

Social Network & Community Theory Convergence

Studying and creating a dialogue around the correlation between virtual and physical community relations through network theories.

An immediate problem found when attempting to study relationship and organizational dynamics between community network members, or actors in the network theory sense, was a lack of research into this area. Precedent research by Dr. Laura Forlano and Dr. Alison Powell, "Global Best Practices to Aid Development of Municipal and Community Wireless Networks in the United States," which assessed technical and logistical considerations of network communities worldwide, provided a solid platform to launch inquiry into the social relations within these networks.

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)¹, Community Building on the Web (systems-oriented approach through roles, leadership, rituals, events)² and Socially-Motivated Wireless Network Communities (cross-layer participation, trust building, community identity, social relationships)³. 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 form of

¹ "Gemeinschaft and Gesellschaft," Britannica Online Encyclopedia, accessed October 21, 2011, <http://www.britannica.com/EBchecked/topic/228066/Gemeinschaft-and-Gesellschaft>.

² Amy Jo. Kim, *Community building on the Web* (Berkeley, CA: Peachpit Press, 2000), 22-22.

³ Panayotis Antoniadis, Bénédicte Le Grand, and Marcelo Dias de Amorim, "Socially-Motivated Wireless Neighborhood Communities" (University Pierre and Marie Curie, 2006), 2-22.

communication in these groups.

As of this writing, twenty eight full writing responses have been collected, which have begun to paint a picture of how task assignments, ritual meetings and individual members play into the social dynamics of each network – additional responses trickle in intermittently.

At the same time as the survey developed, finding ties between physical wireless infrastructure and a scientific approach to human relationships was important to analyze the surveys as well as frame further research and development in the social field. Thus, social networking theory and in particular the work of Dr. Karen Stephenson became formative in assessing communities of interdependence and reiterating the need for reciprocity between users as a perpetual trust incentive.

There are striking similarities between Internet networks and human relation networks. The smallest actor in human relations is an individual⁴, while in an Internet network it is an electronic device such as a smart-phone, laptop or desktop computer. “Clusters” are groups of similar-minded nodes, communicating directly within themselves and less-so with others on the outside⁵. On a physical network, these clusters can be seen as office buildings, schools, homes or any other area where a wireless network exists, with eternal connectivity routed directly to the Internet. Highly centralized relations networks, where a single point of failure could cripple and fragment the entire system, rely on nodes that route a large amount of information to different areas of the network. These are called “hubs,” and are prevalent in Internet and human networks⁶. In an ideal mesh network, nodes are equally distributed routers, as each device is acting as a hub to all other hubs, thus if any one node is compromised the network remains stable. The limits of technology today lead to mesh networks with highly distributed hubs that link to individual nodes, through wireless routers.⁷

⁴ Valdis Krebs, "Social Network Analysis, A Brief Introduction," *Orgnet* (2011), accessed October 22, 2011, <http://www.orgnet.com/sna.html>.

⁵ Raph Koster, "Social Mechanics, The Engines Behind Everything Multiplayer" (slides presented at the Game Developers Conference, San Francisco, California, February 28-March 4, 2011), 123.

⁶ Karen Stephenson, "Of Human Bonding," *People Management*, October 29, 1998, 1. Stephenson, "Of Human Bonding," 1-2.

⁷ Mark Cooper, "From WiFi to Wikis and Open Source: The Political Economy of Collaborative Production in the Digital Information Age," *Telecommunications & High Technology Law* 5 (2007): 152.

A “gateway” allows information to pass from one cluster to another, or from one person to the other⁸. In a human network, this would be an actor that controls the communication flow, while in a wireless network this would be a gateway to the Internet, a Virtual Private Connection or another physical location in the community network. In an ideal mesh network topology, these gateways would be distributed equally across the network to ensure optimal bandwidth for all clusters and nodes.

Strong and weak ties, or quantified relationships, between nodes and clusters⁹ 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 organizing¹⁰ 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.

