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Clouded space: Internet physicality

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Clouded Space: Internet Physicality

by

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CERTIFICATE OF APPROVAL

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MASTER'S THESIS

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This is to certify that the Master's thesis of

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has been approved by the Examining Committee for
the thesis requirement for the Master of Fine Arts degree
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ABSTRACT

On Friday October 21st, 2016, there was a large-scale hack of an Internet domain hosting provider that took several websites including Netflix, Amazon, Reddit, and Twitter offline. Dyn, a cloud-based Internet Performance Management company, announced at 9:20AM ET that it resolved an attack that began at 7AM ET that day. However, another attack happened at 11:52AM ET. The attacks raised concern among the public and directed our attention towards Internet security. This also revealed the precariousness of Internet infrastructure. The infrastructure being used today is opaque, unregulated, and incontestable. Municipally provided public utilities are built without any transparency; thus, we do not expect failure from those systems. For instance, the Flint, Michigan water crisis raised issues of water infrastructure. Not only did the crisis spark talks about the corrosion of pipes, but also larger societal issues. Flint, a poor, largely African American community, became a victim of environmental racism—a type of discrimination where communities of color or low-income residents are forced to live in environmental dangerous areas. In order for myself and the larger public to understand this opaque system, we need to understand the infrastructure and how it works.

With regards to Internet infrastructure, I focus on data centers, where there are backup servers, batteries and generators built into the architectural landscape in case of failure. There is a common held thought that overshadows the possibility of imminent technological failure—it cannot happen. This sort of thinking influences other modes of our daily lives: individuals building concrete bomb shelters underground for the apocalypse, stocking food, but not preparing for data breakdown. The consciousness of loss is further perpetuated by technology and its life expectancy.

Clouded Space: Internet Physicality attempts to explorer the unexceptional infrastructure of the Internet and how it exists right beneath our feet. That in itself is not

very cloud-like. The work questions integrity of our infrastructure as much as environmental issues, highlighting the questionable relationship we have with data and our inclination to backup data to protect ourselves from failure. This is a relatively new topic and the challenges are not well understood. There seem to be cracks in the foundation, and though they are not yet obvious, they appear to be widening.

PUBLIC ABSTRACT

Clouded Space: Internet Physicality attempts to explore the unexceptional infrastructure of the Internet and how it exists right beneath our feet. That in itself is not very cloud-like. The work questions integrity of our infrastructure as much as environmental issues, highlighting the questionable relationship we have with data and our inclination to backup data to protect ourselves from failure. This is a relatively new topic and the challenges are not well understood. There seem to be cracks in the foundation, and though they are not yet obvious, they appear to be widening.

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Introduction

On December 10th, 2016, David Newbury, a lead developer at Art Tracks, tweeted a map of the Internet from 1973 from his father's archive.[1] At that time, it was called ARPANET, Advanced Projects Agency Network, a project funded by the Advanced Research Projects agency of the United States Department of Defense. Newbury explains, "For each of these three terminals, I had three different sets of user commands. So if I was talking online with someone at SDC, and I wanted to talk to someone I knew at Berkley or MIT about this, I had to get up from the SDC terminal, go over and log into the other terminal and get in touch with them… if you have these three terminals, there ought to be one terminal that goes anywhere you want to go where you have interactive computing."[2] The flow chart is stark contrast to how it is represented today.

In 2003, the Opte Project was launched by Barrett Lyon to create an accurate representation of the Internet. The map evolved from a simply diagram to a three-dimensional, cell-like visualization.[3] Although it is aesthetically appealing, the map gives very little information, instead, it contributes to the overwhelming sense that leads to widespread apathy. The new maps now show an unclear representation and abstraction of the Internet.

In combination with the maps, the stock images paired with Internet stories always depict the Internet as mysterious portals where men in hoodies code in the dark,

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[1] David Newbury, (Twitter 12/10/2016) https://twitter.com/workergnome/status/807704855276122114?lang=en

[2] Sarah Emerson *Mapping the Internet Was Really Easy in 1973* (New York, Motherboard Vice, 12/17/2016) https://motherboard.vice.com/en_us/article/mapping-the-internet-was-really-easy-in-1973-arpanet.

[3] Barrett Lyon *The Opte Project* (Lyon labs, 2014) http://www.opte.org/.

surrounded by green digital letters. What these images are missing are the physicality—they blind us to the invisible and lose sight of all other things that we ought to see.

