ACTIVIST INFRASTRUCTURES: The Role of Community Wireless Organizations in Authenticating the City

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This paper seeks to understand the ways in which social structures – in particular, artists, activists and community groups – and technological infrastructures – streets, architecture and telecommunications – authenticate the public spaces of cities at three levels: first, the use of traditional and new media for the annotation of public space; second, the use of new media for political action during the Republican National Convention in New York in 2004 and to build a back-up emergency communications system following Hurricane Katrina in New Orleans in 2005; third, the role of community wireless networks in building the social and technological infrastructures of activism and contributing to the sustainability of cities. Rather than an empirical study of the above examples, the goal of this paper is merely to connect disparate issues and raise questions, which may lead to the formulation of a more cohesive research agenda in this area.

Keywords public space, new media, community wireless organizations

Introduction

The appropriation of public space including parks, streets and buildings has long been a central goal of activism in the urban fabric. These instances of urban activism range from graffiti and street art, such as the Mosaic Man's decorative lampposts in New York's East Village, through the community garden movement, to the coordination of sophisticated protests and transnational social movements via mobile phones and text messaging, such as those in Seattle, Manila and Madrid. In many ways, the goal of urban activism, whether by communication or political action, is the *authentication of the city*. This paper seeks to understand the ways in which social structures, particularly artists, activists and community groups, and technological infrastructures, namely streets, architecture and telecommunications, authenticate the public spaces of cities at three different levels: first, the use of traditional and new media for the annotation of public space; second, the use of new media for political action during the Republican

National Convention in New York in 2004 and to build a back-up emergency communications system following Hurricane Katrina in New Orleans in 2005; third, the role of community wireless networks in building the social and technological infrastructures of activism and contributing to the sustainability of cities. Rather than an empirical study of the above examples, the goal of this paper is merely to connect disparate issues and raise questions, which may lead to the formulation of a more cohesive research agenda in this area.

First, this paper offers several international examples of both old media and new media interventions in the city, in an attempt better to understand how public spaces are authenticated for the purposes of activism. While old media allow artists and activists to annotate their cities, often in clear visual and aural terms, new media – specifically, the ubiquity of computing, including mobile and wireless technologies – offer both new opportunities and challenges for activism. This is because, unlike parks, streets and buildings, the new information architecture of cities, while in some ways increasing in importance when compared to the physical architecture, is often completely invisible to the naked eye.

Second, this paper briefly analyzes the ways in which mobile and wireless technologies were used for political protest during the Republican National Convention in New York in 2004 and, more recently, deployed as a back-up crisis communications network following the aftermath of Hurricane Katrina in New Orleans. The New Orleans example is raised mainly as a *tabula rasa* to spark our imaginations about the types of social and technological infrastructures that activism demands. Much the same way that the redevelopment of the World Trade Center site and lower Manhattan were re-envisioned following September 11, New Orleans, despite the magnitude of its very real human tragedy, offers an opportunity to rethink our cities from scratch.

Finally, this paper examines the emerging worldwide community wireless networking movement, focusing specifically on a comparison of the composition and activities of groups in New York and Berlin. Community wireless networks are of interest in the context of activism in the urban environment for two reasons: first, as community groups themselves, and second, in their role as developers of new technologies. This section touches on the largely undocumented social structures of community wireless networks within what is perceived as a growing transnational social movement around issues of free information infrastructures, and points to the role that these groups play in the development of these technological infrastructures. Thus, in short, this paper raises questions about the nature of new media activism in the urban context, and about its role in the authentication of cities and their social and technological infrastructures.

