Lets Mesh

Research Process & Report 2014

Parsons, School of Design Strategies

Table of Contents

Introduction

Our inquiry into wireless mesh networks comes at a pertinent time when considering the current state of world affairs. The only world that our species has known is at a pivotal crossroads.
The current generation is faced with the volatility, uncertainty, complexity and ambiguity of global powers and systems. Globalized problems play out along side matters of daily struggle and manifest as symptomatic of dysfunctional structures of control and governance. We can no longer depend on the age old industrial paradigms of harder, better, faster, and stronger.

As a species we are beginning this century in dire conditions; we have more global refugees than at the peak of World War 2. The first global warming refugees are already seeking support, shelter, and assistance, their number will rapidly continue to rise as climatic displacement continues at an accelerating rate. The anthropocene is upon us, the human race has acted as a geologic force and transformed the face of the earth in the last century as nations sought and continue to seek expansion, material or economic. The global effects of our push for economic growth are only appearing now as we see ecological catastrophes like the North Atlantic gyre and the acceleration of ocean acidification.

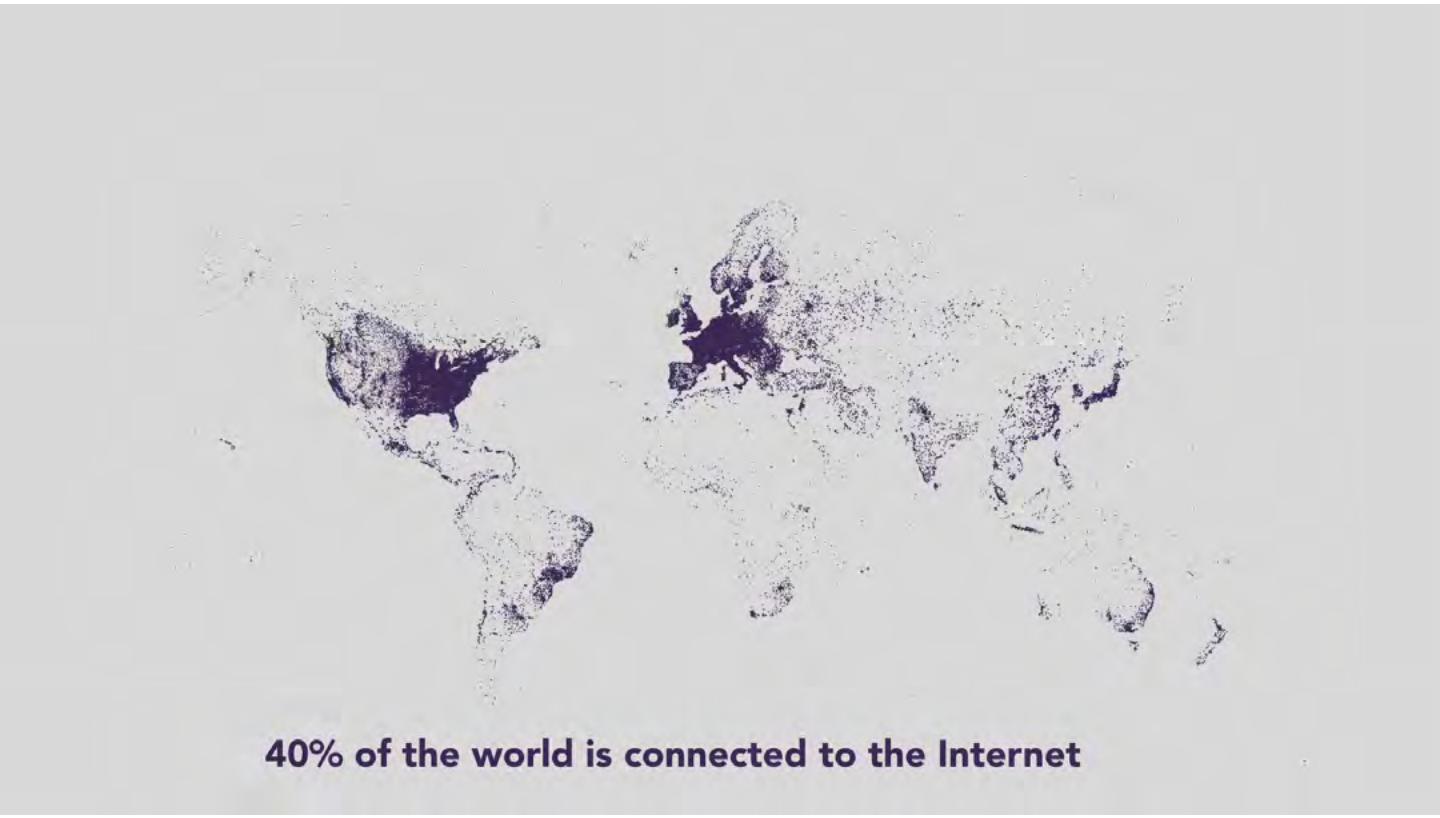
One of the ways we can work to combat the complex problems our world faces today is to foster global understandings and human connections so we may all help discuss, educate, share information about, and combat dilemmas we face, together. By connecting every human being on this planet in order to develop a world community in which a larger portion of humanity is working together towards ensuring our survival as a species there is hope that the Internet may be a key tool in these efforts. As a mode of peer to peer networking, we feel that wireless mesh networks are part of this solution. Beyond this, mesh networks also offer attributes that lend themselves to creating more resilient, secure, autonomous communications networks.

The documentation in this report covers our brief research period in understanding mesh networks in a global and localized context and includes the raw documentation. We synthesized this information to develop our final presentation, a introduction to global network literacy and mesh networks as an alternative network infrastructure. Please feel free to contact us if you have any suggestions on how to strengthen, improve or further assist our research.

Sincerely,
TNSmeshnet

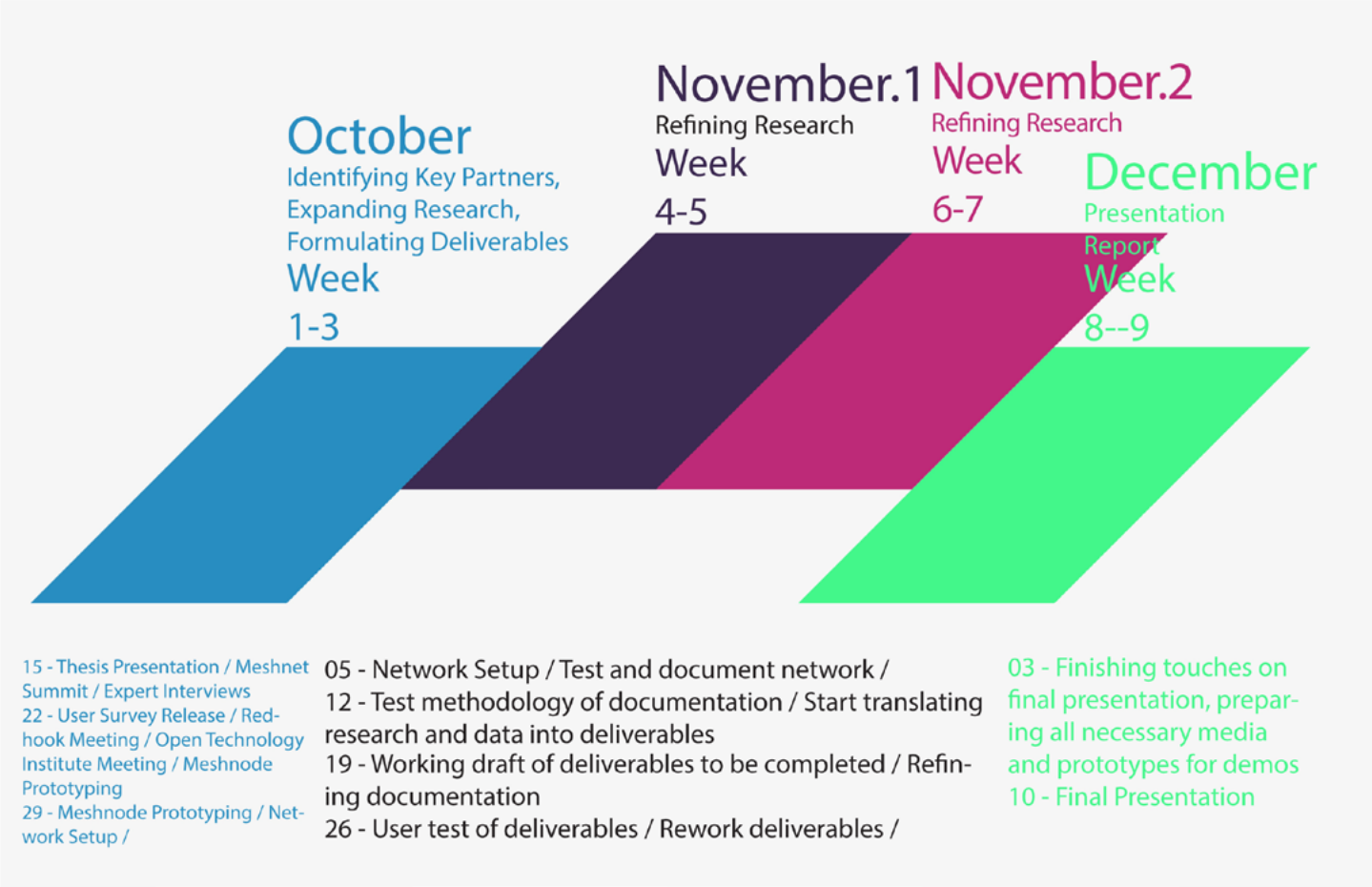
Initial Inquiry

We had no idea where we were going or where we would end up. We just knew that we had to take on a new iniative and mission in our work as designers, creatives and human beings. There is a sentiment shared amongst our group members that we are living in a very special century. We are the first generation born with or alongside the internet, we have been so lucky to reap its benefits of access to knowledge and media. After doing some light research we became aware of our space of privilege in being able to connect to the internet. Up until 2013 there was less than 80% of America online. In the world there are over 60% not connected to the internet. We think that this is a space we can put our time and effort in to change.



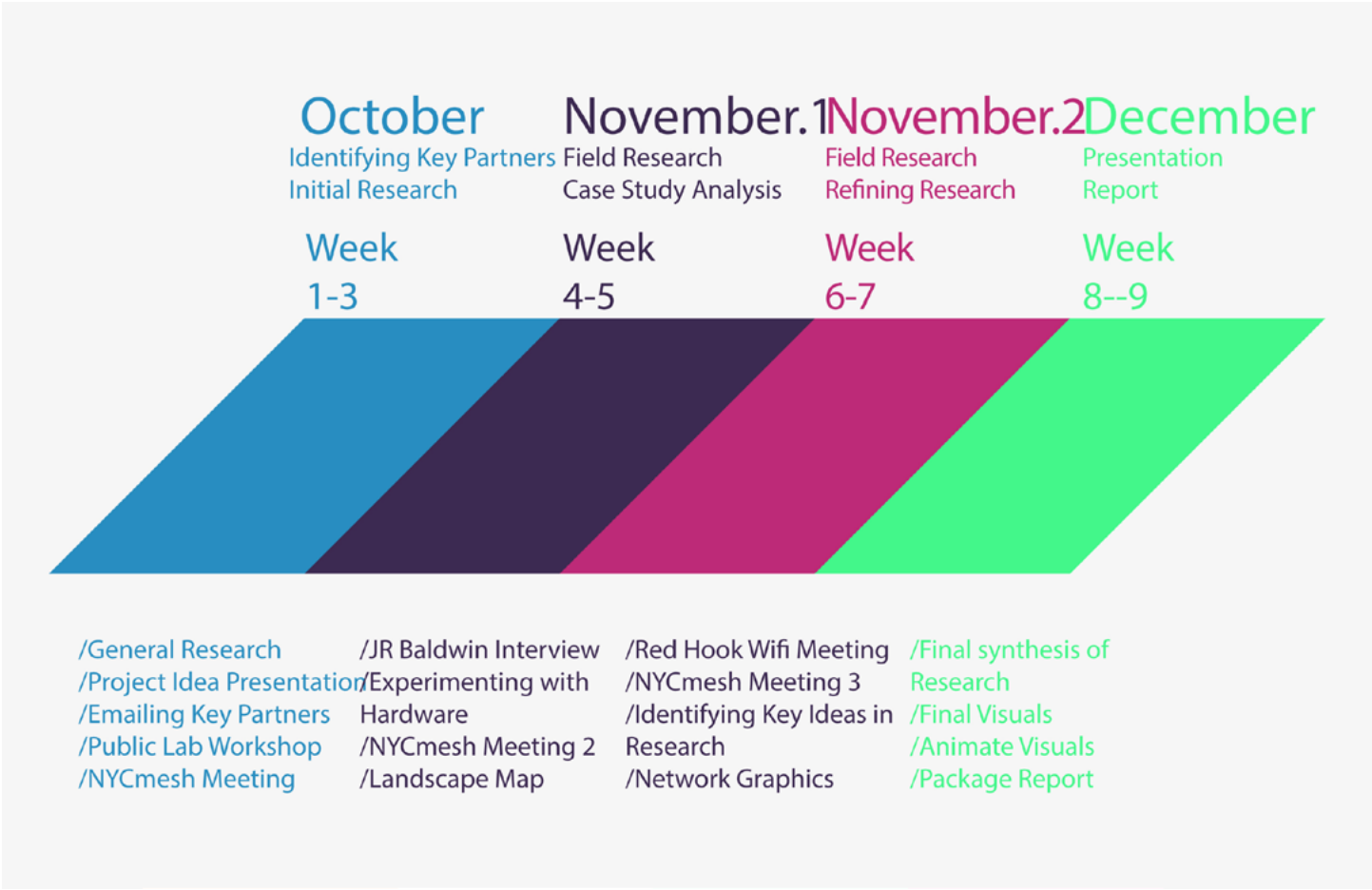
Timeline

Proposed Timeline



Our initial timeline focused on learning how to setup and test a wireless mesh network while also developing a understanding and knowledge about the current state of the physical internet network and infrastructure. October focused on reading wireless mesh-network and wireless case studies and field research, going out and meeting different groups and institutions.November was dedicated to basic network enginerering and telecommunications engineering through the use of a tiny mesh network. December was to synthesize and present whatever information we managed to learn from this short sprint. A hindsight dive into the history, theory and hardware through a DIY guide.

