Peering Ahead: An Examination of Peer-to-Peer Signal-Sharing Communities that Create Their Own Affordable Internet Access

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ABSTRACT This study expands upon existing research by shedding light on the challenges and opportunities facing participants in peer-to-peer wireless signal-sharing initiatives. The study relies on resource mobilization theory to gain a deeper understanding of why members of community mesh networks in the United States join the movement and how they sustain it. The researcher conducted semi-structured interviews with the founders of 12 unique U.S. networks. The projects examined illustrate the desire for alternatives to traditional ISPs, as well as deep commitments to digital inclusion and local ownership. Informants reported feeling personally invested in the future of their projects because they contribute technical support and other forms of labour. However, the deployment of mesh technology creates a unique set of legal and policy issues.

KEYWORDS Telecommunications policy; Peer-to-peer networks; Resource mobilization theory; Community networking; Wireless

RÉSUMÉ Cette étude va au-delà de la recherche existante en jetant de la lumière sur les occasions et les défis soulevés par les initiatives de partage de signaux poste à poste sans fil. L'étude se fonde sur la théorie de la mobilisation des ressources afin de comprendre plus en profondeur pourquoi les membres de réseaux maillés collectifs aux États-Unis se sont joints à ces réseaux et comment ils les supportent. La chercheuse a mené des interviews semi-structurées avec les fondateurs de douze réseaux américains différents. Les projets examinés révèlent un désir pour des alternatives aux fournisseurs Internet traditionnels, ainsi qu'un engagement profond envers l'inclusion numérique et la propriété locale. Les personnes interrogées ont dit en effet qu'elles se sentaient personnellement investies dans l'avenir de leurs projets parce qu'elles y contribuaient une assistance technique ainsi que d'autres formes de travail. Cependant, le déploiement d'une technologie à maillons soulève un assortiment singulier de questions légales et politiques.

MOTS CLÉS Politique de télécommunications; Réseaux poste à poste; Théorie de la mobilisation des ressources; Réseau collectif; Sans fil

Introduction to the study

If nations across the Americas are to boast a progressive communication infrastructure—one that is both affordable and accessible to all—market forces alone cannot

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dictate a regulatory framework. Rather, both federal and local policymakers should play an active role in connecting all citizens to broadband. In communities throughout the Americas, digital inclusion advocates are already pushing for equal access to communication technology. They are looking beyond connectivity to consider media ownership, content, and literacy as significant determinants of who is able to benefit from the Internet (Media Alliance, 2007). In April 2010, the United States became the last industrialized country to release a national strategy for promoting high-speed Internet adoption (Atkinson, 2007; Baller & Lide, 2006; Bleha, 2005; Vos, 2007). Such a roadmap for expanding access is clearly needed, considering that just 67% of Americans have residential broadband subscriptions (Horrigan, 2010). When commercial Internet access became available in 1990, the United States led the world in broadband deployment. Its descent has been steep, however. From 2000 to 2009, the United States plunged from 4th place to 15th place among industrialized nations, in terms of Internet subscriptions (Organisation for Economic Cooperation and Development, 2010). The comparatively high cost of broadband, caused by a lack of competition among telecommunications companies, poses a major barrier for non-adopters in the United States (Dailey, Bryne, Powell, Karaganis, & Chung, 2010). However, the emerging prominence of a viral communications architecture suggests that it could potentially, if supported with research dollars and political will, move the United States closer to universal broadband access and return the nation to its previous status as a technology leader. As a result, the country’s middle class could grow, strengthening the tax base and the overall economy.

Viral networks rely on shared broadband signals, or a model of peer-to-peer networking. The emergence of what Castells (2007) refers to as “mass self-communication” has the potential to radically challenge the dominance of traditional cable and telephone Internet service providers (ISPs). Instead of information passing from “one to many,” it may travel from “many to many” (Castells, 2007; Rafaeli & LaRose, 1993). Just as collaborative applications like blogs and wikis dramatically lower barriers to entry (Bowman & Willis, 2003; Bruns, 2005; Drezner & Farrell, 2004)—by allowing anyone with a computer to post or edit content—shared Wi-Fi has the potential to help democratize Internet connectivity and expand digital inclusion efforts. Consequently, powerful reasons exist for public policy to focus on broadband. It is distinct from gadgets such as mobile phones with GPS capabilities or hand-held movie players. By contrast, broadband is a “prosumer” (Atkinson, 2007; Toffler, 1980) technology that blurs the line between producer and consumer. Specifically, it enables consumers to both create and distribute content—and thus to contribute to economic expansion and innovation (Atkinson, 2007; Shirky, 2001). When thousands of ordinary citizens use broadband connections to collaboratively produce “intellectual and cultural goods” (Benkler & Nissenbaum, 2006), the potential exists for new software applications, new Web portals, and new opportunities for communication to benefit the global commons.

This study aims to weigh in on the current policy debate over how to most efficiently bring affordable broadband access to all Americans by approaching Wi-Fi signal-sharing as a promising “last mile” technology able to reach every home for a fraction of the cost required to lay fibre optic lines, DSL, and cable (IJIS Institute, 2005). The research focuses
on a dozen community wireless initiatives in the United States committed to digital inclusion—which this study defines as realizing the goal of bringing the benefits of Internet connectivity, skills, and hardware to everyone who wants them. In 2004, the first National Summit for Community Wireless Networks, held in the United States, kicked off a movement that now includes “tens of thousands of community and municipal broadband initiatives” across the globe (International Summit for Community Wireless Networks, 2010). In recent years, grass-roots broadband initiatives have moved away from building Wi-Fi hotspots that blanket neighbourhoods and, rather, are experimenting with technology that allows residents to securely share existing wireless connections.