Theoretical Framework & Literature Review

The authentication of cities by their social and technological infrastructures is primarily provided by the fields of science and technology studies,

communications, and, to some extent, by what may be considered to be an emerging field of research, namely the social studies of architecture and urban planning. In an age of the pervasive globalization and commercialization of cities around the world, it is no trivial question to inquire about the authenticity of urban centers, which traditionally have represented the public sphere. However, in this context, authentication also serves as a useful concept because it carries both a traditional and a more technical meaning. Most commonly, to authenticate means "to prove genuine"; however, in communication systems, authentication "verifies that messages really come from their stated source, like the signature on a (paper) letter," (Howe, 2001). In particular, in the world of community wireless networking, the issue of authenticating users of free, public Internet hotspots is much contested, as it raises privacy concerns. It is for this reason that the term authentication has been adopted here.

Within the framework of science and technology studies, this paper applies the concept of the social construction of technology to telecommunications infrastructures and architecture, with an emphasis on the related notions of participatory and user-centered design, democratic innovation and bottom-up policymaking. Complementarily, in the field of communications research, Carey's ritual view of communications, which understands communications as a cultural practice in an anthropological sense, is also of value in understanding the ways in which artists and activists make their messages known in public spaces (Carey, 1988). In addition to these theoretical frameworks, five additional concepts serve to shape the following discussion. Two of these ideas, namely Paul et al.'s "collaborative urbanism" and Perlman's principles of "urban sustainability", explain the necessity of re-imagining and redesigning cities with a focus on public participation, while the others – Kang and Cuff's envisioned "friction mall" and Noam's model of the commons as an enabler of commerce – are concerned with the social, legal and economic implications of new media and ubiquitous computing (Kang & Cuff, 2005; Noam, 2005; Paul, Shetty, & Krishnan, 2005; Perlman, 1999).

Citing a problematic "urban pedagogy that regards the city only as a technological or physical artefact" in the case of Mumbai, India, Paul et al. advance a need for a "collaborative urbanism that treats the city as an extra-curricular space by which we can reconstruct existing institutional frameworks." By its very nature, collaborative urbanism, conceived as a response to a political regime of predatory development, tactical negotiation and blurry urbanism, demands the active participation of a wide variety of stakeholders in the design of the city's physical infrastructure. In this way, we can envision ways in which artists and activists might contribute to the authentication of their cities through engagement in the processes of urban planning, assuming that there are mechanisms for doing so (Paul, Shetty, & Krishnan, 2005). Along with the concept of collaborative urbanism, it is useful to consider Perlman's six principles of urban sustainability as distilled from the Mega-Cities project, which can be summarized as follows: the

importance of urban sustainability for global sustainability, the importance of alleviating urban poverty, the need for strong civil society and grassroots initiatives, the need to transform "micro" solutions into "macro" impact by transforming public policy from the bottom-up, the need to form collaborative partnerships and link local initiatives with global ones through a transnational network of non-governmental organizations, and the need for social justice, political participation, economic vitality and ecological regeneration (Perlman, 1999).

A better understanding of the ways in which activists use new media is of critical importance to urban sustainability. This is because mobile phones and wireless technologies are quickly being adopted – with over two billion mobile phone owners by 2008 – and the capabilities of technologies are merging. In addition, these technologies are increasingly relevant in urban locations, since over half of the world's population will be living in cities by the year 2007. The largest of these cities, called "mega cities," with populations of over 25 million, will face serious challenges in terms of their sustainability. These cities will only be capable of becoming sustainable if they are able to build strong communities and civil society groups. In addition, in a number of these cities, young people – the demographic most familiar with mobile phones and wireless technologies – will make up the majority of the population.

While some elements of the telecommunications infrastructure litter the urban landscape with a myriad of wires, antennas and satellite dishes, others are as invisible as the airwaves they use to communicate

Telecom cables and cellular antennas on top of buildings in Budapest (June 2005); Satellite dishes in apartment buildings in Berlin's Kreuzberg (October 2004).

Nonetheless, these new information and telecommunications infrastructures have already had and will continue to play an increasingly important role in the social, economic and political life of cities.