Actual Timeline



We managed to complete our initial goal of producing a presentation and report that we proposed at the start of the project however the way we got to that conclusion differed greatly. We found out very soon that dedicating time to setting up and testing hardware wasn't our forte diverted more time towards meeting the different stakeholders in New York city as well as reading case studies and white papers about mesh networks and internet literacy. The need to understand the history of the actual internet became very important in understanding where mesh networks fit in and the current policy, politics and business surrounding its use.

How Might We?

How might we create safer and more and resilient communities through redundant and self healing communications networks.

8

How might we enable localized dialogue in order that foster new relationships within communities through locally oriented computer networks?

5 Whys?

Why are you doing the project?
C: We want to join the conversation in bridging global the digital divide.
N: We want to expand the popular usage of meshnetworks and alternative infrastructures in general.

Why do you think it is important to bridge the digital divide?
C: We've had access to internet communication and it has made a huge impact in our lives and we think that access to internet communication will make a profound in other peoples lives as well.
N: We think Internet access should be treated as a human right, the free flow of communication and information is necessary for a democratic society.

Why is internet communication important?
C:Internet and communications technologies give access to information for individuals, this access enables them to tap into data resources that then empowers them to take action based on the knowledge or data they acquire.
N:

Why is information important?
C: Information enables individuals to make informed decisions about their life whether that means shifting their farming patterns or educating themselves on solar technology.
N: Critical thinking and decision making requires accurate and varied information sources for it to be productive to the society or individual.

Why is enabling individuals important?
C: Empowering individuals also empowers our society as a whole. The empowerment of individuals through knowledge is the most effective way to have a positive impact on a person/peoples life.
N: an informed public is a public with the most agency.

Grid of 9 & 4

Data, Online Privacy & Surveillance	App: Collect and record personal data: gps, purchases, communications, travel habits, biomectrics, activity, etc. Exploring data ownership and liscensing.	Awareness Proposal/ Hardware: Mesh networks, distributed network infrastructure, encrypted networking	Awareness : commerical oriented data collection and usages. Propose: encrpted OS/ communications platform
Housing & Tactical Urbanism	Mapping & Awareness: Speculative actors and rent change over time.	Info Hub and Resource Kit: Aggregator for tennant rights	Awareness: Visualizing what it means to spend more than 50% of income on housing.
Renewable Energy Technology	Awareness/App : Personal energy use calculator and visualization of what it looks like to generate that amount of energy.	Hardware : How can individuals generate enough energy at home to cover their daily usage	Awarness/Proposal: Smart Grids and distributed renewable infrastructure. Feed-in Traiffs

DOMAIN	METHOD
Network Access - Digital Divide Network Awareness (commercial and physical nature) Internet/ Data Privacy	Education Media (Web and Print) Meshnet Hardware
GOAL	**ROLE**
Helping to bridge the digital divide Community Owned Infrastructure Resilient and alternative communication infrastructure	Artist Designer Engineer Educator Researcher

Going through the various thought exercises of the 5 Whys, Grid of 9 & 4 as well How Might We helped us download and transfer any questions on why we were looking into the space and what sort of questions we should lead our research and analysis of our findings.

Initial Research

We started aquainting ourselves with internet literacy, net neutrality and mesh networks through scraping whatever online news articles. Once we were able to formulate a basic understanding of the space we started to dive into a handful of whitepapers, case studies and reports that specifically addressed specific issues such as user case scenarios, technical specifications and tangential spaces such as existential risk, urban design and object philosophy.

Report Context

This report would not be possible without the hard work of other fellow individuals and groups that have poured countless hours into studying how to connect the rest of world in the same hope of producing a better tomorrow for generations to come. Without these reports and white papers we would not have been able to grasp such a wide array of concepts over the course of several weeks. Their insight has also aided us in shifting our perspective on design to serve society rather than enterprise and profit, which has been paramount in dedicating our minds, bodies and time to this space. We can only hope that more designers will be able to engage in this crucial conversation in connecting our world.

This document stands as a 10 week dive into the space of mesh networks and telecommunications as a whole. We are not engineers or programmers, we enter this space as artists and design strategists with no prior experience in the field. Our quest for understanding and comprehending this space from a new vantage point has produced many insights into the future of mesh networks and wireless network. On first entry we questioned our place but as we delved further we realized there is a crucial need for design strategist as we are able to strengthen and support other aspects of developing a network through forms communication and design strategy (systems and participatory), ethnography and qualitative analysis. The work we we have produce serves as a good entry point for any individual seeking to further their study of mesh networks or as a literacy guide in understanding the basic landscape of mesh networking.

Viral Communications

Viral Communications was written in 2003 at MIT Media which predated MIT's Roofnet project which was founded in 2006 and later became Meraki that was acquired by Cisco in 2012 for $1.2 Billion dollars. The Viral Communications proposal written by David Reed and Andy Lippman elucidated many of the macro technical concepts that involved mesh networks. It informed us of the distinction between "buying communication and doing communication" which informed our distinction between the importance of centralized versus decentralized networks. Which allowed us to start comparing the current internet architecture that was developed from DARPA. It also enabled us to generate an understanding of network redundancy created by wireless mesh networks and the importance of participatory cooperation in developing any sort of decentralized network.

Wireless Networking for the Developing World

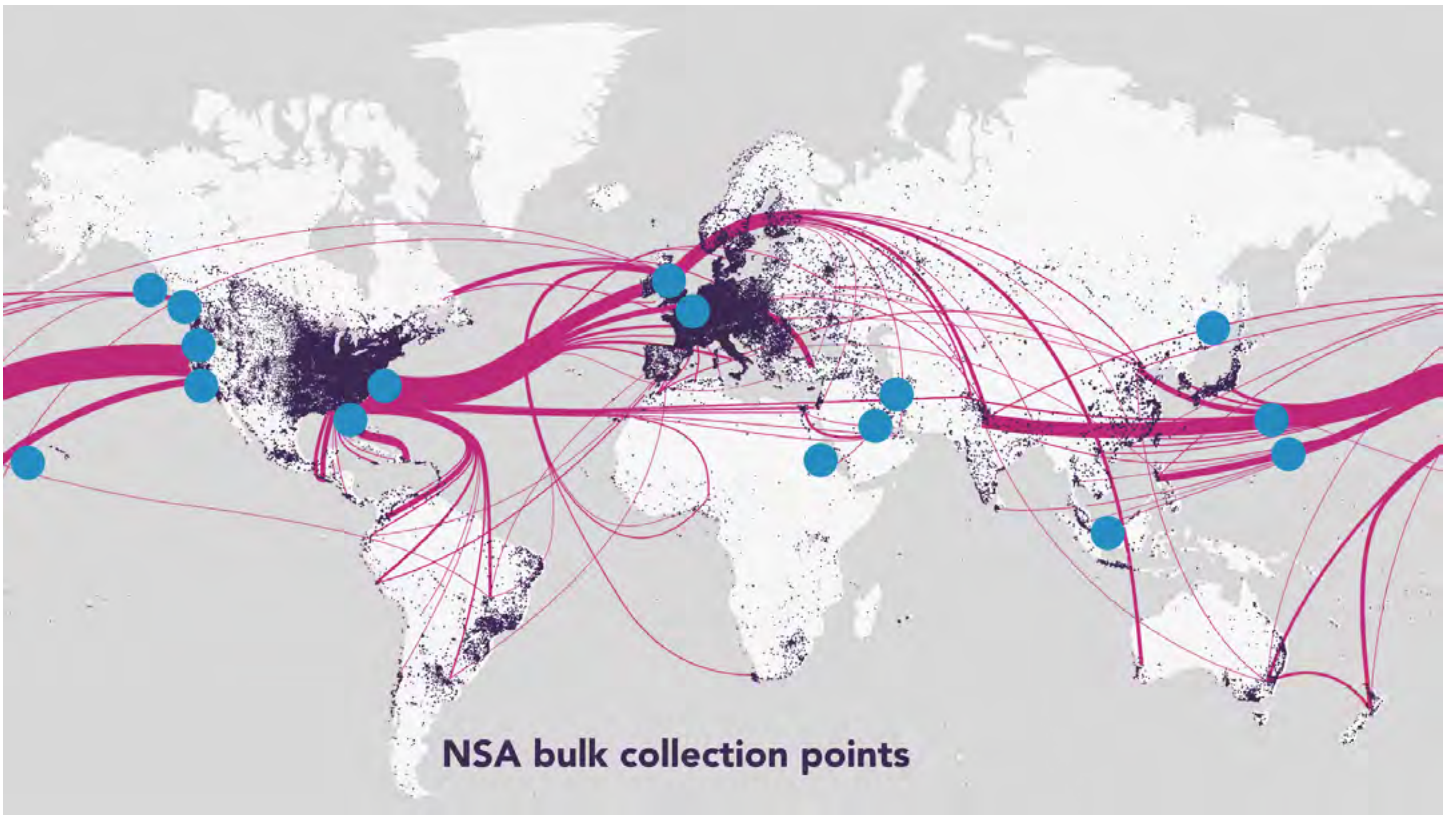
WNDW Guide book made possible the understanding of not only specific technical concepts related to mesh and wireless networking but also gave us insight into wireless and mesh networking case studies around the world. The ability to see into case studies around the world accelerated our understanding and allowed us to learn from the settings and scenarios each of these case studies faced. In particular, community mesh networking in Red Hook Brooklyn, wireless network setup in the University of Ghana and wireless network setup in Garwhal, India. The Red Hook case study gave us leads to interview the people behind the Red Hook mesh which had a profound impact on the course of our research and how we positioned ourselves in the mesh network landscape in New York city.

The Cost of Connectivity

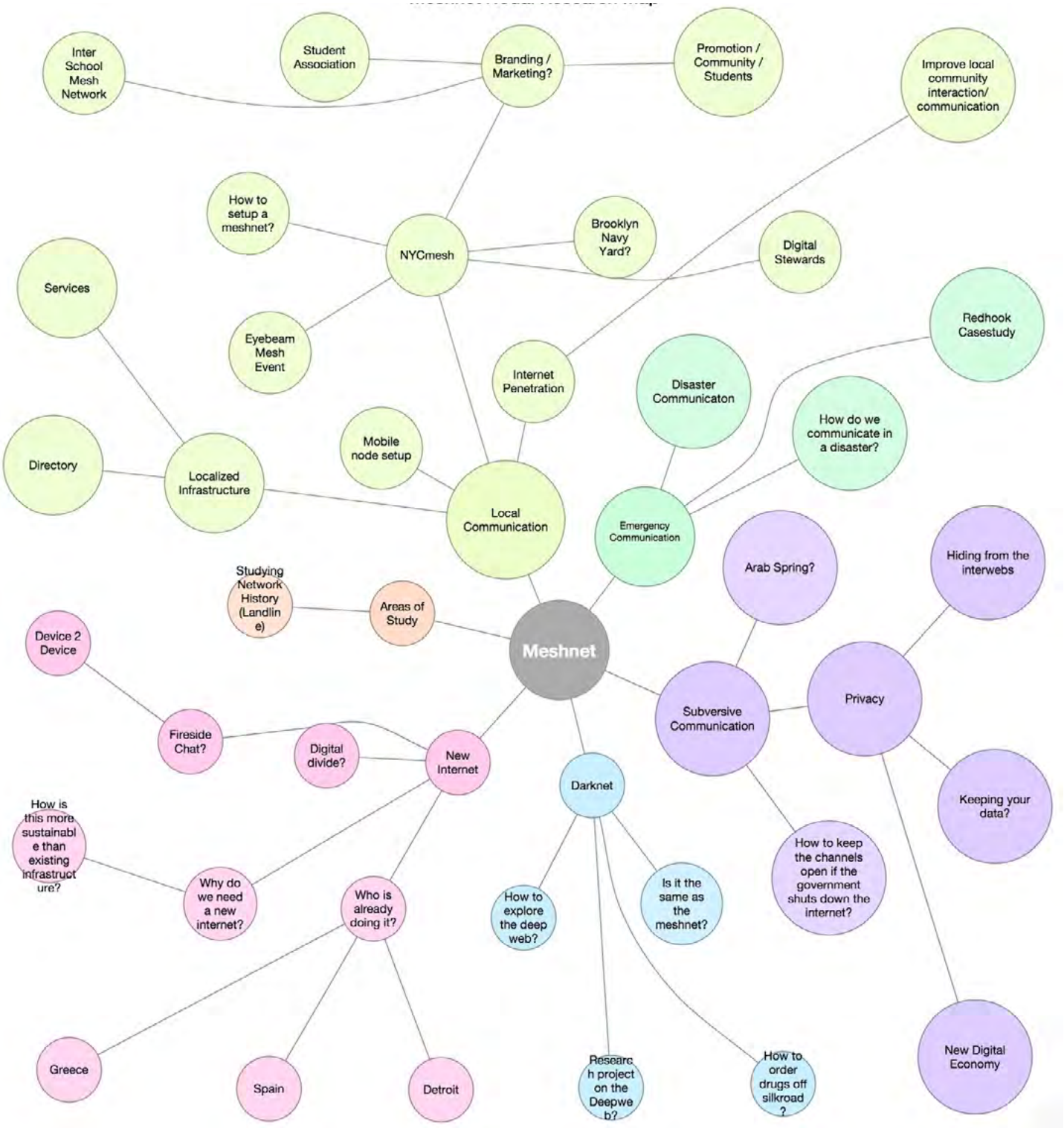
OTI's Cost of Connectivity report helped us analyze and understand the current systemic limitations of not only the infrastructural model of the internet but also economic models related to the internet on a global level. This macro perspective also gave us context for how to frame the scale and importance of delivering Their findings made us aware of how, what and who is perpetuating the digital divide between the connected and unconnected, especially in our home country of America.