A “tremendous amount of excess capacity” (Benkler, 2005, p. 75) is routinely deployed throughout the U.S. communication infrastructure, with typical Internet subscribers using less than 2% of their personal bandwidth limits (Francis, Elnegaard, Eskedal & Venturin, 2006; Meraki, 2008). The best way to capture this capacity and create a “survivable infrastructure … is through improving the conditions for social sharing and exchange of the excess capacity users own” (Benkler, 2005, p. 75). This type of sharing functions on a model of redistribution that is costless to the giver, in contrast with financial transactions within the commodities market. Mesh networks, created by users themselves, grow virally. In a viral communications architecture, components are both “independent” and “scalable,” and “each new element adds capacity to the system” (Lippman & Reed, 2003, p. 2). A wireless mesh network design includes at least one access point with a direct connection to the Internet—via fibre, cable, or satellite link—and nodes that hop from one device to the next. As the popularity of these networks grow, new users add nodes. As a result, signals have shorter distances to hop and more redundancy is built into the network, ultimately strengthening the network (Rowell, 2007). Therefore, traditional telecommunication companies—predicated on central infrastructure that acts as a go-between among nodes and has a finite capacity (MIT Communications Futures Program, 2008)—are much less necessary for one to access the Internet.

Advances in technology, coupled with consumer demand for ubiquitous connectivity, are fuelling the peer-to-peer networking trend. The failure of high-profile city-wide broadband deployments across the United States—notably in Philadelphia; Portland, Oregon; San Francisco; and New Orleans—has also helped propel the community networking movement. While each grass-roots network examined in this study grew out of a unique set of circumstances, they all share a common catalyst: a lack of access to affordable and reliable broadband. At the time of data collection, about 15 non-profit community wireless initiatives in the United States utilized mesh technology, promising free Internet access through bandwidth-sharing. The wireless signal-sharing movement is made possible by the skills, connections, and financial assets supplied by its supporters. Additionally, people who share Wi-Fi signals are driven by ideology as much as pragmatism. Because this research delves into the motivations of both the users and developers of signal-sharing technology, resource mobilization theory serves as an appropriate framework. The following literature review provides additional context.
Literature review

Resource mobilization theory applied to mesh networks

The resource mobilization approach emerged as a subdiscipline of social movement theory during the early 1970s, a historic period that bore witness to large-scale protests and high-profile political actions. The Civil Rights and anti–Vietnam War movements, along with various struggles against colonialism in Asia, Latin America, and Africa (Little, 2008), forced sociologists around the world to adjust the lens through which they studied social movements by explaining the rational, purposive facets of activism (Waterman, 1981). Communication scholars followed the lead of sociologists and also began grounding their research in resource mobilization principles. This perspective is distinct in that it applies economic and organizational concepts to contemporary social movement theory (Meyer, 2005) and considers social movements as augmenting mainstream politics rather than as offering an alternative to them. While the approach is not universally accepted, it does offer an ideal framework for understanding how peer-to-peer broadband networks emerged and how participants sustain them.

A critical point made by resource mobilization theory is that average citizens—people stereotyped by contemporary pollsters as “soccer moms” and “NASCAR dads”—would lack the know-how to participate if professional advocacy organizations did not make political action accessible through outreach campaigns and citizen engagement. Therefore, core group members develop a strategy to catalyze the sentiments expressed by those who feel alienated. By forming coalitions, these network members maximize their influence and often attempt to distinguish themselves from other groups (McCarthy & Zald, 1987). They attract financial and human resources, seize media attention, foster relationships with people in power, and develop an organizational structure (Hannigan, 1985; Kendall, 2008). Resource mobilization theory assumes that a social movement will fail to produce change without adequate resources. Alliances between grass-roots actors and institutionalized factions such as political parties and government agencies are also necessary (Gamson, 1975; McAdam, 1982; Tilly, 1978).

Community broadband networks are just one element of a larger media reform movement focused on ensuring media outlets serve the public interest, as well as foster independent and diverse sources of information (Free Press, 2010; Media Access Project, 2010; Reclaim the Media, 2010). The relatively weak position of Wi-Fi signal-sharing activists in the United States is working both for and against the movement’s best interests. While Internet activists are deploying peer-to-peer networks in numerous cities, these efforts remain mostly underground and have yet to draw in a critical mass of participants—certainly not enough to attract the ire of the incumbent ISPs. Should the telecommunications industry feel compelled to squash signal-sharing initiatives in the future, it will likely attempt to do so through a combination of legal and political strategies. As Thomas (2006) points out in his assessment of media reform efforts, any analysis of social movements must account for the fact that “the language and styles of corporate organizational management practices are now an essential part of the organizational culture of movement actors” (p. 23). For instance, several of the most visible ad hoc network leaders do not merely adopt characteristics typical of corporate culture,
they are corporate. Additionally, social movement organizations deal with the dichotomy between fighting to achieve long-term goals—in the case of the Wi-Fi signal-sharing movement, expanding broadband access by creating mesh networks—and obtaining the necessary management skills and resources to survive day to day.

The activists behind community mesh networks possess access to the media and relationships with policymakers. People initiating and joining non-profit signal-sharing networks, the core of this grass-roots movement, typically boast technology and IT knowledge. In fact, they are in a position to mobilize only because they have acquired these resources. Those who join signal-sharing communities are linked through common interests, including the desire for ubiquitous connectivity and digital inclusion and to force change in the telecommunications industry. Finally, many broadband subscribers who choose to share their wireless signals do so for ideological reasons, with the intention of making a political statement. Still, the question arises: Why do people join social movements when they can benefit from the work of others willing to bear the costs of achieving a common good? What are the incentives to contribute rather than “free-ride” (Olson, 1965)? This question must be posed because the costs of defending an interest are obvious; time, money, and even safety are often sacrificed for the common good. Successful new social movements result in collective benefits, and participants often get involved in hopes of obtaining some personal resource (McCarthy & Zald, 1987). Actors perceive mobilizing as a pathway for aggregating resources. If everyone chips in, resources will flow into the movement, making it that much more efficient. While most peer-to-peer networks were founded to provide Internet access to disenfranchised members of a community, the benefits to elite participants in the movement should not be ignored, either.