Kang and Cuff's "friction mall" is a utopian vision of the way in which we might go about embedding the public sphere into future pervasive computing applications. The basic characteristics of the friction mall are open, decentralized, peer-to-peer interactions rather than centralized, hierarchical domination. For example, in the friction mall:

> *a whole new range of sociopolitical intermediaries could help facilitate 'political shopping' by providing not only information about quality and price, but also about social, environmental, and justice consequences. Before ordering veal parmigiana, Paul McCartney might sing into one's ear about animal cruelty. Before buying on overpriced shirt at Abercrombie & Fitch, the National Asian Pacific American Legal Consortium might provide a reminder about the firm's sorry history with racial minorities. Choosing among three fungible gas stations at a nearby corner, one might rely on the Sierra Club's recommendations*
> *(Kang and Cuff, 130).*

In this example of political shopping enabled by pervasive computing, Kang and Cuff explain how it might be possible to construct an "activist shopper," the importance of which should not be overlooked. In addition to political shopping, Kang and Cuff state that pervasive computing applications that allow one to meet like-minded strangers with whom they may not necessarily interact could serve to strengthen the public sphere. Kang and Cuff introduce the following design principles, which embed elements of the public sphere into future pervasive computing infrastructures: the protection of privacy, transparency of surveillance mechanisms, open access to information, and public exchange and sharing of experiences (130-143). Noam's model of the commons as an enabler of commerce further supports the rational for building these elements into the design of future technological infrastructures rather than opting for hierarchical, centralized, proprietary systems. Noam argues that community-based sharing arrangements that have been observed in information technology and telecommunications, including open source software, music file-sharing and Wi-Fi (wireless fidelity) sharing, are vital for the creation of markets, particularly in the early stages of innovation. Thus, economic models based on grassroots communities and the sharing of knowledge and resources should not be automatically dismissed by corporations, but rather they should be embraced for their creativity, energy, interactivity and peership (Noam, 2005).

The Authentication of Public Space

This section will present examples of graffiti, street art, and activism using both new and traditional media from New York, Tokyo, Vienna, Berlin and Budapest in an attempt to learn how activists authenticate public spaces. Messages displayed on lampposts, walls, posts and windows all serve as media, or, perhaps more appropriately in the context of new media, as interfaces for activism in the urban environment. In New York's East Village, over 67 lampposts covering three square miles have been transformed into street art over the past nearly 20 years by Jim Power, a homeless Vietnam veteran who is legally blind in one eye. Power, known as the "Mosaic Man," uses colored tiles, mirror shards and seashells to annotate the poles with designs and messages that he believes make up the world's largest mosaic trail.

The "Mosaic Man" at work in New York's East Village with his dog Jesse; an advertisement for the website EastVillage.com (Cliff McKenzie, Grit.com).

In November 2004, Power was inducted into City Lore's New York City People's Hall of Fame, and his work is part of a permanent display at the Museum of the City of New York (McKenzie). Similarly, freestanding advertising kiosks, lampposts and telephone booths such as those shown below in Budapest and Vienna have become the canvas for art and activism in cities around the world.

Advertising kiosk in Budapest (September 2004); Lamppost adorned with yellow dots in Vienna (September 2004); Telephone booth in Budapest (June 2005).

Instances of art and activism in the city can be playful: for example, by changing the meaning of a commonplace sign or symbol such as "Wet Paint" into "Ain't Wet". In this case, one realizes that the intent is to alter the message being sent by the original sender, perhaps the New York Metropolitan Transit Authority, and, instead to subvert and replace it with a message from a new sender, perhaps an average "straphanger." It is in this way that the concept of authentication is useful in analyzing the practice of activism in public space. But they can also be explicitly political, such as a poster protesting at Hungary's joining of the European Union with the words "EU Nem!" or "EU No!").