Internet as a Human Right

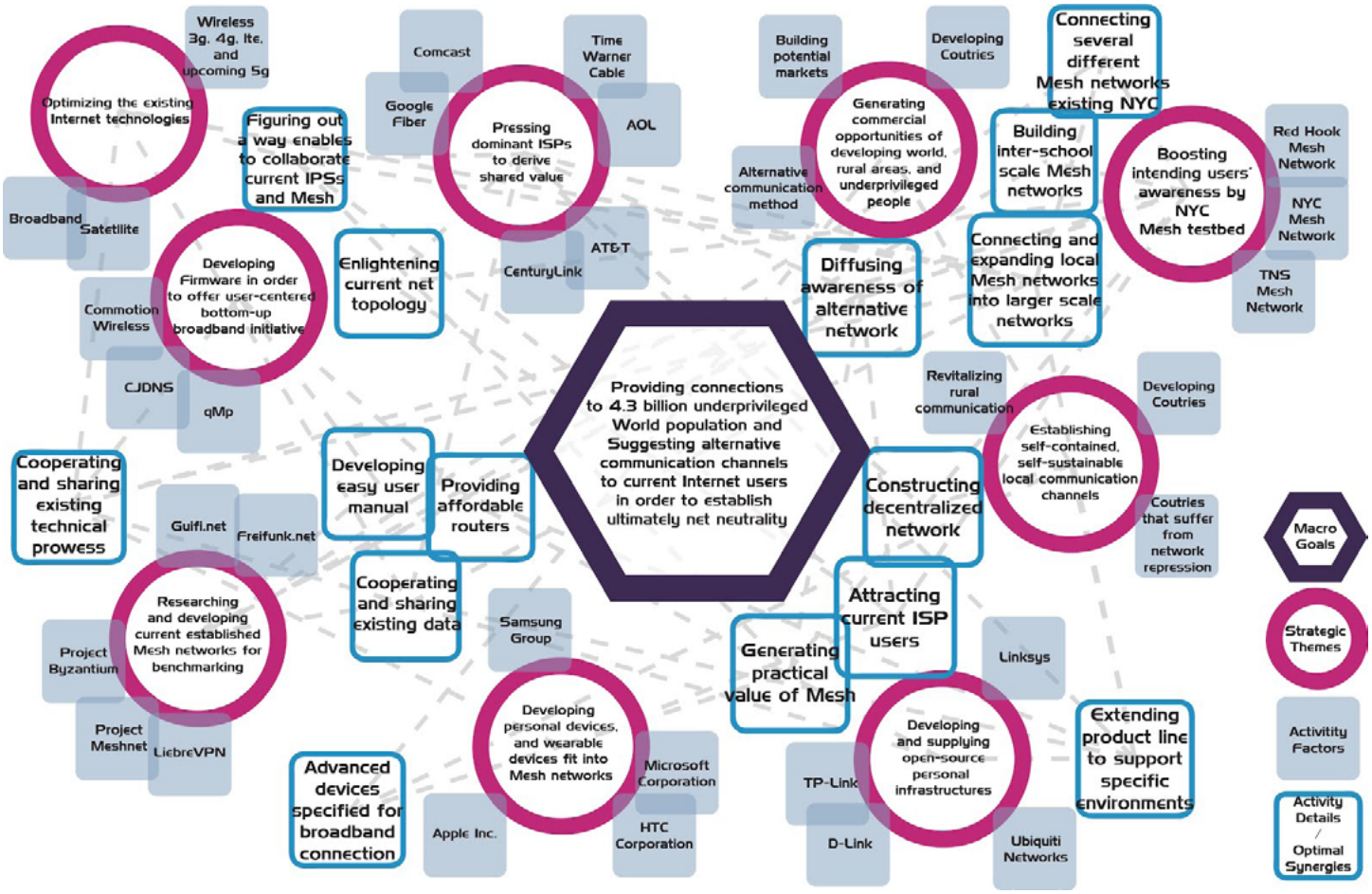
Internet.org white paper on connectivity help us put together a vision for future of connectivity. Combining insights on technological trends between internet and mobile progression paired with emerging technology in the use of solar drones and balloons (Google and Mary Meeker's State of the Internet) enabled us to paint a rather positive future in regards to connecting the remaining 4.3 billion people. It also touched on concepts of more efficient data compression and new ideas for data caching which will illustrated the importance of developing smarter protocols and software layers on top of the hardware. However this white paper also reminded us of the potential dark acceleration into human extinction. An ideal situation where we got the remaining 4.3 billion people connected would be that maybe our world will become a better place, but the other side is that maybe getting these 4.3 billion people online will only accelerate the current problems we face because the remaining 4.3 billion that will be connected will enter the internet through the current neoliberal paradigm we exist in today. "Progress" might kill us or save us depending on what type of progress comes out of global connectivity.



Landscape Node Map



Refined Nodal Map

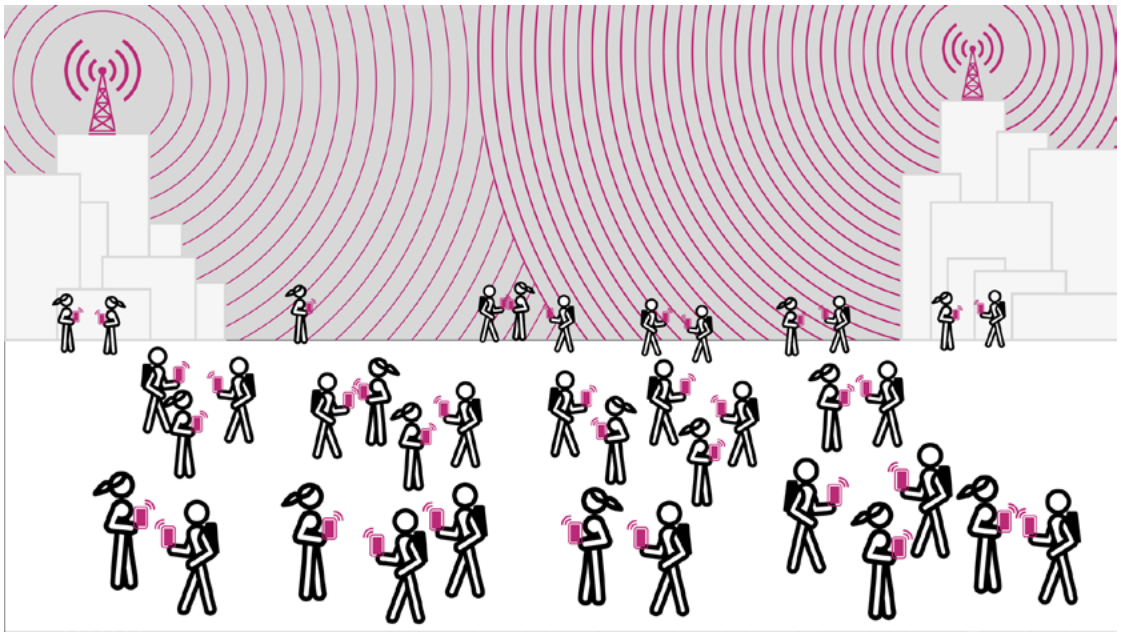


We took the questions, areas of interests and reasons of concern from our thought exercises and then translated them visually using nodal mindmaps. This helped with processing the range of different topics we were interested in as a group and allowed us to further focus our research into specific areas. This then allowed us to zoom into specific ideas and regarding meshnets and zoom into the spaces that compose of these ideas. This process of downloading thoughts onto paper and then visually mapping them enabled us to generate specific paths of inquiry which lead us to discover many of the reports, whitepapers and case studies that informed our project through the course of the semester.

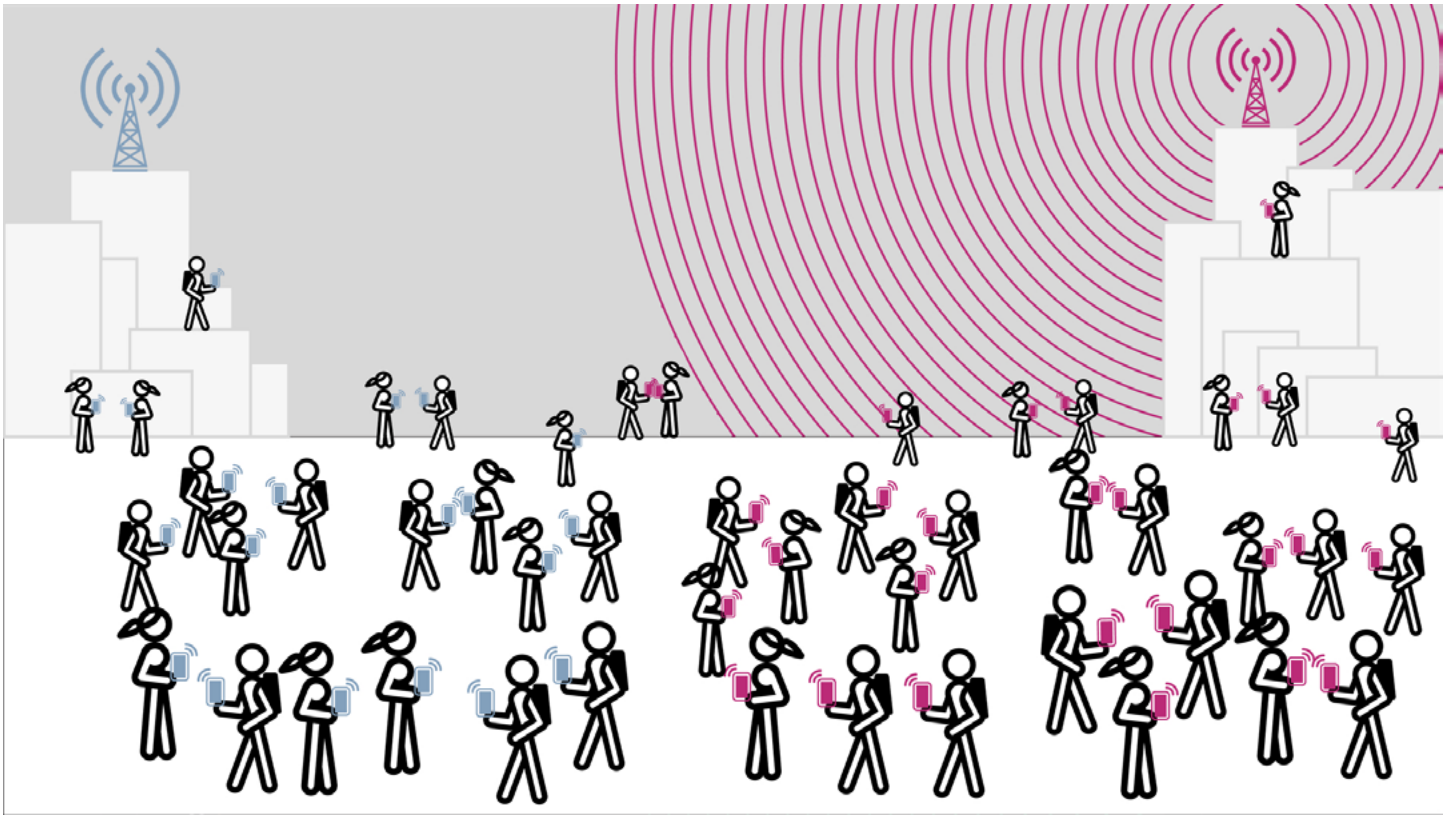
Case Studies

Out of the many case studies we read these were the three most pertinent in developing an understanding of the potential use cases for utilizing a mesh network or a wireless network. We open up with the recent bluetooth mesh network that took place in Hong Kong as a low hanging fruit to bring in a situational understanding of how powerful a meshnet can be in responding to a lack of communication. We then scale upwards to the largest and most succesful wireless mesh network located in Spain to bring in an understanding that this alternative infrastructure can be deployed beyond a local context and into a regional one. We then finish with our examination of the Red Hook case study which drives in the importance of incorporating a resilient infrastructure in a city context not only for combating crisis but for also providing open access to all members of the community.

