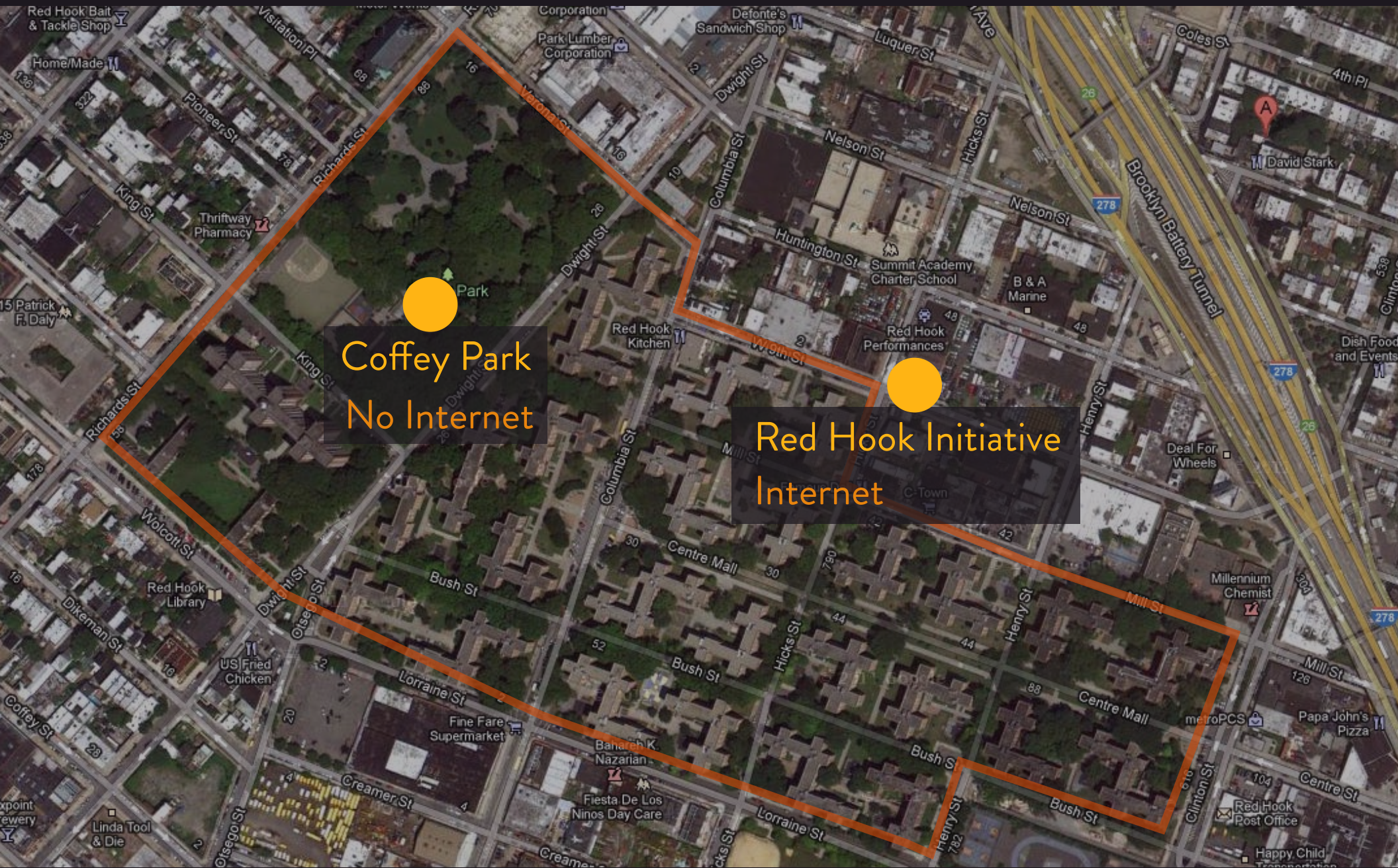




Thesis Journal
TidePools

jrbaldwin

Red Hook Housing Projects



Coffey Park
No Internet

Red Hook Initiative
Internet

Overview

This thesis proposes a series of social incentive mechanisms to augment communication and exchange on a hyper-local, individual and community level, with the goal of encouraging development and maintenance of wireless mesh community networks. These incentives are implemented onto wireless network routers and broadcasted to devices that connect to these routers through captive portal interactive websites. Providing cultural and needs-based value in mesh networks is needed to ensure mesh technology is in the public consciousness and installed on devices and routers before a communication outage occurs. A combination of policy and grassroots, community engagement are necessary for long term implementation¹, but individual interest must spark from extending a network's value beyond the immediate need for Internet connectivity – of which, this thesis is aimed to do.

Social goals:

- Localized engagement to build network from grassroots level, until it reaches size to warrant municipal support.
- Ensure people know about mesh / have software installed before communication outage.

A new surge of interest in decentralized Internet initiatives has emerged since Internet shutdowns during the Arab Spring, threats of Internet censorship by first world governments and natural disasters crippling centralized communication infrastructure. Mesh networking technology integrated into wireless devices in communities, and throughout cities is a commonly proposed solution. Mesh networks allow for ad hoc devices, such as smartphones and routers, to communicate directly with each other, instead of relying on centralized communication devices. Although mesh is theoretically reliable, there are social and technical hurdles to overcome when attempting to deploy this technology on an individual and municipal level.

Working through the New America Foundation and Red Hook Initiative, the project is field testing the effectiveness of localized social software for civic engagement and network building throughout the Red Hook Housing Projects in Brooklyn, New York City. The 10,000 plus members of the community interact with the Internet primarily through Android smartphones², which provides a unique testbed for developing modular, emergent software that resides on local wireless routers and devices. While the primary goal for the Red Hook Initiative

members is to provide low-cost Internet to the residents (a unique aspect that mesh networks offer), they are aware that community-specific software is important in leveraging this type of system. Overtime, as the network and software evolves to address local needs, organic awareness of and an initiative towards wireless Internet infrastructure will hopefully arise.

The notion of hybrid spaces, wherein physical and virtual worlds are merged into a shared interactive experience³ is an important step towards collective engagement. In this way, wireless routers, or WiFi hotspots can be considered location-specific, alternative spaces or “counter publics”⁴ of autonomous expression of people and groups outside the majority. Devices that connect to these alternative places are virtual representations of individuals inhabiting these hybrid spaces. As radio waves are not restricted to geo-locative borders, a non-cartesian, time-based approach to mapping location, relying on user-generated landmarks and groups is used to map the reach of these virtual social spaces. A series of passive and active (asynchronous and synchronous) interaction modules, taking into account the migratory patterns of transients and locals⁵, collection mechanics and skill-based, intrinsic economies (social capital), will be studied in their effectiveness in urging face to face engagement and network building.

Design questions:

- What, if any, social incentive mechanics lead to network building in communities?
- Is there a direct correlation between proximity-based relationships and virtual communication? For instance, are Facebook users communicating more often with close neighbors or far away friends? If it's the former, would it make more sense for local communication exchange to occur directly with each other to decrease overall bandwidth usage?

1 Ileana Apostol, Panayotis Antoniadis, and Tridib Banerjee, “Places on the Net” (University Pierre and Marie Curie, University of Southern California, 2009), 1-2.

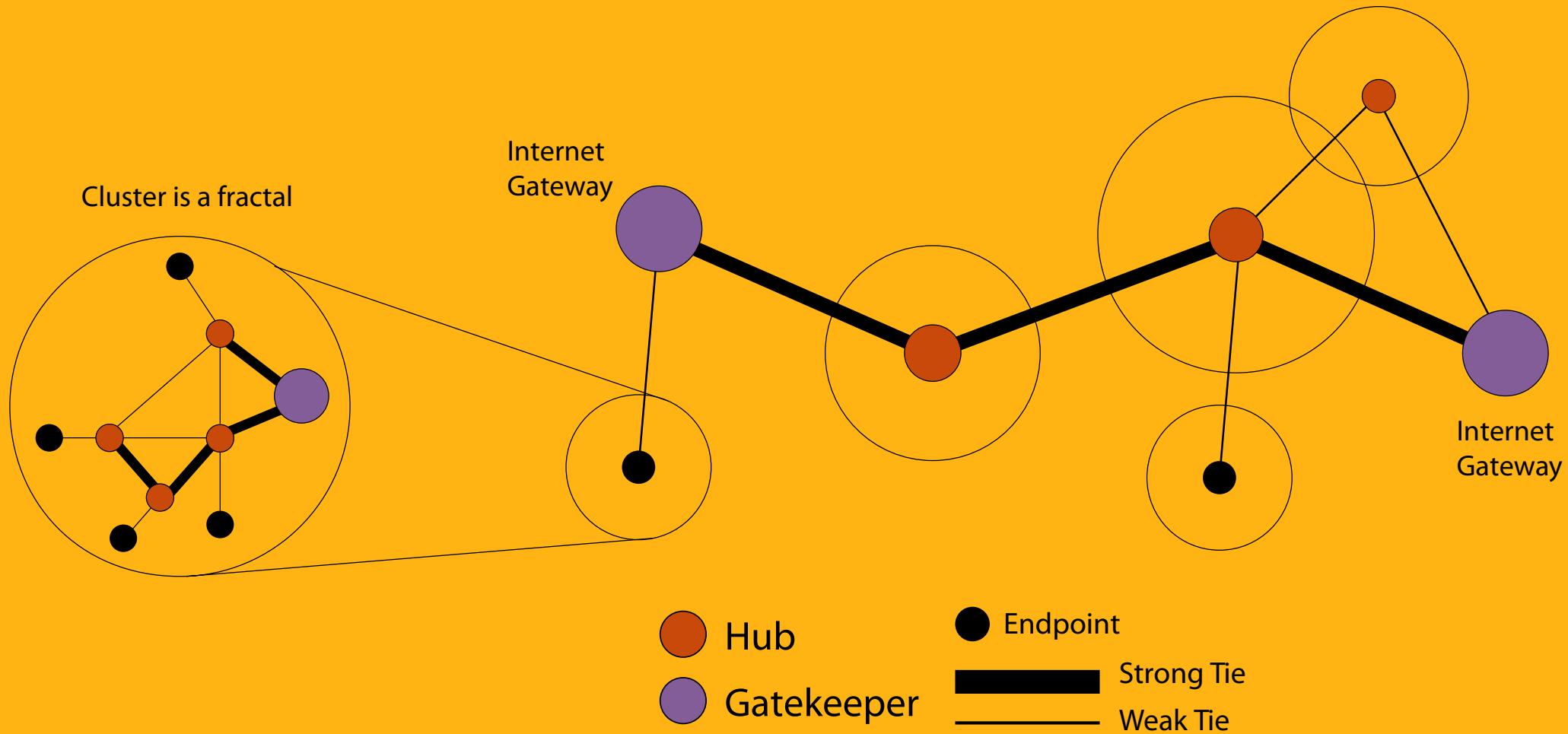
2 Anthony Schloss, interview by author, digital recording, Outpost Cafe, Brooklyn, October 25, 2011.