Manipulation of signage in New York's Union Square Station (August 2005); Political poster in Budapest (September 2004).
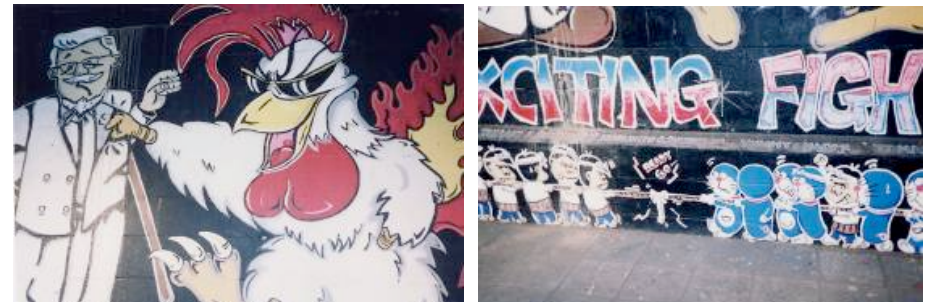
Walls are also canvases for art and activism in the city, the most obvious example of which, perhaps, is the Berlin Wall.

A fragment of the Berlin Wall at Potsdamer Platz (October 2004)

Art covering the side of a former squatter house in Berlin (October 2004); Graffiti on the pedestal of a historic building in Budapest (September 2004).

Murals depicting the clash between commercial culture and traditional culture as a result of globalization in Yokohama (1994).

Finally, slogans displayed in windows also offer possibilities for art and activism in the urban environment.

"NO Software Patents" t-shirt and "Definition of Open Source" poster displayed in the window of Newthinking in Berlin (October 2004)

Newthinking, which has been open since June 2004, is the world's first store for Free Software such as GNU/Linux. The store, an explicitly aesthetic, non-technical space in the center of Berlin's Mitte gallery district, serves as an educational space for beginner to advanced and professional Linux users, and as a meeting spot for the Free Networking community.

Having briefly explored some of the ways that artists and activists have authenticated the public spaces of their cities in the past, we now explore the more recent phenomenon of the use of new media. In contrast to the examples above, which illustrate the visual annotation of physical space, these examples, meant only to represent a small sample of the hundreds of such projects, show how people might virtually annotate and transform physical space with the use of new media, in particular mobile and wireless technologies.
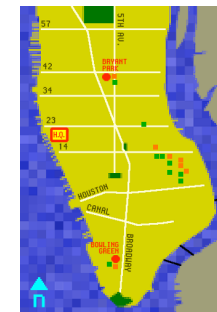
PROJECT	DESCRIPTION	IMAGERY
Yellow Arrow	Yellow Arrow allows participants to mark space both physically, through the placement of yellow stickers, and virtually, by sending thoughts to a unique number via text messaging from a mobile phone. In this way, participants are able to share "what counts" with their local communities and link with like-minded global communities, thereby collaboratively creating a "subjective atlas" of their cities.	
	In addition, the YellowArrow.net website allows participants to annotate their arrows with photos and maps in an online gallery. Of interest to the artists are the "unique characteristics, personal histories, and hidden secrets that live within our everyday spaces." The project began in May 2004 at an urban art festival on New York's Lower East Side (http://global.yellowarrow.net).	
Urballoon	Urballoon is an interactive communication balloon which allows participants to send their personal expressions, whether in textual or visual form, for broadcast in public spaces. The project, which has been presented in parks in New York since 2002, uses free, public wireless networks to receive submissions from the Internet (http://www.urballoon.com).	
NodeRunner	NodeRunner, started in New York in 2002, is a scavenger hunt game where teams scour the city for the greatest number of open wireless access points, document them using digital cameras, and denote them on a map (http://www.smartmobs.com and http://www.noderunner.omnistep.com)	
StoryCorps	StoryCorps, a national oral history project that celebrates "shared humanity and collective identity," allows people to record each others' stories orally in	

soundproof recording booths deployed in train stations such as Grand Central Terminal and the World Trade Center Path train station in New York. The project has been in existence since 2003 (http://www.storycorps.net).

Blinkenlights

Blinkenlights transformed the former East German Ministry of Education building at Alexanderplatz in Berlin into the world's largest interactive computer display by using computers to manipulate 144 lamps on the top eight floors of the building. The project also allowed participants to play the classic arcade game Pong and to display love letters on the screen by sending messages via mobile phone text messaging. The project, created by the Chaos Computer Club, ran for 23 weeks in 2001 and 2002 (http://www.blinkenlights.de/index.en.html).