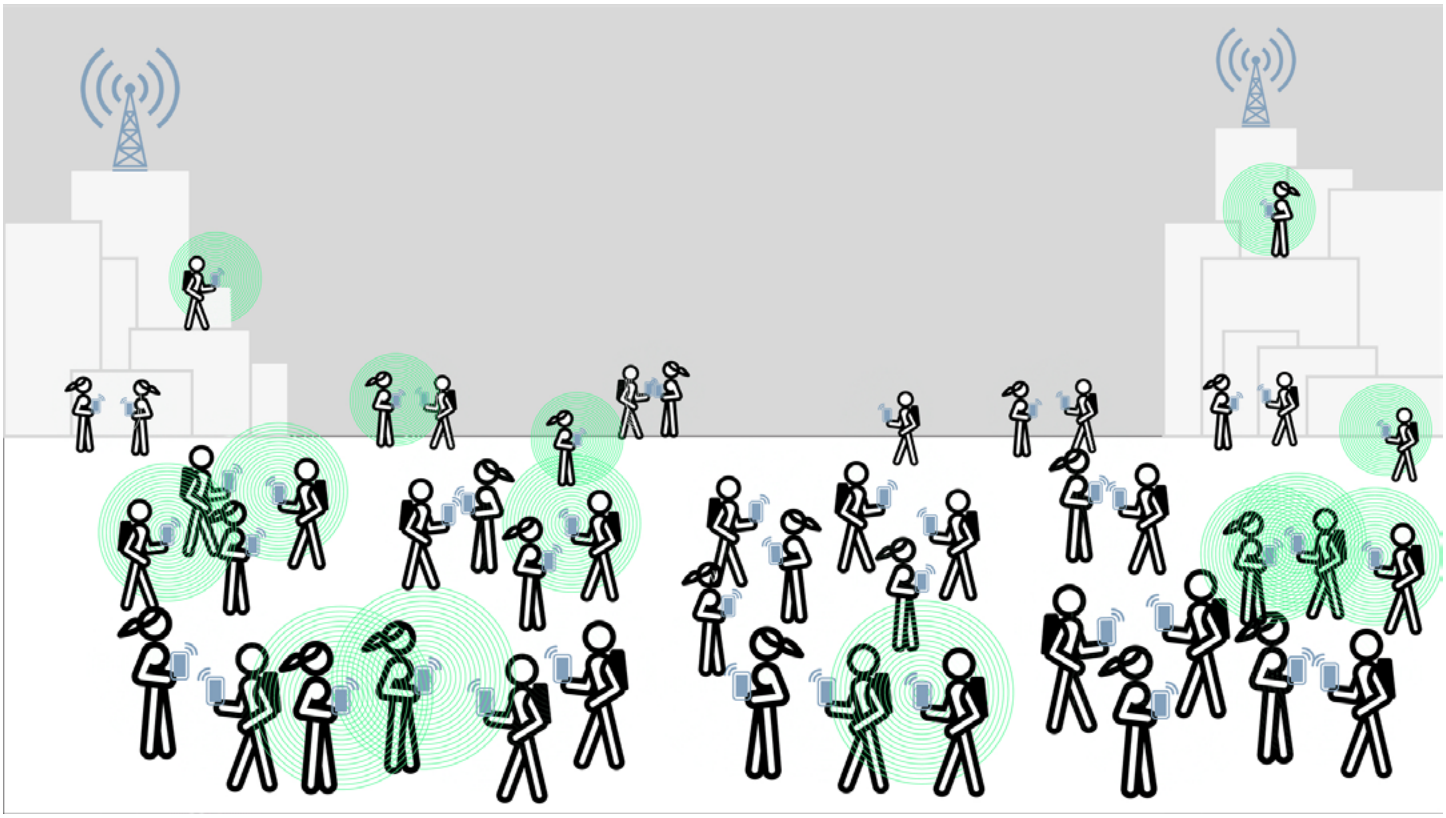
FireChat

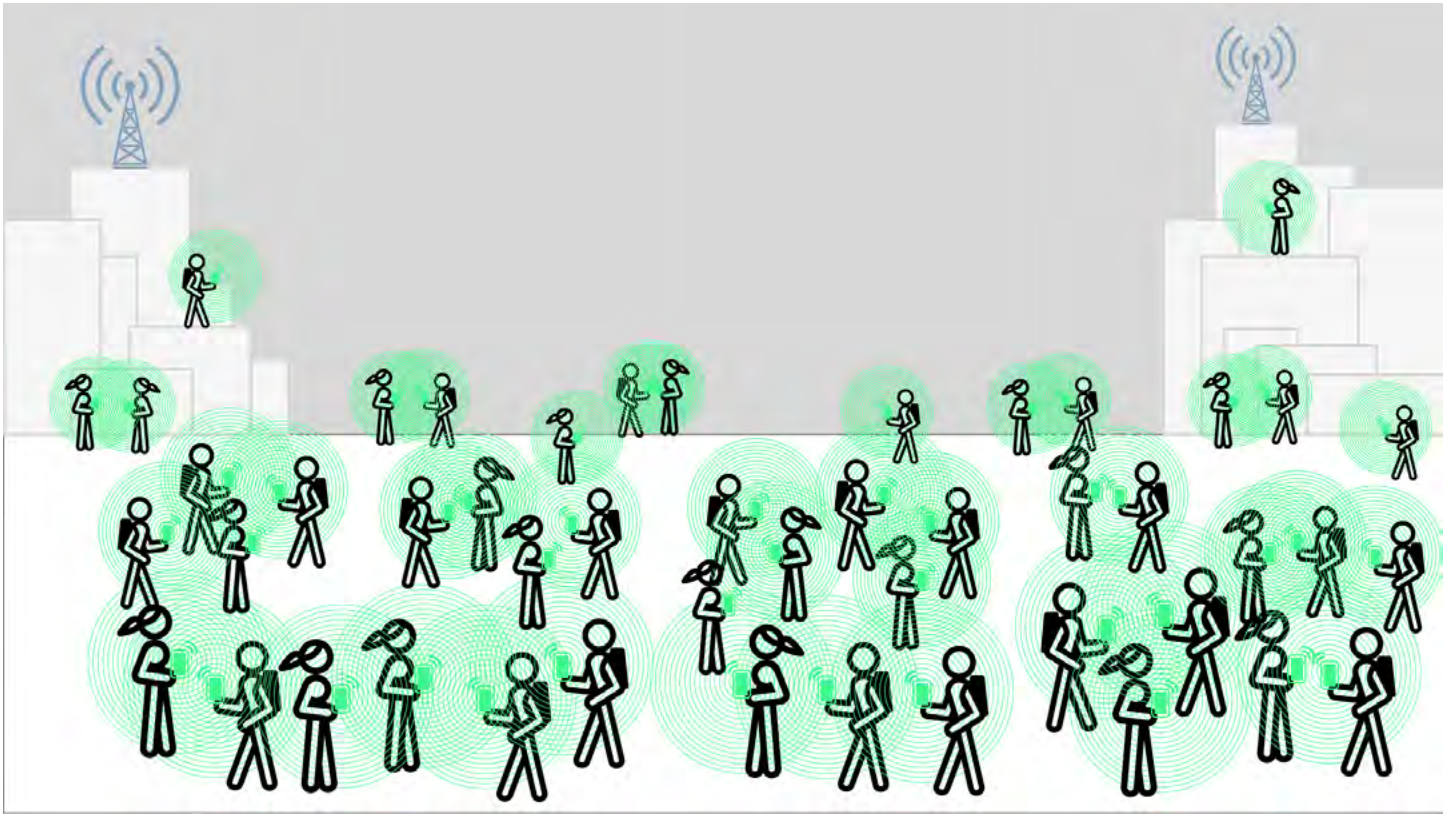


In Hong Kong this last October there were a wave of protests dubbed as the 'Umbrella Revolution'. What resulted was a dense concentration of protesters in an urban setting, a byproduct of this density is high network usage. Furthermore in a political setting there is always the worry that the government may lock down communications.



In response to this the application 'FireChat' had over 500,000 downloads. FireChat allows individuals to setup a device to device network enabling low data communication like instant messaging even when cellular and internet services are down.



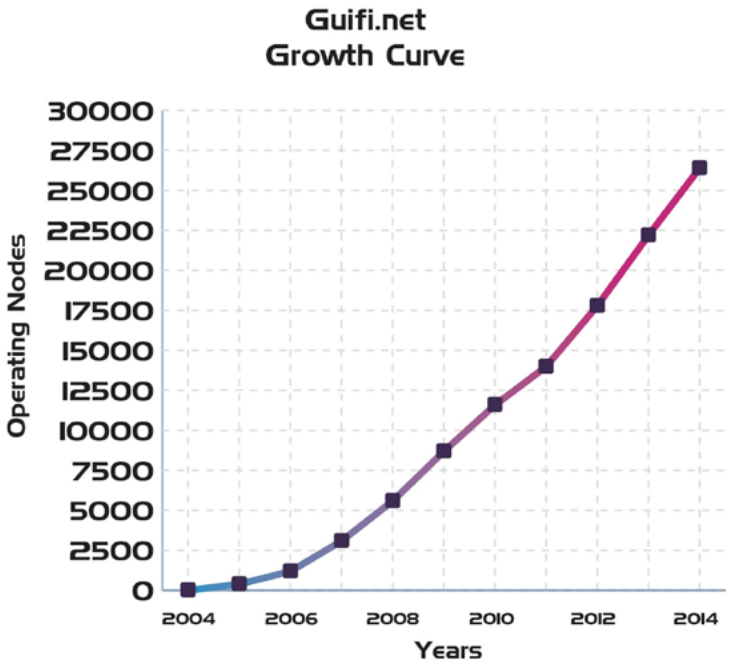


A result of this technology that allows devices to talk to one another was a user generated peer to peer network throuh bluetooth technology. At one point in time there was a 37,000 user (node) network in place that allowed protesters to communicate on issues ranging for medical assistance, clean up, food supplies, and range of other topics. The FireChat case study showcases the power of resilient, self organizing user controlled networks in the face of institutional and environmental threats towards maintaining open communication channels.

GUIFI

Introduction

Amongst several successfully established mesh networks in Europe, Guifi.net is the most successfully scaled case because it has literally established the biggest mesh network community in the world. There are currently 26,512 official working nodes and is growly daily

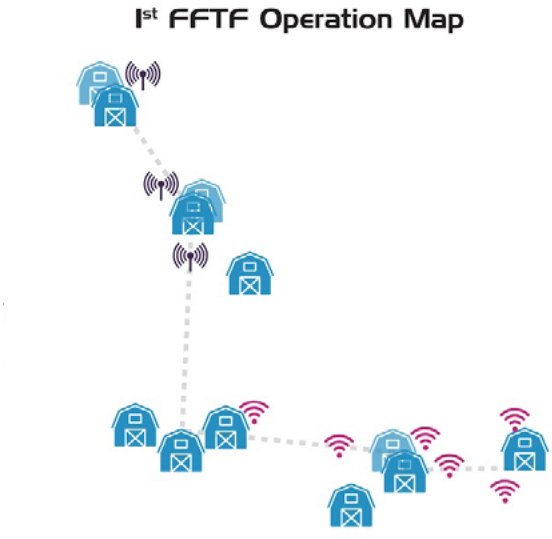


What is GUIFI?

Guifi.net, based on Catalonia, Spain, began to support rural local communities of Catalonia in 2003 and now densely connects Catalonia and Valencia. Although it is low density comparing to numbers of domestic nodes, Guifi.net connects some nodes in Portugal, Slovenia, and Sweden as well. Guifi.net has been supporting community networks since 2003 and leveraging a vast experience deploying wireless broadband led by users. With Guifi.net, local people were able to set up own networks and communicate through the networks without commercial Internet Service Providers.

How Did it Start?

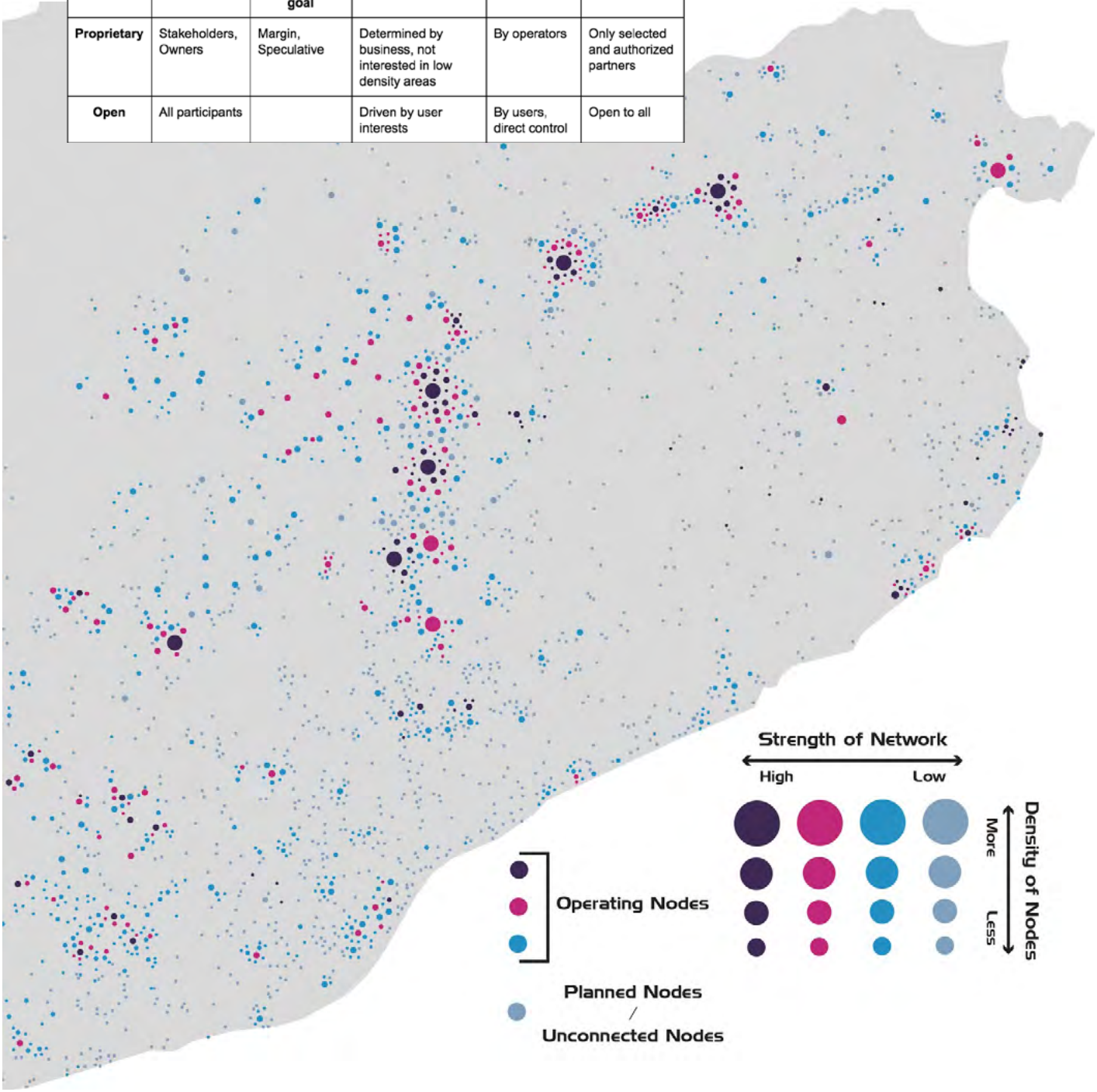
The predominant characteristics of Guifi.net are closely connected to its start-up; the primary purpose of Guifi.net is FFTF, Fiber From The Farms. Because Guifi.net is not only conceived but also led by underprivileged users, Guifi.net takes 100% bottom-up broadband initiative which ensures its core concept, FFTF. In other words, volunteers merely purchase a router then can easily setup a node with qMp, Quick Mesh Project.



Where Did it Come In?