2 NetHood, accessed October 19, 2011, <http://nethood.eu/studio/index.php/>.

4 Michael Warner, *Publics and Counterpublics* (New York, NY: Zone Books, 2002), 115-117.

5 Paul Dourish and Genevieve Bell, “Divining a Digital Future: Mess and Mythology in Ubiquitous Computing” (Cambridge, Massachusetts, MIT Press, 2011), 83-84.

Ideal Metropolitan Topology



Where are they?

Why aren't more wireless mesh network communities prevalent in the world? What social and technical factors lead to successful community and municipal networks? These initial questions drove research into studying community relationships on a network theory model as well as an array of community-based theoretical frameworks. The most successful community networks were driven by strenuous geographical, economic and/or social conditions. For example, the Athens Wireless Network, with over 3,000 members and spanning multiple Greek islands, is successful due to the lack of business provided by traditional Internet Service Providers, the geographical scattering of the Greek islands and the socially independent nature of the Greek people. The Freifunk networks, and specifically the one in Berlin, Germany, was very prevalent for a while, until the socio-economic situation improved and people moved away from the community-owned option, as the "network wasn't offering additional content or services or something of value that would keep [one] there."⁶ In the Dharmasala wireless network, a mesh community was needed to create communication channels between exiled Tibetan monks living in the high mountain regions of the Himalayas.

To gain a better understanding of the interoperability of wireless community networks around the world, a qualitative, socially-focused survey was conceived as a sub-link on the thesis site. Questions derived from research into community theory, such as *Gemeinschaft vs. Gesellschaft* (Community & Interdependence vs. Society & Independence)⁷, *Community Building on the Web* (systems-oriented approach through roles, leadership, rituals, events)⁸ and *Socially-Motivated Wireless Network Communities* (cross-layer participation, trust building, community identity, social relationships)⁹. With nineteen questions overall, they varied from questions about reciprocity between members, to individual roles, dealing with malicious users, ritualized meeting spaces, relations to other networks and personal optimism about the network. The survey was also set up to translate into a large variety of languages, as a majority of these networks are not in English-speaking countries. The survey requests were then seeded out to a variety of general and community specific mailing lists, as this is the primary

6 Laura Forlano, interview by author, digital recording, Joe The Art of Coffee, New York City, October 03, 2011.

7 "Gemeinschaft and Gesellschaft," *Britannica Online Encyclopedia*, accessed October 21, 2011, <http://www.britannica.com/EBchecked/topic/228066/Gemeinschaft-and-Gesellschaft>.

8 Amy Jo. Kim, *Community building on the Web* (Berkeley, CA: Peachpit Press, 2000), 22-22.

9 Panayotis Antoniadis, Bénédicte Le Grand, and Marcelo Dias de Amorim, "Socially-Motivated Wireless Neighborhood Communities" (University Pierre and Marie Curie, 2006), 2-22.

form of communication in these groups.

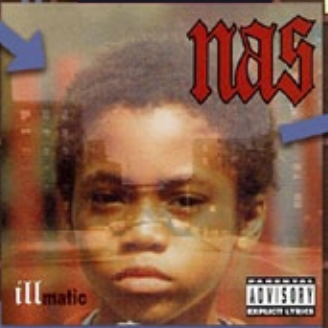
Strong and weak ties, or quantified relationships, between nodes and clusters is very important when studying the flow of information packets across a wireless network, as there is always a limit to the shared bandwidth (Internet connection) in a community network. Nodes and clusters with strong ties require more bandwidth to properly communicate between each other, while weak ties can be less prioritized. These strong ties are the "backbones" or "highways" of traditional, centralized Internet networks – the nature of mesh networking limits the formation of such static structures, thus an emergent, ad hoc approach to backbone organizing⁶ could be addressed through studying strong ties on a network. Areas with the highest level of communication, such as between two universities, could be urged to connect via directional antennas, fiber optics or multi-radio routers to free up bandwidth for the rest of the network.

Combining the human and Internet communication networks into a qualitative and quantitative analysis could allow for optimal and stable network infrastructure. By metering communication between nodes and clusters through frequency, significance, and packet size, while factoring in the number of node messages passed through before their destination, a technical and a social relations approach to mesh communication could emerge. The stakeholders of this project, those that are handling the technical construction and mesh protocol implementation of these networks, such as Free Network Foundation, Freifunk, Commotion and others, could benefit from this analysis as well.

Along with the strenuous geographical, economic and/or social conditions that drove mesh network development, a series of social and technical considerations have to be addressed. To ensure quality of service, designated backhaul routers and antennas that form ad hoc backbones infrastructure must be incorporated with and allow blanketing of WiFi access points for maximum space for connections. On a social level, an atmosphere of trust, interdependence and reciprocity needs to be instilled, by creating a ritualized experience that leads to face to face interactions.

PHILIP GLASS / ROBERT WILSON
EINSTEIN ON THE BEACH

Physical Borrow (vinyl)



Digital Share (MP3s)



Hybrid Artifacts & Space

Engaged stakeholders are those that work with mesh technology and the people willing to go into micro-communities or clusters, and setup the basic infrastructures or teach the principles to local enthusiasts. Additional stakeholders and users need to rely on an interface to engage and perpetuate an information exchange economy to keep the mesh alive. The ritualization of online and offline meeting spaces, both before and after the community formation, help to create cyclical sparks of interdependence.

After interviewing Laura Forlano, a formative researcher in the field of wireless community networks, the idea that mesh communication would more easily form through pre-defined sharing economies, such as “a group of families sharing a car, eco-housing or co-housing situations where people are sharing daycare,”¹⁰ became clear. Working within already-existing physical clusters, where internal exchange, interdependence and trust prevail is important. “Once the social layer is developed...” Forlano says, it won’t be “...hard to find communities that see value in that.” Empowering these pre-defined clusters with tools that let the network grow out naturally is the desired and most stable course of action.

On communities that tend to be more individualistic (Gesellschaft theory), such as in New York City, Forlano says they are “not interested in sharing, [it’s] not part of living life, maybe at work or with friends,” but it’s not part of the inherent culture. A shift from this mindset “could change based on residential design.” Or, possibly, through manufacture of a reciprocal economy by augmenting physical and virtual interactions between neighbors.

The interview with Laura Forlano, combined with earlier social networking theory evaluations that emphasized the need to merge exchange between virtual and physical users and inspiration from a team of researchers working through an effort called “NetHood,” helped to emerge a series of socially-driven interfaces. Through additional research into “Community Building Over Wireless Mesh Networks,” a very influential IEEE draft article for the overarching thesis research, more recent work had been found through one of the original authors at NetHood. Panayotis Antoniadis, and two other researchers proposed a “hybrid community” that merges physical and virtual space in an attempt to answer the question: “Can wireless technology, peer-to-peer systems and social software help to build sustainable and convivial neighborhood communities?”¹¹

The Nethood website proposed theoretical artifacts of convergence between

10 Laura Forlano, interview by author.

11 Ileana Apostol, Panayotis Antoniadis, and Tridib Banerjee, “Places on the Net” (University Pierre and Marie Curie, University of Southern California, 2009), 1-2.

virtual to physical, physical to virtual and hybrid interfaces.¹² This inspiration was used as a launch point for development of practical needs addressed through software applications for proximity-based communication and reciprocal exchange. The goal for each of these applications was to build trust and interdependence between users, that are separate from, but extensions of the need for mesh networks.

