RECLAIMING NETWORKED SPACE THROUGH ALTERNATIVE MODELS OF CONNECTIVITY

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Introduction

The advent of computer networking brought with it promises of solutions and conveniences to work in favor of humanity, but it also introduced previously unfathomed problems and complications. Technology theorist Benjamin Bratton, channeling French philosopher Paul Virillio states, "the invention of any new technology is also the invention of a new kind of accident."[1] The Internet, a product of many minds building upon the inventions of older minds, has been characterized as both a panacea and an instrument of oppression.[2] But, like any tool, it is only as effective as the human beings who wield it. Recently there have been many hardware and software innovations used to create information networks that enhance and compliment the Internet. This research suggests that these alternative networking techniques have the power to promote digital democracy through challenging incumbent access providers by fostering community engagement and redefining our relationship with infrastructure.

In today's techno-political climate, the Internet has been tamed by agents powerful enough to control one or more aspects of its utility. Technology firms create suites of products that provide useful services to users, but also entrap them in walled gardens characterized by inoperability between providers. While these services are often offered to the user free of cost, these institutions collect data from the users by storing and analyzing communication and search history. This data is used to classify users into marketing demographics, which is sold to media buyers who target them with directed advertising.

Government agencies also have operations in place that amass and catalogue enormous amounts of data on citizen behavior online, including phone records and

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[1] Metahaven, "The Cloud, the State, and the Stack: Metahaven in Conversation with Benjamin Bratton," accessed April 4, 2015, http://mthvn.tumblr.com/post/38098461078/thecloudthestateandthestack.

[2] Evgeny Morozov, *The Net Delusion: The Dark Side of Internet Freedom*, 1st ed (New York: Public Affairs, 2011).

email communications. The most notable and far-reaching of these operations is the NSA's PRISM program, which was revealed to the public by former NSA contractor Edward Snowden in June 2013. The Snowden revelations brought these actions into the public eye, but to many it reinforced what was already suspected; that the US government was performing surveillance operations on its citizens and worldwide. Yet, despite the disclosure of the PRISM program, true reform has yet to take place. Collective outrage has not led to mobilization against the NSA's policies, and many Internet users in America and worldwide have been provided with ineffective means to protect their privacy.

Still for others these privacy issues are not a priority, for network access is out of reach to them due to economic disparities stemming from unequal deployment of networks by Internet Service Providers (ISPs), and lack of technological competency. What is known as the "digital divide" affects a certain segment of our country, and it is amplified along trends consistent with social and economic inequality.[3] Members of lower socio-economic classes as well as minorities are disproportionally affected by the technology gap.

Alternative Models of Connectivity

Alternative networking is a broad term that refers to anything that falls outside of the traditional model of connectivity. The traditional model is where the end user connects via "last mile" access from an ISP who, in turn, connects via backbone access from a Tier 1 provider. In this example, the ISP is the gateway between the consumer and the Internet. The ISP may own or lease the last mile infrastructure, and therefore commands a large amount of control of how the data is shaped, and how the infrastructure is deployed. Comcast, the country's largest Internet provider, has been criticized for only providing infrastructure to locations where it is commercially advantageous, thus leaving out rural and poor areas that do not meet this criteria.[4] However, because many of the important protocols and specifications that comprise the Internet have been classified as open source, computer networking can exist and be functional on its own, without needing to abide by the traditional model.

There is a host of emerging technologies on the market that will make development of alternative networking much easier. What was once the exclusive realm of geeks and computer enthusiasts can now be utilized by artists and activists. In the past decade, the evolution of web design and other coding practices has swiftly jettisoned into the realm of creativity and craft. This paradigm shift has set a precedent for other technological endeavors, and computer networking has the potential to follow a similar trajectory.

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[3] Karen Mossberger, "Toward Digital Citizenship: Addressing Inequality in the Information Age," *Routledge Handbook of Internet Politics*, 2009, 173–85.

[4] Gerry Smith, "AT&T, Comcast Have Spotty Record Of Giving Internet To Rural And Poor," *The Huffington Post*, accessed April 27, 2015, http://social.huffingtonpost.com/2014/06/12/att-comcast-mergers_n_5484595.html.

There are many tools that are available now to construct new networking arrangements. Along with the rise of "maker culture" in the past few years, creative hardware manufacturers have introduced dozens of microcontrollers—small, use-specific computing devices—to the market.[5] Products like Pinnocio mesh networking "scouts" and Spark Core Wi-Fi development boards are approximately the size of your thumb, and come with out-of-the-box configuration. These emerging tools have the potential to bring alternative networking into the mainstream.

