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Culture and Code: The Evolution of Digital Architecture and the Formation of Networked Publics

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CULTURE AND CODE: THE EVOLUTION OF DIGITAL ARCHITECTURE AND THE FORMATION OF NETWORKED PUBLICS

by

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ABSTRACT

CULTURE AND CODE: THE EVOLUTION OF DIGITAL ARCHITECTURE AND THE FORMATION OF NETWORKED PUBLICS

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Culture and Code traces the construction of the modern idea of the Internet and offers a potential glimpse of how that idea may change in the near future. Developed through a theoretical framework that links Sheila Jasanoff and Sang-Hyun Kim's theory of the sociotechnical imaginary to broader theories on publics and counterpublics, *Culture and Code* offers a way to reframe the evolution of Internet technology and its culture as an enmeshed part of larger socio-political shifts within society. In traveling the history of the modern Internet as detailed in its technical documentation, legal documents, user created content, and popular media this dissertation positions the construction of the idea of the Internet and its technology as the result of an ongoing series of intersections and collisions between the sociotechnical imaginaries of three different publics: Implementors, Vendors, and Users. These publics were identified as the primary audiences of the 1989 Internet Engineering Task Force specification of the four-layer TCP/IP model that became a core part of our modern infrastructure. Using that model as a continued metaphor throughout the work, *Culture and Code* shows how each public's sociotechnical imaginary developed, how they influenced and shaped one another, and the inevitable conflicts that arose leading to a coalescing sociotechnical imaginary that is centered around vendor control while continuing to project the ideal of the empowered user.

To Courtney,

my wife and partner through this crazy journey.

Without your amazing support and encouragement, none of this would have been possible.

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Introduction: Imaginaries in Conflict

Science and Technology Studies and the Production of a Networked Society

The January 1975 issue of Po*pular Electronics* announced with all the fanfare it could muster that "The era of the computer in every home- a favorite topic among science-fiction writers- has arrived! It's made possible by the POPULAR ELECTRONICS/MITS Altair 8800, a fullblown computer that can hold its own against sophisticated minicomputers now on the market" (Roberts and Yates 1975). The Altair 8800 was one of the first affordable home computer kits, and it helped to create a groundswell of interest into the growing home computer industry. It is one part of a story that leads to the modern construction of the world we live in today.

I was born six months after the Altair 8800 was released. The personal computer and I grew up together, and the world we knew changed drastically. Like many my age the story of the computing world is a part of my lived history. I still remember my father's IBM PS/2 and learning to write code in a strange language called Pascal.

```
program BeginDissertation;
begin
     writeln('Twenty-five leagues from New York, at the heart of
     network of electric lines, is found a dwelling surrounded
     by deep and quiet deserted gardens.[1]');
end.
```

The digital world became my world, and now it is a part of every element of the work we do and the lives we lead. Our lives are infused with the technology that we grew up in and around. Our fiction, our games, our politics, and our beliefs exist in conjunction with the technologies and systems we build and create (Jasanoff and Kim 2015). The computer, the Internet and the resulting technologies they helped spawn are no different. We tell our technical histories the way we tell our personal histories, through

[1] This is the opening line to the 1886 novel, *L'Ève future,* by Auguste Villiers de l'Isle-Adam (L'Isle-Adam 2001).

story and narratives. Yet, within those narratives are hidden components to a larger sociotechnical imaginary (Jasanoff and Kim 2015).

When I began this dissertation, I wanted to tell that narrative. Too often, we position our protagonists as either the people or the machine. In one context, we tell the story of the computer (Haigh 2018, 8) or the story of the Internet (Abbate 2000). In another, we tell stories about the people who build the systems, the developers and creators (Berners-Lee 2000; Wallace and Erickson 1993). We may even tell stories about those who are lost with the system, whose voices are often lost or silenced in the rise of these technologies (Lanier 2009; Eubanks 2018; Noble 2018). We have heroes and villains, and from that we craft the narrative of our modern technological existence. In this dissertation, I wanted to frame that narrative in a different context. I wanted to pull away from a uniform focus that created an, in my view, untenable division between the technology, its users, its developers, and our understanding of that technology.

I struggled with this story for quite a while. Every path I took sent me into a direction that focused on either the technology or the people, or into what was a systems-level analysis of that moment and context. While such work was important, Spinuzzi's (2003) framework had already done an excellent job of that type of work. I originally thought that I would use a mix of Spinuzzi's genre ecologies and Latour's Actor Network Theory to set the tone for my narrative. Every time I did, I found I wasn't telling a history as much as I was describing a system. I wanted to work at a level that allowed me to think of these systems as part of a broader conversation and evolving narratives.