MagicBike and Public Broadcast Cart

MagicBike, a mobile Wi-Fi hotspot, shares free Internet connectivity as a "socially conscious infrastructure, bicycle culture," (http://www.magicbike.net)

Public Broadcast Cart, a shopping cart communication system, enables any pedestrians to become active producers of audiocasts rather than mere audiences

(http://www.ambriente.com/wifi/).

New York Live

New York Live is a live public video conference between New York and Budapest which ran for five hours a day for nearly a week in August 2004. The project was a collaboration between the Visual Works Contemporary Art Association (http://www.vizualismuvek.org/index.html) in Budapest and NYCwireless (http://www.nycwireless.net) in New York, in collaboration with other sponsors. The project allowed concert-goers at one of Europe's largest music and arts events – the Sziget Festival – to see, hear and interact in real time with passers-by in New York's East Village. The purpose of the project was to deconstruct the image of American popular culture as an icon (or idea), thereby circumventing mainstream media images and allowing people to communicate and interact on their own terms. In addition, the project examined the ways in which the dynamics between the two cities were shaped not only by physical technological factors (i.e. screen size, connection speed), but also by contextual factors (i.e. location on street, time of day) and socio-cultural factors (i.e. the social norm that New Yorkers do not typically interact with strangers as they walk down the street).

A two-hour reunion between a Hungarian woman living in New York and her brother in Budapest, whom she had not seen face-to-face for four years.

A New Yorker performs live over the video conference for an audience in Budapest.

From NYC to NOLA

In the earlier section we saw some of the ways in which traditional and new media have been employed by artists and activists to authenticate their public spaces. In the current section we explore the ways in which new media have been used for political action, specifically in light of the protests at the Republican National Convention in New York in August 2004. Three new media applications in particular come to mind with respect to the RNC protests: Bikes Against Bush, Moport, TxtMob, and a mobile phone application developed by Indymedia. Unfortunately, Bikes Against Bush, http://www.bikesagainstbush.com, never made it to the RNC, since it was confiscated by the New York Policy Department prior to being deployed, due to claims that it would permanently mark city streets. The project uses a wireless Internet enabled bicycle to retrieve short political messages sent to a website and to print them on the street in water-soluble chalk. Another application that was design specifically for the RNC protests is Moport (http://www.moport.org), a free service that allows participants to generate and share mobile phone reports, thereby collectively reporting about events in real time via text and digital pictures. Over the course of the RNC, Moport collected and documented 300 photographs and text accounts of the protests. In addition to being used to disintermediate the RNC, mobile and wireless technologies were also used to alert activists of police movements, warnings, news and announcements. In particular, independent journalists and activist groups used a free service called TxtMob, http://www.txtmob.com, to coordinate their actions. According to Indymedia, "…activists are using existing technology that is virtually cost free to mobilize hundreds of actions and thousands of activists," as reported by Jeremy Scahill of the national radio and TV show Democracy Now!. In addition, the New York Independent Media Center set up a 24-hour information line to broadcast breaking news and a calendar of events. "Our task is to help facilitate horizontal communication and information distribution to all the activists in the streets," says Evan Henshaw-Plath, the Indymedia activist who developed the information line. "We've appropriated technology as an essential tool for radical social change." Despite little publicity, the information line received more than 2000 calls over a 4-day period (Forlano, 2004). These uses of mobile and wireless technologies for activism are particularly salient because, traditionally, it is the government or police forces which are better able to organize and coordinate their movements in response to political protests, since they have a well-developed, centralized communication system.