Characteristics and Implementation

Alternative networking can improve digital democracy and combat the widening technology gap by adhering to two principles. First, alternative networking should be able to provide a low barrier of entry to set up. And second, it should be able to provide useful and desirable services. Adhering to these two principles will give alternative networking a shot at more widespread adoption.

Dominant ISPs are able to provide extremely high bandwidth speeds to many people due to their control of the last mile infrastructure and vast financial resources. Alternative networks are mostly small-scale, and community driven. They do not have the resources to compete with ISPs, and that is not their intention. Rather than focusing on bandwidth and throughput, alternative networks aim to provide more versatile avenues of connectivity. Even so, in order to make a successful contribution to the community, an alternative network must be able to provide an acceptable end-user experience that facilitates adoption

Alternative models of connectivity can protect us from the monopolization of the Internet by "state" or "cloud" entities because the building blocks are available to everyone. People can take advantage of the vast resources and create custom architectures to suit the needs of their particular implementation. In doing so, people can help close the digital divide, support digital democracy, and have the potential to reinvigorate the public sphere by engaging their community.

Creating and deploying networks, whether isolated or linked to the Internet, will become as easy and commonplace as building a webpage or starting a blog. Advancements in website and blog hosting service gained popularity in the early 2000's thanks to services provided by the now defunct webhosting companies Tripod and Angelfire. It stands to reason that personalized networks can follow in these footsteps thanks to the popularity of small wireless integrated microcontrollers and other recent advancements.

Developments in micro infrastructure devices are gaining popularity due to the ease in which networking interfaces can be integrated into PCB boards.[6] Made possible by

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[5] Maker culture is a subset of do-it-yourself (DIY) culture that makes ample use of 3-D printing technology and wireless networking advancements. The focus is typically a convergence of robotics, 3-D printing, computer programming and networking.

[6] PCB, or printed circuit boards are hard, flat boards that have circuitry embedded (printed) upon them, along with other microchips.

advancement in wireless networking technology, they have the ability to deploy network infrastructure rapidly and flexibly. These devices, such as the Pinoccio, and Flutter wireless, can be powered by small, rechargeable batteries, and have powerful radios to broadcast their signal.[7]

These advancements are helping people take more control over technology, and networking should follow this trend. Pervasive, ubiquitous networking is rapidly moving into the mainstream, and it is imperative for the public to stay ahead of the curve and take control early on to prevent state and cloud entities from monopolizing the services. Mastering low cost networking hardware and emergent protocols are of key importance to maintaining openness in network infrastructure.

It is clear that traditional models of connectivity have a tendency to discriminate against groups of lower socio-economic status. Access to the Internet through ISPs comes at a cost that may be out of reach for some. Additionally, infrastructure owners do not typically provide services to geographic locations that are not profitable or sustainable to be deployed. Alternative models of connectivity such as community designed mesh networks can circumvent the need to force alignment with an ISP by amplifying and sharing a few access points to the larger community. Alternative networking initiatives find ways to mobilize neglected communities to implement their own network infrastructure. Community run networks tend to have higher levels of engagement and provide bonding opportunities due to the collaboration involved.[8]

Mesh networks using Wi-Fi technology by design are better applied to higher population density areas because of the necessarily limited distance between nodes.[9] But rural areas can benefit from alternative networking techniques such as free space optical (FSO) communication. FSO networks most commonly utilize laser light or LED technology to create data links between distances of up to 3 km.[10]

Globalization and localization can work in concert and should be considered as two sides of the same coin. The adage "think globally, act locally" is applicable in the alternative networking movement. Much of the character of the Internet has been ascribed to its ability to connect the entire world. There is a benefit in this, to social and economic applications. People tend to be more conscientious toward members of their

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[7] The Pinocco is a small but powerful wireless mesh device.

[8] J. Soderberg, "Free Space Optics in the Czech Wireless Community: Shedding Some Light on the Role of Normativity for User-Initiated Innovations," *Science, Technology & Human Values* 36, no. 4 (July 1, 2011): 423–50, doi:10.1177/0162243910368398.

[9] Mesh networks are decentralized; each node is able to communicate with every other neighboring node. Contrast with the centralized model of traditional networks, where each node connects to a single routing node.

