method for allocating local loop costs between local service, which uses only the local loop, and long-distance service, which uses both the long-distance network and the local loop. Interestingly, when the recommendations were instituted, the regulators did not see that as a means of advancing universal service. As late as 1965, less than 3 percent of the local loop costs were recovered from long-distance service.

Starting in 1965, however, the regulators deliberately began moving money from long-distance service to subsidies for local service, and the amounts increased over the years. This process proceeded in accordance with political understandings and technocratic considerations of the powers that be. The politicians wanted affordable local telephone service and Bell, understandably invested in the preservation of the Bell-centered system, embraced universal service as a justification for preserving the status quo. Gains from the declining costs of long-distance technologies provided a source of money to subsidize local service, and the FCC essentially provided the technocratic expertise needed for its collection and disbursement. In this way, by around 1980, telephone penetration eventually reached 90 percent of US households (Belinfante 2006; Jayakar and Sawhney 2004; Mueller 1997; National Governors Association 1988).

In sum, in the case of telephony, the argument for the extension of service to rural areas was primarily made in action, wherein those desiring it simply went ahead and built networks for themselves—illegally at first, but then lawfully after the expiration of Bell's patents. While Bell could see the social and economic need for telephone service in rural areas, it could not fathom its intensity. Clearly, Bell misread rural demand on both counts—social and economic. The mushrooming of bottom-up activity was a clear indication that inequity mattered to those who were affected by it. Moreover, it also established that the demand for telephone service in rural areas was sufficient to make the investment economically viable. More broadly, the resulting network provided an adequate foundation for the subsequent development of universal service, which was a gradual process.

GAINS AND TRAVAILS

At the turn of the twentieth century, *Drover's Journal*, published in Nebraska, noted that “no modern invention has so thoroughly revolutionized rural communities, as the telephone” (Dilts 1941, 32). Such proclamations of revolutionary change are typically celebratory, as was the case here. Even when there is much to celebrate, as we will see, our analytical project prompts us to look beyond the gains to the travails—a look that is deep and long term (table 5.1).

INDIVIDUAL

Gains What Bell had dismissed as “the sentimental side of the question” was a major existential issue for rural dwellers, who had to traverse vast distances on a daily basis. Testimonials on the need for connectivity abound, including the following: “When bitter winter days housed us in we had only one contact with the world. That was the telephone” (Nordyke 1938, 24); “It was heavenly to have the telephone. Talking to folks is next thing to seeing them” (Pound 1926, 32); and “an ever ready friend” that could “make your farm house the center of a city” (Atwood 1984, 82). These comments, as sentimental as they might sound, speak to rural dwellers’ gains from access to telephone service.

Table 5.1 Universal service: Gains and travails

	Gains	Travails
Individual	<p>Reduced barriers of distance for social communications</p> <p>Reduced barriers of distance for business communications</p> <p>Enables calls for emergency assistance</p>	<p>Dividends of connectivity are dependent on power differentials between the parties connected</p> <p>Consequences of the scaling-up of telephony from area networks to a global one were not understood; scaled-up networks engender asymmetrical extralocal relationships</p>
System	<p>Revelation of untapped latent demand in rural areas it had failed to fathom</p> <p>Quickened pace of technological advances</p>	<p>Caught off guard by the emergence of competition in rural areas</p> <p>Access issues attracted federal scrutiny</p>

On the economic front, too, rural dwellers have a greater need for telephones, given the rural distances, than their urban counterparts (Mulrooney 1937; Pound 1926). They also have a higher intensity of use, as a rural homestead is both a place of residence and a center of production (Fischer 1987). For instance, a study on the incoming and outgoing calls of twenty-seven Iowa families had the following breakdown: business (44.6 percent), social (35.2 percent), household (11.1 percent), and miscellaneous (9.1 percent) (Holland 1938).¹¹

Travails Neighboring farmers' desire to somehow connect with each other motivated them to put together jerry-rigged networks. Once rural telephony became a business, the independents shifted their focus to connectivity among small towns. By building these short-haul toll lines, the independents increased the value of the services they offered (Mueller 1993). As Phillips (1939) noted, "even the value of the town telephone is largely made of its ability to contact the farming trade area surrounding our small communities" (24). These short-haul lines, in other words, facilitated interactions between parties that already had long-standing ties (e.g., a farmer and the supplier of agricultural implements in the nearest small town). Leveraging their position as area hubs, the independents went on to establish connectivity with city businesses interested in communicating with their customers in the countryside. This was a case of "the periphery advancing on the center" (Mueller 1993, 360).

