Social and Economic Effects of Community Wireless Networks and Infrastructures

Abdelnasser Abdelaal
Ibri College of Applied Sciences, Oman

Information Science
REFERENCE

Managing Director: Lindsay Johnston
Editorial Director: Joel Gamon
Book Production Manager: Jennifer Yoder
Publishing Systems Analyst: Adrienne Freeland
Assistant Acquisitions Editor: Kayla Wolfe
Typesetter: Henry Ulrich
Cover Design: Jason Mull

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Social and economic effects of community wireless networks and infrastructures / Abdelnasser Abdelaal, editor.
pages cm
Includes bibliographical references and index.
Summary: “This book highlights the successes of community wireless networks but also boldly addresses the potential risk factors and broader socioeconomic concerns, exploring previous successes and failures, various designs, and potential challenges with CWNs”--Provided by publisher.
ISBN 978-1-4666-2997-4 (hardcover) -- ISBN 978-1-4666-2998-1 (ebook) -- ISBN 978-1-4666-2999-8 (print & perpetual access) 1. Information technology--Economic aspects. 2. Telecommunication. 3. Wireless communication systems. I. Abdelaal, Abdelnasser.
HC79.I55S598 2013
384.3’3--dc23

2012043392

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 13
Lessons Learned from Grassroots Wireless Networks in Europe

Gwen Shaffer
California State University – Long Beach, USA

ABSTRACT

Grassroots groups in a number of European countries are building Community Wireless Networks (CWN) on small budgets. In underserved regions, CWNs are even surfacing as the principal Internet Service Providers (ISPs). These networks have identified and implemented innovative strategies for providing connectivity—encompassing aspects ranging from software development to infrastructure design and skills training. In other words, these grassroots Wi-Fi networks mobilize human, technical, and financial resources to create sustainable alternatives to telephone and cable companies. This chapter provides an understanding of both the strengths and weaknesses of these initiatives. The authors use data from action research and interviews with leaders and participants of six successful community Wi-Fi networks in Europe. The findings show that these ad hoc initiatives are forcing local incumbent ISPs to lower prices and alter terms of service agreements. In addition, these projects broaden the public sphere, create opportunities for civic engagement, and transfer knowledge among community members. The chapter suggests that community wireless networks should be fostered by governments and the European Union in order for them to function as true alternatives to conventional ISPs, particularly in the last mile. They conclude the chapter with key learned lessons and policy implications.

DOI: 10.4018/978-1-4666-2997-4.ch013

BACKGROUND

Grassroots groups in a number of European countries are building large-scale public telecommunication infrastructures on extremely small budgets. The majority of these projects rely on a model of peer-to-peer networking. Instead of information passing from "one to many," it may travel from "many to many" (Castells, 2007; Rafaeli & LaRose, 1993, p. 277). Because a great deal of excess capacity exists in corporate-owned broadband networks and personal networks, this type of bandwidth redistribution and sharing is costless to the giver. Mesh networks, which are created by users themselves, grow *virally*. The design includes at least one access point with a direct connection to the Internet—via fiber, cable, or satellite link—and nodes that hop from one device to the next. As the popularity of these networks expands and their social objectives are advertised, new people join the network and share their nodes. As a result, signals have shorter distances to hop, higher bandwidth is available, and more redundancy is built into the system, ultimately strengthening the network (Rowell, 2007).

In underserved regions of Europe, wireless community networks are even surfacing as the principal Internet Service Providers (ISPs). In other words, the rapid growth of these projects suggests that community, neutral and free networks can function as true alternatives to conventional operators, particularly in the last mile. This research finds that these projects are creating opportunities for civic engagement and public participation for their members. Additionally, the data collected for this study finds out that grassroots Wi-Fi networks in Europe are helping to mobilize human, technical, and financial resources—simultaneously providing affordable broadband connectivity and advancing technology. It also examines the practical and theoretical implications of these initiatives. In particular, the research examines how both ISPs and government entities are responding to CWNs that use mesh technology, and whether their reactions signify a shift in the political economy of telecommunications. This study is based on action research supported by data collected through qualitative interviews with both leaders and participants of six established mesh networks in Europe.

THEORETICAL FRAMEWORK

The resource mobilization theory 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. This approach offers an ideal framework for understanding how peer-to-peer broadband networks emerged and how participants sustain them. The resource mobilization approach emerged as a sub-discipline 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 groups struggling 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). Subsequently, communication scholars began using these concepts to ground their own research. While this approach is not universally accepted, a critical point made by resource mobilization theory is that average citizens would lack the know-how to participate in political action and, thus, must rely on professional advocacy organizations. Therefore, core group members develop a strategy to catalyze the sentiments expressed by those who feel alienated (McCarthy & Zald, 1987). They attract financial and human resources, seize media attention, foster relationships with people in power, and develop an organizational structure (Kendall, 2006; Hannigan, 1985). Resource mobilization theory as-

sumes that a social movement will fail to produce change without adequate resources and alliances (Gamson, 1975; Tilly, 1978; McAdam, 1982).

The activists behind these CWNs possess access to the media and relationships with policymakers. People initiating and joining non-profit signal sharing networks, the core of this grassroots movement, typically have technology and IT knowledge (Cho, 2008; Abdelaal & Ali, 2012). In fact, they are in a position to mobilize resources only because they have acquired these resources. This research finds that those who join signal-sharing communities are linked through common interests, including the desire for ubiquitous connectivity, digital inclusion, and forcing 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 (Lawrence, Bina, Culjak, & El-Kiki, 2007). Still, the question arises: Why do people join social movements when they can benefit from the work of others who are willing to bear the costs of achieving a common good? What are the incentives to contribute rather than free-ride (Olson, 1965)? These questions must be posed because the costs of defending an interest are obvious. These costs (e.g. time, money, efforts, and even safety) are often sacrificed for the common good. As with CWNs, successful new social movements result in collective benefits, and participants often get involved in hopes of obtaining some personal resource (McCarthy & Zald, 1987).

It would be remiss to not acknowledge arguments articulated by critics of resource mobilization theory. In general, these theorists contend that this sub-discipline of social movement theory deemphasizes both the complexities that define grievances and the role that ideology plays in social movements. Scholars point out that informal actors and networks, not just those who are socially integrated, participate in social movements (Fox, Piven, & Cloward, 1991). Additionally, because the approach pays scant attention to historical contexts—especially to the structural 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 proponents for defining actors by their strategies, as opposed to by key social relationships.

CONTEXT

The number of citizens using the Internet varies considerably among the countries studied as part of this research. As of 2010, the Internet penetration rate was about 75% in Austria; 71% in Czech Republic; 47% in Greece; 66% in Spain; and 83% in Germany (Council of Europe/ERI Carts, 2012; Internet World Stats, 2012). Denmark is among the most connected nations in the world, with an Internet penetration rate nearing 90% (Internet World Stats, 2012). The European Commission is attempting to bolster broadband access and services for all EU citizens by proposing to spend nearly €9.2 billion from 2014 to 2020 on related projects throughout its member countries. The funding is part of the proposed Connecting Europe Facility initiative, and at least €7 billion would be available for investment in high-speed broadband infrastructure (European Commission, 2011).