I grew up intimately with the Internet evolving with me socially, but recently I have noticed that the Internet has dramatically changed. Throughout *Clouded Space*, I am interested in showing what is missing from these maps: the physicality and the maintenance of the Internet. It is pertinent for the public to challenge the network and its protocols rather than blindly accepting the current system that has been facing problems since its inception. There are several established artists already exploring the physicality of the Internet, but not many have done work in video. *Clouded Space* will add a different perspective to the multitude of artists who are currently exploring the subject matter.

Data Center

I began my journey in the data center. Data center constructions in Iowa are multiplying. Currently, there is a Google Data Center in Council Bluffs and a Facebook Data Center is in West Des Moines. Microsoft also revealed in 2016, project "Insignia" and will build two data centers in Des Moines.[4] This made me think, why Iowa? What attracts corporations to build data centers in Iowa and not in Metropolitan areas where there are more Internet Users? The location of these data centers motivated me to explore the trend.

A data center is a large facility that houses multiply servers for businesses and companies to efficiently run their cloud computing services. The data center collects, stores, processes and disseminates data whenever required. The building prioritizes machines over humans and are built to withstand failure from natural disasters. Stepping inside a data center was quite magical—I felt like I was on a science fiction movie set and time-traveled fifty years into the future. There was something dystopic about being in a space with little human presence and being surrounded by rows of server fans generating a constant drone. The following information is provided from their cheat sheet handout:

The university of Iowa data center is housed in the
University of Iowa information Technology Facility (ITF).
The facility was approved in 2008 by the Board of Regents
with a budget of $33,628,000, but the actual cost was

[4] Matthew Patane *West Des Moines' Data Center will Be Microsoft's 'Largest' in U.S*. (Iowa, The Des Moines Register, 7/22/2016) http://www.desmoinesregister.com/story/tech/2016/07/22/new-west-des-moines-data-center-gets-475m-incentives/87406160/.

$29,790,586. Construction began in November 2009 and completed in December 2011. The ITF provides proper electrical ventilation, and air-conditioning requirements for servers. It's designed to withstand tornadoes and power interruptions, and if far from the areas of campus that flooded in 2008. There are two data halls, each 7,200 sq. ft. with 36'' raised flooring. The gross size is 42,811 sq. ft (a football field is 48k sq. ft. when measure from goal line to goal line.[5]

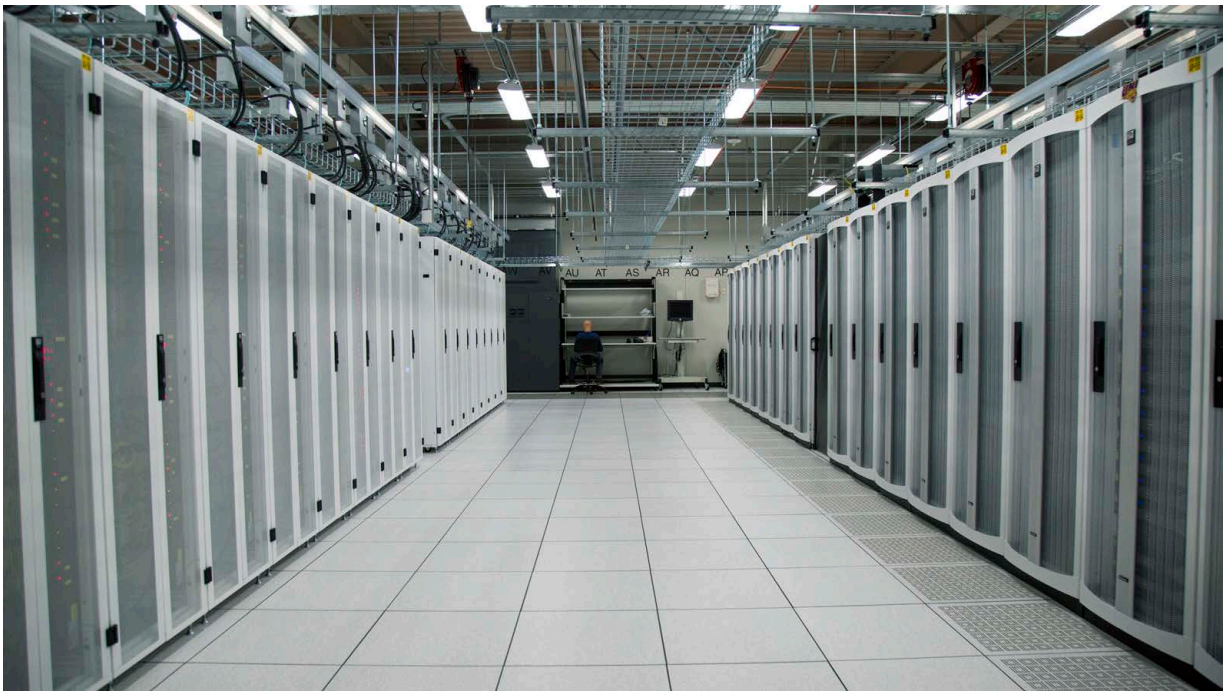

Figure 1. University of Iowa *Data Center*

[5] University of Iowa ITF handout (Iowa, University of Iowa, 2014).