Sheila Jasanoff's work to this end was transformational. Her development of the idea of a national sociotechnical imaginary is exactly what I needed. A national sociotechnical imaginary is a "collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects" (Jasanoff and Kim 2009, 120). Jasanoff argues that these imaginaries occupy "the theoretically undeveloped space between the idealistic collective imaginations identified by social and political theorists and hybrid by politically neutered networks or assemblages with which STS scholars often describe reality" (2015, 19). As such, the idea of the sociotechnical imaginary allowed me to reframe these narratives not as stories of protagonists and antagonists, but as our, human and machine, journey through a changing imaginary, or more importantly, a journey through the intermingling and collision of multiple imaginaries.[2]

To do this, I dig into Jasanoff's imaginaries. Instead of accepting them as existing constructions, I am interested in looking at how broader national sociotechnical imaginaries are built. To do this, I draw on Michael Warner (2005), Nancy Fraser (2014), and Frank Farmer (2013) who have developed a considerable body of work examining the rise and movements of publics and counterpublics in modern society. Their work, as a challenge and extension to Habermas's idea of the public, resonates well with the idea of imaginaries within each of these groups (Habermas 1991). Keeping the sociotechnical tied to the national level has benefits for political research, but it invariably links these imaginaries to groups that may not be included within those national borders. It is this assumption of the national space as being an inclusive public that Nancy Fraser and Warner resist with regard to the public sphere. Fraser argues that limiting the public sphere to a "Westphalian" model assumes that the communication does not occur or transcend those borders when it obviously does. The interests and circulation of texts within the public sphere does not stop at those borders (2014, 20). Warner presses further suggesting that the public sphere is more a collection of different publics and counterpublics all in conversation with their own practices, ideas, and imaginary (2005, 55). I would suggest the same critiques hold validity when considering a national sociotechnical imaginary. Indeed, Jasanoff suggests this in her placement of sociotechnical imaginaries between collective social imaginaries, of which publics are one,

[2] Although, I suppose we all have our heroes and villains.

and the more hybrid human-machine assemblages of that we often favor in STS scholarship. In so doing, she highlights a missing piece of the scholarship surrounding publics. They are not purely human assemblages but are, instead, hybrid formations of humans and their technology.

In this dissertation, I argue that the development of the modern Internet arose in conjunction with the imaginaries of the public who built and used it. Their ideas about what technology should do and how it should operate were more than technical discussions, they were social and political arguments about the nature of the society in which they lived. It is an argument that seeks to refocus our attention on how we think about our technology and how our technology adapts to that thinking. In the course of outlining my argument, I retrace the history of the networked computer as a social and technical construction from the 1970s on. Certainly, I could not include every aspect of this story,[3] but I worked to create a linked narrative that could incorporate those elements that were left.

My argument pushes us to think about how we approach popular media, technology, and technical communication. In terms of technical communication, when we describe and define what technology does, we inscribe our imaginary upon it and its users. In turn, those technologies reinscribe similar imaginaries into later versions of our work. We see this throughout our techcom discourses. The aforementioned Spinuzzi examines the genres within the ALAS system in Iowa and highlights how the users of the technology adapt it to fit their understanding of how the technology should operate even when the technology is not yet built to work as such (Spinuzzi 2003, 117-118). For Spinuzzi these "destablizations" are alterations to genre which are themselves a creation of social action (Miller 1984). We see similar ideas echoed in the work of Hallenbeck, and in the re-appropriation of bicycles by women in defiance of the dominant sociotechnical imaginary (Hallenbeck 2012). The women who shared and traded bicycle guides that were explicitly written for women were a cultural counterpublic

[3] UUNET, USENET, and IRC are three examples of early 90s Internet applications and networks that I only touch on in this piece but are included in terms of the broader discussion of the imaginary.

straight from Farmer's description (2013, 56).[4] Sociotechnical imaginaries play an incredibly important role in the creation and distribution of technology and technical communication. Understanding them and their influence and direction can help us become more effective and efficient communicators and developers.

In one sense, this dissertation is an exploration of a story that many of us know. It is the story of our lives crafted through a series of machines and their functions. In another, is a challenge to rethink our roles and influences in that narrative to consider how and why we think about our technology and online world the way we do. We may not know what the next chapter holds, but we can hold fast to the imaginaries we believe, crafting our systems and our communication in accordance the worlds we imagine. As Jasanoff reminds us, "Analyzing sociotechnical imaginaries emerges, then, as a form of intensely political narration, reminding both observers and the observed that the seen reality is not the only one about which we can dream" (2018, 340).