The predominant characteristics of Guifi.net are closely connected to its startup; the primary purpose of Guifi.net is FFTF, Fiber From The Farms. Because Guifi.net is not only conceived but also led by underprivileged users, Guifi.net takes 100% bottom-up broadband initiative which ensures its core concept, FFTF. In other words, volunteers merely purchase a router then can easily setup a node with qMp, Quick Mesh Project.

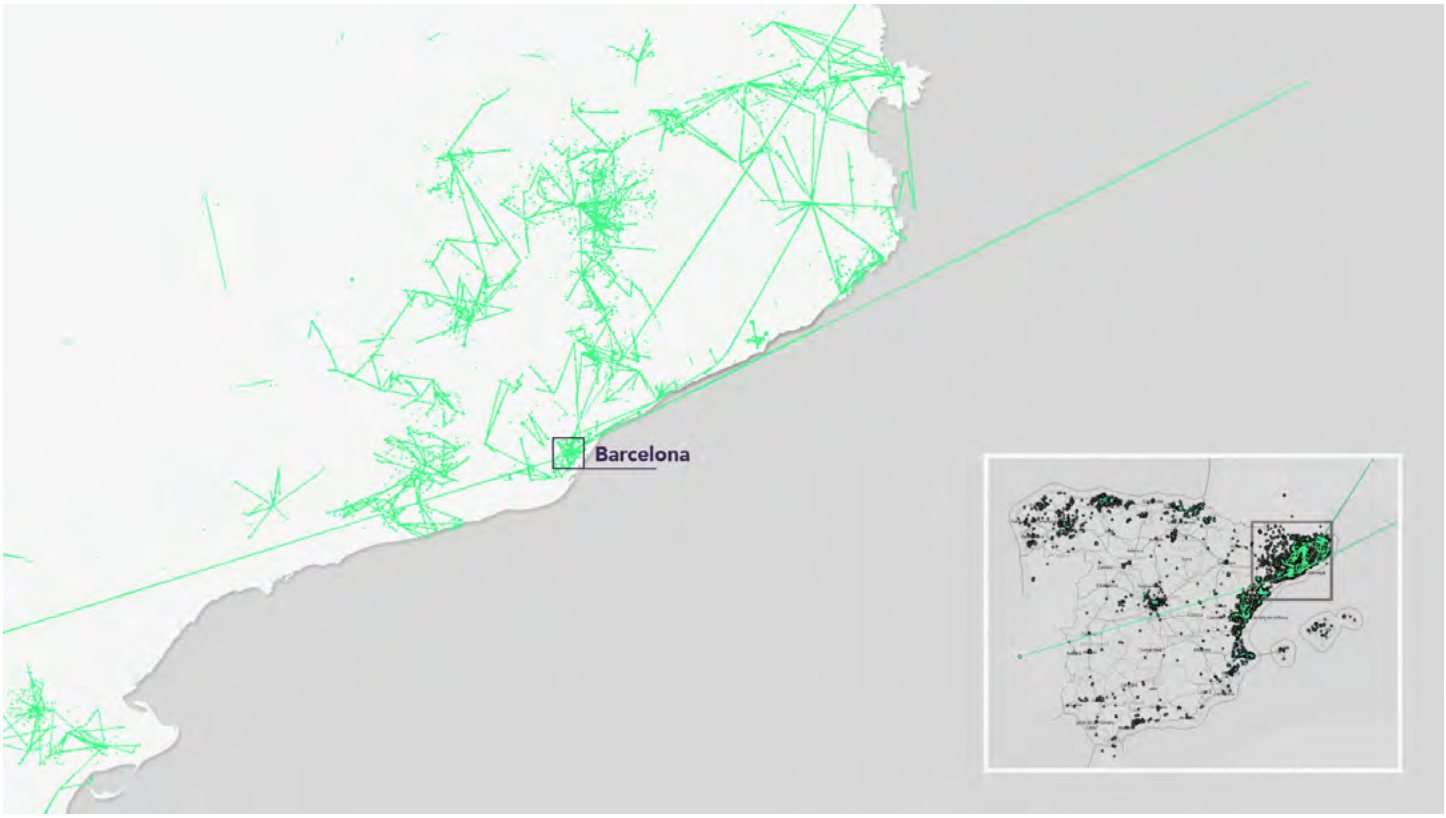
	Investor	Business goal	Coverage	Service level	Competition
Proprietary	Stakeholders, Owners	Margin, Speculative	Determined by business, not interested in low density areas	By operators	Only selected and authorized partners
Open	All participants		Driven by user interests	By users, direct control	Open to all



Social, Environmental and Economic Implications

Guifi.net is not only a self-sufficient mesh network, but also there are possible further steps as a social factor, such as flourishing commercial market, fortifying communities, enabling new stakeholders and self-service operation by developing new business models. In addition, there is room for innovation and cooperation for underprivileged developing countries and net neutrality which is the recent emerging issue in developed countries.

In terms of sustainability, Guifi.net is much harmless in both economic and environmental ways. There are no need of massive infrastructure investment like submarine fiber-optic cables and no need of periodic maintenance of infrastructure. Therefore, it does not have to dig in the group or pour money into submarine fiber-optic cables.



Also Guifi.net has stable performance comparing to a centralized commercial Internet Infrastructure because of is decentrailzed structure which is a fundamental characteristic of mesh networks. In other words, it has a self-organizing and self-healing sustainable structure, and it ensures Guifi.net to act like a giant organism.

Red Hook

Before Hurricane Sandy

The RHI WiFi was first developed in March 2012 by JR Baldwin (Parsons) and Anthony Schloss (RHI) to help provide internet access to the underserved community of Red Hook. This new WiFi allowed the community to have an extra method of communication on top of calling and texting as internet was previously unavailable in the area. Due to Red Hook's isolation from the borough, corporate internet providers did not find helping the existing 5000 public housing and low income areas valuable. RHI WiFi Meshnet was established before the devastation of Hurricane Sandy.

During and After Hurricane Sandy

During Hurricane Sandy in October 2012, Red Hook was one of the most affected areas in New York City due to its low-lying geography and its closeness to the water. A wide area of the community was flooded with building and infrastructures permanently damaged. After the devastation, much of the area's power was lost. However, the RHI building managed to stay in power, thus allowing the RHI WiFi to continue providing the community with a source of post disaster communication. Instantly, users found immediate relief by being able to use RHI WiFi to communicate to their friends and family within the community. The RHI WiFi had become an obvious communication alternative. FEMA came and quickly establish immediate communication via satellite internet for emergency response workers. After 30 days post Hurricane Sandy and FEMA, Red Hook was still without power and a source of internet communication. Their usual telecom providers never returned to restore service in the areas that previously had connection. Brooklyn Fiber, an independent internet provider, decided to provide RHI with internet connection.

Post Sandy

With the RHI established prior to Hurricane Sandy, the disaster helped accelerate the adoption of meshnets in Red Hook. RHI Wifi has created an engaging platform that has helped communication between residents and boost local businesses.

Sustainability

The RHI is currently sustained through a "Digital Steward" program developed by OTI and Allied Media Projects. The rigorous one year fellowship program educates and trains young adults to install, maintain, and repair routers and promote adoption of the RHI WiFi network through a rigorous. The goal of the program is to promote career development and increase technical capacity within Redhook. Stewards spend 3 months in technical training (hardware, software, networking), 3 months in media production (video making, graphic design, web design, social media), 3 months in community projects and sharpening their skills, and their last 3 months with an internship at a tech company. At the end of the course, students are able to have a sufficient networking knowledge to continue helping the RHI or venture off to find jobs in the same field. Past stewards have held internships at Brooklyn Fiber, Sky Packets, Verizon Wireless, and more.

There are currently 28 nodes that help facilitate the RHI WiFi meshnet. The network runs on OTI's Commotion Wireless firmware which is a free and open source communication tool that allows a meshnet to be created. It is highly sustainable and resilient to disasters and outages since it does not need connection to the existing Internet.

Future & Progress

The future goals for RHI Wifi includes expanding into the New York City Housing Authority (NYCHA), expanding digital steward program, increase resiliency and stability, and increase community investment and involvement.

However, according to an interview with Anthony Schloss, RHI and OTI have yet to establish a viable metric system to measure their progress and success for the RHI WiFi. OTI is still assisting the development of RHI along with their support of developing new applications.

Stemming from a communication angle, RHI WiFi has become a humanitarian use to help better connect the Red Hook community. It has allowed young adults to become educated. It has also helped with job creation in and around the community.

Field Research

The field research conducted through the last few weeks focuses more on mapping out the qualitative aspects of mesh networks in relation to variety of use case scenarios around the world. We were able to identify several key partners working in the mesh space in New York as well as potential institutions that could be a part and support a node infrastructure in New York city. We also explored tangential areas such as disaster mapping as well as technical dives to help understand how to better create a front end use case for the network

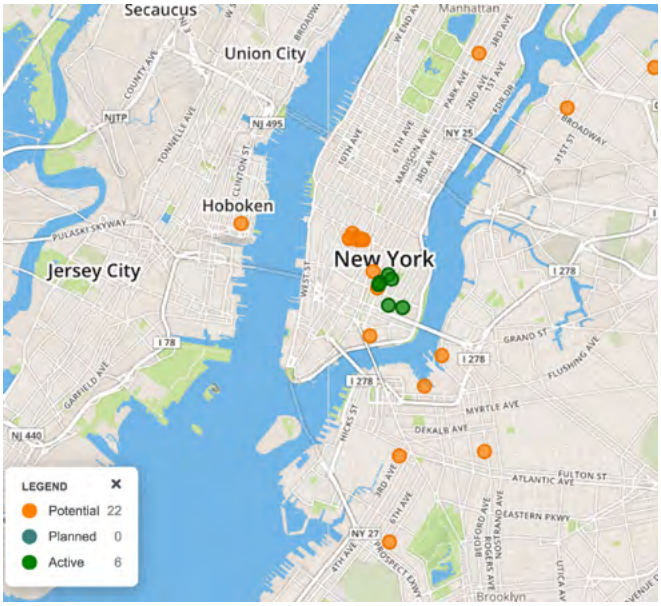
NYCmesh

Our time spent with NYCmesh took place over the course of several weeks. We attended several meetings that helped orientate us to the space of mesh networks on a theoretical level as wellas on a technical level. Participating with the group we we were also able to identify our role in the mesh networking and general wireless telecommunications space. The importance of designers, advocates, strategists and ethnographers was and is sorely lacking in the group. This is a huge hurdle because the inherent design of a wireless or mesh network requires that people connect to each other physically before they do digitally. NYCmesh was a key resource in helping us further our understanding of mesh networks in general.

Meeting 1: Introduction to the internet and mesh networks

Meeting 2: Installing meshnet protocols into routers

Meeting 3: Talking about the potential for growing and expanding NYCmesh in the Lower East Side



Public Lab

October 19, 2014, we attended a DIY Geo-mapping workshop held at ApexArt hosted by Elizabeth Barry, co-founder and director of urban environment of Public Lab and part-time professor at Parsons SDS. We thought this would be useful complementary research because at our early stages of research, we were angling mainly towards disaster relief and resilience. We believed that geo-mapping with weather balloons may allow provide quick terrain surveys post disaster to decrease information delay.

Image above: Fastening the camera into the weather/stabilizer cradle, then setting the camera to take a photo every 7 seconds.

Image top right: Posing under the airborne DIY mapping balloon. Based on the amount of memory you have stored on your camera's card you can walk around continously snap photograph of the land from above.

Image right: Publiclab.org DIY Balloon Mapping Kit. You would then upload your images online to map knitter, an open source online mapping platform.

J.R. Baldwin


hackers
network
people
need
research
design
CJDNS
main
something
started
Hong
DT
problems
based
Germany
Commotion
NYC
social
distance
space
adoption
going
community
Whats
civic
download
point
streets
around
Digital
one
networks
terms
most
connect
duty
play
real
benefits
same
mostly
Hook
part
now
routing
OSLR
factors
learn
school
see
side
even
failed
important
tried
make
create
maintain
think
tool
used
angle
barrier
reality
right
only
Batman
low
being
figure
brought
heavily
situations
hard
Open
everyone
technology
time
theres
having
Theyre
come
after
Red
question
group
changed
splash
things
page
stewards
basically
technical
internet
mesh
meshnet
happening
highways
system
stuff

Interview Summary

While gathering preliminary research at a DIY Drone Geo-Mapping workshop, we met Parsons SDS professor, Professor Liz Barry, who informed us about a former Parsons MFA Design & Technology student, JR Baldwin. JR Baldwin is a designer initially collaborated with RHI and Anthony Schloss to create the "Red Hook Initiative Wifi". Eventually through feedback from RHI workshops, Tidepools was conceptualized through human-centered design. It has become the main open-sourced local platform that allow connected users to communicate, place mark, and organize events in Red Hook. Tidepool has since developed a mobile application featuring new features such as real time bus tracking, stop & frisk compliant survey, and RHI Radio. There are still many features that are currently in development.

From attending several weeks of NYC Mesh's meetings at Utopia School in Long Island City, Queens, the use of the CJDNS protocol over others was really stressed. However, through interview with JR, he has found many complications with adoption with the CJDNS protocol. From his discoveries, he had found OTI's CommotionWireless firmware to be the easily adoptable (plug and play).

From attending several weeks of NYC Mesh's meetings at Utopia School in Long Island City, Queens, the use of the CJDNS protocol over others was really stressed. However, through interview with JR, he has found many complications with adoption with the CJDNS protocol. From his discoveries, he had found OTI's CommotionWireless firmware to be the easily adoptable (plug and play).

Red Hook Wifi

Interview Summary

The Red Hook initiative is a great case study and connection for the establishment of the TNS Mesh. They are a great resource for learning more about the network, especially all the cost and management of the meshnet, The implementation of the mesh net within red hook is also a great learning point of the way we can implement it in the New School. Their greatest current use cases: social connections, community center with internet access, helping the youth community, digital literacy, redhook hub (online information sharing, content sharing), content created by technologist and artists (creating that bridge). These are all systematic uses for the way we develop the students in the new school.