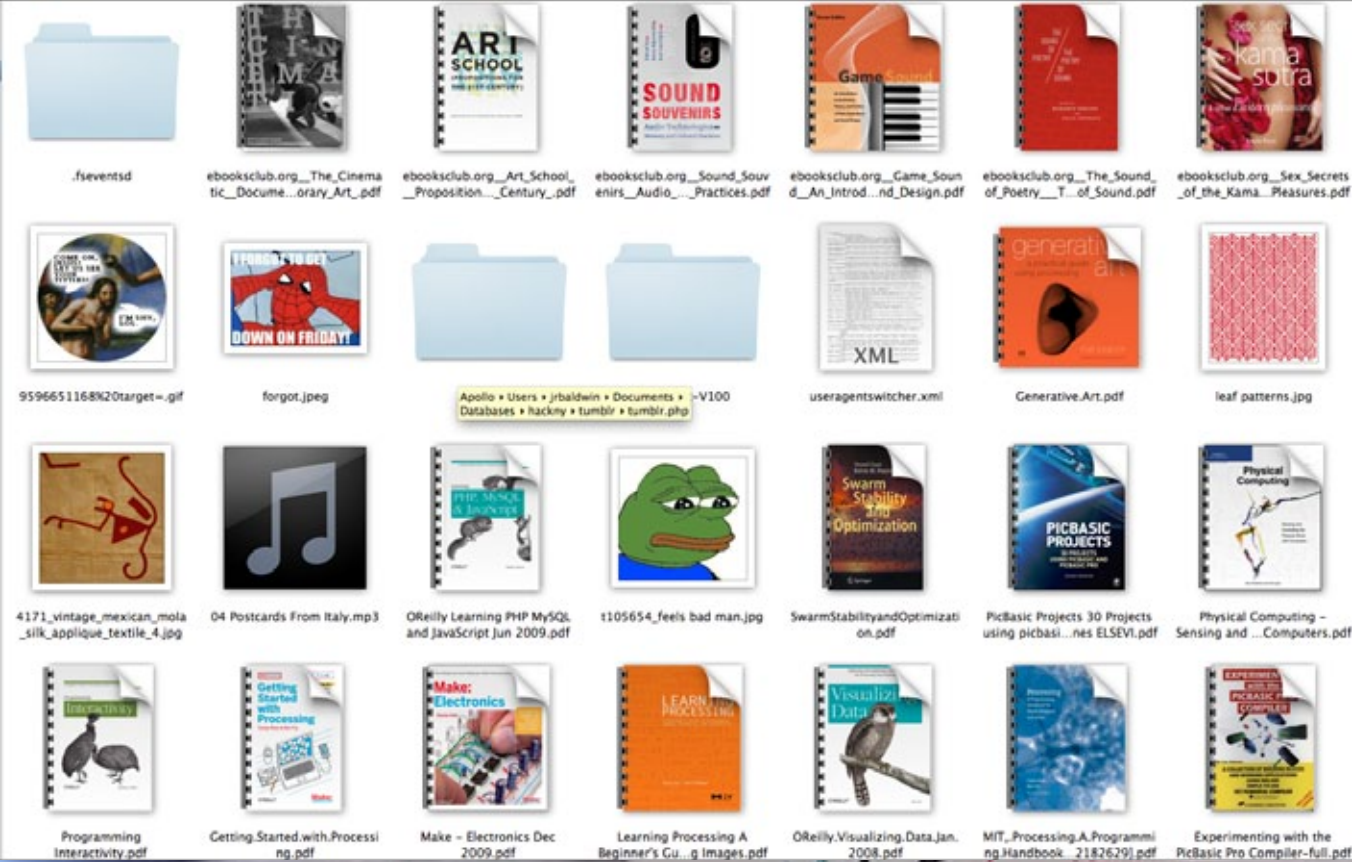
Merging physical and digital media, such as hardcover books and e-books, DVDs and MPEG-4 files, LP records and MP3s, into one personal, online media-shelf, gives users the ability to show off their stuff – in the same way people have bookshelves in their living rooms to show off their favorite titles, their personalities, is very important for underlying communication between users.¹³ When neighbors or friends visit and glance at that shelf, conversations arise about similar interests in the author, director, genre, etc. The act of letting the other borrow that piece of media creates a very strong social bond of trust. Bridging digital and physical commodities, a hybrid bookshelf, may justify proximity mesh environments. The neighbor can borrow a book, movie or album physically, opening up chances for face to face trust-building interaction, or copy it digitally over the local network. The digital atmosphere allows clusters of people in both digital and virtual realms to share like-minded media, creating a complex, self-contained exchange economy.

Merging physical food items from a community into one digital fridge would further augment a reciprocal exchange between users. Listing shared items, such as eggs or sugar, yesterday’s leftovers, or the latest produce from community gardens or food co-ops could provide incentives for shared meals and a borrowing economy. As Laura Forlano responded to this idea, “signaling to people their similarities, and their differences”¹⁴ would build an underlying awareness of other individuals, with varying interests, forming the community as a whole.

12 NetHood, accessed October 19, 2011, <http://nethood.eu/studio/index.php/>.

13 Amy Jo. Kim, “Putting the Fun in Functional: Applying Game Mechanics to Functional Software” (slides presented at a Google Tech Talk, Mountain View, California, January 30, 2009), <http://www.youtube.com/watch?v=ihUt-163gZI>.

14 Laura Forlano, interview by author.



Drop



MFADT Book/Paper EXCHANGE

Get Points! by sharing your books!

If it's a PDF or e-book, put file on USB Dead Drop to the left. If it's a physical book, email the person and coordinate a meetup! Copy me on the email to get points.

List what research you need below.

jrbdwain@gmail.com

Book/paper Name	Requested by (name)	Email	Request Filled by	Digital or Physical Item
O'Reilly Javascript	Jonathan	jrbdwain@gmail		

USB Dead Drop on window ledge, share digital files there

A/Synchronous Exchange

Is there a direct correlation between proximity-based relationships and virtual communication? For instance, are Facebook users communicating more often with close neighbors or far away friends? If it's the former, would it make more sense for local communication exchange to occur directly with each other to decrease overall bandwidth usage?

The “Global Innovation and Local Talent” talk at the New School, from the UNICEF team, discussed methods and strategies in implementing SMS, or text messaging, tools in mobile networks throughout African countries. According to Christopher Fabian of UNICEF, the most effective, stable and long-lasting developments involved educating locals from these communities in Python computer coding and structural network knowledge.¹⁵ This provided self-sustaining, interoperable technical communities autonomy, that didn't require further intervention than from the initial catalyst by an outside influence. They were also more adept at addressing local needs and issues that unforeseeably arose.

Educating the community on networks as a whole, while teaching the most interested members how to setup antennas, flash routers with new firmware and program their own mesh tools will be an important factor in long-term mesh survivability. Each community network has its own specific socio-political, economic and topographical issues that only a local community could navigate and influence.

This realization, combined with the notion of a Wireless Network Community as “a generator, catalyst and supporter of neighborhood collective action... [that could] sustain convivial, and creative communities”¹⁶ lead to the idea that physical and virtual reciprocal exchanges between groups connecting to the mesh should be modular and customizable. In this way, unforeseeable clusters with unique goods, ideas and services to offer to the community network could easily setup custom parameters and contribute to the overall economy. For example, the Red Hook Housing Projects has a community radio project, that could use the mesh to stream locally and receive live feedback from listeners, to create a positive feedback loop. That specific tool could not be hard-coded into a grand design plan, but must come naturally from within the community.

A passive, asynchronous experiment was conducted over the course of a few

15 Christopher Fabian, “Global Innovation and Local Talent” (lecture, The New School, New York, NY, October 6th, 2011).

16 Ileana Apostol, Panayotis Antoniadis, and Tridib Banerjee, “From Face-Block to Facebook or the other Way Around?” (California State Polytechnic University, University Pierre and Marie Curie, and University of Southern California, 2008), 7.

months to measure back chatter communication within the Design and Technology community at Parsons. A USB storage dead drop, “an anonymous, offline, peer to peer file-sharing network in public space,”¹⁷ was placed on a window mantle with the instructions: “Take a file, leave a file.” Over the next few months of the experiment, the drive was populated with a variety of images, music, e-books and documents (some sharing common themes), creating an open, anonymous conversation amongst the twelfth floor lab dwellers. As earlier research into game theory applied to community, Will Wright, the creator of Sim City and The Sims, emphasized the need for designers to “give players a large possibility space,” by creating open systems for maximum personal customization, which leads to a community of “player created content.”¹⁸