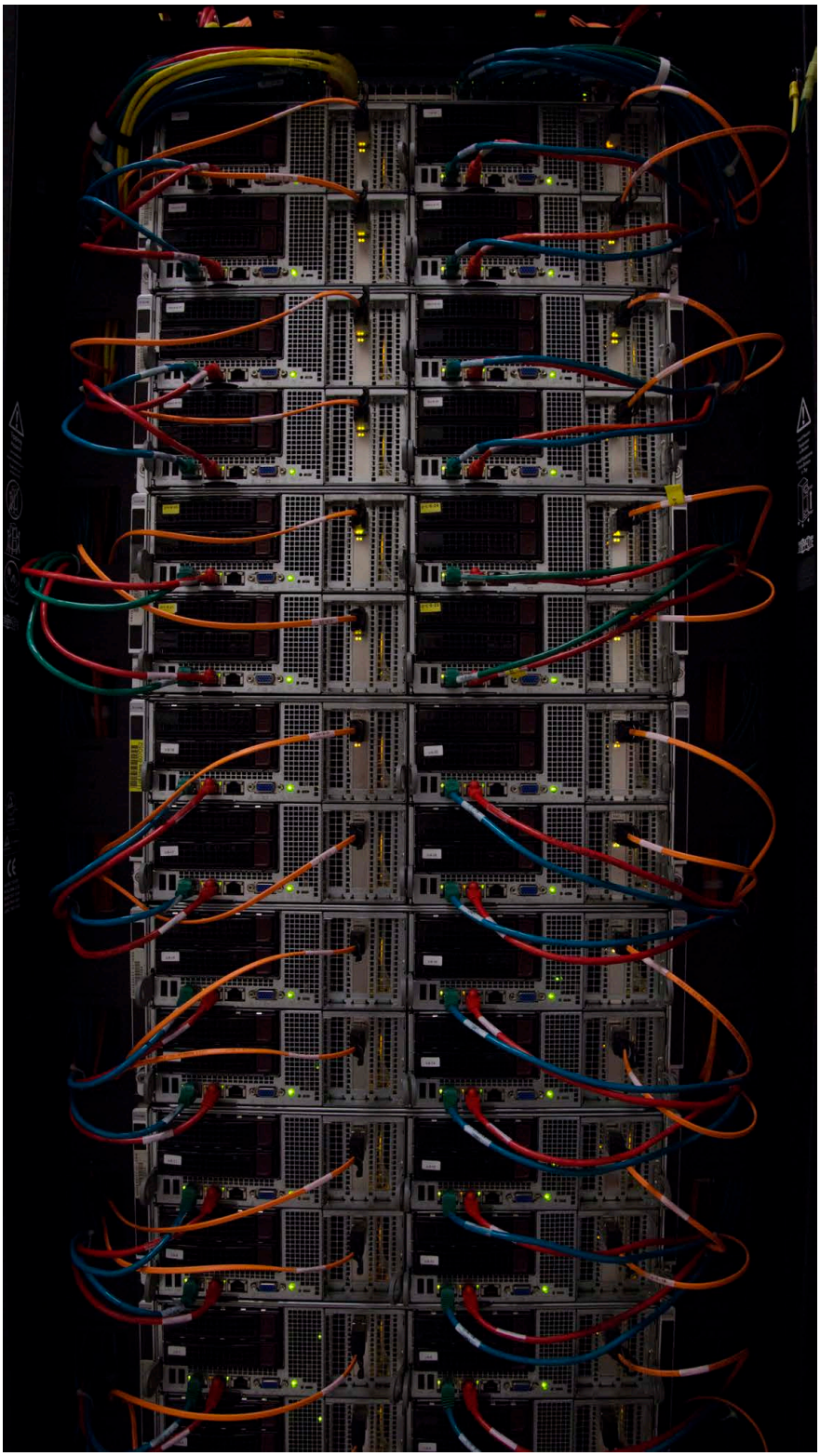

Figure 2. Server

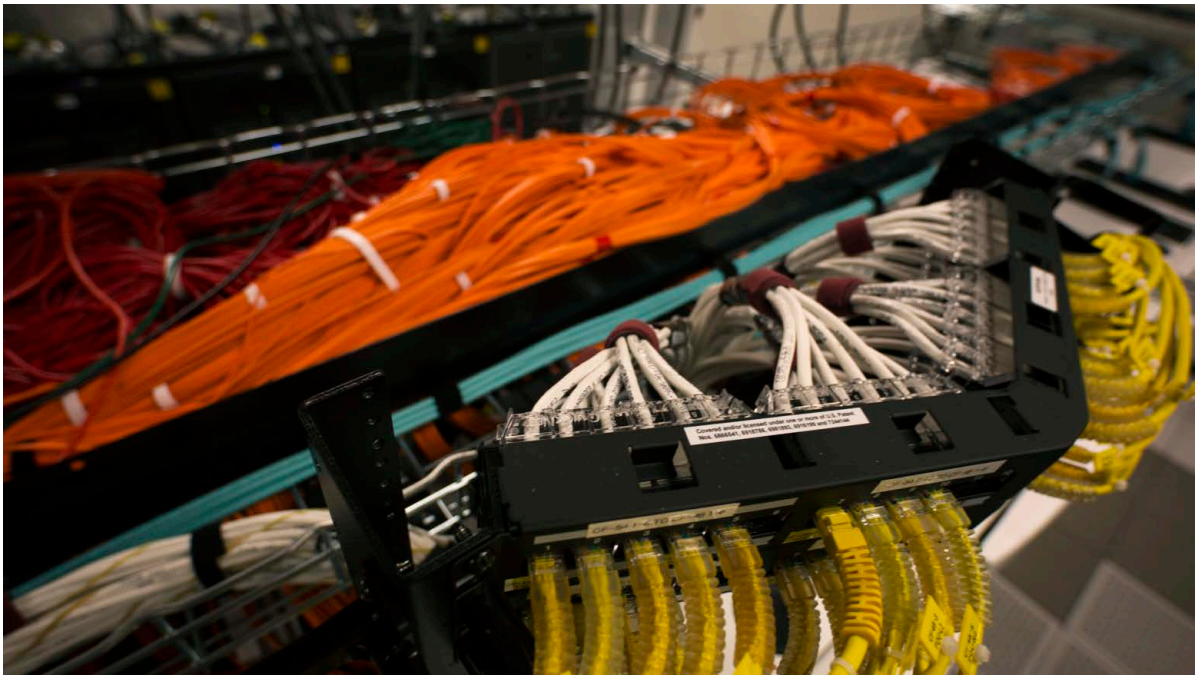

Figure 3. Cables

I found that Iowa is an attractive place to build data centers because of low risk natural disasters. Iowa also has great tax incentives for data center construction. Data centers are required to meet the minimum size requirement of 5000 sq. ft. and are eligible for an investment of $200 million over the first six years of operation can receive a 100% abatement of the sale and use tax on the physical plant, cable plant, computer equipment, cooling infrastructure and purchased electricity.[6]

What surprised me was the amount of electricity that goes into cloud computing. All data centers require continual flow of power—with it, it cannot function properly. In case of power outage, businesses may encounter disruption and may have to suffer

[6] David Chernicoff *US Tax Breaks, state by state* (DataCenterDynamics, 01/06/2016) http://www.datacenterdynamics.com/content-tracks/design-build/us-tax-breaks-state-by-state/95428.fullarticle.

productivity and loss of revenue from disconnection of the system. UPS or Uninterruptable Power Supply can save businesses from running into that problem. Data centers also test the generators every month in case of failure, which uses massive amounts of energy, but it is necessary for the tests. What was interesting was that on average data center servers use 6 to 12 percent of the electricity to keep servers idling and ready in case of a surge in activity that could slow or crash their operations.[7] Servers can overheat when they are not kept properly. In order to maintain efficiency, it is essential to also supply the facility with continuous cooling which helps prevent the system to get overheated. Raised floors with a cooling system underneath is also common in data centers.

"Go paperless, Go Green" CommonWealth Edison's slogan feed into the rhetoric that digital is better for the environment than printing—that is certainly not the case. James Glanz writes in an article on the New York Times regarding data center energy use, Estimates place global output at 30 billion watts of electricity per annum, which is approximately 30 nuclear power plants of the equivalent generation from coal.[8] It was apparent to see the amount of energy that goes into maintain data centers, in addition to the monthly testing that they do. I knew that in *Clouded Space*, by only focusing and presenting the data centers, I am simplifying the concept of the Internet—I would basically fall into the same trap that the stock images are doing. I stepped outside of the data centers and started to explore the wired component of the wireless Internet connection.

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[7] James Glanz, *Power, Pollution and the Internet* (New York: The New York Times, 9/22/12) http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html.
[8] Ibid.