It would be remiss not to acknowledge arguments articulated by critics of resource mobilization theory. In general, these scholars contend that this subdiscipline of social movement theory de-emphasizes both the complexities that define grievances and the role that ideology plays in social movements. They point out that informal actors and networks, not just those who are socially integrated, participate in social movements (Piven & Cloward, 1991). Additionally, because the approach pays scant attention to macrostructural, historical contexts—especially to the inequality inherent in power relationships—its usefulness for explaining collective action is limited (Buechler, 2000; Canel, 1997; Kendall, 2008). New social movement theorists, most notably Touraine (1985), criticize resource mobilization supporters for defining actors by their strategies, as opposed to by key social relationships.

Minimal academic research has focused specifically on the role organized wireless signal-sharing initiatives can play in narrowing the digital divide in the United States. Among the broadband studies that do exist, they primarily focus on ISPs—that is, the supply-side of broadband connectivity. This research aims to extend knowledge about Wi-Fi signal-sharing by also delving into the “demand side” of the phenomenon as a means of better understanding potential paths to closing the digital divide. In light of these factors, the following research questions emerged:

**Research Question 1:** What motivates people to “steal” wireless signals?

What motivates people to share their own wireless signals?
Research Question 2: What are the impacts on both the users and providers of mesh networking? And what can policymakers learn from their experiences?

Methodology
The flexible nature and depth of semi-structured interviews made them ideal for this study. The researcher conducted qualitative interviews, lasting between 60 and 90 minutes each, with a dozen representatives of community mesh networks. These telephone interviews, which took place between July 2008 and January 2009, began with a list of about 10 prepared questions directly related to digital inclusion, organizational structure, and policy initiatives relevant to expanding broadband via peer-to-peer networking. All interviews were audiotaped and transcribed to ensure that exact quotes would be available for analysis. Similar statements were combined into encompassing categories and concepts. The frequency of statements determined whether a theme was major or minor. It should be noted that unique perspectives were also incorporated into the data analysis. “Outliers,” like these, are meant to protect against the fallacy of exceptional consistency in data—a potential weakness in qualitative methods (Aldoory & Van Dyke, 2006). Finally, the researcher used the tenets of resource mobilization theory as a framework for interpreting the findings. The ethics board of the researcher’s home institution approved the research protocols used in this study.

Each informant represented a distinct grass-roots network in the United States. The largest city hosting an initiative claims nearly 1.3 million residents, while the smallest town’s population hovers at about 22,000 residents. The study encompasses community wireless initiatives varying in age from a few months old to nearly eight years old. In terms of traffic, network usage ranged from fewer than 100 unique users per month to 21,000 unique users per month. Following are brief descriptions of the network representatives interviewed. Because informants agreed to participate anonymously, they are identified by pseudonyms throughout the paper.

“Ryan” single-handedly built a network in the commercial district of a large Rust Belt city. At the time of the interview, it averaged nearly 300 users per day and activity was increasing.

“Jack” administered a network in a medium-sized college town in a Prairie state. This initiative did not track activity but was experiencing a decline in usage due to the fact that about 80% of its 50 nodes were non-operational.

“Douglas” co-founded and served as the primary administrator for an initiative in a large city in the Pacific Northwest. Daily, a maximum of 40 people used this ad hoc network, among the first grass-roots wireless initiatives in the United States.

“Charles” was hired to deploy and maintain the nodes for a free mesh network in a college town in the Northeastern United States. At the time of the interview, the network had been functioning for about three months and 20,000 unique users had logged on.
“Jacob” represented a non-profit network in a sprawling rural Southeastern community with nearly 400,000 residents. About 400 households subscribed to the network, and up to 50 people purchased passes for daily access. “Victor” founded a mesh network in a medium-sized Southern city in mid-2007. About a year later, nearly 600 people had used it, and Victor planned to expand the initiative statewide.

“Howard” and a partner purchased dozens of mesh repeaters and personally deployed them in early 2008, creating a wireless network that covered the entire downtown of a college town in the Great Lakes region. Within months, more than 7,800 people had logged on to the network.

At the time of data collection,

“Todd” had recently commissioned a feasibility study exploring how to most efficiently create a mesh network in an underserved borough in New York City. While Todd’s non-profit organization provided free computers and skills training, nodes had yet to be set up when he participated in an interview.

“Alexis” worked with a rapidly expanding ad hoc network that covered about 80% of a high-tech city. About 150,000 people had registered to use the “Ubiquitous Net” network, and this informant’s work was focused specifically on expanding it to low-income communities.

In 2003,

“Zachary” led efforts for a non-profit organization attempting to create ad hoc networks in three underserved communities throughout a Midwestern state. One initiative was deployed in a former coal-mining town, while another was in a Latino neighbourhood of a major city. Only the wireless network established in a predominantly African-American neighbourhood of the major city remained operational—and a different non-profit organization had assumed leadership of it.

“Jordan” spearheaded a group of volunteers that had deployed mesh nodes in low-income areas of a large Southwestern city since 2002. About 15,000 people relied on the various networks to connect to the Internet from home.

In 2006,

“Quinn” founded a mesh network with the hope of bringing “free Internet access to everyone” in his community, located in a metropolitan area in the Sun Belt. At the time of the interview, the network included 25 access points used by about 80 people each day.

Data findings presented in the following section are organized according to primary themes that arose during interviews. These themes deal with issues related to technology, policy, user motivations, and network sustainability.
Findings and analysis

Digital inclusion

A commitment to expanding digital inclusion is a primary incentive to develop mesh communities, based on data collected during interviews with network founders and administrators. Quinn, the informant from the Sun Belt region, reported that he and fellow group members believe “the digital divide is a real problem and it is widening every day.” Other informants spoke in detail about daily tasks—from banking transactions to obtaining government services and filling out job applications—that require online access. Jack, who administered a community network in a college town in a Prairie state, said the project began with the idea that it could play a “social justice” role. “We think the network can perform and reinforce a lot of the good functions of a neighbourhood organization, in that it makes people aware they are not on some island of information,” he said. Jack noted that his grass-roots initiative enabled school children to get online from home for the first time, demonstrating that wireless community networks can help close the digital divide. Victor, who developed a mesh network in his Southern city, asserted that if the government paid for just a few gateways to the Internet and then distributed mesh routers, the digital divide could be nearly eliminated. Friends who shared a passion for IT founded a mesh network in a Southwestern city, reported Jordan. “At first, we had no higher purpose,” he stressed, noting that early deployments were in privately owned apartment complexes. However, network founders ultimately decided to undertake projects only in affordable and low-income housing developments. “We didn’t want to be involved in just hooking up landlords for their own benefit,” Jordan reported. Quinn, the founder of the signal-sharing community in the Sun Belt, said he is confident that by contributing free bandwidth, participants in his network are creating an alternate “path” for disenfranchised residents who may have computers but lack connectivity.