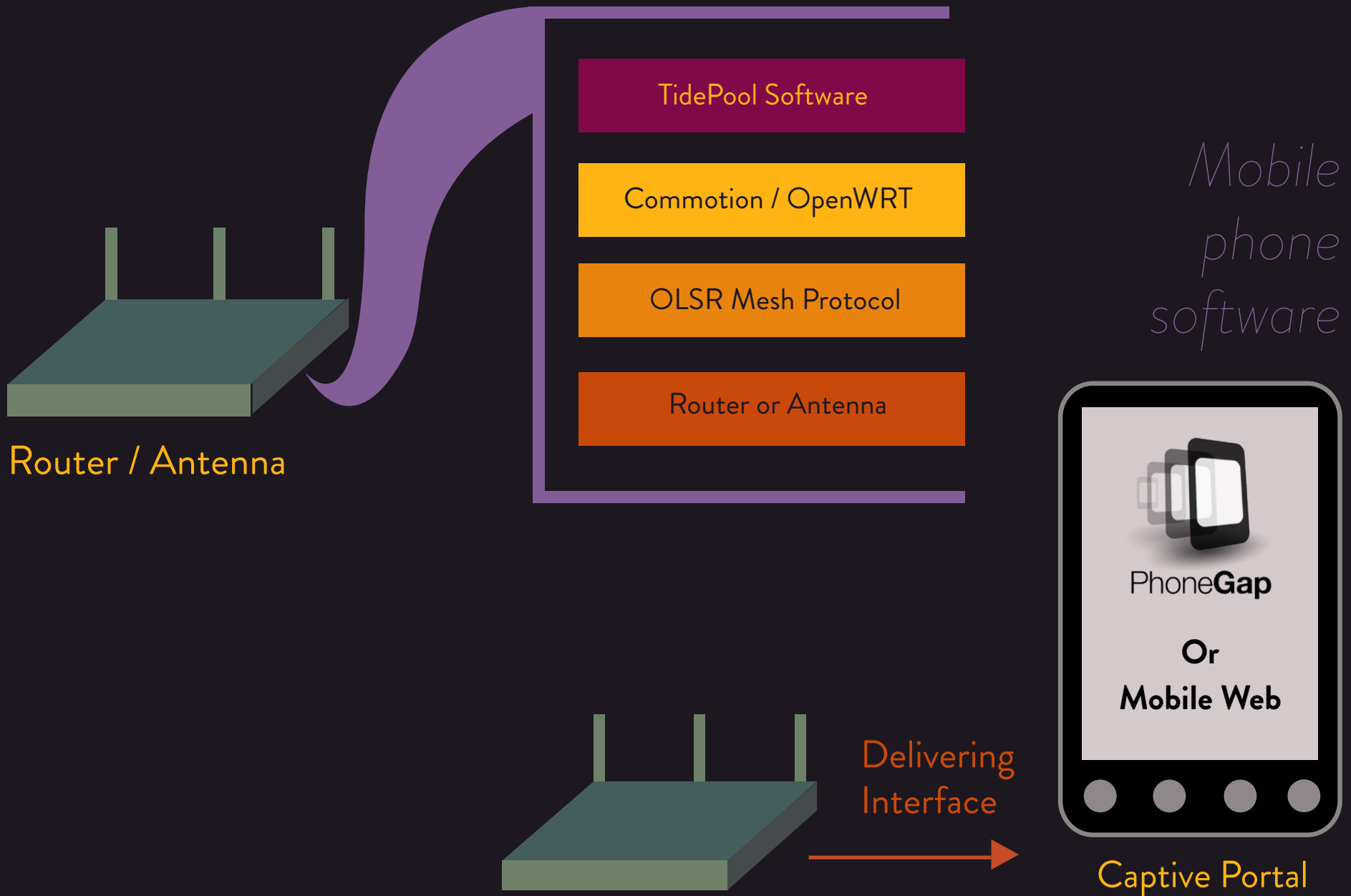
Another experiment conducted at the same time involved a more active, synchronous relationship between participants. This took a more direct approach to a needs based physical and digital economy – that of books between students in the 12th floor lab. A physical book lending combined with digital eBook sharing interface were presented, but did not receive the same level of feedback that the USB dead drop did. This could be a side effect of poorly designed layout, but could also be an argument against purely synchronous communication methods for shared spaces of familiarity over long spans of time.

Emergency preparedness and wireless communities are interlaced. Treating the mesh network as a secondary layer of communication, a community must have an immediate and well-publicized backup plan that includes wireless ubiquity, or the ability to dispatch wireless nodes soon after a disaster or political situation. By ingraining mesh network awareness in the culture, making it distinct but compatible with the regular Internet and providing localized communication incentives and features, a community could be fully autonomous after a crisis. A collection of proposed storyboards, to create a short film around this concept, were developed (see images contained in folder).

17 Aram Bartholl, “DeadDrops,” accessed June 14, 2011. <http://deaddrops.com/>.

18 Will Wright, “Lessons from Game Design” (discussion at SD Forum, Computer History Museum, Mountain View, California, November, 20, 2003), <http://www.youtube.com/watch?v=CdgQyq3hEPo>.

Starts with Routers



On the Technical Front

Technical research was mostly thoroughly conducted during Chaos Communication Camp in Berlin, with Freifunk, there was still more to learn from the Freedom Network Foundation's approach to ad hoc and static wireless mesh infrastructure. The "Freedom Tower," an intriguing solution for open space transmission, where an array of directional antennas, mounted on a tripod, beamed outward like a giant omnidirectional antenna,¹⁹ began to convey a deeper sense of form and philosophical statement when it was dropped onto Zucotti Park at Occupy Wall Street. Along with other Freedom Towers at Occupy Los Angeles and Austin,²⁰ with the next step being to link them all directly through a Virtual Private Network (VPN), the Freedom Network was making a statement about their vision for a grassroots, interconnected community. The functional, yet political form of the Freedom Tower brings up the notion of wireless devices, such as antennas and routers, as taking on other visible roles in the community perspective. Personal routers for home use work best when placed by a window, in order to connect to the rest of the network, although many users choose not to do this – could the form of the router dictate its optimal function? If it were shaped like a plant, and placing it near a window to obtain solar-powered energy would give positive feedback, would this technical problem be overcome? Would providing a localized interface between a user's computer and the plant device produce empathy?

When considering the building of software on top of completely decentralized mesh networks, the traditional method of connecting to other devices on a network through a centralized routing system must be reconsidered. Routers usually store a listing of devices within the area they serve, forwarding requests to connect one device to the other by looking up the correct IP address. In a mesh, two other approaches could be implemented instead. By using a method known as DNS multicast to discover other devices on a local network, zeroconf protocols such as Bonjour on OSX and Avahi on Linux reduce the complexities of service discovery.²¹ As the network grows from tens, to a few hundred nodes and eventually to thousands and beyond, a Distributed Hash Table, such as Telehash, is important for keeping a record of all known devices, spread across many "seeds" or servers around the world.²²

Jeetu Golani and Erle Pereira, developers in India and Australia, are working

19 Free Network Foundation, accessed October 13, 2011, http://www.freenetwork-movement.org/commons/index.php?title=Main_Page.

20 Douglas Rushkoff, "Occupy Wall Street beta tests a new way of living," CNN Opinion, October 25, 2011, accessed October 25, 2011, http://www.cnn.com/2011/10/25/opinion/rushkoff-occupy-prototype/?hpt=us_c2.

21 ZeroConf, accessed October 21, 2011, <http://www.zeroconf.org/>.

22 TeleHash, accessed October 12, 2011, <http://www.telehash.org/about.html>.

on mesh software called eBrainPool, which will allow users on a mesh network to share programs from other computers – essentially, if a neighbor has Photoshop, the software lets the other neighbor run it directly onto their computer.²³ As their work also requires a decentralized means to communicate, a collaboration to investigate zeroconf tools has formed between this thesis and their work.

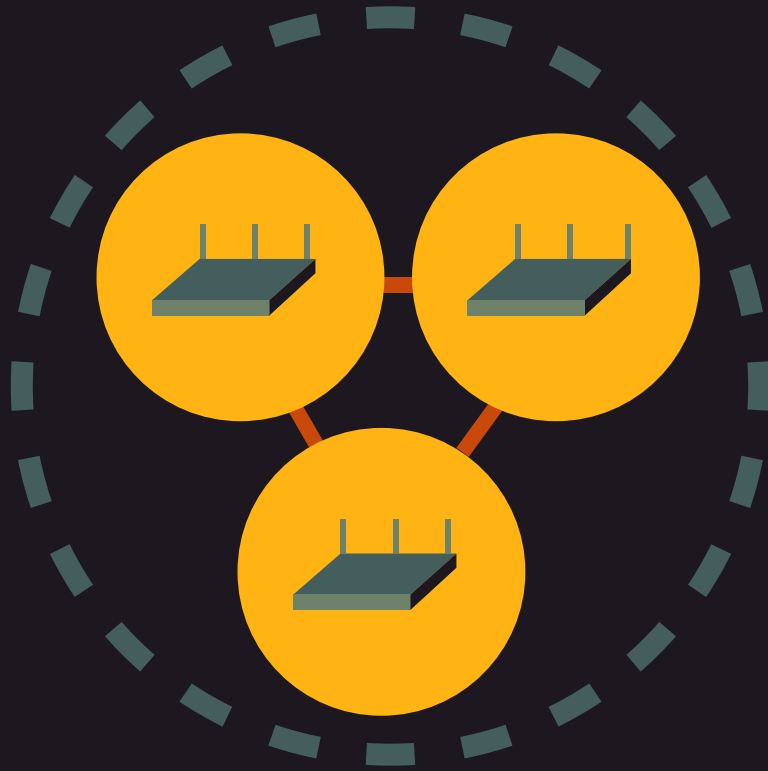
While those technical approaches might be considered best practice, the thesis project, for now, is using the concept of captive portal software (as well as DNS redirecting) to create interactive websites delivered to mobile devices when users connect to wireless routers. By combining an embedded HTTP & PHP server, DNS server and SQLite server, with file storage on 8GB USB drives directly mounted to the wireless router, a very portable, fully interactive device with broadcasting capabilities has been formed.