Even without this massive government effort, the cost for high-speed broadband is dropping throughout Europe (International Telecommunication Union, 2011). Technological advancement is a key factor driving this decline. Specifically, as next generation technology and government policy have matured, it is cheaper for new entrants to offer higher speed broadband (Analysys Mason, 2011). Of course, as more ISPs compete, Internet fees drop. However, an inability to afford an ISP subscription is not the main reason informants cited for participating in a CWN. In fact, participants

are part of a movement that kicked off in 2004, during the first National Summit for Community Wireless Networks, held in the United States. That movement now includes "tens of thousands of community and municipal broadband initiatives" across the globe (International Summit for Community Wireless Networks, 2010). In recent years, grassroots broadband initiatives have moved away from building Wi-Fi hotspots that blanket neighborhoods and, rather, are experimenting with technology that allows residents to securely share existing wireless connections. Projects using this type of mesh architecture are the focus of this study.

RESEARCH METHOD

Qualitative researchers develop particular ideas, perspectives, or hunches relating to the topic under investigation (Cormack, 1991) and allow the theory to emerge from the findings. This type of inquiry is meant to enhance understanding of the world from the perspective of the subject—not to impose the researcher's outlook on study participants. With this in mind, I primarily collected data through qualitative semi-structured interviews. Specifically, I conducted face-to-face interviews with leaders and participants of European community mesh initiatives between February 27, 2009 and March 18, 2009. In addition to interviews, data collection involved observation of access points and demonstrations of hardware and software programs used to manage the networks. Broadband activists were asked about the role volunteers play in sustaining their projects, as well as about their relationships with the political establishment and with ISPs. Questions also probed how policy reforms could facilitate their work.

I selected the six CWNs based on their demonstrated sustainability, number of participants, innovation and commitment to digital inclusion. The following is a brief description of the studied networks and sources of data:

- Freifunk in Berlin is an open access mesh network run entirely by volunteers since 2003. The informant for Freifunk is one of the original co-founders.
- Funkfeuer is a free network in Vienna, with a Wi-Fi signal covering about one-third of the city. The Funkfeuer informant co-founded this project.
- The Athens Wireless Metropolitan Network was created by volunteers in 2002. The informants for this project included five participants.
- Guifi.net began in a rural, underserved community in Central Catalonia, Spain. The informants for this project included the network's co-founder and two other active participants.
- Czfree.net consists of many community ISPs across the Czech Republic, connected to one another via peering agreements. I collected that data through interviews with members of KlFree.net in Kladno; KHnet.info in Kutná Hora; and Spojovaci.net in Prague.
- Djurslands.net serves about 8,000 households, institutions and firms in rural Denmark. The founder of Djurslands.net was the informant for this research.

DESCRIPTION OF THE CASES

I have studied a mix of urban and rural wireless networks. The following is a brief description of the investigated cases:

Urban Networks

Freifunk Network

Following reunification of East and West Germany in 1989, the national telephone company ripped out old copper lines before determining that laying fiber would be prohibitively expensive. As former

East German neighborhoods gentrified, the tech-savvy residents moving in became frustrated at the lack of high-speed Internet access. "I moved into this area and, as a computer specialist, I couldn't stand living in a place with no broadband," reported a co-founder of the Freifunk initiative in Berlin. In 2002, this informant placed antennas on the roof of his building, connecting 35 residents to the network. His friends, then, set up more wireless nodes and began sharing bandwidth in Berlin, with the goal of creating a highly decentralized network with no ownership. They formalized Freifunk, meaning "free radio," in 2003.

As of March 2009, this mesh network included about 1,000 nodes—blanketing 10% of the city in free Wi-Fi. To host an access point for Freifunk, participants can rent or purchase a router for about $50, then "reflash" it by downloading firmware from the group's website. Any wireless device may be used to connect to the network, and the traffic is not centrally managed. Network participants are not asked to sign a terms of service agreement either. "There is social understanding that accompanies a shared network but no written policy," the Freifunk co-founder said. Participants who subscribe to our network donate a percentage of their bandwidth to the network. "It is important that people have the freedom to decide how much and how often they want to share," the informant reported. Coverage and speed of the network varies throughout Berlin. "If you live next to someone with a fiber ISP connection, you are lucky," he added. To bolster coverage, Freifunk members installed dedicated links—antennas that extend wireless signals 200 to 300 meters—on church steeples. The Berlin initiative has inspired smaller "Freifunk" networks in the German cities of Leipzig and Weimar.

Athens Wireless

Another urban initiative is the Athens Wireless Metropolitan Network (AWMN), which has began under parallel circumstances. In 2002, high-speed Internet access remained unavailable in various sections of the city. Although the incumbent phone company did offer DSL service, it was "slow" and "expensive," according to informants. Frustrated, a group of about 10 friends from a technical Web forum connected their computers. As a result, a large signal sharing initiative has started and it claimed 3,000 participants at the time of data collection. While online gaming remains a popular aspect of AWMN, its members have created dozens of services and applications that reflect their personal interests. About one-third of AWMN participants have installed $1,300 mesh "backbone nodes" on their rooftops, informants reported. These antennas communicate with one another and serve as the primary infrastructure for the network, providing average connection speeds of 130 megabits per second (mgbs). Another 2,000 "clients" have installed the network's routing software, enabling them to connect to backbone nodes but not to extend Wi-Fi signals. AWMN is concentrated in Athens, but strategically located access points—typically on the sides of mountains—and university-owned backhauls link the network to emerging Wi-Fi projects on the islands of Evia, Aigina, and Salamina.

Czfree.net

Political realities also played a direct role in creating a CWN in the Czech Republic. After 41 years of communist rule, the peaceful "Velvet Revolution" allowed Czechoslovakia to revert to a liberal democracy in November 1989. When the country split into Slovakia and the Czech Republic three years later, the Czech government swiftly privatized industries such as banks and manufacturing. Under corporate ownership, the phone company instituted a rate structure beyond the means of the typical Czech family. In the mid-1990s, Internet subscriptions cost as much as $110 per month and required customers to sign contracts committing them to up to five years of service, informants reported. When wireless routers became avail-

able in 1998, students in Prague purchased dial up service and began sharing bandwidth. Commercial DSL service made it possible for projects to formalize. They created websites and actively recruited members, and many began writing their own routing protocols and building antennas.

Today, dozens of community initiatives throughout the country belong to the umbrella organization Czfree.net. Although Czfree.net is loosely organized, most participating networks have agreed to peer—or seamlessly transmit data over their infrastructures—creating a de facto nationwide network with two key benefits. First, interconnectivity greatly improves the flow of data files. Second, individual networks gain leverage when negotiating bandwidth prices with ISPs. KlFree.net in Kladno is among the largest community Wi-Fi networks in the Czech Republic, with about 5,000 access points. It has evolved from wireless signal sharing to 75% of participants directly connected to fiber. Spojovaci.net is a smaller initiative with 200 meshnodes and 5,000 participants. "We started out using Pringles cans because a real antenna was too expensive," a key leader reported. Today, members invest about $200 each to buy open source antennas and Wi-Fi cards. Between 2003 and 2009, KHnet.info grew to include 120 mesh nodes and one direct gateway to the Internet. At the time of data collection, more than 2,000 households paid about $20 per month to subscribe to the network. Czfree.net initiatives support an array of applications: Web hosting, email, anti-virus software, game servers, voice, and video.