However, other informants reported scepticism that peer-to-peer networking can help municipal governments meet digital inclusion goals. “It makes us feel good to say we’re bridging the digital divide, but I’m not sure that’s really the case,” asserted Howard, the informant who deployed a mesh network in a college town in the Great Lakes region. Jordan, who administers the ad hoc network in the Southwest, characterized ad hoc networks as a symptom of the problem—lack of Internet access—rather than the solution. Signal-sharing maximizes the efficiency of bandwidth that is available, “but it’s only filling a gap” that municipal and federal governments need to address, Jordan said. Alexis, the informant closely involved in the Ubiquitous Net project, stressed that while free access to the Web is a key element to closing the digital divide, it is “just one” necessary piece for getting low-income people online. “It’s about social justice, which is more complex than giving someone a router,” Alexis said. As a result, her organization is working to expand the wireless community network to include access to computers and content that is “personally relevant” to new Internet users.

The comments from these informants embody the spirit of resource mobilization theory, which purports that social movement actors capitalize on personal resources and knowledge to achieve their goals (Kendall, 2008). Rather than merely complaining about a problem, such as a lack of affordable Internet access, a core group of activists
brings together other disaffected community members to create an organizational structure. This group then collectively draws upon its resources—perhaps ties to the political establishment, professional skills, media contacts, or financial capacities—to alter the situation (Kendall, 2008). The grass-roots network leaders interviewed for this study all recognized the digital divide as a problem in their communities and, at the same time, determined the government was unlikely to address it. In reaction, they developed and implemented action plans to provide broadband access on their own. The mere fact that, in a peer-to-peer network, discourse takes place over community-owned infrastructure eliminates the mediating role typically played by corporations. As a result, these social actors may create cultural and political meanings on their own terms. By helping close the digital divide, these actors are creating wider structural change in both broadband infrastructure and the public sphere.

Like the goal of closing the digital divide, a majority of informants mentioned a desire to strengthen community. Jacob, whose non-profit runs a mesh network in the rural Southeast, envisions Internet access as a “community-building tool” for a region located far from both the “seat of power” in the state capital and the economic centre of the state. Similarly, Zachary, who helped launch three mesh networks in the Midwest, stressed that he and his peers are not “technologists.” Rather, they perceive Internet access as a tool for achieving ambitious economic development goals. Zachary cited the Internet’s potential to open new commercial markets for local entrepreneurs—potentially enabling them to “compete with Amazon.com”—and “connect” neighbours to one another. Howard, the study participant from a Great Lakes college town, cited ad hoc networks worldwide as an opportunity to help disenfranchised residents feel less intimidated by the Internet. “The Internet is a very sterile, lonely place, and the fact that this type of project builds community is pretty remarkable,” Howard noted.

Repeatedly, informants reported a desire to help close the digital divide as a driving force behind the creation and maintenance of their wireless initiatives. Yet the data reveal that even dedicated supporters of peer-to-peer networks harbour doubts regarding the potential for these initiatives to bring Internet access to the masses. These comments highlight the reality that even “successful” grass-roots initiatives are limited in their reach. While volunteer-led efforts serve an important purpose—in terms of raising awareness, building community, teaching skills, and expanding access in small communities—some informants suggest digital inclusion goals are more likely to be fulfilled when government officials and incumbent carriers intervene. This is unlikely to happen, however, without a more progressive political economic model that takes into account civic engagement and deliberative discourse, as opposed to market considerations alone. Policy decisions that increase media consolidation and lock out landline competition are the result of a political economy that favours a concentrated, corporate-run media structure over local, independent broadcasting and publishing outlets. Currently, the U.S. Congress and other governing bodies in the Americas tend to consider how their decisions impact industry, rather than how they can enhance “the lifeworld” (Habermas, 1987), with its focus on how people interact, how they make rational decisions, how they contribute to culture, and how they contextualize life experiences. Until governments develop policies that legitimize and encourage
peer-to-peer signal-sharing, it will be difficult for community Wi-Fi networks to achieve digital inclusion objectives.

**Technology and network design**

Broadband activists have adopted unique approaches in their efforts to expand access, partially evidenced by the varied mesh devices chosen for build-outs. Network administrators interviewed for this study generally agreed that the technology chosen for deploying a network was secondary to its mission. “Although the technology had a symbolic role, it was really a method for achieving a goal. We were interested in the use—strengthening access to neighbourhood economies and neighbour-to-neighbour relationships,” reported Zachary, the informant who helped launch three networks in a Midwestern state. Five deployments studied for this research use proprietary devices from Meraki, a start-up based in San Francisco, CA, that obtained partial funding from Google. Informants cited the ease of installing the equipment—several compared it with plugging in a toaster. “It is so easy, you really don’t need to be a nerd to do it,” said Howard, from the Great Lakes town. By contrast, seven other wireless community networks examined were built with open source routers. This means network designers reconfigured firmware that comes standard on “off-the-shelf” equipment and rewrote the code specifically for their network requirements. The informants representing these initiatives felt strongly about customizing and controlling their own management structure. “We do a lot of experimenting with the technology to see what is most effective ... so there are no set rules,” reported Douglas, who co-founded the ad hoc network in the Pacific Northwest.