In this way, counter public WiFi spaces can be formed anywhere to for a dynamic set of objectives. They can be freely broadcasted to anyone within a specific physical vicinity, with the capacity of Face to Face interactions for further physical action & engagement.

It has been physically challenging to install routers, antennas and ethernet cabling on rooftops in the rain and on shaky ladders. I plan on interviewing professionals in this field to gain a better perspective on their best practices.

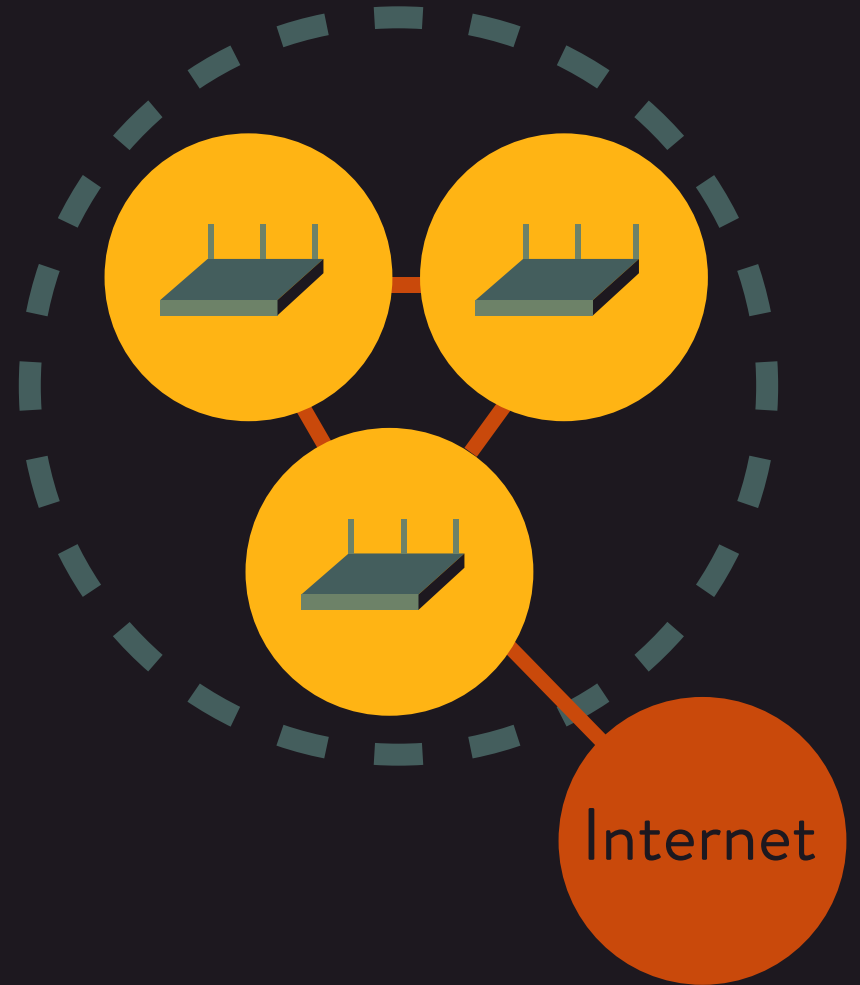
23 eBrainPool, accessed September 09, 2011, <http://www.ebrain.in/about-ebrain>.

Remain a Counter Public



Local Area Network

Move to the Public



Internet

Counter Publics

After re-watching the last episode of David Lynch's *Twin Peaks*, I was inspired by the counter public space that Agent Cooper enters when visiting the Black/White lodge. It exists outside of the visible spectrum – one can only enter through a ring of sycamore trees, when Jupiter and Saturn are in alignment. Is this similar to entering alternative spaces through WiFi gateways? Could a wireless network be interpreted as an alternative room/space/world? Can one create their own custom room/space/world? Will they allow others (friends, similar groups, community) to enter their custom spaces?

In Stanley Kubrick's "2001: A Space Odyssey," the astronaut Bowman enters a portal beyond Jupiter and the infinite, arriving in a non-locative Louis XVI-style room, that maps the 4th dimension (time) on a 3d plane. What happens when multiple people on a network create their own rooms? Does it become a shared, non-locative space? Does it grow to a city, eventually? This brings me back to Italo Calvino's poem/prose "Invisible Cities," wherein Marco Polo and Kublai Khan discuss "cities and memory, cities and desire, cities and designs, cities and the dead, cities and the sky, trading cities, hidden cities," which all turn out to be the same, constantly shifting city.

In Haruki Murakami's "Wind Up Bird Chronicle," Toru, spends more and more time in a non-locative hotel room in Tokyo, which he enters through an intangible portal at the bottom of a well. Later on, he wanders through the hotel, encountering distorted hallways and unstable rooms, revealing plot lines in non-linear progression.

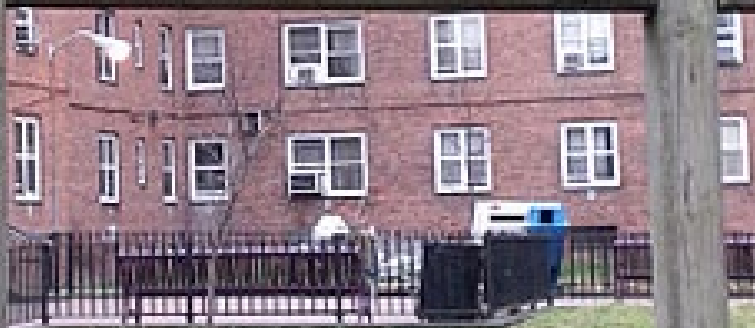
I'm reminded of the "counter publics" of Michael Warner's theory²⁴ that Alison Powell refers to in her thesis, as separate, autonomous spaces for groups and people that lie outside of the majority.²⁵ In "Divining a Digital Future," Dourish and Bell write that local belief systems of the Warlpiri and Kaiditch peoples of central Australia hold that a separate Dream state exists in addition to the physical landscape. This dreamscape "carr[ies] the resonances of human activities and events...patterns of habitation and settlement, migrations, meetings, battles, and births and deaths...leave their impact on the land...experience of the landscape is thus a cultural one...the topography of the land is...encountered as physical, mythical, and historical."²⁶ Could non-locative personal and group spaces merge with a physical, mythical and historical catalogue of past events, in a community or other shared experience?

24 Michael Warner, *Publics and Counterpublics* (New York, NY: Zone Books, 2002), 115-117.

25 Alison Powell, "Co-productions of Technology, Culture and Policy in North America's Community Wireless Networking Movement" (Concordia University, 2008), 58-59.

26 Paul Dourish and Genevieve Bell, "Divining a Digital Future: Mess and Mythology in Ubiquitous Computing" (Cambridge, Massachusetts, MIT Press, 2011), 80-81.

Welcome to...
**RED HOOK WEST
HOUSES**
NEW YORK CITY HOUSING AUTHORITY



PLEASE DO NOT FEED THE ANIMALS
NO SMOKING
NO ALCOHOL
NO DRUGS

No smoking within the park.
No fumar dentro del parque
在公園內禁止吸煙

COFFEY
PARK


Neighborhood Software

As the primary goal of this thesis is to foster new and existing real world, community social networks, invoke face to face interactions to build trust and interdependence amongst community members, and provide forms of information exchange, this module was initially an analysis of pre-existing “getting to know your neighborhood” websites. Specifically, why each and every one of these sites, no matter how shiny and promising, have continued to fail at community adoption.

These top-down designed, hyper-local websites attempt to create meaningful connections between neighbors, but have consistently failed at engaging on a large scale. A running assumption is that one neighbor would like to borrow a ladder from another neighbor, which will lead to a reciprocal exchange economy. Visually, these neighbor’s houses are represented as the standard suburban, westernized tract housing. There is no community-specific identity, while interactions are assumed to be synchronous and active, not at all passive or asynchronous. The sites: i-Neighbors, Front Porch Forum, Fat Door and Next Door all measure success in local mass adoption, relying on community recommendations and civic action, expecting participants to be intrigued enough to contribute to this information economy consistently and without exterior rewards. An intriguing trust aspect of “Next Door,” is that all neighbors need to verify their physical address as part of a neighborhood, but do geographical borders align with social borders? ²⁷

The most successful localized digital service is Craigslist, which allows for semi-anonymous, semi-trusted buying and selling, satisfying a real need. It is not, however, a model of long term community building, with lasting connections or trust between participants.

Policy Integration

After discussing the policy aspects of ad hoc mesh networking technology with the Berkman Center at Harvard, I became quite inspired by this very different approach to the traditionally very decentralized take on empowering users through these networks. They understood that a combination of grassroots and municipal/policy efforts were needed to bring mesh networks into realization. I have begun to integrate these notions into my thesis, and will continue to do so in the coming months. Here is a write up I did for the Berkman Center of where social aspects of mesh can merge with a policy angle:

Public Safety and Emergency Planning (with Ad Hoc Mesh networking)

From a technical angle, it is problematic to install mesh-enabling software on users’ phones, devices and laptops to create a mobile ad hoc networks – difficulties include ease in gaining “root” access to devices, violating warranties, incompatibilities between mesh protocols and ease of installation/use for non-tech users. Battery life and CPU cycle consumption are also major factors when routing other users’ traffic through the mesh, while bandwidth optimization (to minimize the number of hops) through ad hoc backbones is still theoretical.