This worked fine until the center, Bell, was provoked into action. Then the full consequences of connectivity, which is a double-edged sword, started to kick in.¹² Bell first started building its long-distance network, and later realizing that the independents were growing in the 100-mile-radius regional calling market, it moved into this arena. Employing a systematic approach, including enticing many independents into sublicensee arrangements, Bell prevailed over the independents. Federal intervention and the subsequent Kingsbury Commitment obligating interconnection—albeit at terms unfavorable to the independents (see Mueller 1997)—and the cessation of acquisitions saved the remaining independents but reduced them to appendages of a Bell-centric national system.

In sum, the farmers, and then the independents, deployed telephonic connectivity in ways that empowered them. At first, they could do so relatively simply because they were operating in the isolation of rural areas,

which were not of much interest to Bell. Later, when Bell did become interested, the arena greatly expanded. While the independents continued to deploy telephonic connectivity for their own empowerment, in the expanded arena, new actors who pursued their own goals were also in play. Moreover, these bigger and more powerful actors, especially metropole-based corporations, did not deploy telephonic connectivity to facilitate and strengthen existing relationships. They instead deployed connectivity to forge new relationships that were mostly metropole-centric and far more asymmetrical than the ones of small-town businesses and nearby farmers. The collateral damage of this metropole-centric refashioning was the fraying, if not sundering, of existing relationships, which were local and far less asymmetrical. Now connectivity was manifestly a double-edged sword.

As a general principle, the dividends of connectivity depend on the power differentials among the parties connected (Mulgan 1991; Samarajiva and Shields 1990a, 1990b). In the period when the independents ruled the roost in the rural areas, a period when Bell ignored the countryside, the power differentials between the area hubs and the surrounding communities were much smaller, relatively speaking. The dividends of connectivity, which were significant in the local context, stayed local. With the formation of a nationwide system, rural communities were now embedded in a system marked by far greater asymmetry, and consequently, the dividends of connectivity overwhelmingly accrued to distant parties.

SYSTEM

Gains Bell also profited from bottom-up rural telephony initiatives, as they revealed untapped latent demand that it had failed to recognize. Furthermore, the resulting competition fueled technological advancement. For instance, Bell's reluctance to move from manual switching systems, which it had painstakingly perfected, to mechanical switching systems, which the independents had pioneered, lasted only until competitive pressure compelled it to do so (Mueller 1989). On another front, Bell pushed the development of long-distance technologies to secure a decisive competitive advantage (Garnet 1985; Lipartito 1989). These technological advancements very likely would have occurred even if Bell did not face competitive pressure, but not at the pace they did under that pressure. Moreover,

over the long haul, Bell not only emerged as the victor, but it also enjoyed a nationwide, integrated network. In this new order, the independents that remained were reduced to appendages of the Bell system.

Travails Bell was caught off guard by the emergence of competition in rural areas. Furthermore, this competition grew vigorously, with independents' market share reaching 49 percent in 1907. Bell was at a loss about how to contain this until its long-distance strategies started to work.

Furthermore, competition in rural areas brought the Bell system under close federal scrutiny. It had avoided antitrust action by making the Kingsbury Commitment of 1913, but eventually, another antitrust action led to the breakup of the Bell system in 1982.