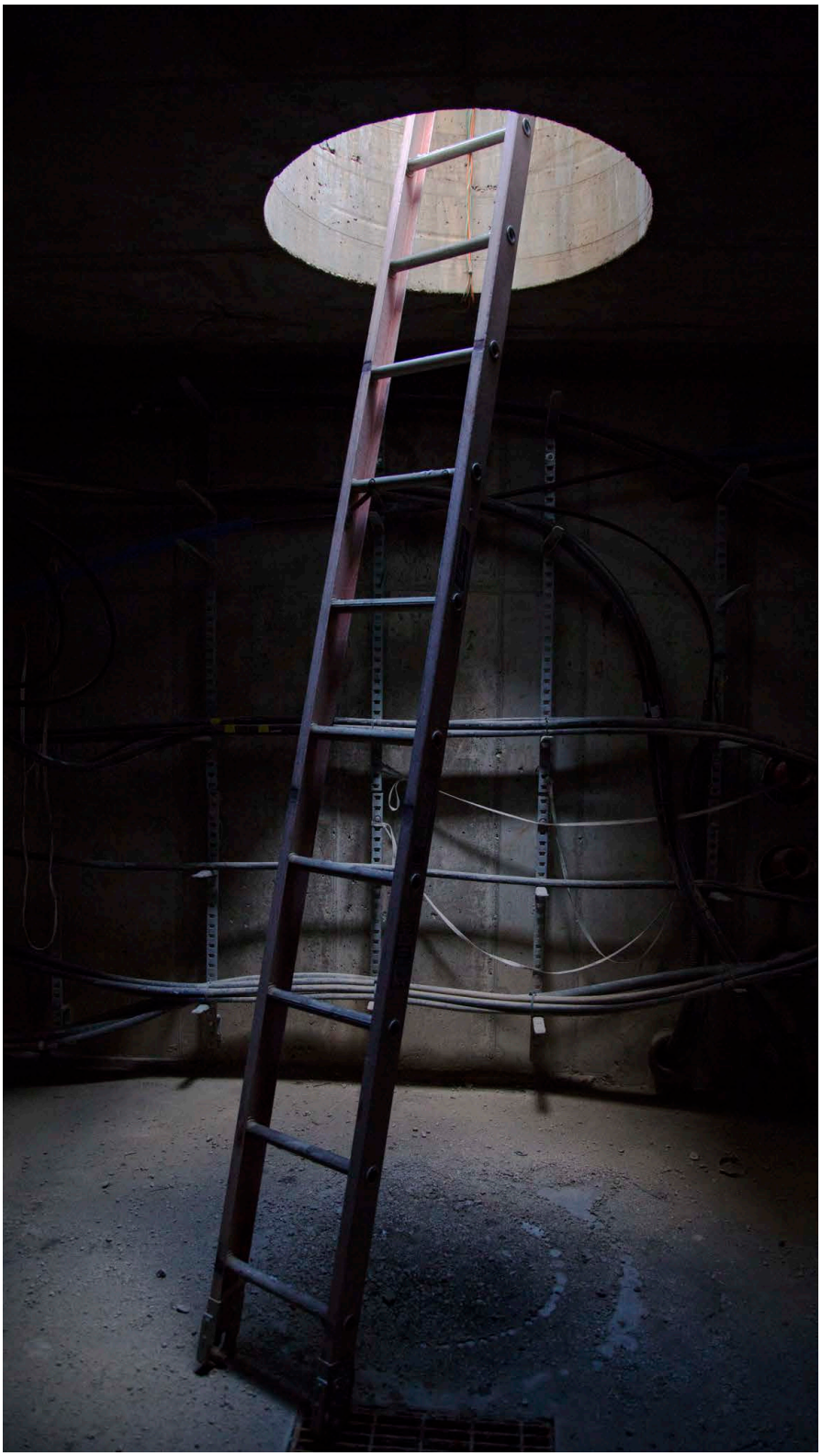

Figure 4. ***Underground***

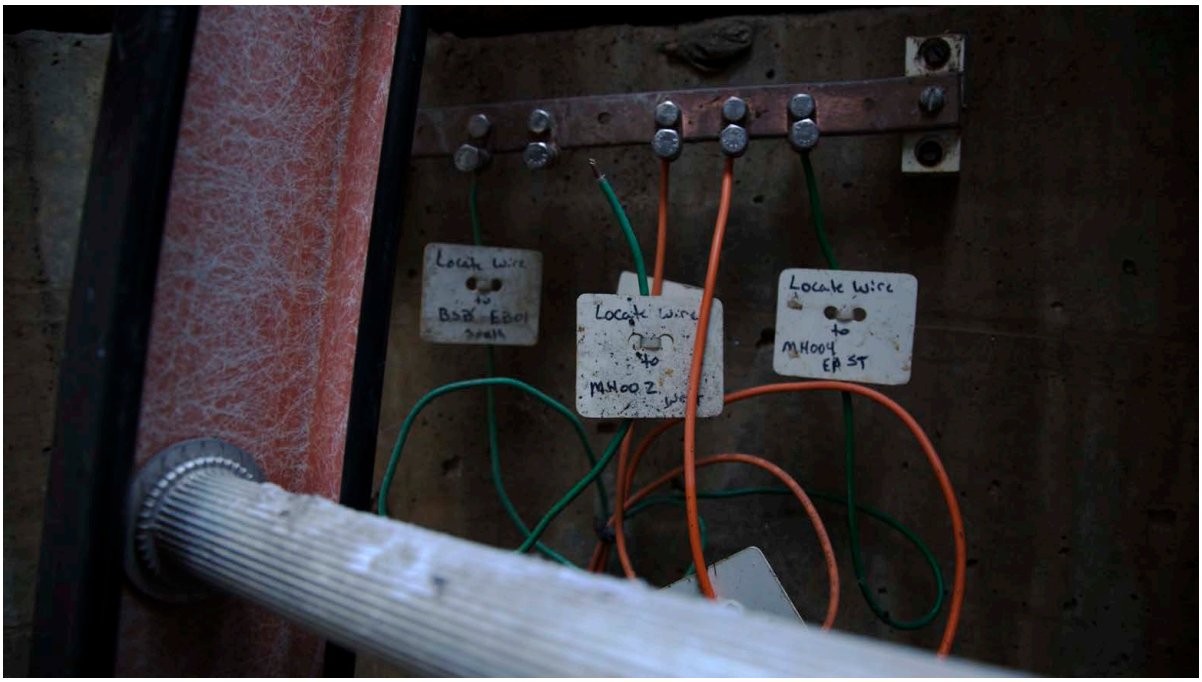

Figure 5. ***Locate Wires***

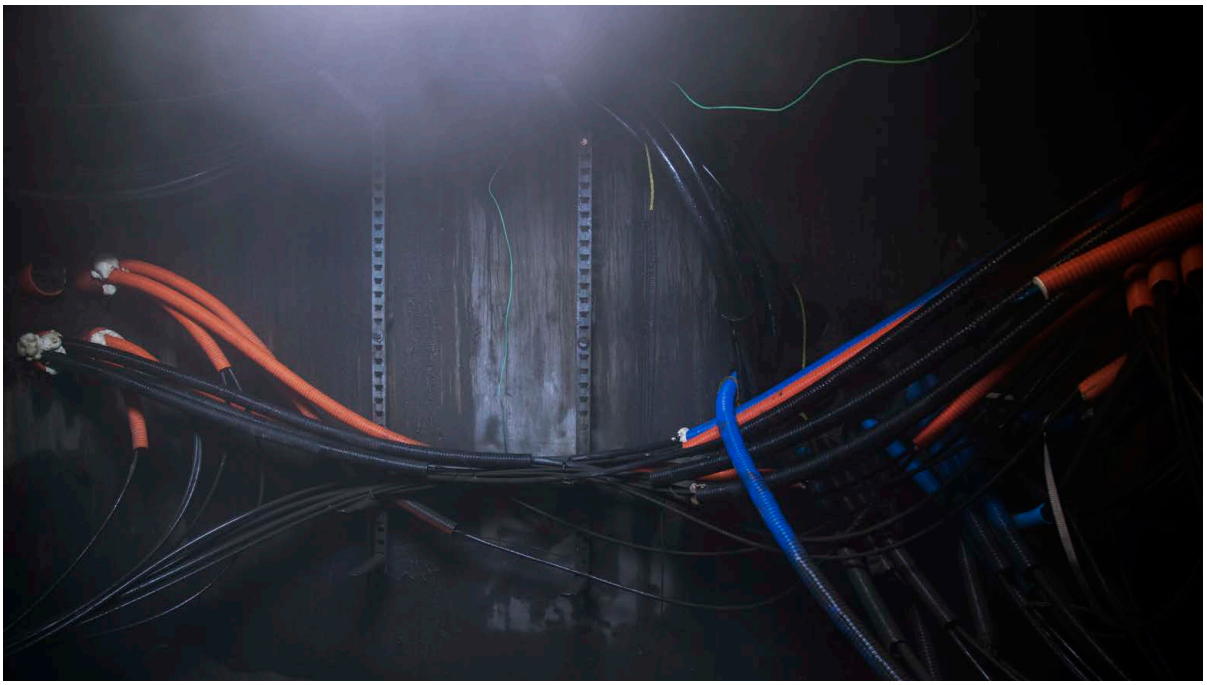
Figure 6. ***Underground #2***

Figure 7. ***Underground #3***

Figure 8. ***Underground Cable Wires***

Outside

Writer Andrew Blume's Internet was out so he called a technician to take a look at it. The technician explained his problem: a squirrel had chewed a piece of the cable that was running out of his house. "Here was the Internet, the most powerful information network ever conceived! Capable of instantaneous communication with any place on earth! Instigator of revolutions! Constant companion, messenger of love, fountain of riches and beloved distraction. Stymied by the buckteeth of a Brooklyn squirrel."[9]

Ingrid Burrington claims that once you decode the signs in the city where the fiber optic cables lie, you will find out that the Internet exists everywhere and we walk over them every day.[10] Luckily, with the constant construction happening in Iowa City, there were a lot of signs that indicate what cables or pipes lie underground. The signs included orange flags, orange spray-paint, and manhole covers.

Construction of infrastructures do not give the public the democratic options to its formation—this has prevented the chance of a dialogue about infrastructure which has been designed to be ignored—it is only noticeable to the public when it is not working. The following works concerned with the Internet Infrastructure stress the importance of understanding the physicality and maintenance of the Internet in the context of artistic experimentation.

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[9] Andrew Blume, *Tubes: A Journey to the Center of the Internet* (New York: HarperCollins Publishers, 2013), 2.