From a socio-technical perspective, mesh networks increase in reliability as the number of users increases. Until a critical mass of meshed devices is within range, the network is unreliable or non-existent. Easily deployable or pre-installed relay nodes between well populated areas could help quality of service. Another difficulty is ensuring that users have access to or have already installed mesh technology on their devices, before a loss of centralized communication services (through natural disasters, political uprisings, etc.). Otherwise, the technology will not be able to satisfy unforeseeable, immediate needs.

There are a few ways to incentivize the enabling of mesh on devices before a communication shutdown. It could be as simple as creating a culture of latent sharing, in the way that donor stickers work on driver’s licenses. This creates a social capital of readiness and awareness, if the user is able to subtly show off their installed mesh software, or “donor card.”

Mesh software could also be active in hyper-local exchange and communication between networked users. Skill-based task assignment and user roles in communal, technical and social areas mimics self-assembly/swarm theory in the ad hoc assembly of decentralized infrastructure. Creating a culture of readiness, willingness and ritualization (meetings/events) could help to spread awareness



to additional user groups. An intrinsic, skill-based currency (such as Mozilla's Open Badge project), combined with an extrinsic participatory currency may help to drive this forward.

Another approach is to appeal to phone manufacturers directly to enable a standardized emergency system, which is what the developer behind Auto-Bahn, an Android (and soon iPhone) P2P messaging system is trying to do by expanding the use of Bluetooth and WiFi during emergencies (not clear if it includes mesh networking). <http://hackerdemia.com/>

Community Wireless Networking and Policy

In "From Face-Block to Facebook or the Other Way Around?" Apostol, et al. call on urban planning to "encourage the creation of [Wireless Network Communities]," due to the "capability [of WNCs] to increase social capital" and "inclusiveness." They could be "active[ly] operat[ed] through policy implementation and city sponsorship."²⁸

There's a history of success and failure in the introduction of wireless networking into communities. Municipal and grassroots based wireless networks have thrived in particular settings, originating from and their ability to address local economic, geographic and cultural conditions. A multi-faceted approach to policy, based on these granular conditions, could be considered when working on the community level.

In "Divining a Digital Future," Dourish and Bell note that formal mechanisms regulating infrastructures have impact on everything from appropriate forms and formats of content, pricing, decisions about component parts and standards, data traffic speeds, and backhaul rates." They propose that "[t]acit forms of regulation might include family choices about service providers and device placement within the home, religious proscriptions about device types and usages, and the placement of infrastructural nodes [in a spacial/social boundary context]."

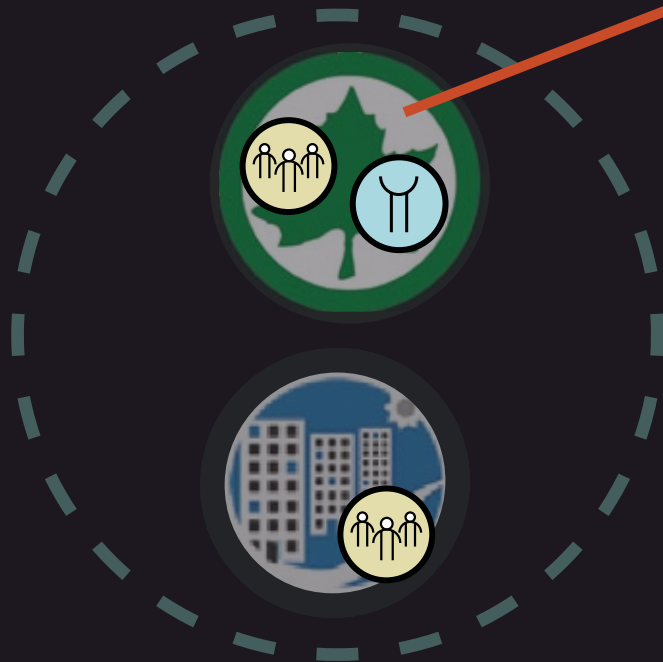
Two hundred years ago, British colonial forces made a treaty with the Maori, the indigenous people of New Zealand, to secure their "lands, villages...and treasures". These treasures included "material and non-material...sacred places," which allowed the Maori nation to claim a legal share of the newly erected 3G wireless radio waves traversing their lands. Dourish and Bell question how deployed infrastructure and the spaces they inhabit are understood by users/groups (and when scaling up). They ask: "Who should participate in this discussion? Whose opinions and experiences are relevant? How might such individuals and institutions be included in both

28 Ileana Apostol, Panayotis Antoniadis, and Tridib Banerjee, "From Face-Block to Facebook or the other Way Around?" (California State Polytechnic University, University Pierre and Marie Curie, and University of Southern California, 2008), 10.

conversations about deployment and regulation?"²⁹

The first standardization of mesh networking on a protocol level has been seen through IEEE 802.11s (ratified July 2011), with the first device to use an earlier draft standard being the One Laptop Per Child project. Other hardware is now beginning to support this protocol natively (Ubiquiti Networks NanoStations and Bullets through their AirOS firmware). There is critique of its usefulness amongst the OLSR, BATMAN, and other mesh protocol communities, but it is a first step toward a standard that device manufacturers can start calibrating, optimizing and building software for.

29 Paul Dourish and Genevieve Bell, "Divining a Digital Future: Mess and Mythology in Ubiquitous Computing" (Cambridge, Massachusetts, MIT Press, 2011), 106-107.



Coffey Park
Red Hook Housing Projects

Groups / Landmarks	Upcoming Events	
 Picnic Tables Click for more	<div style="border: 1px solid gray; padding: 5px; background-color: #e0e0e0;"> Internet Group Meeting at 4:30, at Picnic Tables </div> Click for more	
<div style="border: 1px solid gray; padding: 5px; background-color: #e0e0e0; margin-bottom: 5px;"> Lorem ipsum dolor sit amet, consectetur adipiscing elit. Donec tempor urna vestibulum ante faucibus non porttitor tortor ornare. Sed eu mauris felis. </div> <div style="display: flex; align-items: center;"> Internet Group joined Coffey Park </div>		
Home	Help	Internet

TidePool Interface

“What would be it to offer a technology that make space legible in radically different ways?” Dourish and Bell question in “Diving a Digital Future,” after discussing a shift from the nodes and separation of networked mobility to fluidity of networked flow and connectedness – to “maintain an essential identity while adapting to local conditions.”³⁰ They propose a shift in mobile interface that moves away from Cartesian grid coordinates to instead focus on the relationships and histories of people in relevance to each other and the spaces they inhabit and move through.

This conceptual spatial approach, coupled with the idea that WiFi radio waves don’t conform to geo-locative boundaries has influenced the navigation aspects of the interface design. Being nearby to landmarks represented in the interface, as wireless networks are proximity-based, allows face to face interactions to occur within walking distance. WiFi hotspots, or access points, where individuals can connect to the network are represented as both physical places and spaces for digital engagement in a hybrid space. For example, in the Red Hook Housing Projects, Coffey Park and the Red Hook Initiative are places of both digital and physical interaction. Considering fluidity and Yochai Benkler’s notion of granularity of control³¹, it is possible to add more landmarks to the community space that may not represent an exact area. For example, in Red Hook, some of these include “Paradise” and the “Trip Towers.”

From an overarching design perspective, I was inspired by the idea of tide pools for what they represent on a conceptual level. The gravitational pull of the Moon effects the ebb and flow of tide pools. The ritualization of lunar cycles, coupled with seasons and festivities is deeply engrained in community relationships and bonding. Tide pools themselves are fascinating self-contained, micro worlds with their own unique flora and fauna. When the tide comes in, all these microcosms are merged together – like counter public WiFi spaces with their own unique members, merging into the public realm with interconnected mesh networking. Strolling along the coastline, peering into these little micro worlds and finding unique features and treasures could relate back to someone walking amongst communities and being enveloped in unique cultural experiences on a physical and digital level.