Another interesting point is the way they got funding, finding non-profit organizations to apply for grants seems like the way to go. Their goal of 50 000 dollars will have an fiscal sponsor overhead cost of 15% but it is a clear margin to where the new school would be targeting when deployed at the university. Looking for non profit organization in relation to the lower east side would be the way to go suggested by the red hook initiative as they seem like the closest neighboring, partnering with will not only help us but help to start links between the other meshes in NYC.

Physical Node Locations

NYCHA housing near Red Hook Iniative

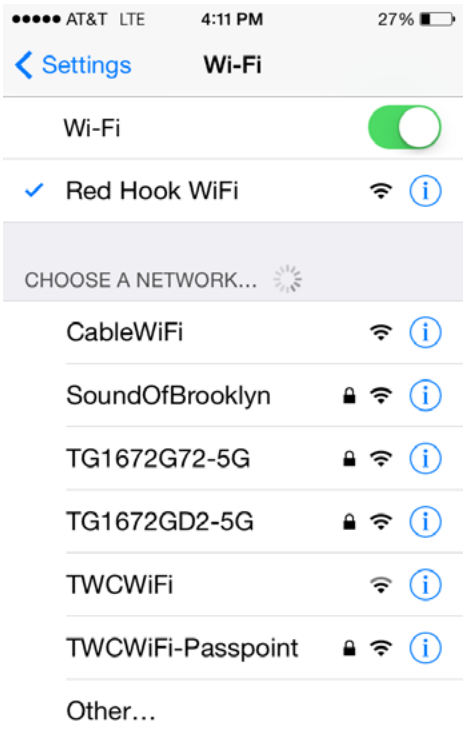
RHI's roof has some key meshnet nodes

A Red Hook Wifi Wireless Node on a Office

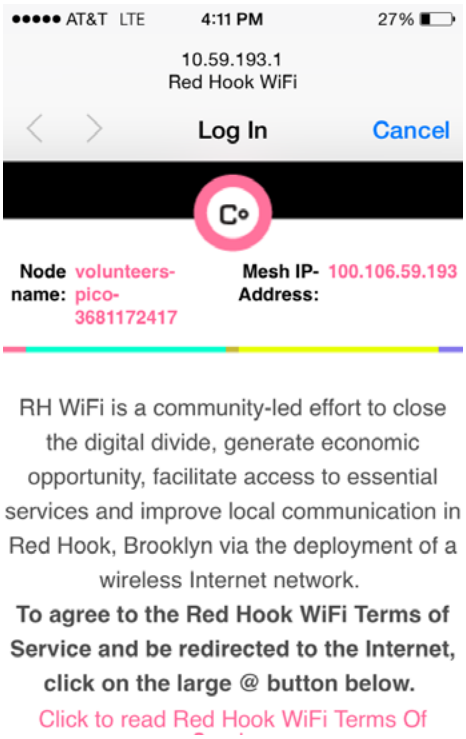
A Red Hook Wifi Wireless Node on a Office

Rob, one of the digital stewards showing us the different parts in setting up the node.

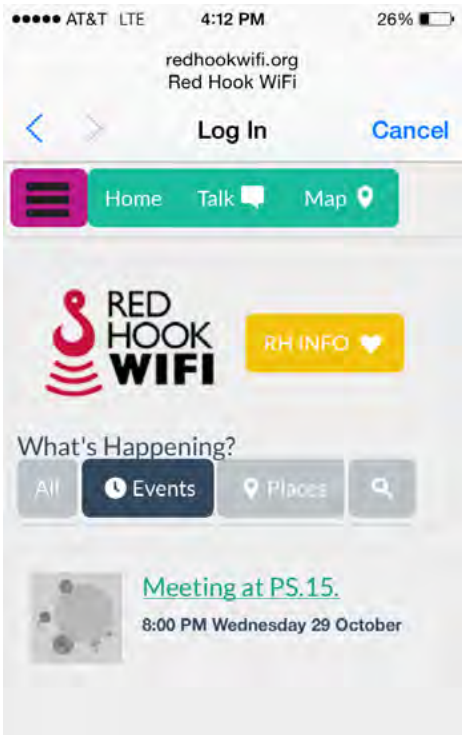
Red Hook Wifi Login



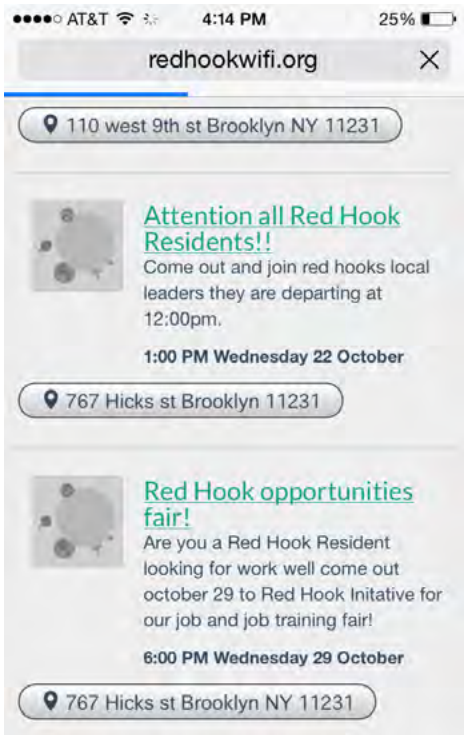
Red Hook has free public wifi



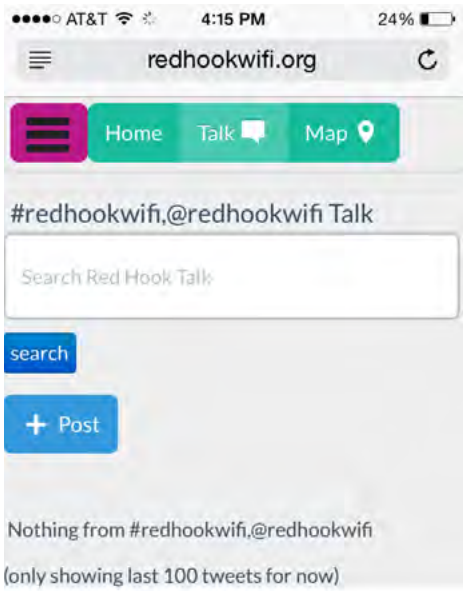
Captive portal info page



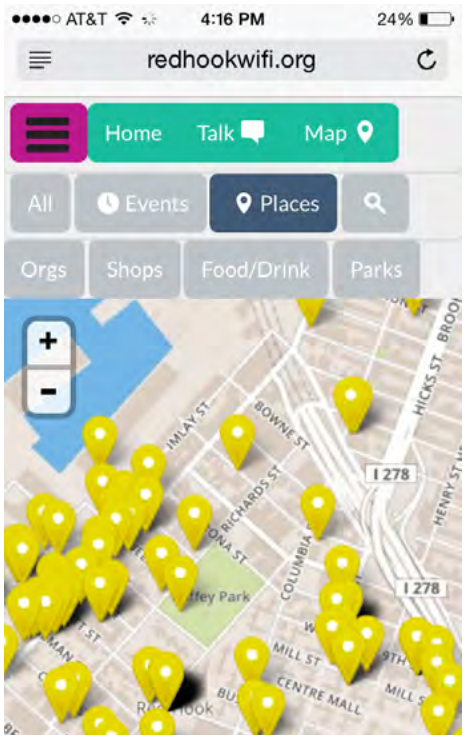
Red Hook Wifi home page



Local events and listings



Chat, message board, buy and sell page



User generated mapping

34 Synthesis

Meshnets & The Physical Internet

For 40% of the world the internet is an invaluable resource. But it could be doing a better job for more people, 60% is still unconnected. There are long cables and wires that wrapped around the globe like ribbons, they are the physical internet. This trans-national network of wires and cables is the infrastructure that makes instant global communication possible. It is a corporate, privately owned network of wires. It is because of this global structure that an email sent to someone one mile away can travel hundreds or thousands of miles before it is received.

So why don't we keep local communications local? Because this global routing, and the physical backbone actually help make mass state surveillance possible: when a small number of cables carries the majority of the internet's traffic it makes it very easy to collect it all. For example, there are 22 known US bulk data collection points of major internet cables around the world. At these locations all traffic that runs across the cables is copied, one copy continues to it's destination, the other goes to the data centers of intelligence agencies. On top of security concerns, the private ownership of this physical infrastructure creates a disparity in connection costs and access speeds around the world. The fastest connection available in NYC is half the speed and ten times the price of the fastest connection offered in Seoul, a city with 1 million more residents than NY. That $30 connection in Seoul is 100 times faster than the average US connection. In korea it would take 7 seconds to download a movie that would take 11 minutes to download in the US.

The prices paid by customers is set by "last-mile providers", this would be your Internet Service Provider. The most common people connect to the global backbone of the internet is through underground cables owned by an Internet Service Provider, this is called broadband. A growing number of users connect wirelessly to the backbone through cellphones, using mobile broadband – this includes 3G, 4G or LTE. In remote hard to reach regions with little to no infrastructure there are satellite internet connections, but these are expensive, slow, and unreliable.

The problem right now is that users rely on internet through a single point or mode of connection and have no other way to connect if their internet goes down due to heavy traffic or natural disaster – not even to their neighbors. After a disaster it can take weeks to reconnect everybody in these types of centralized networks and that is too long. As we look to connect the next 60% of the world, this should be a major topic of concern.

There is some movement on the part of some companies out of Silicon Valley to accelerate global internet access. Right now Space X, a private space venture, is trying to increase the effectiveness of satellite connections to help increase internet access worldwide, they are planning to launch 700 small satellites to do just that. Facebook and Google are also invested in plans to connect the world from the

sky. Facebook is looking at solar powered drones and Google is starting to launch low atmospheric balloons. Even with all these ambitious new projects to connect the world, there is still another problem: there are all all these ways to connect to a global network, and yet neighbors still aren't even directly connected to each other.

But there is another option: it's a type of wireless networking already in use around the world. It's called Wireless Mesh Networking, or Meshnets for short. Mesh networking is not new, it's a fully developed technology, thanks to the likes of MIT, Cisco, and many more, that is used primarily for enterprise network solutions. For example, a mesh could be deployed in a large office building or hotel to create an evenly distributed wi-fi network. While mesh networks have been heavily developed for use in enterprise type applications, they been left almost entirely untouched for other uses. One application that has not met it's true potential is serving community networking needs. Mesh networks could serve as localized internets while also acting as resilient community owned infrastructure for connecting to the global internet.

Mesh nets use radio nodes and wifi hotspots to spread a wireless self forming and self-healing distributed network over a neighborhood or city. Anyone connecting to mesh becomes part of the infrastructure. A node is any device that is programmable and can send and receive radio signals. This means smartphones, computers, routers and radio antennas. Mesh Networking can make networks more local, secure and resilient. The de-centralized infrastructure in a mesh is treated as a commons, owned by all who participate and use the network.

They can be used to share your internet connection with your neighbors or to create a local network of platforms and applications for just your community. This network is peer to peer, neighbor to neighbor, friend to friend. If one node in the network goes down, your message will be re-routed through the closest active node so it can continue on to the recipient. This is what a self healing resilient network is capable of. No matter how you use them, once a mesh infrastructure is in place, the community has a resilient communication backbone that can stay in use during times of disaster.

In Red Hook, NY a community organization sought to use wireless networks to foster local interaction and increase internet access. The Red Hook Mesh was born in the fall of 2011. After setting up an initial mesh backbone and developing several apps to use on it, like a tool to document stop and frisk encounters, the Red Hook network became a critical component in the relief efforts following the devastation wreaked by Hurricane Sandy. The majority of the neighborhood was without power and other utilities from the storm. But when FEMA saw that the network was already in place they simply pointed a satellite with an internet connection down at the mesh. This made internet available across the network.

The mesh enabled affected residents to communicate immediately after the disaster in order find information about damage, contact loved ones and to seek relief aid. It provided a means of notifying residences, first responders and local organizers as to where to find resources and help. After the storm the need for establishing a resilient communication network became apparent to the community and the wireless mesh was significantly expanded and is delivering internet connectivity to more and more people everyday.

Future Scenarios

Near Future Scenarios of a Resilient Infrastructure Lower East Side, Manhattan, New York, New York, United States 2020 C.E.

A category three hurricane by the name of Arlene just struck the eastern seaboard. With winds of up to 163 miles per an hour the total damage caused by this super storm is nearly quadruple of the last major storm to hit the region, Hurricane Sandy. With death tolls surging in the thousands, millions displaced, and hundreds of billions in economic damage America is at a loss for words.

A state of national emergency has been declared, two carrier groups from the Norfolk Naval base in West Virginia have been recalled from their missions in the Arabian Gulf to mitigate the crisis as much as possible. The national guard has also been summoned. Global humanitarian responses from allies and neutrals alike are also underway to help America with its worst natural disaster in its history as a nation. A grim indicator of the rapidly changing weather conditions and patterns our planet is now rife with.

Several hours after the storm hit Lower East Side's disaster neighborhood volunteer response units had started to assemble at pre determined staging locations. Washington Square Park, Tompkins Square Park, Sara D Roosevelt Park, and Seward Park. Resource mobilization started to proceed with urgency, among the resources being mobilized was a system check on the nycMESH network. In developing a rapid and agile response in establishing communications, collecting data in the face of natural disaster the implementation of wireless, decentralized network infrastructure was one of the main disaster resilience priorities after the Hurricane Sandy in 2011. The vulnerabilities in centralized infrastructure systems had been made more aware with their failure in to get back online or self heal in the rebuilding process post disaster when compared to decentralized infrastructure systems. A huge push in decentralized communication and energy took place in many disaster prone regions around the world as a strategic defense in the of natural disasters.

Mesh network activation was confirmed across radio frequencies. The backbone infrastructure of node stations came to life and neighborhood response units were now communicating on voice and video channels. Decentralized data mapping start to take place as recon teams started to survey damaged areas on foot and recorded data on the Global Disaster Response Institute Mapping application. In little than 2 hours the main response centers already had a rough picture of the most affected areas of the Lower East Side through rich data mapping via smart phones and the wireless mesh network. Several weather

balloon mapping units were launched several hundred feet up into the air to perform a photographic survey of the surrounding area. Balloons were each attached with cameras that were able to wireless stream photographs directly to mappers on the ground generating a real time live mapping feed of the area. At the same time two satellite uplink stations were activated in Washington Square Park and Seward Park giving an internet uplink to the area, the neighborhood disaster response team was now relaying real time data to the Global Disaster Response Institute that uses cloud super computers to perform real time analysis, mapping and simulations of how to best respond to a disaster of this size.