[10] Ingrid Burrington, *Crash Course in Digital Literacy* (New York: Media Evolution, 2014), https://www.youtube.com/watch?v=ThyY4V_YXKA.

Digital Inequality

Iwan Baan's photo of the aftermath devastation of Hurricane Sandy revealed that Wall Street still had power, whereas the rest of New York was without. Since the terrorist attacks of September 11, 2001, the area surrounding Wall Street had become highly militarized and surveilled.[11] The Baan's photo not only documented and memorialized the disaster—it became highly politicized and uncovered new views about the distribution of power. This could be applied to the Internet Infrastructure: Internet is everywhere, but some places are favored over others.

Today, not having good Internet access puts users at a disadvantage for activities such as job searching, business growth, and education. Internet Service Providers (ISP) like AT&T have been guilty of discrimination of their service offerings—a form of digital redlining. They have billed residents in lower income areas to pay full price for Internet that could not reach three megabits per second. "According to data published by the FCC from its Form 477 surveys of providers, AT&T's fastest reported download connection for VDSL (its current version of Digital Subscriber Line Service) was 1.5 mbps or less for households in about 21% of all census blocks in the cities of Cleveland and Detroit."[12] Those blocks are mostly in inner city neighborhoods with many low-income households. ISPs neglect to provide good Internet to lower income communities because they fear that they are less likely to sustain a return on their investment. ISPs can easily provide to individuals and communities the services that can help promote full

[11] Ibid.
[12] Angela Siefer *"Access From AT&T" Not Available to 1.5 Mbps Households* (National Digital Inclusion Alliance, 9/05/2016) https://digitalinclusion.org/blog/2016/9/5/access-from-att-problem/.