The evolution of each of the community Wi-Fi networks discussed in this section is unique. Even so, they all serve as examples of self-interest group that expanded to encompass the public interest. By decreasing the fee of Internet access, these viral networks enable more people to access information and express ideas online. In step with the political model of resource mobilization theory is the concept that social actors realize the flaws inherent in the existing power structure and make up their minds to resolve the problem themselves (McAdam, 1982). The decision by early adopters of mesh technology to share bandwidth can be explained no other way. These actors did not wait for government intervention or a shift in corporate policy. Instead, they created broadband networks that fit both their technology needs and their budgets.

Finally, the ingenuity exhibited by the founders of these networks makes the entrepreneurial model of resource mobilization theory is particularly applicable to European Wi-Fi initiatives. The theory purports that key organizations act as "carriers" (McCarthy & Zald, 1987, p. 12) of social movements, bringing together various groups invested in a mutual cause—affordable broadband, in this case. The theory argues that social actors embrace new technologies as they become available. Some of the networks originated with dial-up bandwidth sharing, then migrated to DSL bandwidth sharing. Today, several grassroots Wi-Fi communities are laying fiber. Another tenet of resource mobilization theory asserts that established institutions participate in social movements, even when doing so is secondary to their mission (McCarthy & Zald, 1987). This reflects a key aspect of European mesh networks, which count schools, hospitals, libraries, and non-governmental agencies among their members. For instance, one network in the Czech Republic partners with a town government to provide free broadband in schools, and allows medical providers and social service agencies to use bandwidth free of charge. Non-profit institutions and schools receive free connections through another Czfree.net network. This participation is significant, according to McCarthy and Zald (1987), because resources must also flow *toward* wireless community networks in order for them to persuade others to join the cause.

In opposition to a proposed Internet data retention law, online privacy activists set up a single Wi-Fi hotspot near Vienna's Museum Quarter in 2003. They intended only to make a political statement, but the effort led the activists to consider

long-term uses for wireless nodes, which were new on the market at the time. They contacted a wireless ISP that had gone bankrupt and the company agreed to give away its Wi-Fi transmitters on the condition that the devices not be used for a commercial network. Suddenly, the activists owned 10 strategically located access points around the city. In late 2003, the co-founders of Funkfeuer hosted a public meeting where they recruited volunteers to help create a mesh network in Vienna. As of March 2009, Funkfeuer had 400 users, including 240 node hosts that place mesh radios and antennas on their rooftops (an upfront investment of about $130). The network owns a 5-gigahertz fiber optic link to the Vienna Internet Exchange, allowing members to share bandwidth for free.

The trajectory of these events vividly illustrates how community networks are redefining the political economy of telecommunications. When the commercial ISP lost money, Funkfeuer converted the company into a project driven by ideology, rather than revenue. Under this new structure, profits materialized in the form of technological innovation and a strengthened sense of community—as opposed to dividends paid to shareholders. Funkfeuer shifted the typical perception of "success" away from its monetary connotation and toward an explanation that privileges public good. This newly defined political economy has gained traction in cities throughout Europe. As Silverstone (2004) noted, it is possible for regulations to also tilt away from corporate priorities and toward critical social and cultural practices.

Rural Networks

In addition to these CWNs in the urban areas of Berlin, Vienna, Athens, and Prague, this study includes analysis of two rural European wireless community initiatives. Both emerged out of necessity, after incumbent ISPs declined to deploy reliable broadband in these sparsely populated regions.

Djurslands.net

In the late 1990s, residents of Denmark's Djursland Peninsula repeatedly asked Tele Denmark to provide residential DSL service. "We realized rural people would fall behind if we didn't do something about it," the project founder said. When the incumbent phone company declined, the informant negotiated with 35 smaller Danish ISPs. "One after another, they said building the infrastructure for rural people was too expensive," he reported. In 2000, the price of access points had fallen to about $10,000, making it financially feasible to connect the region wirelessly. The Djurslands.net informant purchased discounted radios in bulk. Meanwhile, the village of Glesborg built a 50-meter high tower—selling it to the Internet activists for a symbolic single kronen (less than $1). Omni antennas on the tower communicated with devices on the roof of a sports hall 1.5 km away—creating the network's initial link. Djurslands.net officially launched in May 2003, and has evolved to include about 10 fiber gateways to the Internet; hundreds of strategically located access points in villages throughout the peninsula; and wireless connections to the 8,000 households that subscribe (as of mid-2009).

Guifi.net

Although Spanish incumbent carrier Telefónica offered DSL in some parts of rural Catalonia, Spain—about 120 kilometers outside of Barcelona—the service was expensive and unreliable, according to a Guifi.net informant. In 2004, this technology activist conceived the idea to create a CWN by attracting entire village governments, as opposed to individuals. Five years later, 23 town councils subscribed to an ISP, in turn sharing bandwidth with residents via a wireless backhaul. Governments installed 100 antennas on street lamps and roofs throughout their villages, and each of these access points has the capacity to support 30 Internet connections. With an average

population of 2,000 to 3,000 residents, it costs just a few thousand dollars to deploy nodes throughout an entire village. In order to connect to the Guifi.net signal, individual residents and businesses purchase rooftop antennas.

The origins of these two rural networks, Djurslands.net and Guifi.net, are examples of how the political economy of the telecommunications industry deters incumbent ISPs from entering certain markets, regardless of demand for connectivity. The privatization of the European telecommunications industry has led to the deployment of infrastructure and services targeting customers with the most potential to generate revenue, "even if that means greater attention to linking metropolitan centers in global networks, rather than extending networks into rural and generally underserved regions" (Mosco, 1996, p. 202). As Internet infrastructure and computers permeate society and become vital aspects of economic performance, low-income rural regions risk lagging further behind (Parker, 2000). Economic development in rural areas depends significantly on IT access for businesses, non-profits and government (Lentz & Oden, 2001).

While free market principles influenced Spanish telecommunications policymaking during the early years of the Internet, the government also enacted regulations aimed at ensuring that Telefónica remained the dominant carrier (Souvirón & María, 1999). Along these same lines, Denmark's telecommunications industry transitioned from state control to private ownership in the late 1990s. Tele Denmark was forced to relinquish its monopoly in 1998, but remained by far the largest operator (Paldam & Christoffersen, 2004). Grimes (2003) notes that since the liberalization of EU telecommunications policies, universal service obligations have been abandoned and it is difficult for rural communities to compete. The political economic conditions in Spain and Denmark help explain why the founders of Djurslands.net and Guifi.net opted to create their own wireless community networks, as opposed to waiting for incumbent ISPs to connect their sparsely populated regions. These social actors took steps to prevent being cut off from the information society. For instance, farming, fishing, and manufacturing traditionally comprised the core of Djursland's economy. Today, industry has all but vanished from the region, while former agricultural and fishing communities rely heavily on tourism. Since the late 90s, the Grenaa ferry to Sealand ceased operating, the *Daily News Djursland* folded, and the Grenaa Hospital closed along with many shops. While 15 broadband ISPs operate in the region, only Djurslands.net reaches farms and the smallest villages. Djurslands.net can be credited with ensuring the Peninsula did not become geographically and culturally isolated.