After the initial survey and analysis of the disaster had taken place several satellite aid locations were setup along Delancey and Essex street as well as City Hall Park. Mesh network nodes were immediately setup in those locations giving instant communication access and situational awareness to these two satellite response stations.

Near Future Scenarios of a Resilient Infrastructure Lower East Side, Manhattan, New York, New York, United States 2020 C.E.

The LES has an opportunity to develop a new model for how a smart city could actually manifest itself in the near future, or even in the present day. This vision does not stem from a modernist ideology or is the result of a few stakeholders nor does it create a technological divide between the have and have nots as other smart cities have already already communicated in their design and implementation. The potential smart city that could be modeled in the LES has more to do with co-opting pre existing infrastructure into smart infrastructure. This is made possible with a specific backbone infrastructure that allow for ubiquitous wireless communication, mesh networks. A decentralized and wireless based infrastructure that allows for localized, peer to peer communication between humans, devices, and platforms. Wireless mesh networks create a shift in the scale of communication, instead of your data travelling thousands of miles from your device to a server and back again a wireless mesh allows for your data, or data collected from devices to travel through your home router or a series of routers in your local vicinity and then to your device or a friends device. This scale of communication could be called a human scale of communication, or localized scale of communication. Coincidentally this scale matches the scale of the urban design in the LES, a part of New York that was built before the automobile. Hence everything in this section of Manhattan is based off of a human scale, the majority of the buildings are only several stories high were you can walk up the stairs. The roads, parks, and neighborhoods are quaint and packed efficiently together. This match in scale of urban design with the scale in the technological communication create a foundational base for different layers of technology that can be installed into the existing infrastructure and local landscape and flourish.

The basis of this approach stems for the need for community resiliency, in the face of a volatile, uncertain, complex and ambiguous world we as a species must revert to more autonomous and self sufficient modes of existence and veer away from dependency on centralized systems of infrastructure. In the last half decade we've seen large scale natural disasters destroy cities, in this century we have already seen climate change refugees, in the coming decades we will see millions of humans beings migrate from their original habitat due to climatic changes. However in some cases habitants are not able to leave or the standing structure is still habitable but the supporting infrastructure is not working. This is a question of how fast a community can recover after a disaster. Existing modes of centralized infrastructure have shown it can take a long amount of time

before this infrastructure can come back online, like the Red Hook community in Brooklyn, New York. In developing economies that do not even have the luxury of some of these centralized infrastructures are left stranded without basic utilities for months or years in the case of the victims of Typhoon Haiyan.

The Lower East Side can take a step towards developing resilient and smart housing infrastructure that can translate not only in an urban setting, not only in a post industrial nation but in a rural and developing setting where there is abject poverty. This is made possible to the use of decentralized technology: wireless networks, solar panels, water catchment and recycling, biogas harvesting, and the ability to quantify all these existing technologies and the ones to come. The key platform for all of this is the use of wireless mesh networks.

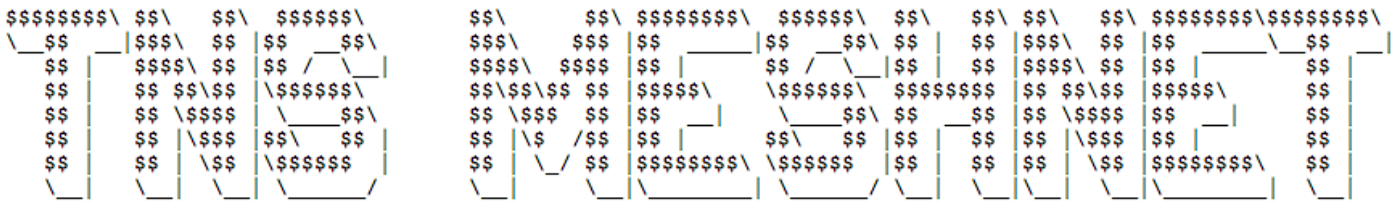
A ubiquitous wireless network in a living environment could allow all these devices to talk to one another locally, it would allow the inhabitants track the amount of resources that pass through these decentralized infrastructures and allow us to manage our living space and resources better. It would allow us to share and allocate resources better within a cluster of houses, in a community. This cluster of houses that are supported by decentralized infrastructure could eventually free us from dependence on massive centralized infrastructures like electricity, water, and internet grids. These centralized structures have shown their vulnerabilities time and time again in the face of climatic variables, economic exclusion, and political intervention.

Installing a resilient wireless mesh network supported by solar is the first step in creating smart local communities. Solar panels with battery power storage allows the mesh network to function autonomously of electrical and internet service providers. Merge these two technologies together and you have a smart grid that merges both internet and electrical utilities in one stack. Your mesh network nodes are able to run a software and sensor layer that interfaces with the solar panel tracking its energy generation and storage capacity, and optimize panels to rotate with the suns axis. Multiplying this technology stack to several houses close to each other and you have wireless energy net that is able to track, store, and share energy and internet amongst neighbors. These two technologies would serve as the basis for co-opting existing structures into smart decentralized structures. Layering on top of this is smart utilities like LED lights or water mains were you could replace traditional valves with smart valves that would be able to track water flow. Adding on an wireless electrical meter could track your energy consumption or notify you of energy leaks or wastage if you have an inefficient appliance. Stacking smart technologies on top of a wireless solar mesh network in a decentralized manner could pave the way towards developing a techno-human permaculture living environment. An iteration on top of Buckminster Fuller's Dymaxion house, but just making the infrastructure of the house quantifiable and networked in with other houses so that you could live in a community of houses.

Decentralized technology is they key to an IoT future that considers the human

and the community. This decentralized smart city model is not predicated on designing a smart structure, community or city that is interlinked with global economic markets, corporations or massive utility companies. It serves the user and the community. There is no grand scheme of harvesting big data generated by a city and selling this data to companies in order to pay for utilities or modeling centralized infrastructure on algorithms. All of these approaches stem from modernist ideals and market efficiencies. They also stem from insular technological approaches that neglect the human scale that is inherent in our development. Cisco, IBM, Siemens, Microsoft develop designs from within their own company models that serve their company, serve their technologies. How much do they actually serve the human? How do they factor in non human systems like the weather, how do they factor human systems like culture, community or commerce? Quantification of soft systems is very hard and we've yet to develop the models to do so, this is why quantified data models are delimiting to a certain extent. How do you map and model qualitative data? Smart cities are the buzz, but how smart are they really? The algorithmic control rooms may produce god like efficiencies but they are only as good as the assumptions that are built into them. They are only as good as the security layers that protect them. This is fundamental flaw in much of smart city planning that is taking place today, it is due paradigmatic entrenchment in the models that are being used to design these smart infrastructures that do not serve the human.

TNS Meshnet & Group



How do we act?

TNS Mesh is acting as a testbed to implementing Meshnet into a wider, systemic environment. There are a few ways we can do this:

1.Creating a TNS mesh network within the campus to start a connection

With the support of The New School SDS (Strategical design school) department, we are able to implement Meshnet within the school to development a closer and alternate communication channels between all personnel within the program and in long-term with the school.

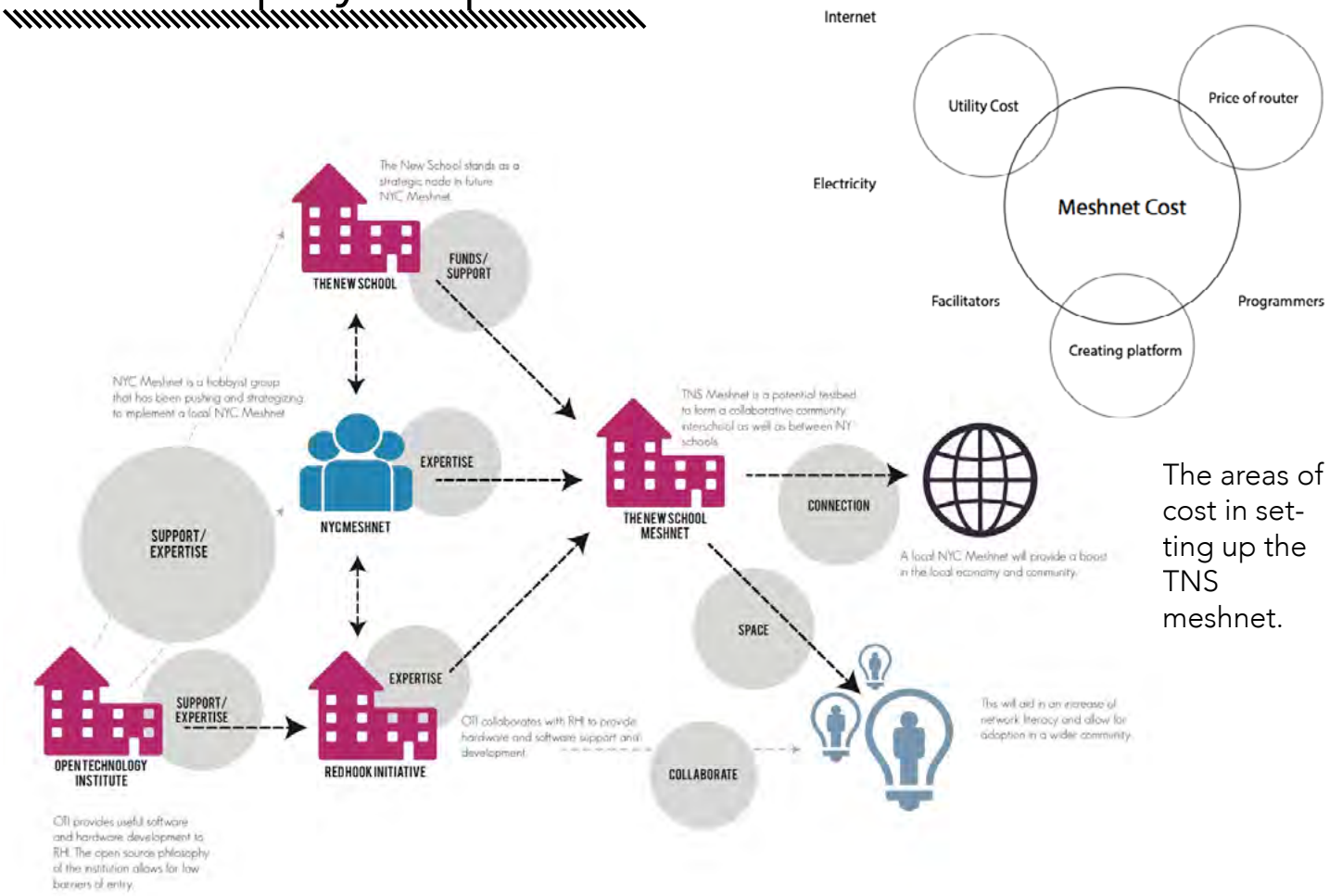
2. Connect with NYC mesh to start a localized network connection within manhattan to other boroughs. (near future)

As we create more awareness of this technology, we can slowly connect our nodes to more localized nodes, connecting outside the campus, teaming up with Mesh societies around New York cities, with brooklyn navy yard, NYC mesh and Redhook to start a city wide connectivity. This could start from a possible student society or club within the school to reach out to external communities and act upon a macro scale of operations.

3. Access rooftops within the campus and seek other university's rooftops creating a educational sharing platform (future vision)

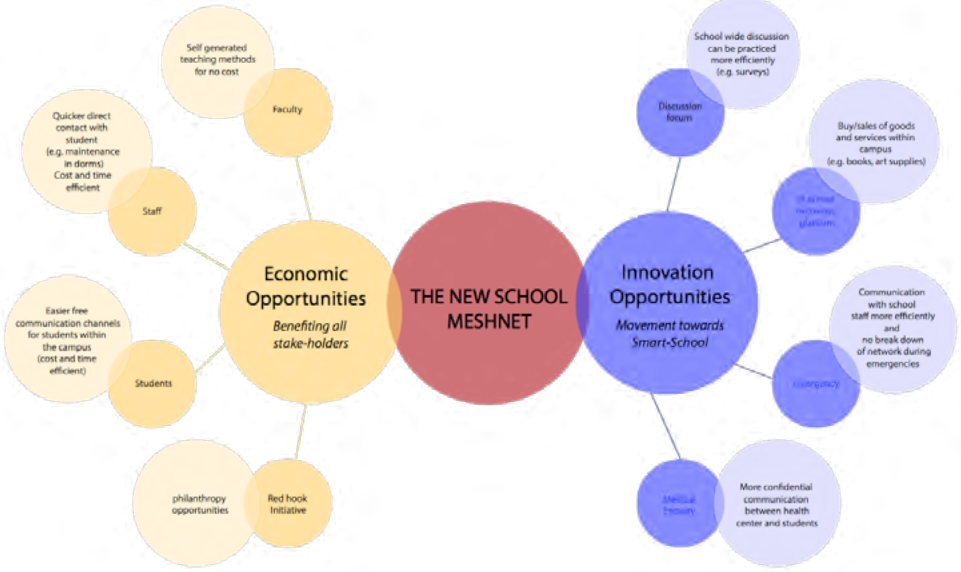
The implementation of Meshnet could increase communication between different school, creating a New York Higher Education sharing platform where different schools and collaborate on projects and on other platforms to create a higher networking reach and wider sharing of information.

Nodal Inquiry Maps



The areas of cost in setting up the TNS meshnet.

A nodal map depicting how the TNS Meshnet would bring in different stake holders to produce a testbed mesh network that could be a shared resource within the school.



A nodal map identifying the potential innovation and economic opportunities in setting up the TNS meshnet group.