Incorporating tide pools back into the non-cartesian landmark interface, users can add additional landmarks or groups inside landmarks, to create social network fractals, a phenomenon observed on all levels of network theory. The use

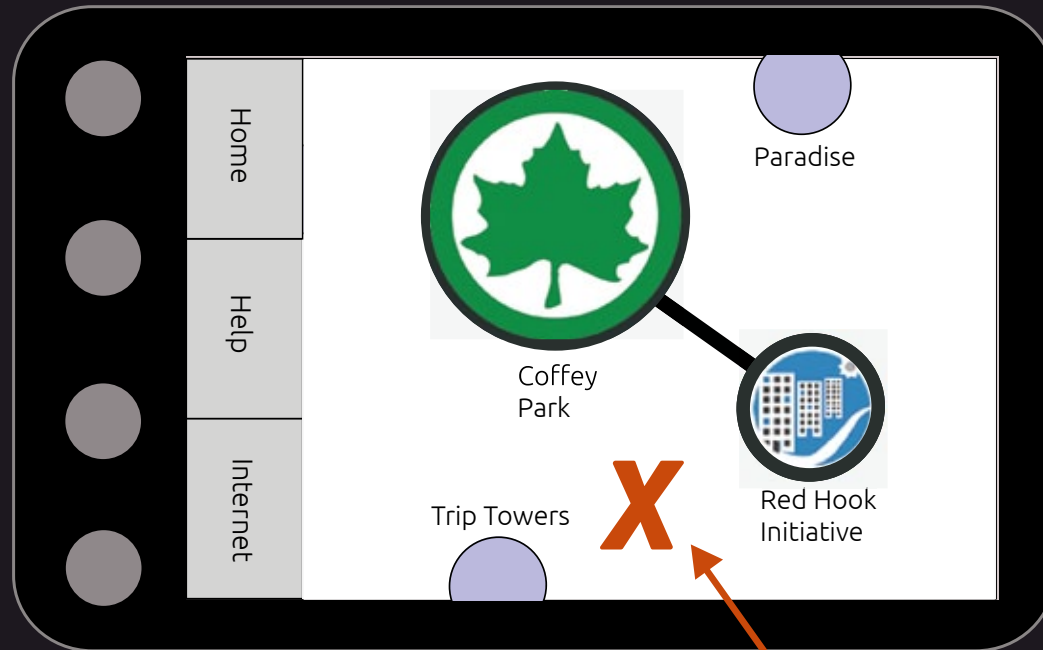
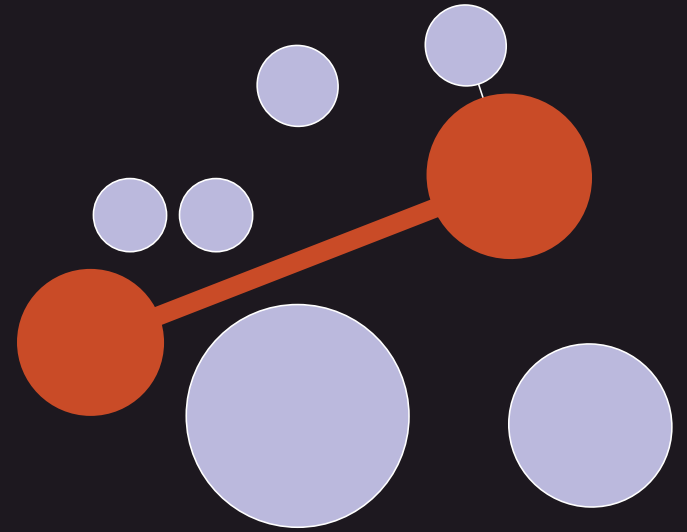
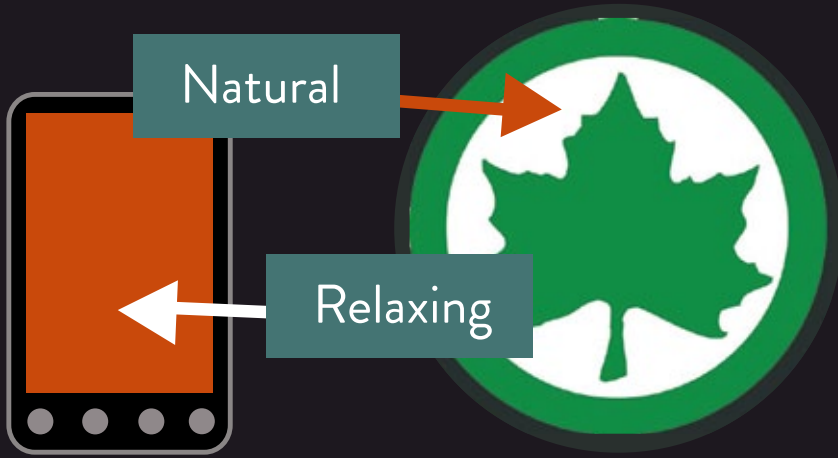
³⁰ Paul Dourish and Genevieve Bell, “Divining a Digital Future: Mess and Mythology in Ubiquitous Computing” (Cambridge, Massachusetts, MIT Press, 2011), 135.

³¹ Yochai Benkler, “Wealth of Networks” (New Haven and London, Yale University Press, 2006), 103-113.

of circles in this case recalls the idea of social circles and reflects on a widely held concept in theoretical physics – that of soap bubble fractal, macrocosmic universes constantly expanding and contracting in and out of existence.

Each landmark and group can be identified with an array of pre-defined or user-generated tags. Working of Dourish and Bell’s consideration of migratory patterns over long periods of time to define cultural boundaries, mobile devices & routers collect landmark and group tags from places frequently visited and deposit them on other frequently visited devices and routers. Over time, as people frequent locations, an overarching sense of familiar user traits may emerge. Thus, a personal radar when entering a new physical space could show the most relatable areas to the individual or group.

To some degree, each landmark or group would take on the look and feel of the space it inhabits and the people it contains. Latent communication feeds embedded in each site with upcoming events announcements could inspire cyclical interaction patterns, where awareness of local events and meetings might lead to face to face interaction at community meetings and genuine civic engagement.



Social Incentives

A series of social incentive mechanics are at the core of the captive portal based interactive mobile project. These incentives are being developed through a process of community and network building theory. The main questions for these interactions are: which ones lead to face to face or ritualized interaction? Can this lead to civic engagement? Can that civic engagement lead to localized network building?

Working with Anthony Schloss from the Red Hook Initiative and Red Hook Community Radio, he has expressed an interest in providing a means to broadcast the community radio project through the wireless network. Creating an open platform off this idea, where anyone can broadcast a one-way stream through the network with some kind of feedback loop for listeners' responses would be the best approach.

Additionally, Anthony expressed concern with the lack of access to computers outside of mobile devices to the residents of the Red Hook Housing Projects, which has been a continuing problem for completing job applications. There has been a sharp takeover of local library resources for applying to jobs on research computers, where librarians have now been taxed with providing tech support to these applicants. Possible methods of smartphone and network based job application utilities to expedite the process is being explored.

On a broader level, a series of synchronous (active) and asynchronous (passive) interactions are proposed. Developed for more local, familiarized settings, these include an image and file drop box or feed with personal and group websites with free hosting (autonomy of information) to be projected to the Internet or remain in the internal network. The latent communication style could be more reminiscent of graffiti, answering machines or message boards than active chat sessions or phone conversations.

Social capital, where acquired skill and participation are rewarded to user profiles on the networked level is very important for a long term intrinsic exchange economies. The Mozilla Open Badges initiative is a great example of how this integrates into real world goals and learning rewards, easily fitting into a community atmosphere with social and technical praise from others in the area. "Badges have been successfully used to set goals, motivate behaviors, represent achievements and communicate success in many contexts,"³² as is stated in the Open Badges white paper on badges in general, is a concept carried into gamification as well.

Synchronous or active interactions could possibly be more fitting for visitors, nomads or mobile users. Taking the notion of the tagged landmarks and groups from the interface design section that migrate with users as they move to new areas, these familiarity incentives could lead to more proactive network building. Similar people moving in between two nearby locations may be more likely to build directional antennas between migratory landmarks. If a correlation between digital and physical information exchange is found to exist, then these strong ties could lead to organic hierarchical back bones for long term network quality of service that forms to social relationships combined with city planned efforts.

A treasure map layer for the non cartesian interface could provide a curiosity incentive to outsiders looking to find hidden locations, such as secret restaurants, points of interest, bizarre landscapes, and other points that aren't defined on traditional maps and wouldn't be relevant outside the immediate space. These unexpected, intriguing miniature Dérives could help to reinvigorate static ecosystems with conversation or outside intrigue in the space.

32 The Mozilla Foundation and The MacArthur Foundation, "Open Badges for Lifelong Learning," (The Mozilla Foundation, 2011), 6.



Organic Hierarchy

Strong and weak ties, or quantified relationships, between nodes and clusters[#] are very important when studying the flow of information packets across a wireless network, as there is always a limit to the shared bandwidth (Internet connection) in a community network. Nodes and clusters with strong ties require more bandwidth to properly communicate between each other, while weak ties can be less prioritized.

These strong ties are the “backbones” or “highways” of traditional, centralized Internet networks – the nature of wireless mesh Internet networking limits the formation of such static structures, thus an emergent, ad hoc approach to backbone organizing³³ could be addressed through studying strong ties on a network. Areas with the highest level of communication, such as between two universities, could be urged to connect via directional antennas, fiber optics or multi-radio routers to free up bandwidth for the rest of the network.

The porous infrastructure of the sponge, seen here as a synthetically reproduced version of the type found in nature, is produced by an automatic process of self-assembly through the protein Silicatein. ³⁴This approach could be catalyzed in mesh networks to build interdependent organic infrastructure not reliant on centralized communication, through the process of swarm theory and social network node clustering.