CONCLUSION

Parallels in the development of rural electrification and rural telephony are striking. The utilities conceived of rural networks in similar ways, and the proponents of rural service critiqued their conceptions in similar ways. Furthermore, proponents' actions on the ground, not their arguments, settled the debate. However, they differed in one significant way: public policy intervention. While the rural electricity cooperatives could erect their own distribution networks, they needed electricity from utilities' power stations since they lacked the scale to generate power on their own cost-effectively. Here, they had to make a case for government intervention, requiring them to clearly articulate their critique of private utilities' approach. Rural telephony initiatives, on the other hand, were not encumbered by such considerations, at least initially, and had a much freer hand. Consequently, they clearly articulated their critique of Bell's approach much later in the process, when a public policy intervention was needed. Initially, their moves were mostly in the realm of action.

Bell was dead against rural telephony, firmly believing that it was economically unviable. On the cost side, it saw the construction of lines across the rural expanse to be prohibitively expensive. On the demand side, it saw limited scope for building up demand, as the population density was low and a typical user's needs seemed to be limited. When estimating construction costs, Bell took rural lines to be extensions of the urban network. In such a conception, the rural geography loomed large—here, the first step

necessarily had to be lines from the urban network to distant settlements. In effect, geography as the determinative factor was intrinsically built into this perspective. From this standpoint, it was difficult to see things in another way, reducing the “ornery” farmers’ demands for service to a nuisance born of a pipe dream (Fischer 1987, 16).

Situated on the margins as opposed to the center, farmers saw things very differently. With their first priority being local connections—to neighbors and nearby businesses—and not the long link to the metropole, they instinctually engaged in a recentering-on-reversal move.¹³ When one decenters long links and center-stages local connections, geography is no longer the determinative factor, opening up a new way of thinking—one that prompts action, in marked contrast to the paralysis induced by the urban-centric view.¹⁴ Moreover, network builders have much greater freedom of action, since now the city is no longer the inevitable starting point for network development and any useful link is a valuable one. What the independents needed was the *means* for making such connections. Given the elemental state of the technology—wires and manual switchboards—this was not a major hurdle.

On the longer arc of rural telephony’s development, the early bottom-up initiatives made a critical contribution by revealing and satisfying untapped latent demand. In its limited view, Bell saw the unauthorized activities of entrepreneurial spirits that strung up jerry-rigged networks as threats to the established order, treating them as a nuisance that needed to be squashed and, at the same time, also downplaying their significance. Looked at in another way, they represented unsatisfied demand, which the independents took upon themselves to satisfy. Once the independents demonstrated the existence of this latent demand, Bell found a new willingness to extend its service to rural areas. Upon entering rural areas, it expanded its presence rapidly, which in turn spurred independents to expand their networks.

Initially, when rural networks first sprouted, regional connectivity was not a major factor. Much like the Anderson-Pendleton-Ingalls network that *Scientific American* first reported on in 1900, they tended to be very local affairs. Later, when independent networks grew, their subscribers’ needs called for connectivity to business associates, acquaintances, friends, and family in the cities. Since Bell refused interconnection with

its urban networks, the independents started entering urban markets, resulting in cities with competing telephone companies in the same area, where subscribers of one telephone company could not talk to those of another. On its part, Bell sought to stem the rising tide of competition by developing long-distance lines that integrated its local networks into a national system. However, at that time, users' needs were mostly regional—nearby towns and the nearest big city. While Bell focused on building out its national system, independents started interconnecting with each other to satisfy users' need for regional connectivity. Seeing their success, Bell realized its mistake and started establishing regional connectivity by enticing many independents to interconnect with its system as sublicensees. These sublicensees essentially became appendages of the Bell system. Subsequently, with the Kingsbury Commitment and other regulatory actions, other independents also became appendages.

The independents, in their celebration of telephonic connectivity, did not see that connectivity has different consequences at different scales. When they created their networks, they were local and isolated. Connectivity at this scale was productive in ways that worked for them, as it facilitated communications within existing personal, social, and business relationships. With the expansion of their networks and interconnection with other networks, the nature of connectivity and its consequences changed qualitatively. In this new arena, connectivity was still productive, but in ways where the extralocal overwhelmed the local. As a result, the independents lost their autonomy. What about the larger rural community?