Who We Are

Team

Parsons The New School for Design
Jerry Choij - Strategic Design
Noah Emrich - Integrated Design
Christohpher Fussner - Strategic Design
Ashim Joshi - Strategic Design
Ben Lang - Strategic Design
Kevin Liu - Strategic Design

Advisors

Parsons The New School for Design
John Bruce - Professor
Caroline Woolard - Professor
DongIn Shin - Transdisciplinary Design

General Support

Parsons The New School for Design
Ed Keller - Professor
Mathan Ratinam - Associate Professor
The Department of Design Strategies
Samuel Haddix - Transdisciplinary Design
Andrea Morales - Transdisciplinary Design
Aran Baker - Design and Urban Ecologies
Anne Duquennois - Design and Urban Ecologies

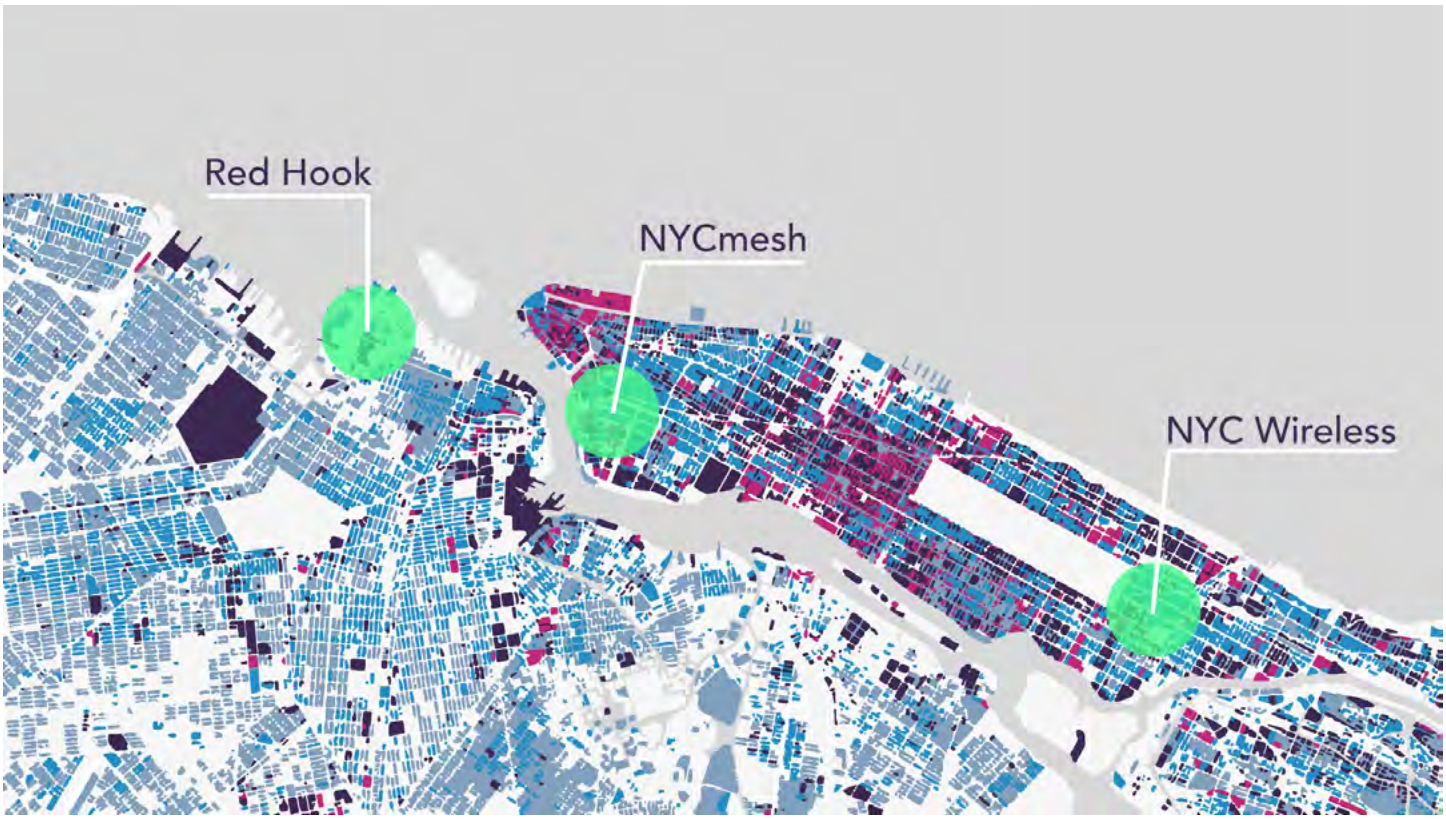
Shared Interest Stakeholders

Red Hook Initiative - Anthony Schloss
nycMESH - Peter Valdez, Brian Hall
Brooklyn Fiber - Erik Veksler

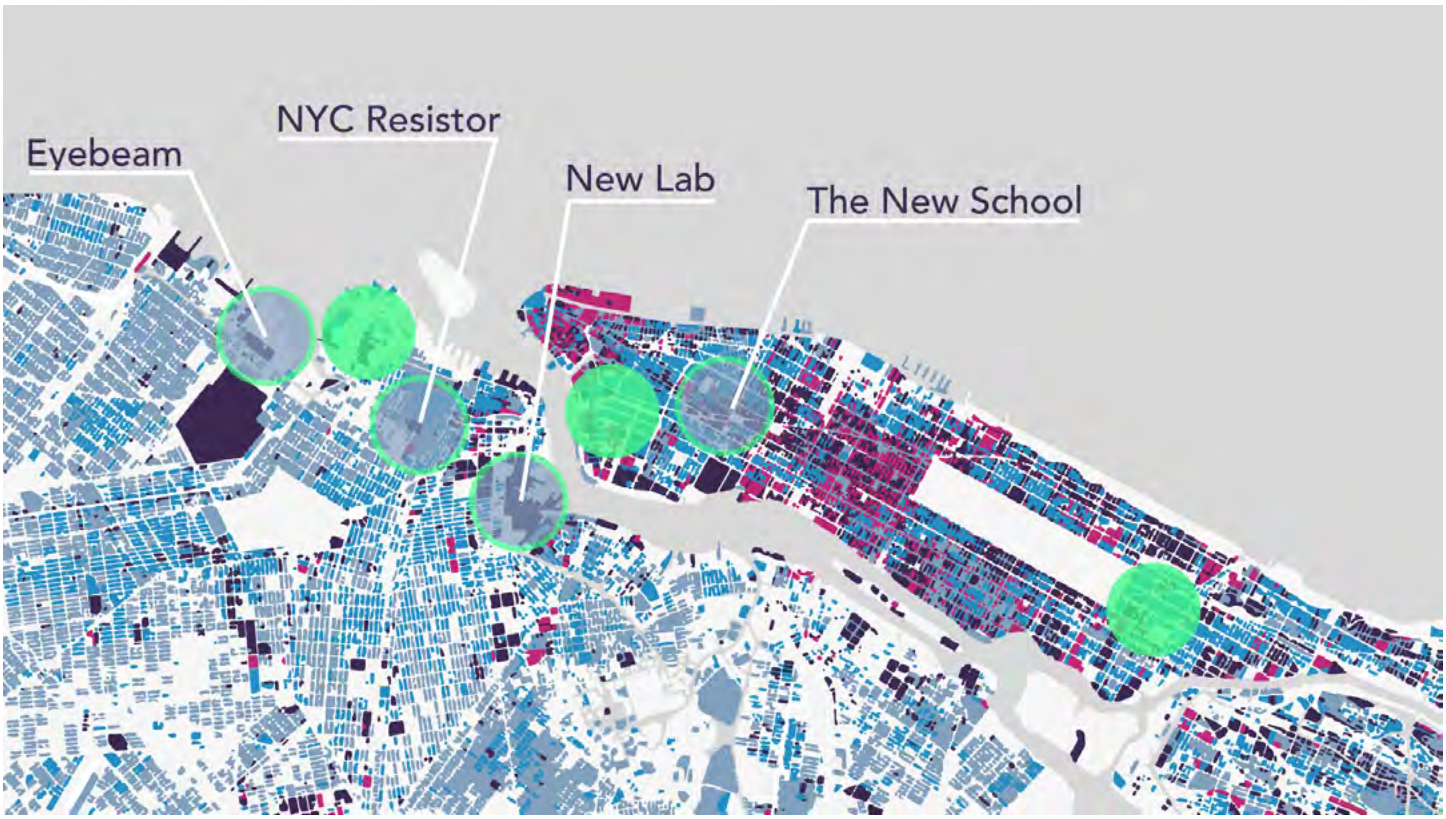
Additional Contacts

OTI - Chris Ritzo
Tidepools - J.R. Baldwin
NYC Resistor - Jonathan Dahan
ArtSTOR - Cody Pumper
Public Labs - Liz Barry

Proposal Summary for New Challenge



Active Mesh Networks in New York City as of December 2014



Example set of partner orgnaizations for a cross city mesh backbone

Node map for an example set of partner orgnaizations

Another possible future for the next semester is developing a plan that relates to mesh networking and resiliency in the city through the New Challenge. We would ideally partner up with some of the masters students we met during the semester that are also studying mesh networks. However their focus seems to be focused directly on how the mesh network develops new forms of connectivity in the city beyond a digital and wireless space.

Our immediate goal would be to work with LESready and Wifi NY through Parsons to better understand what they are implementing in regards to the community disaster preparedness and resiliency plan they recently published.

Ideally we would propose that The New School be part of the wireless backbone that would run through the Lower East Side. In an effort to expand the wireless backbone from the Lower East Side to Union Square.

Our stretch goal would be to create a wireless backbone that would run all the way from Brooklyn by Red Hook and travel through Dumbo and across to the Lower East side then up to Union Square. If executable it would provide a wireless backbone corridor through many of the 'Zone 1' flooding areas. This backbone would be the connection that many communities along the way could deploy their own local neighborhood wireless connections. In times of need even if parts of the backbone went offline due to a storm, they are much easier and faster to rehabilitate than traditional in the ground cable services.

At this time however we are still in the process of contacting our potential partners and have yet to discern the exact space we could potentially assist and be involved in developing a resilient New York City.t

Bibliography

Lippman, Andrew, and David P. Reed. "Viral Communications." Media Laboratory Research (n.d.): n. pag. 19 May 2003. Web. 15 Oct. 2014.

Lumb, David. "How To Build A Low-Cost." Co.Labs. Fast Company, 25 Oct. 2013. Web. 23 Nov. 2014.

Open Technology Institute. "Commotion Wireless: Getting Started." Commotion Wireless. Open Technology Institute, n.d. Web. Nov. 2014.

Russo, Nick, Robert Morgus, Danielle Kehl, and Sarah Morris. "The Cost of Connectivity 2014." New America RSS. Open Technology Institute, 30 Oct. 2014. Web. 17 Nov. 2014.

Wireless Networking in the Developing World. "WNDW - The Book." WNDW - The Book. WNDW.net, Mar. 2013. Web. 12 Oct. 2014.

Zuckerber, Mark. "Is Connectivity a Human Right?" Facebook (2014): n. pag. Web. Jan. 2014. <https://fbcdn-dragon-a.akamaihd.net/hphotos-ak-ash3/851575_228794233937224_51579300_n.pdf>.

Dr.Leandro, Navarro. "Community Networks in Europe Guifi.net, AWMN, FunkFeuer." Systems Group, 1 Feb. 2012. Web. 23 Nov. 2014. http://wireless.ictp.it/wp-content/uploads/2012/02/ictp-leandro.pdf

Roca, Ramon. "The Guifi.net "FFTF" Bottom-Up Broadband Initiative." Digital Agenda for Europe. 1 Dec. 2010. Web. 23 Nov. 2014. http://ec.europa.eu/digital-agenda/en/guifinet-fftf-bottom-broadband-initiative

Bicket, John, Daniel Aguayo, Sanjit Biswas, and Robert Morris. MobiCom 2005: Proceedings of the Eleventh Annual International Conference on Mobile Computing and Networking: August 28-September 2, 2005, Cologne, Germany. New York, NY: ACM, 2005. ACM Digital Library. Association of Computing Machinery, Feb. 2005. Web. Oct.-Nov. 2014.

The Human Scale. Dir. Andreas Dalsgaard. Perf. Jan Gehl. Final Cut for Real, 2012. Amazon.

Baker, Sean, and James Francis. "Project FOGG." Project Fogg. N.p., 2013. Web. 12 Dec. 2014.

Open Technology Institute. "Case Study: Red Hook Initiative WiFi & Tidepools | New America Archives." Case Study: Red Hook Initiative WiFi & Tidepools | New America Archives. Open Technology Institute, 1 Feb. 2013. Web. 12 Dec. 2014.

Halpern, O., J. Lecavalier, N. Calvillo, and W. Pietsch. "Test-Bed Urbanism." Public Culture 25.2 70 (2013): 272-306. Web.

Mattern, Shannon. "Scaffolding, Hard and Soft: Infrastructures as Critical and Generative Structures." Words in Space. N.p., 18 Sept. 2014. Web. 27 Oct. 2014.

Meadows, Donella H., and Diana Wright. Thinking in Systems: A Primer. White River Junction, VT: Chelsea Green Pub., 2008. Print.

Surviving Progress. Dir. Mathieu Roy and Harold Crooks. First Run Features, 2012. Netflix. A Canadian documentary film loosely based on A Short History of Progress, a book and a 2004 Massey Lecture series by Ronald Wright about societal collapse.

Project Meshnet. "Introduction to the MeshNet." Vimeo. Project Meshnet, 2012. Web. 15 Dec. 2014.

Motorola. "MOTOMESH-Mesh Network for Reginoal Disaster Relief - Japan." YouTube. YouTube, n.d. Web. 15 Dec. 2014.

Filippi, Primavera Di. "It's Time to Take Mesh Networks Seriously (And Not Just for the Reasons You Think) | WIRED." Wired.com. Conde Nast Digital, 01 Feb. 2014. Web. Nov. 2014

Brodkin, Jon. "State Laws That Ban Municipal Internet Will Be Invalidated, FCC Chair Says." Ars Technica. Conde Nast, Apr. 2014. Web. Nov. 2014.