In contrast to the RNC case, following the aftermath of Hurricane Katrina in New Orleans, Louisiana in August 2005, activists used mobile and wireless technologies for a different purpose: specifically, for the creation of a back-up emergency communication system. This example is relevant to the discussion of new media activism in the urban context, for several reasons. First, because of the glaring social, political and economic issues surrounding the events, which have brought

issues of race and urban poverty to the forefront of the discussion. Second, as a result of the massive destruction of the social, political, economic, architectural and technological infrastructures of the historic city. Similar to the events of September 11 with respect to the redevelopment of the World Trade Center site, the destruction wrought by Hurricane Katrina—despite the obvious tragedy of the event—offers a unique opportunity to rethink the design of the many infrastructures of New Orleans and apply Paul et al's concept of collaborative urbanism to them. Third, again like September 11, Hurricane Katrina demonstrated the woeful inadequacy of the incompatible, top-down and centralized emergency communications systems in place in the United States, which has already prompted thinking about the types of reforms needed in this area.

Specifically, former FCC Commissioner Reed Hundt has advocated the development of a "resilient, mobile wireless data network that they [emergency responders] can share," using an open source Wi-Fi protocol. Hundt recommends Wi-Fi as a solution for a number of reasons: it can be shared, it is decentralized like the Internet (which was itself designed by the Department of Defense as an emergency back-up system), and Wi-Fi devices can communicate with each other (known as "ad hoc," "grid" or "mesh" networking). This last property is particularly important because it allows the network to grow in strength given an increase in the density of people and vehicles with Wi-Fi devices, an obvious benefit in an emergency. Thus, Hundt recommends the allocation of spectrum for the purpose of emergency response (Hundt & Malamud, 2005).

While, clearly, the dedication of spectrum for emergency purposes is of pressing concern for security reasons, more thought needs to be given to the communication needs of average citizens in everyday life, activism and in extreme situations such as a terrorist or natural disaster. However, while much is known about the emergency communication needs of first responders and the technological systems required to support them, considerably less is known about the social infrastructures of average citizens, how they can be mobilized in disaster situations, and how properties that support them might be built into technological infrastructures. The recent events of Hurricane Katrina make it obvious why such knowledge is necessary: in an extreme situation, it is a matter of life and death. But, knowledge about social infrastructures is also vital for a better understanding of new media activism in the urban context. In the case of Hurricane Katrina, with all communication systems, whether mass media or person-to-person, completely wiped out, activists from Low-Power FM (LPFM) and community wireless networking groups worked quickly to obtain an FCC license and the equipment necessary to create back-up communications systems, so that displaced residents being housed at the Astrodome in Houston, Texas could share information about missing family members and their experiences of the disaster. While kept from broadcasting their signal in the dome itself, ostensibly due to

concerns over energy use, the LPFM station was eventually set up from the dome's parking lot.

Community by Design?

The preceding sections examined the ways in which artist and activists authenticate their cities through the use of both traditional and new media, and the importance of their actions in both situations of protest, such as the RNC, and emergency, such as Hurricane Katrina. This section will examine the social structures of community wireless groups—comparing NYCwireless (http://www.nycwireless.net) in New York with Freifunk (http://www.freifunk.de) in Berlin—within what is perceived as a growing transnational social movement around free information infrastructures and their role as developers of new communications technologies.

Over the past five years, hundreds of community wireless networks (CWNs) have emerged in cities and rural areas around the world. The early history of these groups is not particularly well-documented, and little academic research has been done on them. However, among participants in CWNs, there is a shared folklore about the origins of their groups. Often these stories involve accounts of individuals who, lacking Internet access (and seeking adventures on city rooftops), found ways wirelessly to share it with apartments nearby. In the case of NYCwireless, in May 2001, Anthony Townsend, then a graduate student in urban planning at MIT, together with his collaborator Terry Schmidt found that they could share wireless connections from their apartments with the streets and parks below. Soon after that, they put their knowledge to work to build a communication system for businesses in lower Manhattan that had been crippled by the events of September 11. Since then, NYCwireless has been partnering with parks organizations, business development districts and non-profit organizations to build free, public wireless networks in parks including Tompkins and Union Square parks, Bryant Park and City Hall Park.