Unlike electrification, no grand rhetoric warranted the proponents' efforts to develop rural telephony. They often touted the benefits of rural telephony, but, in marked contrast to electrification, proponents rarely presented or even thought of telephony as a vehicle for regenerating rural areas. Their efforts were scrappy and pragmatic, servicing immediate needs in different ways in different places—there was no sustained rural development framework *per se*.¹⁵ Still, as in the case of electrification, proponents focused on the benefits, giving little or no thought to the potential downside. In reality, telephonic connectivity became another strand in the tighter integration of rural areas into the metropolitan economy, with consequent loss of their autonomy, much like that of independents themselves.

What is curious from the standpoint of our analysis is that the independents scoffed at the barbwire-based lines of the sort strung by Mr. Alley in Indiana. In their arrogance, they pretty much did to people like Mr. Alley what Bell had done to them—something that they had resented. From the standpoint of our analytical project, the independents' reaction to a barbwire-based network calls for reflection and analysis.

We moderns have an easy proclivity to downplay the oddities at the margins of established order, even recently established ones, as in the case of the independents. This could be a defense mechanism—a wishing-away of the anxieties of destabilization, and refuge seeking in the stability of the familiar order (Gehlen 1980). But then, such downplaying could also be a missed opportunity for leveraging recentering-on-reversal. The reality is that recentering can continue *ad infinitum*, as every order provides only a partial understanding. Even a new order born of a recent recentering, such as the one the independents performed, could in turn be subjected to further recentering-on-reversal. Accordingly, although all oddities at the margins of the established order cannot be pivots for recentering, we should keep in mind that any of them could have that potential—and therefore refrain from downplaying them. Eventually, at some point in time, someone will perform a recentering-on-reversal.

Against this backdrop of a larger discussion on recentering-on-reversal, let us do what the independents did not do, and see what we can learn. If we center-stage the barbwire-based lines, what do we see? We see the existence of unmet demand and a novel way of satisfying it. We then have the question of whether there is something qualitatively different here. With regard to unmet demand, in our estimation, it seems to be a matter of degree, as opposed to something qualitatively different. Independents understood the unexpected existence of unmet demand, as it was their own *raison d'être*—the barbwire-based lines basically suggested that demand was wider than what they had anticipated. Further, we find no reports of independents refusing to extend service to more peripheral parts of rural areas where the barbwire-based lines popped up, in marked contrast to Bell's refusal to serve rural areas.

So, it is likely that in due course, the independents would have expanded their networks to areas served by barbwire-based lines. With regard to the mode of networking, however, barbed-wire connection

was truly novel, capitalizing as it did on preexisting assets—barbwire fences—on small patches of land. At the same time, it would be foolhardy to replicate this in areas that did not have preexisting barbwire fences, given that regular telephone wires are cheaper and carry transmissions much more clearly. Furthermore, this mode of networking cannot be easily scaled. All in all, in our estimation, the barbwire-based lines were then basically temporary solutions, akin to military field telephones.

In effect, the independents' downplaying of the barbwire-based lines did not leave them vulnerable to competitive pressure or undermine the development of telephony in general. But the attitude was problematic, both at the human level and the analytical level, where the story need not stop after a single recentering-on-reversal—no matter how spectacular.

Of all the systems covered in this book, telephony is a particularly edifying case in multiple ways. It shows a spectacularly successful instance of recentering-on-reversal, the one performed by the independents. It also shows psychological barriers to reversal, most pointedly in the independents' dismissive attitude toward barbwire-based lines. In addition, it reveals that all oddities at the margins of the established order cannot be pivots for recentering-on-reversal (e.g., barbwire-lines). Yet they need to be examined, closely, and not dismissed. In sum, while the analytical strategy of recentering-on-reversal is not a silver bullet, it is a powerful tool that can deliver big in many contexts, if carried out with care.

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