The Role of Volunteers

The success of each initiative studied in this chapter depends heavily upon contributions from volunteers. Freifunk participants in Berlin contribute a wide range of time and skills. The most passive form of involvement might mean simply installing an antenna on one's roof to support the network's backhaul. At the other end of the spectrum, 5% to 10% of members sustain the network by hosting meetings, answering technical questions in online forums, and developing software, the informant said. A unique role played by Guifi.net volunteers involves presenting information about the initiative to residents of neighboring villages. "We call this 'the wheel' because it turns on and, if we do it right, it creates momentum," one study informant reported. In fact, public presentations describing the necessary equipment, time commitments and costs are Guifi.net's most important recruiting tool. Once a village commits to participating, Guifi.net members deploy the nodes within a few months to ensure local residents remain "motivated" and "optimistic" about the network. Individual node owners are ultimately responsible for maintaining antennas on their own rooftops, but volunteers respond to questions posted to online forums

and, sometimes, physically assist with repairs. Not only are Guifi.net participants resisting the dominant corporate culture, they are creating a new culture. Just as personal computers in the peer-to-peer networking movement each contribute a little bit of power to a much larger Web of machines, Guifi.net members each share their own base of knowledge with neighbors to extend and sustain the network. As Guifi.net deploys nodes throughout entire villages, the influence exerted by incumbent carrier Telefónica lessens—an example of "the edge becoming the core" (Hagel & Seeley Brown, 2005).

While a majority of Djurslands.net subscribers are "passively involved" in the network, a minority are engaged at every level. Volunteers develop hardware, repair equipment, and regularly attend management meetings hosted by one of 10 community boards throughout the sprawling service area. Djurslands.net also hosts a well-attended annual forum where attendees elect new board members, review financial information, and vote on principles for future management. "This is why it is a community network, not just a physical infrastructure," the Djurslands.net founder reported. Similarly, a "core" group of about 30 Funkfeuer subscribers participate in on-line forums, attend weekly meetings and deploy nodes. In contrast to some European networks, whose members are self-identified "techies," a significant contingent of Funkfeuer's active members are not professionally involved in IT. "We have lawyers, a heart surgeon, construction workers, and even a recovering heroin addict," the informant said.

Because each of the approximately 20 Czfree.net initiatives is unique, it is impossible to generalize about the role played by volunteers. The most formalized projects have paid staff and charge their members for highly reliable broadband connectivity; more loosely organized initiatives rely exclusively on unpaid labor and experimental technology. All three Czfree.net networks in this study depend on volunteers to help deploy and repair nodes. An informant for KlFree.net said he devotes more time and "mental energy" to the project than to his professional job. "I spend several hours every evening dealing with administrative and technical aspects of the initiative," a Spojovaci.net leader reported. Additionally, informants for these networks agreed that word-of-mouth endorsements are their primary means of recruitment. "The best method is *jednapanípovídala*, which means 'one woman said.' It means that new members usually get information from their friends, relatives, or neighbors who are involved," the KHnet.info activist explained.

These projects depend on volunteer efforts to constantly broaden the coverage area—a kind of viral marketing effort that creates innovations and expands the public sphere with each neighbor brought into the fold. The commitments made by volunteers with these six European wireless community networks underscore the social movement principles used to frame this research.

Most members of these wireless communities care more about civic engagement than free Internet access. For those deeply involved in the peer-to-peer movement, these initiatives nurture other networks—social, technical, and economic (British Columbia Wireless Network Society, 2006). Others say any drawbacks related to sharing their bandwidth and skills are offset by the convenience of borrowing other people's free bandwidth when necessary (Efstathiou, Frangoudis, & Polyzos, 2005), as well as by the opportunity to experiment with open source technology. However, McChesney (2009) puts forth a more radical theory to explain why social movements, such as peer-to-peer networking, are gaining momentum. McChesney (2009) describes a "severe social disequilibrium" (p. 44) in which the existing system has broken down and reformers are organizing to fill the gap.

Used Technology

Participants in European Wi-Fi initiatives tend to be deeply immersed in the open source software movement, working to improve existing routing protocols and mesh equipment. As many as 60

Freifunk participants with an interest in developing firmware and other technology-related projects are known to drop by the "Hackers Lab" held each Wednesday evening. Freifunk members have optimized mesh routing firmware, including the B.A.T.M.A.N. protocol used today by community wireless initiatives around the world—as well as in the OpenMesh router sold commercially. Guifi.net volunteers developed a program that uses a proxy system to track traffic, an informant said. At the time of data collection, Funkfeuer developers were testing "a more user-friendly firmware," as well as building 5-gigahertz ring around the city. This static network was designed to extend the main uplink to all of Vienna and "allow people to connect more directly and with fewer hops," the Funkfeuer informant said. Innovation is also thriving in the Czech Republic. Among the most creative efforts involves a large community network in a city outside of Prague. Rather than spending potentially millions of dollars to dig up streets and lay fiber cables, these network members threaded fiber through dormant steam radiators.

The Athens network functions as a laboratory for members. It is a venue for them to develop antennas and satellite dish feeders used on backbone nodes, as well as to refine routing protocols and network management software. However, the dozens of applications created exclusively for the Athens wireless community are what makes AWMN distinct. As the names of some of these services imply, they mirror sites found on the public Internet: the auction site Wbay; search engines Woogle and Wahoo; and wTube, to name a few. Some members use the network to float ideas for online services they intend to eventually introduce commercially. For instance, a movie application led to negotiations with an ISP to create a video-on-demand service within the network. "[AWMN] is more important to us than the outside network because it gives us an opportunity to experiment," an informant pointed out.

Management and Organizational Concerns

Decentralization is a key aspect of peer-to-peer architecture—from distributed storage and processing, to information sharing. No server exists to coordinate the activities of the system, and no database stores global information about traffic transmissions (Pourebrahimi, Bertels, & Vassiliadis, 2005). This is analogous to how informants described *management* of their community networks, from decentralized ownership to consensus-based decision-making. Both these technical and social arrangements reflect an open source approach that privileges collaboration, sharing, and a lack of restrictions on use of infrastructure. This philosophy is in direct conflict with traditional social shaping of technology, which reflects "broad and long-term institutional power" (McDowell, Steinberg, & Tomasello, 2008, p. 37). Corporate broadband services are designed and deployed to fulfill the goals of influential organizations and interest groups—likely governments and telecommunications companies. By reinforcing the status quo, the traditional social shaping of technology has strengthened the need for alternatives and, ironically, encouraged community Wi-Fi efforts.