[4] Famer defines "a cultural public as any social formation, established primarily through texts, whose constructed identity functions, in some measure, to oppose and critique the accepted norms of the society in which it emerges" (2013, 56).

Chapter 1: Models for a Social History of Network Technology

Rethinking the Narrative

We like our tools, and we seem to like to tell stories about the tools we create and use. Each story we tell offers new insights about our culture and world, as well as the tool itself. The technologies that pervade our lives often critically structure the way we think about ourselves and each other. Perhaps, this is why crafting a narrative of technological change, especially one focused on communications technology, always seems to carry a temptation to treat those changes as revolutionary. Modern commentary and even some scholarly research on these technologies, from the printing press to the Internet, are often filled with terms that uncritically evoke radical novelty. Talk of innovation and disruption leads to insights about how these inventions have brought about new ways of thinking and sharing, and how they are harbingers of social change. Depending on the author and the aim of the text, the revolution may be catastrophic, benign or utopian. Yet the technology is always positioned as an entity of power and of potential concern. While such narratives can often garner much interest, there is a risk in framing our focus on communication technologies in such a way. Narratives focused on technology as the harbinger of social change can lose focus on the more complex inter-relationships that develop between the technology and society. These relationships place technology as an agent within a far more complex structure of social evolution.

In *We Have Never Been Modern*, Bruno Latour identifies three major misconceptions that trouble researchers who examine scientific and technological progress as part of a broader social narrative. These misconceptions, he argues, arise from the hybrid nature of the work and inevitably lead to limitation in our understanding of science and culture (1993, 3-4). The first misconception is disciplinary positioning. Researchers assume that any analysis of a communications technology belongs within the scientific and technical discipline that developed that technology and that the analyses so performed are merely a function of that ongoing work (Latour 1993, 4). The second is the politicization which seems to follow from the assumption that such analyses are an attempt to reduce the scientific and technical sphere into a political form (Latour 1993, 4). This is often the first response from engineers and scientists who have been taught to think of their work as "politically neutral" and who view any critical analysis of that work as a deliberate attack on their assumed objectivity. The third misconception is “removal,” where analyses are treated as a discussion of discourse and representation, what Latour terms "rhetoric," without addressing the fact that such representations do not eliminate or alter the larger capacities that these technologies carry (Latour 1993, 5). Narratives in this case tend to focus more on the users and use of the technology and the representation of those users and their texts within specific technological instances without addressing how the technologies themselves are contingent within those discourses and beyond. These misconceptions are just as often found in work that examines the evolution of digital communications technology. They remain a temptation for scholars due to the value in approaches that adopt these concepts, so we shouldn’t throw the baby out with the bathwater, ignoring every history which falls victim to these errors.

Some historians can and do design their analyses to fit within narrow disciplinary confines, focused more on technical and scientific content than the broader impact of that content; it is perfectly legitimate to discuss the rise of digital technology in technical terms. Understanding core technologies is important and necessary for any social / historical analysis. Where Latour sees risk, however, is when that disciplinary line is used to artificially segment those technological structures from the broader relationships in which they are positioned. A network protocol's structure and form, for example, are as much political as they are technical. As such, it is also possible to link the rise of technology to the broader political structures that have helped to shape the society in which these technologies are designed and built. Research in digital rhetoric and other related analyses of how and why we communicate in digital networks is absolutely important as long as the technology that enables that communication is not forgotten in the process. When it is forgotten, the effectiveness of the research is limited.

For Latour, this breakdown was evidence of an arbitrary and unnecessary division between human and nonhuman actors in modern critique and the impact and ineffectiveness of traditional critical approaches to thinking about science and technology (Latour 1993, 5-6). For digital technology, the breakdown results in lost context, due to how we position that technology in our study. Much of the work done by digital rhetoricians involves fragmenting the technologies they study and the role those technologies can play within their analyses. Essentially, digital rhetoricians seem to have taken Lanham's dual approach of looking either *at* and *through* the machine (Lanham 2010, 149-150) and made it a sort of starting point for study. [1] Instead of working to switch between views as Lanham suggests (Lanham 2010, 152), they instead focus on only one view. In each of these cases, the technology we use is either the topic of study, science-in-the-making, or assumed as an already existing black box, science-ready-made (Latour 1988, 13-14). In each case, as Latour and Lanham both suggest there is something missing in the overall approach.