civic participation in society, democracy, and economy. However, current practices generate polarization in inequality among the community.

The Internet: Moving Forward

Internet.org is an initiative launched by Facebook to provide access to the Internet to the two thirds of the world currently without it.[13] In order to do this, Facebook launches a carbon-fiber drone that sends satellite signals to people in the area. Facebook appears to be synonymously branding themselves as the Internet and monopolizing untapped markets in Africa, Asia, and South America.[14] Under the guise of a charitable non-profit, Facebook is paralleling past colonial land imperialism and increasing the amount of surveillance in the world.[15] Surveillance not immediately tied to infrastructure, but when cameras are positioned directly next to traffic lights and police presence is increased in poorer neighborhoods, it ultimately becomes connected. Problems are not always resolved by additional infrastructure; unnecessary infrastructure can overwhelm to the point of discomfort. When citizens feel imprisoned by too much infrastructure, it can elicit people to respond in subversive ways that go against the system. One of the most radical forms of human-made infrastructure is the Underground Railroad constructed by African American slaves to escape from their owners. Civilian-made infrastructure can lead to more freedom and control for its community.

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[13] Internet.org *Measuring and Improving Network Performance: an analysis of network and application research, testing and optimization* (https://scontent.xx.fbcdn.net/v/t39.2365-6/12057133_958179554220316_1236052925_n.pdf?oh=1b57295d5af25951beefe979f71cf30c&oe=595953F5)

[14] Ibid.