Additionally, these organic structural hierarchies must move past purely centralized or distributed network models, to account for unquestionable, informal power relations and privilege that Jo Freeman describes in her critique of Feminist grassroots organizations in “Tyranny of Structurelessness.”³⁵ Galloway further criticizes this “web of ruin” as “a new form of control” in the Networks section of “Critical Terms for Media Studies,” whereas the “chain of triumph” in the Greek tragedy sense was a more traditional centralized agency. The ideal, may or may not be a combination of these two network models, an organic hierarchy, the decentralized topology.³⁶

The Occupy Wall Street movement provided a valuable resource of analysis and application toward ad hoc communities forming around similar clusters

of interest, and connecting with strong ties to other like-minded clusters within proximity and around the world. The proximity cluster in this case is Zucotti Park, while similar clusters on the web are the Twitter hash tags united around the movement, the Occupy Wall Street website and forum, the Adbusters website, Indymedia & Anonops IRC channels, scattered Anonymous alliances[#], and the Occupy Together online movement to spread the word nation-wide[#]. Similar physical clusters are the occupy efforts happening in Boston, Los Angeles, Chicago, San Francisco, Portland and many other cities[#]. They are all connected by strong ties through a web and phone interface, contributing to a reciprocal exchange economy of live streaming video, community structuring, protest flier design, the National Lawyers Guild contact information and other bits of information. Within the Occupy Wall Street community, there are smaller clusters, from the medical team to the legal team, that are generating original content or pulling resources from outside through strong and weak ties and sharing them with the other clusters within the closed system of Zucotti Park. The media group is acting as an information hub, recording video from within and around the park, then editing and distributing out to the rest of the world. The community outreach group is engaging local businesses surrounding the park, developing strong ties and sympathy for the movement. From the perspective of thesis research, in ingraining mesh networking as a communication and exchange tool to foster similar group clusters, this is an interesting look into how ad hoc infrastructure can form rapidly and strongly, as long contributors had pre-defined roles and passive social capital atmosphere.

33 Amir Esmailpour, et al, “Ad-hoc Path: an Alternative to Backbone For Wireless Mesh Networks” (University of Guelph and Ryerson University, 2007), 1.

34 Ask Nature, “Protein assists self-assembly of materials:sponge,” accessed November 10, 2011, <http://www.asknature.org/strategy/e2b8c0ff45f7a347bd561de8204307d2>.

35 Jo Freeman, “Tyranny of Structurelessness,” accessed December 15, 2011, <http://www.jofreeman.com/joreen/tyranny.htm>.

36 Alexander R. Galloway, “Critical Terms for Media Studies: Networks” (Chicago and London, The University of Chicago Press, 2010), 281-293.



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Next Steps

The first step is to install permanent captive portal WiFi hotspots at the Red Hook Initiative (with Internet) and Coffey Park (without Internet) with a basic introductory website allowing community members to comment on and discuss a mesh network proposal. At the same time, I will be holding classes with We Endeavor, a Red Hook kids learning program, to generate awareness of and possible intrigue in helping to construct the network. Additionally, I will continue to work with the Red Hook Initiative on the community meeting aspect, while plotting out how to begin connecting the two areas together to provide Internet to Coffey Park. The first social mechanics I will be developing are Red Hook specific, starting with the community radio broadcasting tool.

I will also continue to work with the New America's Commotion wireless project (with Josh King) to implement their mesh networking technology into the project successfully, while beginning talks with an ITP student named Sean McIntyre on how he can contribute to the project as a much more networking technically minded individual (so I can focus on the community and social aspects more clearly).

Additionally, my next main focus of research is into Michael Gurstein and the entire field of theory he developed called "Community Informatics," on networked communities as separate from traditional notions of the actor and node and how technology is assimilated into the community. I've already read quite a bit of an overview and am very excited to dig deeper into this area.

Glossary of Terms

Node - A single person or device that effects other nodes in a network.

Mesh Network - A decentralized network of nodes that speak directly to other nearby nodes instead of connecting to a central area that manages nodal conversations.

Trust - Familiarity or willingness to cooperate between people in a group or community.

Role - A person's specialized job within a community infrastructure.

Cluster - A group of similarly minded individuals or nodes, that communicate loosely to other clusters.

Hub - A person or device that routes information or artifacts to separated nodes or clusters.

Gateway - A person or device that controls the flow information from one area of a network to the other.

Virtual Private Connection - An encrypted, secure link between two nodes or clusters across a digital network that conjures a high amount of trust.

Optimal Bandwidth - A flow of information that is not throttled by malicious nodes, unreliable hubs or gateways.

Quantified Relationship - A metering of communication between individuals in a community network.

Strong Tie - A high level of communication and trust between two nodes or clusters.

Weak Tie - A low level of communication and trust between nodes or clusters.

Community Network - A self-contained, interdependent ecosystem of trust, safety and reliance between members.

Ad Hoc Backbone - A dynamic highway of information that ebbs and flows with the organic structure of the network.

Directional Antenna - An antenna with a focused beam of radio waves that travel

long distances in one direction.

Packet - A box of information that passes between nodes and clusters quickly or slowly depending on a strong or weak tie between said groups.

Reciprocal Exchange Economy - A cyclical transfer of owed objects or information between nodes or clusters that helps strengthen trust and community.

Hybrid Community - A merger of digital and physical spaces, emotions, artifacts, clusters and nodes.

Ritual - A cyclical event, such as seasonal harvests, that strengthens the bonds of communities or clusters overall.

Interdependence - Reliance on others in a community or cluster while retaining autonomy over self.

Peer to peer - Direct exchange between two people virtually or physically without passing through a third party.

Quality of Service - A standard assurance of consistency in communication between nodes and clusters on a network.

Omnidirectional Antenna - An antenna that allows radio waves to spread out in all directions simultaneously.

Hyper Local - Extremely close relations and communication between people in small proximity, such as a neighborhood or apartment building.

Wireless Ubiquity - The point in which a critical mass of wireless coverage, or illumination, allows uninterrupted connection.

Annotated Bibliography

Antoniadis, Panayotis et al. "Community Building over Neighborhood Wireless Mesh Networks." Draft accepted for publication at IEEE Technology and Society. Special Issue on Potentials and Limits of Cooperation in Wireless Communications, March 2008.

A collaboration between social researchers and wireless network technicians to conceptualize the best practices and needs for wireless mesh network communities to thrive in a completely decentralized environment (without municipal/government/corporation support). Notable concepts are cross-layer incentive mechanisms, the notion of the "social layer" on top of the traditional network stack, and the need for trust, reciprocal exchange and interdependence in a community network.

Apostol, Ileana, Panayotis Antoniadis, and Tridib Banerjee. "From Face-Block to Facebook or the other Way Around?" California State Polytechnic University, University Pierre and Marie Curie, and University of Southern California, 2008.

A collaboration between social researchers and policy/community planners. As opposed to the approach taken in "Community Building over Neighborhood Wireless Mesh Networks," this paper approaches the problem from the municipal angle, working with city planners to create a grassroots and civic collaborative environment. The most notable concept is that of the hybrid space (digital and physical interaction environments) that shapes a majority of the arguments presented.

Benkler, Yochai. "Wealth of Networks." New Haven and London: Yale University Press, 2006.

A dense analysis of open source, decentralized versus closed source, centralized networked modes of production and information economies that fuel innovation and collaboration around the world. Notable terms of modularity and granularity bridge into analysis of emergent, interactive environments.

Dourish, Paul and Genevieve Bell. "Divining a Digital Future: Mess and Mythology in Ubiquitous Computing." Cambridge, Massachusetts: MIT Press, 2011.

A computer scientist and cultural anthropologist propose new ways to interpret the messy physical and ethnographic digital nature of the third wave of computing technologies known as ubiquitous computing that permeate the world today. Interpretations of the technology draw from sociology, politics and economics.

Forlano, Laura et al. "From the Digital Divide to Digital Excellence: Global best practices to aid development of municipal and community wireless networks in the United States." New America Foundation, 2011.

An exhaustive and incredibly detailed list of nearly all past and present wireless mesh communities around the world that have formed from grassroots, municipal and a combination of the two. Aspects covered include original motivations to form the networks and factors leading to their success or failure.

Freeman, Jo. "Tyranny of Structurelessness." Accessed December 15, 2001. <http://www.jofreeman.com/joreen/tyranny.htm>.

An analysis of decentralized, grassroots 1970s Feminist groups and the unmentionable, informal power and privilege structures that indirectly influenced decision making. The most intriguing argument against completely distributed network models.

Gurstein, Michael. "What is Community Informatics (and Why Does It Matter?)." Milan, Italy: Polimetrica, 2007.

Already proving to be a very influential research area that I just discovered, Gurstein formed the research theory area known as Community Informatics to study networked communities as separate from traditional notions of the actor and node and how technology is assimilated/adopted into the community atmosphere.

Kim, Amy Jo.. "Putting the Fun in Functional: Applying Game Mechanics to Functional Software." Slides presented at a Google Tech Talk, Mountain View, California, January 30, 2009. http://www.youtube.com/watch?v=ihUt-163gZI&feature=player_detailpage#t=480s.

An influential overview of various game mechanics as applied to social interaction software, including set collections, social capital and intrinsic vs. extrinsic economies.

Koster, Raph. "Social Mechanics, The Engines Behind Everything Multiplayer." Slides presented at the Game Developers Conference, San Francisco, California, February 28-March 4, 2011.

Another influential overview of social gaming mechanics as draw from a variety of other theoretical areas of research. Notable topics covered are clustering, weak

vs. strong ties, social status, leaderboards, rival and non-rival goods, roles, rituals and traditions, lifecycles and trust levels.

Stephenson, Karen. "Of Human Bonding." *People Management*, October 29, 1998.

An introductory article to gateways, clusters, nodes, actors and weak vs. strong ties in information economies. This writing has helped to analyze existing weak power and communication structures in networks in wireless communities and how these can be re-thought.

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