As I design a social narrative for the history of the internet, I hope to rethink those approaches and avoid the standard oppositions while acknowledging their contribution to the technological worldview we currently inhabit. To do this, I must begin by considering how technology itself is co-constitutive of the society it inhabits. Developing, constructing, and using technology are rhetorical acts, and as rhetorical acts they are positioned in, respond to, and result in the change of the broader society. In examining those changes, I will attempt to refigure the technology and its structures as whole and

[1] An example, used by many (Grusin and Bolter 2000; Galloway 2012), is that of a monitor or screen. When we look at a monitor or screen we can examine the type of screen, the shape and size of it, and the features it contains. We can also look through the screen to see what is happening, In such cases, the screen and monitor are not longer the focus of our attention.

separate actors who operate both as agents of change, as we often like to imagine, and as elements subject to the changes in the world in which they exist.

In order to pick apart this human-machine palimpsest that often overlays our historical narratives of technology and tell the story of digital change, we must begin by looking at the development of digital technology as a part of larger socio-technical constructions. Certainly, there have already been a large number of important histories and biographies of early developers and their companies and organizations. These histories help to give us a context for and understanding of how these individuals created our modern infrastructure, but in holding to those arbitrary lines, the authors of these texts often keep their focus firmly fixed on the developer or the technology. To fully tell the story of how modern digital technology has changed within the broader sociopolitical contexts, however, we must look at these systems broadly.

I propose, then, an excavation, a re-examination of histories of the modern Internet as a socio-technical construct. When beginning an excavation, it always helps to have a mapto guide the way. Network engineers and developers rely on protocol models to guide their work, and a version of those models can help us navigate, in metaphor at least, the history of "the Internet." Much of the Internet, as we use it today, relies on a protocol known as TCP/IP, which manages and delivers network traffic all around the world. A layered set of processes (from hardware through software) is called a stack and may parallel the interconnections between the social and the technical. The history, in a sense, evolves through hardware into software, though at each juncture, I will argue, it is in dialogue with social and political arguments about the use and meaning of communications technology.

The TCP/IP network model, as first defined in draft 1122 and 1123 of a Request for Comments (RFC) from the Internet Engineering Task Force, consists of 4 distinct layers: the link layer, the internet or network layer, the transport layer, and the application layer. When data is sent through a TCP/IP network, each layer encapsulates the data from the lower layer and passes it on. Every network transmission contains the sum of the other layers. My exploration of the socio-technical construction of the modern digital network will use that model as a metaphor and guide. This first chapter will act to outline the core elements of the network model and its social corollaries. In the rest of this first chapter I will continue to outline the evolution of and shape of technology and society as interconnected objects. Chapter 2 will establish the link layer, connecting network technology to three contingent publics and highlighting how the publics and the technologies co-evolved with one another. I will then take these connections and encapsulate them within Sheila Jasanoff and Sang-Hyun Kim's work on sociotechnical imaginaries which are themselves a further extension of the social imaginary account developed by Charles Taylor. In Chapter 3, the Internet layer, I build on that characterization to examine the movement of digital technology and the network between three publics that built and used them through the 70s, 80s, and 90s. During this time, the massive changes in technological and networked infrastructure were accompanied by and built through the rise of a new user imaginary that repositioned technology in social, political, and economic contexts.

As I trace and outline this new imaginary, I will examine how different technological protocols and systems come to prominence through a complex system of social and technical interactions that worked to transmit the ideas that were born out through those imaginaries. The transport layer of Chapter 4 traces the evolution of the early World Wide Web and how it was adapted by and for different public imaginaries. As the structure and format of the web becomes more defined throughout the 90s, it does so in response to rapid growth in the dominance of a specific “vendor imaginary” that reshaped how we think about the function and potential use of the Internet. In Chapter 5, the application layer, I will show how this dominant imaginary has been applied in modern infrastructure and become a driver for the modern construction and use of the Internet. While much of that infrastructure can be seen as fundamental to our modern understanding of network architecture, software, and hardware, we cannot ignore the fact that the same imaginary is implicated in many of the major socio-political issues that currently plague our modern digital lives.