A process of mapping communication on these physical and virtual networks, through a basic item exchange led to some interesting results. Creating a network scenario in which two clusters are sharing books in a physical area led to local strong ties developing. Discussing this book, sharing reviews and thoughts, scanning pages, or exchanging a digital version of the book on an online forum cluster with similar minded node clusters from elsewhere in the world led to strong digital ties. As a mesh network deals with localized digital networks, these strong tie developments could begin to merge toward a physical/virtual information and item exchange network.

Combining the human and Internet communication networks into a qualitative and quantitative

⁸ Stephenson, "Of Human Bonding," 1-2.

⁹ Krebs, "Social Network Analysis, A Brief Introduction."

¹⁰ Hossein Kassaei, “Virtual Backbone Formation in Wireless Ad Hoc Networks” (Master's thesis., Concordia University, 2010), 4-5.

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.

Keywords: Node, Actor, Cluster, Hub, Router, Gateway, Virtual Private Connection, Strong Tie, Weak Tie, Ad Hoc Backbone, Multi-Radio, Directional Antenna, Packet

Occupy Wall Street & Hybrid Communities

Studying the ad hoc community infrastructure of Occupy Wall Street in relation to virtual and physical information and reciprocal exchange economies and hybrid community merger theory.

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 alliances¹¹, and the Occupy Together online movement to spread the word nationwide¹². Similar physical clusters are the occupy efforts happening in Boston, Los Angeles, Chicago, San Francisco, Portland and many other cities¹³. 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

¹¹ Ayesha Kazmi, "How Anonymous emerged to Occupy Wall Street," *The Guardian*, September 26, 2011, accessed October 23, 2011, <http://www.guardian.co.uk/commentisfree/cifamerica/2011/sep/27/occupy-wall-street-anonymous>.

¹² Occupy Together, accessed October 21, 2011, <http://www.occupytogether.org>.

¹³ "From Oakland to Melbourne, Over 2,000 Occupy Arrests (Map)," Mother Jones, accessed October 21, 2011, <http://motherjones.com/politics/2011/10/occupy-wall-street-protest-map>.

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 this research, in ingraining mesh networking as a communication and exchange tool to foster similar group clusters, there were methods to investigate on how this ad hoc community sprung up with such stability, seemingly overnight.

Matt, one of the original planners who is still actively involved in five or more working groups, cleared these questions up. “When Ad Busters put the call out several months ago to occupy Wall Street on November 17th, a bunch of New Yorkers were curious and decided to get together and actually make it happen. Starting in early August, we met down at Bowling Green and had our first general assembly in New York.”¹⁴ While some organizing was done on an active listserv email mailing list, with up to 25 emails an hour, all final decisions had to take place in person, during general assemblies. “Since then we’ve met on a weekly basis leading up to September 17th, dealing with all sorts of issues of tactics, food, legal...messaging, reaching out...we would typically have about 100 people at each general assembly and they would last for about five hours.”

After the occupation had started, the original planners had grown exhausted and began to disperse. “At this point, I know less people...new people have come and fulfilled the roles” of those not around since the start of the occupation. He says that the working groups are “organize[d] on a horizontal level, [they] have decentralized committees empowered to make certain decisions without consensus.” New directions that affect the entire community must be brought up for vote during general assemblies. This is a parallel to the organic hierarchy observed through the collected survey results – communities

¹⁴ Matt, interview by author, digital recording, Zucotti Park, New York City, September 25, 2011.

organize ritual meetings to vote on mesh network decisions and other social matters.

On the subject of how influential the movement has been outside of New York, he said they've "had to rely on [them]selves" to communicate outwards, primarily through the 24-hour live stream, which consistently has 4000-7000 viewers, because the "mainstream media is not reporting" on the event. They've received support from within activist circles around the world, from Egypt to Spain and Wisconsin, in the form of monetary and food donations. Scattered clusters sharing the same ideals are creating a supply chain to pump life support into the movement, through a merge of virtual and physical exchange economies.

In mesh community research, this resonates with the view of targeted stakeholders and users. The stakeholders that have to be engaged 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 the 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,"¹⁵ became clear. This reinforced the notion that 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

¹⁵ Laura Forlano, interview by author, digital recording, Joe The Art of Coffee, New York City, October 03, 2011.