The six community broadband projects examined in this chapter have varied relationships with government officials and commercial ISPs—from non-existent interactions to true partnerships. These relationships have political economic implications, as well as consequences for the broadband reform movement as a whole. Freifunk represents one end of the spectrum, as this network has no official association with governmental or non-profit organizations. However, Freifunk's popularity convinced incumbent carriers to amend their terms of service agreements and allow DSL bandwidth sharing among subscribers. In addition, at the time of data collection, the group was talking to Berlin officials about "peering" with an open wireless network being deployed near tourist destinations. Such a move would dramatically

expand Freifunk coverage, the network co-founder said. Some Czfree.net participants are convinced that their projects impact incumbent carriers. For instance, the cost of a typical DSL subscription has fallen to about $58 per month, "and continues to drop," one informant said. At the opposite end of the spectrum, Guifi.net's model depends heavily upon Catalonia officials signing on to the network and installing mesh antennas throughout their villages. The return on their investments comes in the form of free Internet connections for village employees, as well as new economic development opportunities. The Catholic Church also allows members of Guifi.net to install antennas on steeples—typically, the highest points in town. However, Church officials are uninvolved in network leadership "because you can't mix bishops with anarchists," the informant said. Djurslands.net's positive relationship with both local ISPs and elected leaders has resulted in two key benefits. First, the network leases municipally owned fiber, which it relies on for connecting directly to the Internet. Second, villages throughout Djurslands have built towers that host antennas. Djurslands.net also participates in two rural innovation projects sponsored by the European Union. Significantly, because of Funkfeuer's former status as a commercial ISP in Vienna, the network is a voting member of Internet Service Providers Austria. Despite membership in the association, the co-founder insisted Funkfeuer poses no threat to Telecom Austria. "It takes determination to build a node. Telecom Austria realizes most people are content to pay €25 each month for Internet," he said.

A typical AWMN participant is more interested in experimentation than connectivity. In fact, the 3,000 members of this Athens network are exclusively "technical guys," an active member said. "Installing the routing software is complicated so all the people connected to our network have IT knowledge," he said. AWMN members characterize themselves as activists. "We don't just complain about technology, we do something about it," another network leader said. In contrast to Freifunk, Guifi.net, and Funkfeuer—all of which are philosophically committed to a flat governance structure—a legally recognized association runs AWMN. However, just about 200 people pay the $65 annual fee required to join the association. This means just 10% of AWMN members participate in officer elections and set policy for the network. It is association members who develop new software protocols, install strategic nodes, and host workshops and "Antenna Fests." Despite these contributions, some network participants vocally oppose the existence of a governing body. "The association tries to control everything. Individual members should be able to do what we want," insisted an informant who develops routing protocols. The Czfree.net broadband initiative is also run by a board of directors. Spojovaci.net's management decisions are made by elected officers, who host monthly meetings open to all members. Participants in another project, KHnet.info, elect seven new commissioners every three years, and the general membership keeps up with new developments by checking the website and blog.

While two networks examined for this study, AWMN and Guifi.net, are legally incorporated, community Wi-Fi initiatives typically function as "a movement of equals" (Neumann, 2007) that take advantage of decentralized wireless infrastructure to recruit new participants and ensure sustainability. Bauwens (2005b) coined the phrase "equipotency" to explain the concept that all participants in a project *begin* as equals. It is only through the subsequent "practice of cooperation" that levels of leadership are dictated. The equipotency characterizing a peer-to-peer network does not reject the idea of management; but it does rebuff the notion that hierarchy is predetermined by characteristics other than expertise, initiative, and ability. It is a spirit of collaboration—devoid of competition or greed—that defines the community ad hoc networking movement.

BENEFITS OF COMMUNITY WIRELESS NETWORKS

The examined case studies show that CWNs have the following benefits:

Knowledge Transfer

Reflecting the global nature of the Wi-Fi signal sharing movement, as well as its public good ethos, members of European initiatives have traveled to underserved communities across the globe to share their knowledge of building grassroots ISPs. Specifically, participants in Freifunk and Guifi.net met with broadband activists in India and Africa, while members of Djurslands.net spent time helping deploy wireless connectivity in Lithuania and Kakistan. "We just want teach people how to create open networks and improve the tools for deploying them," the Guifi.net founder reported (convictions such as this helped Guifi.net win Spain's 2008 National Telecommunications Award, accompanied by about $20,000. With this money, Guifi.net established a foundation to help develop open, free networks worldwide).

Civic Engagement

The strength of democracy may be measured against how effectively members of a society participate in the political process (Rheingold, 1993). In terms of this study, participation in the open source and broadband reform movements also symbolize forms of civic engagement. A healthy public sphere not only promotes a broad spectrum of ideas, but also ensures access to these ideas (Napoli, 1999). While the members of European Wi-Fi communities are not political in the traditional sense—they may not attend protests or campaign for candidates—they are clearly challenging the status quo. They do this in multiple virtual spaces, such as online forums and blogs, as well as during "hacker nights" and community summits. With each new innovation developed by peer-to-peer network participants, underserved members of society acquire broadband connectivity. More significantly, they obtain access to information and ideas that were, previously, within the grasp of only a select few.

This understanding of civic engagement goes beyond deliberative discourse to "developing the combination of knowledge, skills, values, and motivation to make that difference...through both political and non-political processes" (Ehrlich, 2000, p. vi). By defying customer service agreements, participants in the signal sharing movement introduce resistance to corporate policy as yet another permutation of civic engagement. Not only are these participants resisting the dominant corporate culture, they are creating a new culture. Just as networked personal computers in the peer-to-peer movement each contribute a little bit of power to a much larger Web of machines, participants each share their own base of knowledge with neighbors to extend and sustain the network.

Digital Inclusion

The goal of achieving digital inclusion varies from one network to another. Informants representing Guifi.net, Djurslands.net and Czfree.net—networks that partially or exclusively cover rural areas—were resolute that residents and businesses would suffer if they did not provide broadband access. Despite the goal of closing the digital divide, none of these grassroots initiatives purchase or subsidize equipment for low-income members. "It protects us as an association if we don't legally own the nodes…An ISP approached us but Funkfeuer doesn't own the access points so we can't sell them," the Funkfeuer leader pointed out. The Guifi.net informant agreed that "subsidizing equipment is a bad idea," but for a different reason. "It is important for users to understand that when joining the network, they are providers too. You can't be opportunistic if this is going to work," he said. Freifunk's mesh architecture also means that each node host owns

an equal portion of the network. "The network is a concept, it is not an entity," this study participant reported. This structure facilitates non-hierarchal management of both Freifunk and Funkfeuer. For instance, Funkfeuer has an "official" president, but decisions are typically made by consensus, the informant said. However, this commitment to openness and equality can create new challenges. Funkfeuer's leadership struggles with how to implement stronger security measures capable of preventing spam and viruses, without infringing upon user privacy. Ultimately, software may not provide the solution. "The trick is to involve everybody in the network. If they helped build it, they will want to protect it," he said.