While several informants stressed the “geek fun” aspect of installing open source software on radios, their comments have serious theoretical implications. In fact, these broadband activists are making a political statement by deploying open source devices, which are collectively developed and allow customers to determine how they use the hardware. In this sense, mesh networkers who develop their own routing protocols are challenging key facets of the dominant telecommunications industry. Corporations protect their interests through patents, trademarks, and terms of use restrictions. They lock down devices like the iPhone and prohibit consumers from copying DVDs for which they already paid. By contrast, open source developers rely on external input from users and benefit from the viral spread of their technologies. The open source philosophy mirrors the principles guiding the wireless signal-sharing movement itself. Above all, open source developers privilege collaboration over individual ownership. Without question, however, research and development require investment. This partially explains a recent trend in open source initiatives: companies as diverse as Google, Microsoft, and Oracle are funding them. Open source developers aim to hold true to the movement’s public-good principles, while also reaping the benefits of venture capital. In Google’s case, the company is paying developers to create code that enables the search engine to avoid dependence on external software companies. In another example, the Mozilla Foundation received corporate funding to help create its widely adopted Firefox Web browser. Without corporate investment, Firefox likely would have remained uncompetitive with Microsoft’s Internet Explorer. At the same time, the minds that built Firefox would not have contributed to improv-
ing the browser if it were closed source. The relationship is mutually beneficial. As Wieczorek (2008) noted:

I sort of view open source software as being a community improvement project—people get together to pave the roads & build wells because it benefits everyone. But at the end of that project, people return to their for-profit businesses that rely on those roads—delivering goods to market and commuting to work. In the marketplace these businesses are competitors, but they can all agree to cooperate on projects that no one company would want to undertake on its own. (n.p.)

This touches on the theory of social change within institutions developed on the heels of the Industrial Revolution. Commons (1934) argued that collective actions and conflicts of interest define both the economy and laws. Specifically, stakeholder groups in a particular institution act collectively to carve a niche that accommodates their own practices, while at the same time working harmoniously alongside everyone else. Agre (2004) compares these institutions with computer protocols, or “the code” (Lessig, 1999), that mediate interactions in contemporary life. Together, these two ideas apply to the peer-to-peer networking movement. Actors in the movement must follow a set of rules—written and unwritten—that ensure no single participant constrains the system and renders it useless for the majority. In one sense, the capacity of the bandwidth governs the system. At a more fundamental level, however, it is democratic relationships and a set of shared values that regulate the network. A mesh network cannot exist without the collective, nor can it exist without individual commitments to expanding the public sphere and deliberative discourse within that space. The following section further explores conflicting philosophies within the grassroots Wi-Fi movement.

Ideological positioning
In-depth interviews with community broadband activists revealed that they hold diverse ideological views about the role of community networking. For instance, some informants who participated in this study assert that Internet access should be free, while others argued that users should absorb costs associated with the service. A majority of informants asserted that Internet access should be categorized as a public utility, just like clean drinking water and paved roads. However, several study participants countered this argument, suggesting the government should be responsible for providing broadband only in communities where private companies offer no service. Eleven of the twelve informants shared the conviction that community Wi-Fi initiatives should not display paid advertisements on splash pages or as banners. Jacob, network administrator in the rural Southeast, reported that his initiative is guided by the ideology that locally owned Internet access is imperative in order for “community-based problem-solving” to succeed. Jacob referred to “absentee network owners” who are unresponsive to community needs and who exhibit no interest in collaborating on initiatives such as “job training, emergency services, or economic development.” By contrast, his Wi-Fi initiative was envisioned as a “community-building tool” for the entire region. Prior to the deployment of this network, only those who could make it to a local community centre with public computers had access to broadband.
Jack, representing a network in a Prairie state, reported that “free has been important” to group members. But having spent several years in the wireless community movement, Jack said he had come to believe in the merits of charging users a monthly “maintenance fee.” This model would enable paid engineers to immediately fix network problems, as opposed to waiting until volunteers got around to it, Jack reported. “There’s no reason you can’t create a community-based ISP,” he said. Todd, who is investigating how to best deploy mesh in a New York borough, stressed that consumers must help absorb the costs of building the U.S. telecommunications infrastructure. Companies invested billions of dollars in it and “people who think you can just operate a free network are pretty much out of their minds and not living in reality,” Todd stated. Victor, founder of a network in a mid-sized Southern city, reinforced this perception that communications technology is not an entitlement. The government is obligated to step in only when no ISP services an area, he said. An informant representing a network in the Pacific Northwest, Douglas, echoed this sentiment. “Both historically and today, you won’t hear our group advocating for free Internet access—it needs to be affordable and meet the needs of consumers,” he reported.

On its face, the notion of charging community network members may appear at odds with an open source ideology, which advocates for freely available technology. Considered from another perspective, though, the sentiments conveyed by informants combine political economic realities with public-good principles. While they are clearly committed to expanding broadband access, they are realistic about the long-term sustainability of projects that give away bandwidth. Just as other public utilities charge consumers for water, electricity, or gas service, these informants suggest that community broadband users bear only their fair share of the costs, not generate excessive profits that benefit shareholders or corporate CEOs. When taking into consideration the real-world costs associated with delivering high-speed Internet access—from purchasing mesh equipment to the physical labour involved in deploying the nodes—it is possible to conclude that the public good is better served when community network participants pay minimal fees, ensuring the networks have enough money to continue.