[10] Tom Garlington, Joel Babbitt, and George Long, "Analysis of Free Space Optics as a Transmission Technology," *US Army Information Systems Engineering Command* 3 (2005).

same group, and global networking can produce feelings of inclusiveness. Conversely, local strategies have a positive impact on using resources that can be obtained without the expended energy of transporting them across large distances.

Alternative networks can add networking infrastructure to places that don't have it, and can be done without intervention from major players like ISPs. In other words, it can be accomplished by activist organizations or local communities working together. Additionally, alternative networks can be made privately and hidden, thus providing local free network initiatives the ability to add network infrastructure surreptitiously as deemed necessary.

Adoption and Future Development

It was not long ago when building websites was the exclusive domain of knowledgeable individuals with a strong background in computers and programming. It started as an underground phenomenon, paralleling the rise of programming in the 1980's. Writing and hosting a website in the 1990's required a lot of skill due to the fact that the technology was still relatively new. However, the practice gained traction, becoming more popular each year.

Alternative networks big and small have a future along these lines. In no small part due to the decreasing size and cost of hardware technology, particularly innovations in wireless, networking projects are becoming more and more frequent. Ten years ago the consumer market was populated with relatively few hardware networking options, now wireless chips can fit in the size of dime and can be attached to nearly anything. This should be encouraging to individuals who are interested in building their own "boutique" network infrastructure. With networking hardware following the cycle of Moore's law, it is easy and affordable to build and deploy personalized networks, and incorporate a virtual space into any physical space.[11] The research suggests there is a growing interest in the field, with the many resources and communities of developers offering their support.

In most alternative networking projects, users possessing a strong working knowledge of technology are the ones who typically initiate community-led innovation. Because these projects require an initial configuration of hardware and software, those who have a background in related technology fields comprise the community. If the project gains traction into the wider community, people who have only a cursory knowledge of the technological aspect, fall into other roles suited to their capabilities. Political skills such as management and organization, as well as non-technical design such as promotion and advertising, prove valuable in community construction. So, as the community grows, the concentration of technology enthusiasts diffuses as others lend their skills to the project. This helps adjust the scope to a more inclusive place, allowing for increased levels of participation, and more democratic representation of the group. Because of this

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[11] Moore's Law says that the number of transistors able to fit in a dense integrated circuit doubles approximately every two years. It is sometimes used to account for the explosion in computer development from 1980-2000, and also looked at as self-fulfilling prophecy.

inclusive trait of alternative networking, the ability for developing a public sphere around the technology increases.

Conclusion

This research explores the emergence of network alternatives to the global Internet. New spaces for computer networking to exist are waiting to be discovered. This could be through new and updated protocols, and also through the use of advanced new technology. Wireless routing hardware is becoming more specialized and can be adapted to use for smaller, private network solutions. What is special about this is that individuals and groups that participate in this concept will be bringing their own interests, skills, and motivations to the table. With these tools, the paradigm of the Internet can be re-evaluated.

Computer networking has evolved significantly since it was first conceived. The collaborative and open nature of its foundational codes is imprinted upon its DNA, fostering connections and cooperation to help bring about social good. By presenting humankind with new interfaces to find our place in the world, communications technologies will become intertwined with its effects. However, it is a tool, and it can be used for purposes both positive and negative. If participants continue the practices of sharing and community engagement, the future of alternative networking has the potential to place greater control of the democratic aspects in the hands of the public. By wresting the means of access from the gatekeepers, and constructing new spaces for communication, the possibility of a public sphere becomes much more viable.

The potentials of alternative networking will become evident as the practice matures. The trend of networking hardware and computer chips shrinking in size produces new products that are rapidly emerging, allowing for more versatile integration of spaces and networks. Enthusiasts will continue to develop networking projects that, over time, become adopted by a broader cross-section of the public, bringing unique skillsets that enhance the possibilities of the network.

Much like the evolution of the HTML language from a modest style guide for transmitting documents, to the innovative and creative craft we see today, networking will evolve into a more tangible and substantial practice. These characteristics indicate a reflection of the past promises of democratization, amplified, and offering hope for the emergence of a new virtual public sphere. Reclaiming networks by implementing alternative techniques will yet again shift the balance of power among network communication infrastructures, and the democratizing potential of computer networking may be presented. These alternative models of connectivity will face a trial as they become more widely adopted, and it is up to those who continue to work with the technology make a constructive impact. By sharing work, and providing support for one another, the architects of the future can maintain the ethos that propelled computer networking to the magnitude we see today.

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