While digital inclusion plays an undeniable role in the mesh networking movement, pragmatism appears central to the creation of some CzFree.net initiatives. "The entire point is to get Internet for as cheaply as possible," said an informant with one regional network, Kladno.net. For other wireless community projects in the Czech Republic, expanding Internet access remains a key tenet. KLFree.net partners with a town government to provide free broadband in schools, and allows medical providers and social service agencies to use bandwidth free of charge. Non-profit institutions and schools get free connections through another Czfree.net participant called Khnet.info, which has also created several hotspots accessible to non-members. While Djurslands.net does not offer discounts for low-income families or institutions, in 2008 the network deployed 30 hotspots in Ebeltoft and Grenaa, the "big" town on the Jutland peninsula. Free access points are planned for other villages, as well. Historically, digital inclusion has been a peripheral concern for AWMN leaders. However, the demand for ubiquitous connectivity has spurred the group to deploy hotspots throughout Athens, enabling anyone with a mobile device to freely connect to the Internet from these locations. By creating free hotspots, Khnet.info, Djurslands.net and AWMN recognize that different consumers possess different telecommunications needs. As a result, "the value proposition" for broadband infrastructures "also needs to incorporate consumer choice and flexibility" (Jayakar, 2009, p. 194). In other words, as the use of mobile devices becomes commonplace and demands for ubiquitous connectivity increase, affordability alone is not the key to increasing broadband penetration and closing the digital divide. The reality, however, is that providing free hotspots does not result in short-term profits. Therefore, the private sector is not interested in "the positive externalities" (Tapia, 2009, p. 225) of making free Wi-Fi widely available. In this sense, then, the signal sharing movement in Europe also functions as a form of resistance against capitalism, which commodifies Internet access.

A Guifi.net informant reported that the ability for businesses to run Internet applications ranging from VoIP to surveillance cameras has boosted the local economy. Local hog and cattle farmers also rely on Guifi.net to accomplish routine tasks, such as transmitting test results to veterinarians, he added. "If we don't have Guifi.net, I'm not even able to live here," said the informant, who frequently works from home. Beyond economic development, open access principles play an important role in sustaining Guifi.net. "We are trying to extend Internet neutrality to the edge by providing an alternative to the ISPs," the network founder reported. Similarly, Djurslands.net helped rescue the regional economy, as traditional sources of income like farming and fishing vanished. "People would have had to leave the area in order to compete, and only the poor would be left behind," the Djurslands.net leader said. He credits the initiative with creating 100 new jobs in each village, pointing to a printing press that subscribes to the network as an example. His goal is to connect half of Djursland's 82,000 residents. Network members pay a $325 initiation fee, which goes toward the cost of household equipment and toward a fund for future network maintenance. Additionally, participants pay $15 monthly. This

revenue is just enough to cover network expenses, the Djurslands.net informant said.

With an emphasis on digital inclusion, all six of these Wi-Fi initiatives are helping create a "networked public sphere" (Benkler, 2006) that enables individuals to work from home, to become politically engaged, to participate in community decisions, and to glimpse the world beyond their own backyards. Theoretically, a networked community offers new modes of exhibiting strength, as it is able to both disperse and to concentrate power (van Dijk, 1999). It may be argued that incumbent ISPs *concentrate* power by dictating which services will be offered, in which regions and at which price-points. Wireless community projects offer an antidote to the capitalistic nature of commercial telecommunications companies by *dispersing* power. Specifically, ad hoc initiatives enable users themselves to control where nodes are deployed and which technologies to use. By bypassing entrenched institutions and corporations, ad hoc networks also play a critical role in expanding the public sphere. In contemporary society, entrée into the polity and civic engagement hinge upon access to a reliable and affordable Internet infrastructure. Networks also unify participants around "a sense of shared values and mutual interdependence that comes from social interaction" (Schement, 2009, p. 7). What these grassroots initiatives recognize is that communication technologies enhance not only personal quality of life—by enabling people to keep in touch with friends on Facebook or to look for a new job—but also facilitate the kind of social cohesion that strengthens entire societies.

LESSONS LEARNED

The data collected for this study suggests a number of steps that could be taken by both CWNs and governmental regulators to help create and sustain grassroots broadband networks.

Lessons for Public Sectors

The EU should allocate additional unlicensed spectrum for wireless devices such as mesh routers. Currently, WiFi devices transmit in the 2.4 GHz frequency—the same "junk band" used by microwave ovens and cordless telephones. Currently, the EU is "painfully slow" (Rodriguez del Corral, 2011) when it comes to allocating wireless spectrum for new entrants. Furthermore, existing allocation policies enable incumbents to invest in additional spectrum for the sole purpose of blocking new entrants (Rodriguez del Corral, 2011). However, EU regulators could make available additional unlicensed frequencies, similar to a beach that is free and open to the general public. This move would allow mesh routers to transmit stronger signals, creating more robust networks. It would also reduce costs associated with WiFi transmissions and lead to opportunities for new wireless services and products (Peha, 2009). Media reform groups such as Free Press pushed for additional open spectrum in the United States, and European activists are following their lead. "Once we have that property, we can build totally scalable networks with multiple fiber uplinks," the Funkfeuer co-founder noted. Additional spectrum for wireless devices has the potential to expand the public sphere by creating new virtual spaces for civic participation. Unlicensed bandwidth also has implications for the political economy, as it would encourage development of open source mesh software capable of delivering reliable, inexpensive networking. This is in contrast to the development of proprietary software programs that operate exclusively in spectrum owned by specific operators.

Invest research and development dollars in technology that strengthens privacy and security of Internet networks. Additional EU funding for research on network protection would help ease fears that sharing wireless bandwidth results in increased vulnerability to viruses, hacker attacks, phishing, or other online threats. With greater

security assurances, more Europeans are likely to participate in the CWN movement. As resource mobilization theory suggests, the behavior of government will influence how social movements are designed and deployed. If this policy recommendation were adopted, it could also lead to increased participation in the public sphere by those who currently fear joining a non-commercial broadband project.

Provide micro-grants and other subsidies for community initiatives. CWN participants reported that grants of even a few thousand dollars could cover the costs associated with critical needs—such as hosting servers, marketing their initiatives, purchasing bandwidth and conducting research. These basic functions are necessary for growing ad hoc communities, yet European networks are not necessarily able to fully execute them. By contrast, some of the most successful initiatives are benefitting from governmental support. For instance, Djurslands.net participates in two rural innovation projects sponsored by the EU, and Guifi.net partners with the public sector at both the local and Catalan levels.

Lessons for CWNs

Focus equally on innovation and broadband connectivity. One promising aspect of mesh architecture is that "out-of-the-box" technology requires minimal computer networking knowledge. A set of pre-configured routers may be plugged into the wall and, instantly, a mesh network emerges. For this reason, wireless community activists should continue directing resources toward this robust but simple means of broadband connectivity. At the same time, data collected for this study illustrates that the signal sharing movement is driven, in large part, by "techies" who appreciate the opportunity to develop routing protocols, create new applications, and build mesh hardware. As a result, activities such as "hack nights" and "play days" should remain prominent aspects of peer- to-peer initiatives. As resource mobilization theory points out, individuals are motivated to join social movements because of the emotional and intellectual connection they feel with a broader community when working toward a mutual goal. This perception of a shared status and positive feelings for other members of the group help sustain these projects.