Several other informants reported a commitment to providing Internet access to all Americans at no charge. Quinn, who founded an ad hoc network in a large Sun Belt city, described his goal to provide “free and open access.” Ryan, the creator of a mesh network in the retail district of a large Rust Belt city, said he believes “wholeheartedly” that Internet access should be free. “How do you limit the knowledge of the world to people who can pay for it?” he asked. Whether community network administrators said they advocated for free or affordable broadband, they all stressed the need to create a virtual space for deliberative discourse and enable more of their neighbours to participate in the information society. Community mesh networks exist, in large part, because of participants’ convictions that additional opportunities for community involvement are needed. Network administrators interviewed for this study said they hoped Internet access would lead to more frequent exchange of ideas among network members and serve as a communication channel for organizing efforts. The original architecture of the Internet is inherently democratic, making it a natural extension of the public sphere.
Within this space, no single person possesses more power or prestige than any other (Wallace & Wolf, 1999). The establishment—encompassing everything from administrative politics to organized religion and Wall Street—does not exercise influence in the public sphere (Habermas, 1962). Because so many aspects of political and cultural life now take place in the digital realm, Americans who are not online find themselves increasingly disenfranchised. The informants in this study said they hoped to reverse this trend. The question remains: is this goal achievable in a political economy that concentrates power in the hands of a few telecommunications companies, all of which bar subscribers from sharing bandwidth? Conversely, one must consider whether the digital divide can be sufficiently addressed by non-commercial models, which introduce a different set of challenges. For instance, the virtual democracy touted by study informants could produce a public sphere so cluttered with social networking sites and meaningless content that democratic ideals are drowned out. Without negating the merits of user-generated content, even millions of blog posts and “tweets” cannot be equated with the characteristics of a truly democratic society. With these issues in mind, the following section examines who is volunteering time and skills to the ad hoc networking movement and the broader role volunteers play in it.

Volunteer support
Volunteers are integral to the existence of initiatives such as peer-to-peer signal-sharing, according to resource mobilization theorists (Jenkins, 1983; McCarthy & Zald, 1973, 1987). How effectively a social movement mobilizes volunteers—as well as the material resources and knowledge they bring to the table—largely determines its success.

The role played by volunteers varies dramatically among the 12 viral networks examined for this research. Typically, the initiatives rely on a core group of members to perform tasks such as configuring routers and deploying access points. Volunteers may also be called upon to reboot down nodes or manage network traffic when bottlenecks occur. While volunteers remain a key component of most initiatives, the introduction of relatively inexpensive preconfigured routers has reduced the need to cultivate armies of volunteers, as informants explain in this section. As a result, the nature of the movement is also evolving.

Volunteers remain critical to the success of some ad hoc wireless initiatives. For instance, the administrator of a well-established network in the Pacific Northwest reported that his project is “entirely predicated on significant volunteer involvement.” More than 110 volunteers host and maintain nodes, and at least 15 of them “do work beyond their own node,” reported Douglas, who personally devotes between six and ten hours each week to handling administrative issues related to network operations. Most volunteers participate out of a desire to expand broadband access, while a small percentage of volunteers view the network as an opportunity to “play with” wireless technology and learn more about it, Douglas said. Victor, the informant who founded an initiative located in a medium-sized Southern city, said he coordinates about seven volunteers who assist with designing the mesh and provide direct connections, or gateways, to the Internet. Victor himself devotes between four and six hours per week to the project.

An initiative that took root in three depressed areas in a Midwestern state required network members to assemble nodes. The rationale was that community members
would feel invested in the network if they helped build it. Pierce, the former administrator for this initiative, recalled how “cool” it was to witness adults and teens from the community during “assembly parties.” These events served as both “a means and an end,” Pierce said, noting that at least one community member was offered a job in the IT industry as a result of the skills he acquired.

One of the community mesh networks in a mid-sized college town started out with impressive volunteer participation. Over the past two years, however, interest has “evaporated,” said the informant Jack. As a result, many nodes are down and the network sees minimal traffic. According to Jordan, the informant from a large Southeastern city, his network once boasted dozens of regular volunteers who could be relied upon to help flash open source radios and install them. However, after the group began purchasing preconfigured routers in 2006, many of these volunteers drifted away. Because “installing” these routers means plugging them in, and managing the network is as simple as viewing real-time data aggregated by dashboard software, even this network of 15,000 users is simple to run, Jordan said. He characterized the reduced need for volunteers as “both a good and bad thing.” On the positive side, technology has evolved so that ad hoc initiatives are less complicated and more reliable. The negative aspect is that the challenge of building networks has vanished, Jordan said. “It’s the difference between a ’57 Chevy—where you could take apart every component and change your own oil—and a new Prius that you’ve got to take to the dealership if that one computer chip goes,” Jordan reported.

People who opt to share bandwidth are motivated by a commitment to closing the digital divide, as opposed to a personal benefit such as saving money. They are fed up with the political and social status quo (Stöber, 2004) and feel compelled to act. But these findings suggest political convictions alone may not be enough to sustain the community network movement. Data collected from network administrators suggest participants also seek personal challenge and camaraderie. As resource mobilization theory points out, contemporary social movements are often grounded in “postmaterial” values focused on self-fulfillment, particularly the personal reward that accompanies philanthropic acts (Ingelhart, 1977; Ladd & Hadley, 1978; Miller, 1997; Thomas, 2006; Yankelovich, 1974, 1981). So while “doing good” in itself is important, feeling good about these acts may be equally important to community wireless networkers. Unless this component of the movement can be recreated, the future of grassroots networks is in question. For those who do choose to join the typical project, their contributions of time and money play a pivotal role in the initiative’s success.

Resource mobilization scholars theorize that social actors find self-fulfillment by contributing to society as a whole (Jenkins, 1983; McGuire & McQuarrie, 1994), as is demonstrated by the willingness of volunteers to make personal sacrifices for the goal of expanding broadband access. Classic Marxist thought purports that conflicting economic interests lead to social action. Yet an opposite set of circumstances is driving these informants. These actors became key players in the community Wi-Fi movement after they earned more discretionary income, achieved higher education levels, and found themselves with spare time to devote to the cause. As anecdotal evidence, each of the 12 network informants interviewed for this chapter had, at a minimum, a college
degree and held a professional-level job. The demographics of the viral networking movement likely increase its credibility level in the public eye, as well as with policymakers. At the same time, the demographical make-up of participants implies steep barriers to joining a mesh network.