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?”¹⁶

The Nethood website proposed theoretical artifacts of convergence between virtual to physical, physical to virtual and hybrid interfaces¹⁷. 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 users¹⁸. When neighbors or friends visit and glance at that shelf, conversation arises about similar interests in the author, director,

¹⁶ Ileana Apostol, Panayotis Antoniadis, and Tridib Banerjee, "Places on the Net" (University Pierre and Marie Curie, University of Southern California, 2009), 1-2.

¹⁷ NetHood, accessed October 19, 2011, <http://nethood.eu/studio/index.php/>.

¹⁸ 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>.

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"¹⁹ would build an underlying awareness of other individuals, with varying interests, forming the community as a whole.

The next step in these interfaces would be to create a search feature, where a user in need of an item could easily find it across a physical and digital mapping of the community network. If a cup of milk was needed for a cake recipe, it could be found through a search of nearby neighbors sharing milk, and repayment could come through sharing a slice of cake with the lender. Or, there's opportunity by the lender to borrow a needed item in the future. Either way, these are idealistic examples, that may or may not work when applied to actual situations, but the fundamental neighbor awareness and exchange mechanics are modular.

Keywords: Reciprocal Exchange Economy, Hybrid Community, Ritual, Interdependence, Peer to Peer

Red Hook & Organic Communication/Infrastructure

Conceptual and technical development with the Red Hook Housing Projects to provide a mobile-powered social software, community interface while answering specific research questions in the process.

¹⁹ Laura Forlano, interview by author.

Thesis work has begun with the Red Hook Initiative, a community organization for the 10,000 person Red Hook Housing Projects in the isolated area of Brooklyn. In order to build a community wireless network for their needs, a portion of the thesis research has shifted to technical aspects to ensure Quality of Service and quick implementation of social software on the networked devices. According to the technical lead at Red Hook Initiative, the majority of users in the projects access Internet and other communication through Android smartphones²⁰. This has provided a challenging yet intriguing angle to approach designing community tools for their specific needs – including streaming of their local community radio station.

Although extensive research into technical aspects was conducted over the summer, 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 antenna²¹, 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 Austin²², 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?

²⁰ Anthony Schloss, interview by author, digital recording, Outpost Cafe, Brooklyn, October 25, 2011.

²¹ Free Network Foundation, accessed October 13, 2011, http://www.freenetworkmovement.org/commons/index.php?title=Main_Page.

²² 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.

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 discovery²³. 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 world²⁴.

Jeetu Golani and Erle Pereira, developers in India and Australia, are working 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 computer²⁵. As their work also requires a decentralized means to communicate, a collaboration to investigate zeroconf tools has formed between this thesis and their work.

Several important research questions to consider when conducting tests in the Red Hook network were formed through research into the technical area when combined with conceptual themes. While discussing social correlations in mesh networking with Isaac Wilder from the Free Network Foundation, a mutual question arose – 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?

While attending Contact, a conference on decentralized networks, on October 20th, 2011, task

²³ ZeroConf, accessed October 21, 2011, <http://www.zeroconf.org/>.

²⁴ TeleHash, accessed October 12, 2011, <http://www.telehash.org/about.html>.

²⁵ eBrainPool, accessed September 09, 2011, <http://www.ebrain.in/about-ebrain>.

groups were formed to discuss technical and social issues surrounding mesh network implementation. The question of proximity relations to virtual communications came up again, except a further question was posed: if there was no correlation, then could interactive tools be created to influence and spawn further local communication?

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.²⁶ 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 it’s 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”²⁷ 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

²⁶ Christopher Fabian, “Global Innovation and Local Talent” (lecture, The New School, New York, NY, October 6th, 2011).

²⁷ 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.

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.

An informal experiment was conducted over the course of a few 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,”²⁸ 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.”²⁹

An argument to be made, is that 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.

Keywords: Quality of Service, Android, Omnidirectional Antenna, Multicast, Zeroconf, Distributed Hash Table, Proximity, Hyper Local, Wireless Ubiquity

²⁸ Aram Bartholl, "DeadDrops," accessed June 14, 2011. <http://deaddrops.com/>.

²⁹ 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>.

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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.