TCP/IP Network 4 Layer Model Map and Chapters		
Layer 1	Link	Chapter 2: Publics and Network Technology
Layer 2	Internet	Chapter 3: Implementor Publics and the Rise of the User Imaginary
Layer 3	Transport	Chapter 4: Restructuring the Network Imaginary
Layer 4	Application	Chapter 5: Web 2.0 and Fall of the User Imaginary

Table 1: TCP/IP Network Model Outline

In using a layer model to structure this analysis, I take a page from Benjamin Bratton, who, in his book, *The Stack: On Software and Sovereignty*, builds a broad interconnected set of relationships between political culture and technological culture which he patterns after the Open Systems Interconnection (OSI) Model for digital telecommunications. Like the TCP/IP protocol stack outline above, developers use the OSI stack to identify the interactions between software and hardware systems at different protocol levels. Unlike the TCP/IP model, the OSI model consists of seven layers that move from the bare wire of the hardware all the way to complex high level applications. Both the OSI and TCP/IP stacks act as models for how a technology works. Each layer builds on what comes before, encapsulating its data for transmission and later translation along the network. Bratton adapts and inverts the OSI model to include the large social structures that drive these technologies. For Bratton the political state is a machine, albeit accidental, which is now enmeshed in a worldwide computational enterprise. At the base of Bratton's stack is the Earth and at its top, the User (Bratton 2016, 11).

In defining users, Bratton resists considering them as individuals. Rather he suggests that "In practice, however, the User is not a type of creature but a category of agents; it is a position within a system without which it has no role or essential identity" (Bratton 2016, 251). Earlier he notes that users are "cohered in relation to Interfaces" (Bratton 2016, 12). They are assembled and connected to one another by the systemic elements around them; there is no strong division between people and things, users and tools. This impersonal assemblage of individuals, human and nonhuman, around a system, itself a collection of texts and relationships, seems functionally equivalent to a “public.” A public, as Warner notes in *Publics and Counterpublics*, cannot exist without the texts that it engages with and circulates (Warner 2005, 90-91). Users only exist when there is a system to interact with and use. Bratton's users and their capacity for agency are driven by the systems. So, too, a public's capacity for agency is limited by the systemic structures, institutional constructions, that provide an acknowledgment of that public.

This relationship underscores an important feature of a public and suggests why publics matter in the development of socio-technical structures. While publics are products of response and action, they are also technological creations. Publics exist because texts can be created, viewed, and circulated (Warner 90). Their existence is contingent on and shaped by the very technologies they embrace. The same is true for the larger state and community constructions that develop out of the ongoing interactions between those publics. We can see evidence of this outline early on in Benedict Anderson's *Imagined Communities* which identifies the rise of print technology and its distribution as a key element in the development of the ideas of a nation-state (Anderson 2006, 46). While Anderson's work ultimately focuses on regimes of state, it highlights the importance of technology in the development of community identity on both a large and small scale. Understanding publics and the communities that form around and through them as technoscientific constructions has helped to open new avenues for rhetorical research. In acknowledging the role of technology in community formation, we can start to break down the space between people and technology, to erase, as Latour suggests, the division between the social and technical (Latour 1988, 141). In short, to suggest that there is no such division. Instead, as theories like actor-network suggest, the social, political, and technical elements that push technological advancement are inexorably linked to one another in broad publics (Latour 1988, 247).

I invoke this account of publics for two reasons. First, the reflexive relationship between publics and the creation and circulation of texts provides a pathway for watching the formation and subsequent evolution of the technology as it interacts and adapts to the larger culture. Digital technology has enabled the creation of texts on a level previously unimagined. At the same time, other forms of technology, especially Internet technology, excel in enabling the widespread distribution of those texts. The balance between creation and distribution, and the goals and the publics engaged in those practices alter both the texts and the technology. As methods of creation and distribution ebb and flow, the publics that form around these newly accessible texts change as well. Second, publics are critical to sociopolitical discourse beyond the systems in question. These discourses often predate modern technology. Examining how these technologies come into being as the textual creations of different publics allows us to trace these sociotechnical interactions over time. While technology is a contingent part of any sociopolitical system, it is important for us to remember that it can also be thought of as a text within that system.

Once again, in this dual nature of technology, we see shades of Richard Lanham on "the electronic word," referenced above. Technology can be looked at as a text created within a specific social context developed by its authors with a specific set of motives and goals,[2] or it can be looked through as part of larger system of interactions and practices. The people and publics within those systems enact political ideologies, and as they do, they imbue their texts and technologies with the same ideologies. By tracing how publics and technologies interact and change one another over time we can understand not only how technology and people operate today but examine how and why those interactions have changed. More fundamentally, the changing of these interactions provide us with an understanding the broader sociotechnical imaginaries (Jasanoff and Kim 2009) that sit at the core of this

[2] Although, as Charles Taylor notes, there is a wide variety of different motives and goals can and often do end up working to produce a similar set of techno-social practices (2003, 33).

discussion. These imaginaries are the result of the ongoing sociopolitical discourses carried on by different publics and performed through the creation and development of hardware and software (Jasanoff and Kim 2015). It is the history of that discourse that interests us here. The next few sections will summarize some of the main currents of contemporary historiography of the internet.