Informants mentioned direct connections between their volunteerism and the reality that Internet access is increasingly necessary for average Americans to carry out routine tasks. As “more and more critical services,” such as news coverage and employment opportunities, migrate to the Web, “those without access are put at a serious disadvantage,” said Quinn from the network in the Sun Belt city. Also present was the conviction that providing broadband access for disenfranchised residents in their own communities ultimately strengthens democracy itself. An argument supporting this kind of local ownership of infrastructure and self-governance touches on the theories articulated by Laclau & Mouffe (2001), who envision a democracy in which no individual movement is co-opted by another or forced to assimilate. So while individual community mesh networks share political values, organizing tactics, and management structures, each also maintains its independence. Rather than forming coalitions, grassroots broadband initiatives constantly interact to form new hybrid identities and short-term partnerships.

**Relationships with Internet service providers**

Incumbent ISPs in the United States require each customer to sign a “terms of service” agreement. These contracts include a provision barring the subscribers from attaching any device to their modems that would make it possible to share bandwidth outside the premises. The community mesh networks examined in this study are, of course, challenging these policies by developing and distributing technology that enables multiple people to share a single ISP connection.

The restrictions put in place by incumbent carriers affect peer-to-peer networks in multiple ways. While some informants said they simply “ignore” cable and phone companies, others said they go to great lengths to discourage members from violating terms-of-service agreements enforced by their local ISPs. Jordan, whose initiative deploys mesh technology in low-income housing developments in a large Southwestern city, said his network purchases business lines from the local cable company. This type of subscription allows all 15,000 members to legally share a few paid Internet connections. Jordan theorized that, because the local government limits the number of years tenants may live in subsidized apartments, his Wi-Fi project ultimately creates customers for the telecommunication companies. Residents introduced to the Internet while living in public housing will likely subscribe to a DSL or cable Internet provider after moving out, he noted. When business owners or residents volunteer to host nodes for Howard’s high-traffic network in the Great Lakes, he gives them a brochure identifying three competitive ISPs that explicitly permit bandwidth sharing. If volunteers already subscribe to the incumbent cable or phone company, Howard said he rejects their offers to host access points.

However, not all ad hoc network initiatives strictly adhere to terms-of-service agreements. Victor, the project founder in a mid-sized Southern city, said he discourages network members from hosting access points if they are Comcast or Verizon cus-
tomers. “If you do, anyway, you’re on your own. It is up to the node owners to make sure they are doing it legally,” Victor said. The “official mantra” of the ad hoc network in the Midwestern college town is to “work with ISPs to benefit the community,” Jack the informant said. In reality, though, network members “ignore” their ISP subscriber agreements, he said. Ryan, who deployed and managed a mesh network in the retail district of a Rust Belt city, said that he doubted the local phone company was aware of the ad hoc network’s existence and hoped it “never figures it out.” A website for the Ubiquitous Net initiative states that the company partners with a broadband re-seller whose terms-of-service agreement permits bandwidth sharing among subscribers. However, Alexis, the informant who works closely with the network, said she was aware of Comcast and AT&T customers participating in the community mesh network. In fact, some activists join the Wi-Fi sharing movement specifically because “it is their way of sticking it to the telecos,” reported Douglas, who represents a network in the Pacific Northwest.

Comments from the community networkers interviewed suggest that policies promulgated by incumbent ISPs likely hinder the growth of peer-to-peer networks. Law-abiding citizens may perceive participation as illegal or unethical and therefore avoid it. From a political economic standpoint, however, incumbent ISPs may benefit from accepting mesh networking as a natural evolution of broadband. This has turned out to be the case when dominant technology companies have embraced the innovation fostered by other peer-to-peer applications (Vyzovitis & Lippman, 2004). For instance, consumers have purchased more than five billion songs from the iTunes store and download more than 50,000 movies every day (Apple, 2008). This type of content distribution is a “direct descendent” (Vyzovitis & Lippman, 2004, p. 5) of Napster—an illegal, disruptive grass-roots application. Similarly, cable providers might have been slower to offer voice-over-IP telephony service had they not witnessed the popularity of another peer-to-peer application, Skype. These examples can be examined through Lenin’s assessment of the global capitalist system. He viewed the economy as a political reality or, more precisely, as “an imperialist chain” (Laclau & Mouffe, 2001, p. 60) that leads to class differences and, ultimately, class struggle. In the case of peer-to-peer networks, the “class” is defined not by economic position, but rather by other aspects of identity, such as interest in media democratization or software development.

Technological innovation
A majority of informants cited the opportunity for collaboration with like-minded peers as a key driver behind their participation in signal-sharing networks. Individuals who enjoy testing and applying their knowledge of technology approach mesh networking like any hobby. It provides an opportunity to both socialize and practise skills. At the same time as personal needs are fulfilled, collective actions serve to indirectly strengthen the ad hoc networking movement. Jack’s network in a Prairie state used to host weekly “hack nights.” This unique space consistently drew a crowd of techies who would resolve software bugs and modify hardware features, Jack said. Douglas, from a network in the Pacific Northwest, explained that he and his peers initially deployed mesh networks purely for the technical challenge. “There wasn’t some greater purpose to it for us,” he said. “We would buy radios … and put different open source
software on them to run the way we wanted and to manage it,” Douglas reported. These comments demonstrate that some ad hoc community members participate in order to satisfy a personal desire to socialize and collectively test their knowledge, while simultaneously fostering a more civil society. A similar dynamic characterizes the international low-power FM movement, in which media activists come together for weekend-long “barn raisings” to build studios and antennas (Prometheus Radio Project, 2009). A sense of camaraderie accompanies these events—where participants brainstorm, strategize, create, and collaborate. Collective identities fostered during such experiences are recognized as crucial elements of political action (Jasper, 2005). They are enacted and sustained via “identification rituals” (Jenkins & Form, 2005, p. 340) that supply social movement actors with a positive identification, while also creating a space to negatively brand opponents and those in power. The sense of belonging that accompanies collective actions can be quite powerful (Jenkins & Form, 2005). These bonding episodes represent one aspect of collective behaviour participation, which is necessary to create a social movement. In 2002, Zald & McCarthy (2002) updated their theory on resource mobilization to consider “symbolic” resources, such as hymns sung in church during the Civil Rights movement. Similarly, the social outlet created by “hack night” can be viewed as a resource that strengthens the mesh networking movement. While social bonds are less tangible than routers or antennas, they are equally crucial to the existence of signal-sharing communities.