Deploy networks in low-income and rural communities. In responses to qualitative interviews, proponents of peer-to-peer signal sharing reported a genuine desire to help close the digital divide. Nevertheless, these initiatives tend to emerge in gentrified residential neighborhoods and near tourist areas. Unless grassroots networks spread to disenfranchised communities—where residents will benefit most from free broadband connectivity—the movement's potential to serve the public good will fall short. As repeatedly noted in this study, those who lack communication technology will miss out on opportunities to fully participate in the information society. Furthermore, in order to create ubiquitous connectivity, CWNs must be deployed across diverse communities. Otherwise, they could grow "like a spot of oil," as the Guifi.net informant characterized his initiative. Specifically, access points could be densely concentrated in areas that lack connectivity to one another.

LIMITATIONS OF RESEARCH

This research is limited by the fact that it examines just six of the scores of community mesh networks thriving throughout Europe. However, key aspects of these projects overlap. Therefore, many of the findings in this chapter are generalizable to other European initiatives.

As previously noted, participation in a wireless signal sharing community has the potential to increase opportunities for civic engagement. Therefore, the study also could have examined the peer-to-peer networking phenomenon through a

social capital framework. As Granovetter (1985) observed, individual goals and social influence are understood best when viewed in the context of long-standing social patterns. Another notes that "social capital is produced by the intentional activities of individuals who are connected to one another by ongoing networks of social relationships" (La Due Lake & Huckfeldt, 1998, p. 569).

Yet Sennett's (2006) understanding of social capital is perhaps most applicable to the CWN movement. He focuses on the judgments actors form of their own participation. According to Sennett (2006), "social capital is low when people decide their engagements are of poor quality, high when people believe their associations are of good quality" (pp. 63-64). When viewed this way, social capital is key for sustaining ad hoc communities. If members do not feel loyalty and trust toward the network, they will not make an effort to ensure remains survivable. On the other hand, if members feel a strong sense of loyalty and trust to their network, they are willing to make significant sacrifices to guarantee its sustainability. Another characteristic of social capital involves institutional knowledge (Sennett, 2006). When people understand how a system works, they are more competent at manipulating that system. In the case of CWNs, participants who understand the bureaucracy will have a better chance of persuading politicians, ISPs and other stakeholders to support their goals. However, networks must hold on to volunteers long enough to benefit from this institutional knowledge.

CONCLUSION

The European projects examined in this chapter are truly grassroots efforts, but they also recognize the value of forming partnerships with non-governmental organizations, ISPs and the public sector. While the Wi-Fi initiatives in rural regions are primarily focused on closing the digital divide, many urban signal-sharing networks in Europe center on the development of open source software and hardware. Informants from all six European networks opposed distributing free mesh routers to participants. On ideological grounds, they believe participants should jointly own the network infrastructure, leading them to feel a deeper stake in maintaining the infrastructure. On more practical grounds, distributed ownership protects wireless community projects from legal liability, as well as from buy-out attempts initiated by commercial ISPs. According to informants, European networks are beginning to create free hotspots in response to demands for ubiquitous connectivity. Such moves also expand the public sphere by providing access to non-network members, as well.

European networks depend nearly exclusively on volunteers to help deploy nodes, troubleshoot and recruit new members. AWMN, Djurslands.net and various initiatives in Prague all rely on volunteer board members to set policy and make management decisions. Because European network members are also heavily involved in the open source technology movement, these networks function as laboratories for members to develop hardware and software tools. Ad hoc networks in Europe have also fostered relationships with local officials and institutions. In most cases, these relationships are reciprocal—with governments and social service agencies benefiting from free Internet access, and networks greatly expanding their coverage areas. Future research studies might examine the long-term sustainability of CWN projects using mesh technology in Europe, as well as their impact on local telecommunications policies.

REFERENCES

Abdelaal, A., & Ali, H. (2012). Measuring social capital in the domain of community wireless networks. In *Proceedings of the 2012 45th Hawaii International Conference on System Sciences*. Maui, HI: IEEE Press.

Analysys Mason. (2011). *Ultrafast broadband prices fall to new low in Europe and the U.S*. Retrieved July 16, 2012, from http://www.analysysmason.com/About-Us/News/Insight/Ultra-fast-broadband-prices-fall-to-a-new-low-in-Europe-and-the-USA/

Bauwens, M. (2005b). Peer-to-peer and human evolution. *Integral Visioning*. Retrieved April 16, 2009, from http://integralvisioning.org/article.php?story=p2ptheory1#_Toc107024680

Becker, J. (2002). Theses on information. In Mansall, R., Samarajiva, R., & Mahan, A. (Eds.), *Networking Knowledge for Information Societies: Institutions & Intervention* (pp. 216–219). Delft, The Netherlands: Delft University Press.

Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedom*. New Haven, CT: Yale University Press.

Canel, E. (1997). New social movement theory and resource mobilization theory: The need for integration. In Kaufman, M., & Dilla Alfonso, H. (Eds.), *Community Power and Grassroots Democracy* (pp. 189–221). London, UK: Zed Books.

Castells, M. (2007). *Communication technology, media and power*. Retrieved March 23, 2007, from http://web.mit.edu/newsoffice/2007/media-technology-0314.html

Cherney, L. (1999). *Conversation and community: Discourse in a social MUD*. Chicago, IL: Chicago University Press.

Cho, H. (2008). Towards peer-place community and civic bandwidth: A case study in community wireless networking. *Journal of Community Informatics*, *4*(1).

Cormack, D. (1991). *The research process*. Oxford, UK: Black Scientific.

Council of Europe/ERICarts. (2012). *Internet penetration rate in Europe*. Retrieved July 16, 2012, from http://www.culturalpolicies.net/web/compendium.php

Czfree.net. (2009). Homepage. *Wireless Broadband Community*. Retrieved February 23, 2009, from http://czfree.net/home/index.php

Djursland International Institute of Rural Wireless Broadband. (2009). *Homepage*. Retrieved February 23, 2009, from http://diirwb.net/

Efstathiou, E., Frangoudis, P., & Polyzos, G. (2005). *Stimulating participation in wireless community networks*. Retrieved April 21, 2009, from http://mm.aueb.gr/technicalreports/2005-MMLAB-TR-01.pdf

Ehrlich, T. (2000). *Civic responsibility and higher education*. New York, NY: Oryx Press.