Telling the History of the Digital Public Sphere

Changes in technological innovation have become an expected part of our social and political discourse. Over the past 50 years, industrialized societies, the world over, have experienced massive changes in the way they interact with digital technology and, in turn, each other. In the United States, the explosive growth of Internet technology has been likened to a new Industrial Revolution that has reshaped our economic, social, and political understanding (Brynjolfsson and McAfee 2016, 11-2). The impact of digital internet technology on the modern world has indeed been profound. In their excitement to highlight the revolutionary changes wrought by technology, many authors end up portraying their histories as an inevitable march toward progress. This becomes apparent as the focus of many of these authors, is not the past but the future. Both Klaus Schwab's (2017) *The Fourth Industrial Revolution* and Brynjolfsson and Mcafee's (2016) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* upon which Schwab builds take a future-focused approach in which they track the past to a new wondrous techno-future that, at times, borders on the utopic. Thus, when the past is discussed it is used as a foil against this future. To be fair, the future is not always a bright one. Dystopian visions of our technological present and future are just as common. Where Schwab looks to the past as a sort of failed experiment now technologically improved, books like Sherry Turkle's (2016) *Reclaiming Conversation: The Power of Talk in a Digital Age* and Eli Pariser's (2011) *The Filter Bubble* use the past as a foil against what they see as the negative impacts of digital technology on the present and future. Certainly, these comparisons can be useful. They do not, however, provide a context for how these situations changed or why, nor do they work to understand how the different social and technical interactions from the past are re-inscribed in more modern terms. In focusing so intently on the changes that have occurred, they have also missed something even more profound: how many of these systems work to promote the continued preservation, for better and for worse, of the status quo or the current imagined structure of technological use and design.

Computing and the Network in the Public Mind

Shifts in the nature and construction of digital technology cannot happen without our conceptions of that technology also changing. So as computer technology came of age in the middle of the 20th century, its social and political possibilities evolved in tandem. By the 1970s, digital networks and computer technology were common fixtures in the public imagination. As these technologies had advanced following the Second World War, public awareness steadily grew; however, the actual elements of these technologies, the systems and tools, were largely unavailable outside a few laboratories. These early systems were expensive both to build and maintain and had relatively primitive capabilities which nonetheless required a high level of expertise to operate and program. There were no tech startups, or even Philo Farnsworth inventing television in his garage; digital technologies and the construction of digital products were large-scale industrial enterprises that required significant capital investment and infrastructure. Because of these constraints, these early network technologies existed primarily in government, academic, and corporate research. For those outside those infrastructures, technology was linked to that industrial perspective; the machines these organizations used were not agents of liberation but tools of control and automation. These fears were only compounded as the power of the technology grew and its importance to military power become essential. Technology was power, but that power was dangerous and could easily lead to disaster. These fears were echoed in Eisenhower's prescient warning of a "vast military industrial complex" and further exacerbated by the ongoing threat of nuclear assault. For many, these technologies represented a dehumanizing power, a false promise that housed darker authoritarian ideals that sought to erase the individual (Horkheimer 2013, 107).

The publics engaged within these technical spaces were isolated. The texts and systems they shared were closed systems of hierarchical control (Edwards 1997). As such, the was little distinction between developer and user. Most computers systems of the time required “hand” programming of some sort for even the most basic of behaviors. This limited the set of potential users and maintained a flattened structure in terms of tools and code. Developers used computers to generate reports and information which was then printed back into physical form and provided to other users. Computer use was connected, then, to a sort of niche technical specialty separate from the experience of most people.

The power and fear of digital technology in the public imagination was common fodder for entertainment. Radio, television, and film, the dominant broadcast mediums of the time, regularly featured computers in their works. These broadcast mediums were tightly controlled platforms, but they responded to and thrived on these broader public concerns. The works they created became sources for the reinterpretation of the technical realities in which they lived. Films and movies often struggled with the perceived power the computers held along with the opaque nature of their control and use. Quite often, technology was portrayed as something alien and anti-human. In the 1964 episode of the *Twilight Zone*, “The Brain Center at Whipple's” (1964) this fear of technology is plainly evident. In this case, the fear is one of automation: that technology will remove the need for human labor. This fear, tied to the very economic structures that drive modern capitalism, has been a fundamental public concern since the days of the early Luddites. In the episode, however, no one fights back. It opens with Mr. Whipple of the Whipple Corporation delivering a filmed address to his stockholders highlighting a new computer system. As Mr. Whipple talks, he proudly informs his shareholders that this new machine will erase 61,0000 jobs which he then crosses out on a black board as he notes that this means they will save $4 million by not having to pay for employee hospitalization and welfare. As the episode progresses, more and more people are let go as the plant becomes more automated. Resistance, it is suggested, is overwhelmed by the creeping normalcy of technological change. The entire factory is not laid off at once, but instead in drips and drops until Mr. Whipple himself is eventually removed leaving only the technology in charge.