Marketing
Word of mouth is by far the most common method cited by study participants for both promoting use of their networks and encouraging residents and business owners to host nodes. With one exception, none of the ad hoc networks examined had a marketing budget or salaried staffer charged with outreach activities. A number of informants echoed the sentiment expressed by Quinn in the Sun Belt that “getting the word out is one of the more challenging aspects of the project.” Jack, representing the well-established initiative in a Prairie state town, cited a website as the network’s primary marketing tool. But network organizers also worked hard to develop a “pretty strong” presence among other local progressive organizations. As a result, activists entrenched in other social justice issues helped grow the network, Jack said. Pierce’s initiative in the Midwest took a “neighbourhood-centred” approach to attracting participants by presenting at churches and community organizations, he reported.

While most network users learned about the mesh build-out in a Southwestern city via word of mouth, Jordan said he distributes fliers and sends out email “blasts” as well. Some users learn of this network while simply “stumbling around on the Internet” in search of an open service set identifier, or SSID, he added. (An SSID is the name for any wireless access point available for connection.) Community network informants described several creative, low-cost marketing techniques. The established initiative in the Pacific Northwest created stickers featuring the initiative’s logo, which volunteers posted in cafés and other locations where the network is available, Douglas said. Howard, the co-founder of a network in a small city near the Great Lakes, said he and his partner created a brochure geared toward both potential node hosts and network users. This pamphlet, along with coverage from several daily newspapers and
the local public radio station, led to increased interest in the project, Howard said. Similarly, the network in a medium-sized Southern city has been the subject of articles in the local daily newspaper and a regional magazine. “We absolutely saw a big spike [in network usage] after that publicity,” Victor reported.

It is important for grass-roots networks to market their projects for reasons that transcend the practical, such as expanding coverage. Rather, informants strive to publicize their efforts because they recognize that pluralist discourse is a catalyst for action. The more frequently it flows through civil society, “the more it can inspire radicalized resistance” (Smith, 1998, p. 69). Messages must be carefully tailored to achieve the movement’s objectives. The way activists talk about their broadband initiatives must be in line with existing norms, while at the same time their messages must reframe accepted practices in a new way (Smith, 1998). In general, study participants said they are convinced of the benefits of media coverage, but lack the resources to implement communication strategies.

Limitations of this research
Few women participate in the grass-roots networking movement, as evidenced by the fact that 11 of the 12 informants interviewed for this study are male. While the research acknowledges this gender division, it does not explore the underlying reasons that might explain why the situation exists. Ahuja (2002) attempted to identify the underlying factors that may contribute to the status of women in technology. It was not until the early 1980s that women began to pursue careers dealing with information systems, and even then the demands of motherhood and “structural factors” held them back (Ahuja, 2002). Even before career choices come into play, computer classes and camps were filled with boys (DiDio, 1996), while girls were encouraged to focus on non-science subjects such as literature and history. When women do choose careers in the IT field, the work environment does not make it easy.

Powell co-authored an article examining challenges she faced while studying Île Sans Fil, a community technology initiative in Montréal (Peddle, Powell, & Shade, 2008). According to the study, Powell’s experience as an academic who theorizes about technology was “not perceived as being useful to the group members involved in producing technology” (Peddle, Powell, & Shade, 2008, p. 18). Despite her contributions to the group, Powell found that many male network members considered her research trivial when compared with core goals such as writing software code and deploying infrastructure. Similarly, in her study of low-power FM radio activists, Dunbar-Hester (2008) found that women possessed fewer technical skills than their male counterparts. Despite the egalitarian principles guiding the low-power FM movement, this reality often led to a lack of gender equality and challenges for female participants. Wireless networks can play a significant role in helping to uplift disenfranchised members of a society by providing access to information, education, and professional development. Excluding women from the process of shaping and deploying this powerful tool will potentially limit their opportunities to benefit from it.

Conclusion
Social scientists have used resource mobilization theory to help contextualize contem-
porary social movements ranging from immigration reform to environmentalism. Until now, however, communication scholars had not considered how the framework applies to broadband activism. The ad hoc networking movement is committed to principles of local autonomy and democratization. Yet, at the same time, actors can likely achieve their digital inclusion goals only with governmental and foundation support. While the data collected for this study find that individual mesh networks occasionally receive funding, the research found no institutional support directed toward the mesh networking movement as a whole. Furthermore, rather than sharing resources, the majority of local signal-sharing projects exist in isolation. An obvious tension persists between the need for individual initiatives to focus on sustainability and the broader agenda of the grass-roots networking movement to push for open infrastructure and other telecommunications policy reforms. Actors in the signal-sharing movement do not seek to topple incumbent carriers; they strive only to carve out a space for peer-to-peer networks that offer an affordable, non-commercial alternative to traditional broadband providers. From the perspective of these activists, the Internet functions as far more than a commodity to be bought and sold. In fact, study participants described wireless community networks as modern-day town squares that enable the exchange of ideas and opinions—as extensions of the public sphere.

In addition, this study highlights the critical role technological innovation plays in the grass-roots networking movement. In fact, the data suggest that the opportunity to help develop open source applications and platforms—on which competing providers may offer content and services—and create infrastructure is nearly as important to community wireless projects as is connectivity itself. Community wireless initiatives possess the potential to disrupt the telecommunications industry by enabling consumers to take advantage of broadband signals without subscribing to an ISP. As end-users gain increasing control over technology, the implications for the political economy of telecommunications could be dramatic. Currently, incumbent ISPs exercise their dominance by capping bandwidth levels, centrally managing traffic, and bundling products (e.g., selling Internet and voice services together). In the emerging paradigm of grass-roots networks, however, participants operate and maintain their own systems—relying on telecommunications companies solely for backbone connectivity. These alternative broadband providers will encounter fewer barriers to entry as equipment becomes less expensive, more reliable, and easier to install, and as governments make additional unlicensed spectrum available.

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