European Commission. (2011). *Digital agenda: Commission proposes over €9 billion for broadband investment*. Retrieved July 16, 2012, fromhttp://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=7430

Fox Piven, F., & Cloward, R. (1991). Collective protest: A critique of resource mobilization theory. *International Journal of Politics Culture and Society*, *4*(4), 435–458. doi:10.1007/BF01390151

Freifunk. (2009). *Was ist Freifunk? Homepage*. Retrieved February 23, 2009, http://start.freifunk.net/

Funkfeuer. (2009). *Don't log onto the net—Be the net!* Retrieved February 23, 2009, from http://www.funkfeuer.at/

Gamson, W. (1975). *The strategy of social protest*. Homewood, IL: Dorsey Press.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*, 481–510. doi:10.1086/228311

Grimes, S. (2003). The digital economy challenge facing peripheral rural areas. *Progress in Human Geography*, *27*(2), 174–193. doi:10.1191/0309132503ph421oa

Guifi.net. (2009). *Homepage*. Retrieved February 23, 2009, from, http://guifi.net/

Hannigan, J. (1985). Alain Touraine, Manuel Castells and social movement theory: A critical appraisal. *The Sociological Quarterly*, *26*(4), 435–454. doi:10.1111/j.1533-8525.1985.tb00237.x

Hegel, G. (1820). *Philosophy of right*. (H. Reeve, Trans.). Retrieved April 19, 2007, from http://www.marxists.org/reference/archive/hegel/index.htm

International Telecommunication Union. (2011). *ICT services getting more affordable worldwide*. Retrieved July 16, 2012, from http://www.itu.int/net/pressoffice/press_releases/2011/15.aspx

Internet World Stats. (2012). *Internet and Facebook usage in Europe*. Retrieved July 16, 2012, from http://www.internetworldstats.com/stats4.htm

Jayakar, K. (2009). Universal service. In Schejter, A. (Ed.), *And Communications for All* (pp. 181–202). Lanham, MD: Rowman & Littlefield.

Kendall, D. (2008). *Sociology in our times* (7th ed.). Belmont, CA: Wadsworth.

La Due Lake, R., & Huckfeldt, R. (1998). Social capital, social networks and political participation. *Political Psychology*, *93*, 567–584. doi:10.1111/0162-895X.00118

Lentz, R., & Oden, M. (2001). Digital divide or digital opportunity in the Mississippi Delta region of the U.S. *Telecommunications Policy*, *25*(5), 291–313. doi:10.1016/S0308-5961(01)00006-4

Little, D. (2008). Collective behavior and resource mobilization theory. *Understanding Society*. Retrieved February 29, 2008, from http://understandingsociety.blogspot.com/2008/01/collective-behavior-and-resource.html

McAdam, D. (1982). *Political process and the development of black insurgency, 1930-1970*. Chicago, IL: The University of Chicago Press.

McCarthy, J., & Zald, M. (1987). *Social movements in an organizational society: Collected essays*. New Brunswick, NJ: Transaction Publishers.

McChesney, R. (2009). Public scholarship and the communications policy agenda. In Schejter, A. (Ed.), *And Communications for All* (pp. 41–46). Lanham, MD: Rowman and Littlefield.

Meyer, D. (2005). Social movements and public policy: Eggs, chicken, and theory. In Meyer, D., Jenness, V., & Ingram, H. (Eds.), *Routing the Opposition: Social Movements, Public Policy, and Democracy* (pp. 1–26). Minneapolis, MN: University of Minnesota Press.

Mosco, V. (1996). *The political economy of communication*. London, UK: Sage.

Napoli, P. (1999). The marketplace of ideas metaphor in communications regulation. *The Journal of Communication*, *49*(4), 151–169. doi:10.1111/j.1460-2466.1999.tb02822.x

Neumann, J. (2007). Community wi-fi in UK and Germany: A roundup. *Nettime Discussion Board*. Retrieved February 14, 2008, from http://www.nettime.org/Lists-Archives/nettime-l-0710/msg00034.html

Olson, M. (1965). *The logic of collective action: Public good and the theory of groups*. Cambridge, MA: Harvard University Press.

Paldam, M., & Christoffersen, H. (2004). Privatization in Denmark, 1980-2002. *Social Science Research Network*. Retrieved April 13, 2009, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=514242

Parker, E. (2000). Closing the digital divide in rural America. *Telecommunications Policy*, *24*(4), 281–290. doi:10.1016/S0308-5961(00)00018-5

Peha, J. (2009). A spectrum policy agenda. In Schejter, A. (Ed.), *And Communications for All: A Policy Agenda for a New Administration* (pp. 137–152). Lanham, MD: Lexington Books.

Poster, M. (1995). *CyberDemocracy: Internet and the public sphere*. Retrieved April 16, 2009, from http://www.hnet.uci.edu/mposter/writings/democ.html

Pourebrahimi, B., Bertels, K., & Vassiliadis, S. (2005). A survey of peer-to-peer networks. In *Proceedings of the 16th Annual Workshop on Circuits, Systems and Signal Processing*. Veldhoven, The Netherlands: IEEE.

Rafaeli, S., & LaRose, R. (1993). Electronic bulletin boards and 'public goods' explanation of collaborative mass media. *Communication Research*, *20*(2), 277–297. doi:10.1177/009365093020002005

Rheingold, H. (1993). *The virtual community*. Reading, MA: Addison-Wesley Publishing Co.

Rodriguez del Corral, A. (2011). Financing high speed broadband—What do you think? *European Broadband Portal*. Retrieved July 16, 2012, from http://broadbandeurope.wordpress.com/2011/05/01/financing-high-speed-broadband-what-do-you-think/

Rowell, L. (2007). Can mesh networks bring low-cost, wireless broadband to the masses? *netWorker*, *11*(4), 26–33. doi:10.1145/1327512.1327514

Schement, J. (2009). Broadband, internet and universal service. In Schejter, A. (Ed.), *And Communications for All: A Policy Agenda for a New Administration* (pp. 3–27). Lanham, MD: Lexington Books.

Sennett, R. (2006). *The culture of the new capitalism*. New Haven, CT: Yale University Press.

Silverstone, R. (2004). Regulation, media literacy and media civics. *Media Culture & Society*, *26*(3), 440–449. doi:10.1177/0163443704042557

Souvirón, M., & María, J. (1999). *The process of liberalization and the new telecommunications regulations*. Granada: Editorial Comares.

Tapia, A. (2009). Municipal broadband. In Schejter, A. (Ed.), *And Communications for All*. Lanham, MD: Lexington Books.

Tilly, C. (1978). *From mobilization to revolution*. Reading, MA: Addison-Wesley.

Touraine, A. (1985). An introduction to the study of social movements. *Social Research*, *52*(4), 749–787.

vanDijk, J. (1999). *The network society: Social aspects of new media* (Spoorenberg, L., Trans.). London, UK: Sage.

Waterman, H. (1981). Reasons and reason: Collective political activity in comparative and historical perspective. *World Politics*, *32*, 554–589. doi:10.2307/2010135

KEY WORDS AND DEFINITIONS

Community Network: A co-operative, non-commercial network that enables members to share not only bandwidth, but also skills and knowledge.

Digital Divide: That gap that separates those who have access to the best in information technology from those who do not.

Digital Inclusion: Realizing the goal of bringing the benefits of Internet connectivity, skills and hardware to everyone who wants them.

Mesh Network: A networking technology that enables signals to hop from node to node, choosing the most efficient path. Just one gateway node must have access to the Internet.

Political Economy of Telecommunication: The production, distribution, exchange and consumption of the Internet and other digital mass media—with a focus on how these values influence those in power and societal change.

Resource Mobilization Theory: A social movement framework that focuses on the critical role that resources such as money, knowledge, ties to the establishment, and media access play in helping a social movement succeed.

Telecommunications Policy: Rules developed by governments, in consultation with various stakeholders, regarding how telecommunications systems will operate.