Notably, the depiction of the computer in this episode is an interesting figure in and of itself. Like many computers depicted prior to the 1980s it is a large and imposing structure with a strange and unintelligible array of lights and switches that blink at regular intervals. While the computers of the time were certainly large and imposing these elements were capitalized upon in the popular entertainment of the period. The large light, blinking with a regularity that suggested an intelligence that was not human. The imposing structures, industrial monoliths, conjured up visions of an industrial state devoid of human empathy. As symbols of power and capacity, these machines were remote and inaccessible. They were powerful, alien, and dangerous.

Here too, the paradox of our technological relationships arise. As computers grew in power, publics were torn between their desire for powerful tools and their concern over what that technology might do to society. In some respect, episodes like the ``The Brain Center at Whipple's" were almost prophetic. Computers and digital technology would increase corporate productivity to previously unheard levels, and yet wages have stagnated (Bivens et al. 2014. 10). In the ``The Brain Center at Whipple's" the CEO is eventually forced out, but he is not forced out by the technology. He is replaced by a robot, a replacement that was ordered by a very human board of directors. The fear of technological replacement, then, is not so much a fear of technology, but a fear of how that power can be used by those with the ability to marshal those technologies. The episode aired was 10 years before Americans began to see a significant decline in manufacturing jobs and wages (Atkinson 2012, 1), but the fear of automation and replacement and the rule of a technologically advanced elite was a dominant theme throughout much of the early computer age.

Often, technological power was expressed as a form of scientific power which, in the mid-20th century, meant military strength. Even when technology was embraced as a positive, it often was done so in a military context. Early science fiction books as well as science fiction on the screen highlighted digital technology as a form of military power. Having that power meant protection and safety. Technology was a rigid system of control and strength. Like the military, its rules and behaviors were beyond the realm of the general public (Edwards 1997, 104-106), and yet the general public relied on these entities for protection and survival. This idea is one carried over from the scientific advances of the nuclear age where people saw that knowledge and scientific capacity meant national security. Even some of the more progressive television series of the late 1960s carried on with this ideal. *Star Trek*, for example, positioned technical superiority as a surety of military safety. The starship *Enterprise* was a military vessel that would often use technological superiority as way to protect a semi-utopian vision of the future from aggressive invaders. Even in more family-oriented shows like *Lost in Space* the civilian family was still connected to broader government conflicts. Dr. Smith, the bumbling co-traveler and sometime antagonist of the family, was a spy who corrupted the robot that was supposed to protect the Robinsons and their ship stranding them all in space.[3] Technology was presented to the public as a political sign of strength and a warning of what happens to those who do not keep up. These series reflected the fears that many had of technology gone out of control or lost in the hands of enemies who could hurt them. Technology was portrayed and designed as something beyond the general public and yet it constituted a consistent and apparent threat to their safety. For these individuals the chance of

[3] The robot from *Lost in Space* is also remarkably similar in design to that of the robotic Mr. Whipple at the end of "The Brain Center at Whipple's"; it was itself recycled from Robbie the Robot in the film *Forbidden Planet*.

death by a cold and impersonal technological creation was, like the clicking hand of the Doomsday clock of the *Bulletin of Atomic Scientists*, mere moments away.

For technological researchers, however, this fear was a boon. It was precisely this fear that Vannevar Bush had used to rationalize his push for increased funding for science and technology research (Edwards 59). Technology at this level may have been cold, impersonal, and dangerous, but it was also the only way to remain safe in world that was rapidly becoming more technologically advanced. If research was not funded, the country risked falling behind. Funding research, empowering various government agencies and public-private partnerships, was the only way to protect the country (Edwards 1997, 12-14). This opened the floodgates for research and, as I will discuss later, created opportunities for interdisciplinary collaboration that had been impossible before (Turner 2008, 58). It also established a very specific view of what and how that research was to be developed.