[15] Holly Randell-Moon and Ryan Tippet. *Security, Race, Biopower*. (London: Palgrave Macmillan UK, 2016).

There have been efforts recently to create a citizen-run Internet around the world. One recently was done in Red Hook, Brooklyn with Mesh Networking. Mesh networking refers "to a broad class of wireless networks in which nodes collaboratively route packets… they can also act as edge networks to a larger network infrastructure, such as the Internet, letting wireless nodes route through one another for complete IP connectivity."[16] During Hurricane Sandy, Red Hook was able to establish Internet connection through the use of mesh networking, while surrounding areas reliant on ISP Internet were unable to connect.

Conclusion

By no means am I advocating for people to stop using the Internet—I love the Internet. The Internet is a powerful tool that can subvert traditional forms of communication and social protocols. A few radical examples include Arab Spring, bitcoin, crowdfunding, activism, removing government censors, and many more. Understanding that infrastructures are not just roads and waterways, but are also comprised of social components, expands the definition and can elevate its importance to a community. The Flint Water crisis and the construction of the oil pipeline through Standing Rock are two examples of how issues surrounding an area's physical infrastructure can be provided widespread attention through the use of Internet infrastructure. Physical pipes and the Internet pipeline often suffer from similar infrastructure issues; therefore, the Internet should borrow similar language to discuss failures surrounding its system.

[16] Samuel Madden and Philip Levis *Mesh Networking: Research and Technology for Multihop Wireless Networks* (IEEE Computer Society, July/August 2008).

No matter how physically removed it is from sight, the Internet remains rooted as a foundation of the community, affecting the social fabric of all our lives. *Clouded Space* demonstrates how the overlapping resources of these networks conflate individual infrastructure. Throughout research, the series informed new ways of thinking brought about by the way the Internet has impacted our society. Now, the ubiquity of IOT (Internet of Things) and the increased availability of Internet access is no longer solely the property of the state. Cracks in the Internet infrastructure have started to show, and beneath them a darker reality of the state of digital communication is being revealed. Unless we deter further cracks from happening, we will continue to live in ignorance. The goal of *Clouded Space* is to alleviate those mysteries by charting the physicality of the Internet and imagining an alternative form of Internet connection that is safer and available to a larger audience.

Bibliography

Blume, Andrew. *Tubes: A Journey to the Center of the Internet*. New York: HarperCollins Publishers, 2013.

Burrington, Ingrid. *Crash Course in Digital Literacy* (New York: Media Evolution, 2014), https://www.youtube.com/watch?v=ThyY4V_YXKA

Chernicoff, David. US Tax Breaks, State by state. DataCenterDynamics 01/06/2016http://www.datacenterdynamics.com/content-tracks/design-build/us-tax-breaks-state-by-state/95428.fullarticle.

Emerson, Sarah. *Mapping the Internet Was Really Easy in 1973*, New York, Motherboard Vice, 12/17/2016, https://motherboard.vice.com/en_us/article/mapping-the-internet-was-really-easy-in-1973-arpanet.

Glanz, James. *Power, Pollution and the Internet*. New York: The New York Times, 9/22/12. http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html.

Internet.org. *Measuring and Improving Network Performance: an analysis of network and application research, testing and optimization.* https://scontent.xx.fbcdn.net/v/t39.2365-6/12057133_958179554220316_1236052925_n.pdf?oh=1b57295d5af25951beefe979f71cf30c&oe=595953F5.

Lyon, Barrett. The Opte Project. Lyon labs, 2014. http://www.opte.org/.

Madden, Samuel and Levis, Phillip. Mesh Networking: Research and Technology for Multihop Wireless Networks. IEEE Computer Society, July/August 2008.

Newbury, David. *Twitter* 12/10/2016. https://twitter.com/workergnome/status/807704855276122114?lang=en.

Patane, Matthew. *West Des Moines' Data Center will Be Microsoft's 'Largest' in U.S. Iowa*. The Des Moines Register, 7/22/2016. http://www.desmoinesregister.com/story/tech/2016/07/22/new-west-des-moines-data-center-gets-475m-incentives/87406160/.

Randell-Moon, Holly and Tippet, Ryan. *Security, Race, Biopower*. London: Palgrave Macmillan UK, 2016.

Siefer, Angela. "Access From AT&T" Not Available to 1.5 Mbps Households (National Digital Inclusion Alliance, 9/05/2016) https://digitalinclusion.org/blog/2016/9/5/access-from-att-problem/.

University of Iowa ITF handout. Iowa, University of Iowa, 2014.