Wireless Park Lab Days outreach event at City Hall Park in September 2003.

The organization has also worked with Community Access, an organization that provides housing for mentally ill residents, to build wireless networks in their buildings in Manhattan, Brooklyn and the Bronx.

In Berlin, Freifunk (or "free radio," a reference to the unlicensed electromagnetic spectrum which makes Wi-Fi possible) began when Juergen Neuman, an entrepreneur with his own technology consulting business, moved to Freidrichshain in 2002 (a neighborhood in what was formerly East Berlin) and found that there was no high-speed Internet connection available. So, similar to the pioneers of NYCwireless, he discovered a way to share Internet access with a friend in a building nearby. The organization works in partnership with a group of computer programmers participating in a collaborative called C-base. As a result, they have been able to build a wireless mesh network of over 100 nodes in Berlin. Freifunk, an umbrella organization similar to Indymedia, now has affiliates in cities all over Germany and in other German-speaking countries. While perhaps considerably more technologically-savvy than average citizens, it is important to point out that a number of the key figures within Freifunk and its partner organizations are completely self-taught.

In the first few years of the community wireless networking phenomenon, although CWNs were aware of each other's presence, the groups operated relatively independently. However, in 2004, there were a number of significant efforts to bring such groups together face-to-face, as well as to link them with other media activists, to form the beginnings of a social movement around spectrum issues. Most notable of these were the National Community Wireless Networking Summit in Champaign-Urbana and the Fresh Air Free Networks in Djursland, Denmark. In addition, a third event, the World Summit for Free Information Infrastructures (http://www.wsfii.org), took place in October 2005,

bringing together participants from the community wireless, open source and open mapping communities.

Currently, CWNs around the world are participating in the ongoing development of the technological infrastructure in their communities by innovating and implementing open source mesh networking protocols. The two largest such projects are those built by the Champaign-Urbana Community Wireless Network (CUWiN) and Freifunk (mentioned above). In this way, CWNs are becoming important sources of user-driven innovation, the value of which has been widely documented in a number of disciplines. CUWin, founded in 2000, grew from three mesh network nodes in 2002 to 50 nodes in January 2005. As described above with reference to the "ad hoc" network for emergency communications, the network allows individual nodes to communicate with each other, regardless of whether or not they are connected to the Internet. As described by Sandvig et al.:

> *CUWin and some other community wireless groups are not attempting to implement the same systems as those run by traditional telecommunications companies that have let them down: instead they are attempting to build a new kind of system – a wireless dynamic mesh network – in a configuration that is unlikely to be produced by industrial research and development*
>
> *(Sandvig, Young, & Meinrath, 2004).*

In addition, the design of the dynamic mesh network is closely related to CUWin's goals as is illustrated by the following:

> *As a loosely organized group, CUWin wanted a network that anyone could join or leave at any time. CUWin wanted the ability to efficiently share bandwidth from a small number of sources of backhaul (Internet connectivity) in order to reduce costs. Members wanted high-speed connections across town so that they could create an alternative to traditional Internet service, phone service, television service and analog AM/FM radio (e.g., using Voice over Internet Protocol and multimedia streaming)*
>
> *(Sandvig, Young, & Meinrath, 2004)*

However, in order to achieve these goals, CUWin engineers need to be able to understand and manipulate the software on Wi-Fi devices. Unfortunately, the manufacturers of such devices have not provided adequate documentation, thereby presenting a significant bottleneck to user-driven innovation in this area (Sandvig, Young, & Meinrath, 2004).

This section has presented CWNs as examples of activism in the urban context, their role in a growing transnational social movement surrounding issues

of free information infrastructure, and the ways that they are building technological infrastructures well-matched to their goals as cooperatives.

Conclusion

In summary, we have seen some of the ways is which social infrastructures – artists, activists and community groups – authenticate their cities using traditional and new media, and by developing new technological infrastructures that embed values such as community, democracy and sustainability.

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