While digital infrastructure often remained firmly locked behind governmental, industrial, and research boundaries, there was a growing movement of individuals who sought to bridge those gaps. Capitalizing on existing architectures, they developed systems of access that opened these systems to broader audiences. These early digital networks allowed companies and consumers access to technological resources that were once unavailable. While limited, this type of access would become commonplace over the next decade and helped to reframe peoples' perception of and relationship to these newly-built and growing digital networks.

The 1970s also saw an explosion of consumer technology that help to promote interest in the growing hobby computer market which challenged the view of the computer as an industrial tool. As transistors and other components became cheaper and easier to produce, manufacturers flooded the market with new devices. In the 1970s, this technology was focused primarily on the distribution and consumption of media. Televisions and radio became more advanced and more accessible. Audiences could soon engage with these technologies and the media they carried on a national level. This created new forms of conversations and a growing political awareness linked to technological innovation. Television fundamentally altered the political landscape. Political propagandists had long discovered that their skills were just as useful in developing advertising campaigns (Tye 2002, 49). They formed advertising firms whose techniques were then used by politicians seeking election in an ouroboros-like manner.

Television shows and newscasts brought together audiences and publics in new ways. As the popularity of television grew, so too did the number of counterpublics that surrounded it. As Frank Farmer (2013) points out in *After the Public Turn* these publics would draw on these larger works that were produced and distributed by mainstream firms and appropriate them for their own work. The zine culture of the 1970s existed in large part as a response to these growing themes within the dominant cultural media-sphere and offered those left out of that space a chance to build their own. While these publics were more focused on manual distribution methods, the zine culture of the 1970s would figure heavily in the shaping early forms of communications technologies in the 1980 especially in early electronic bulletin board systems which provided early computer users a local space of digital communication that often replicated the style and approach of the earlier zine communities.

The Personal Computer: Power and Boundaries

The rise of digital bulletin board systems (BBS), precursors to the modern Internet, arose in tandem with the explosion of the personal computer (PC) in the 1980s. During this time, the home computer kit, first imagined as the tool of a hobbyist in the 1970s, was transformed into an accessible tool for the broader public. As the PC entered the market it had a profound effect on the perception of digital technology and its relationship to the individual. Digital technology was no longer a tool for the industrial and quasi-governmental powers. It was a tool for the people. The growth of the PC was driven by two factors, the rapid decrease in the cost of digital components coupled with a rapid increase in processing power (Brynjolfsson and McAfee 2016), 54-56. The 1980s saw the eventual outcome of Moore's law writ large across digital architectures. Moore's Law, as defined by Intel co-founder Gordon Moore in 1965, stated that the number of transistors on a chip would double every year for the foreseeable future (Brynjolfsson and Mcafee 2016, 40-41). This meant that every year, the processing power of a computer chip would almost double while at the time dropping in price. This law has largely proven correct, and only recently have we begun to see the physical limits of Moore's Law. In the 1980s, this meant a drastic increase in power and processing capability, not just for industry and government, but for home hobbyists and eventually the broader commercial public.

It is hard to overstate the importance of Moore's Law for the technology industry and the publics that surround it.[4] Moore's Law set the tone for the modern digital age, and that tone was one of inevitable progress. As a rhetorical tool, it carries an impressive amount of power. Moore's Law undergirds the mythology of digital technology couched in a teleological view of its own history. The power and capacity of technology is increasing, Moore claims, and this is viewed as a universal good. Technology is meant to become more powerful and that power is defined in strict terms, by the number of transistors that could fit on an integrated circuit. For designers and developers, this push for more power, faster machines, and more capacity helped to drive computers into the mainstream, but that single-minded focus left larger analyses by the wayside. It left potential for development and design that were focused less on aspects of more power and more on structures of usability and access. Challenges which, in some cases, are only now being addressed.

Moore's Law drove a shift in industry focus that began to develop in the late 1970s and 80s. In the 1960s and early 1970s, processor development was growing and changing to meet the needs of the

[4] The rhetorical value outweighs the accuracy of the law which has been revised to make it appear true even when it was not (Mollick 2006).

enterprise systems that required them.[5] This meant that while attention to power and storage was important, much of the development focus was on developing core system tools and programming languages that allowed the users of digital technology to more easily work on and develop for these emerging systems. With the development of the Unix operating system at Bell Labs and the creation of the C programming language which became the defacto language of Unix and its successors throughout the 1970s (Ritchie 2003), these core structures were in place and ready for expansion by the 1980s.

Soon, however, the focus was not on the language and the tools, but on the power of the system. PCs were sold based on the quality of their processor and the storage they had. This became the important indicator and drove developer and researcher budgets and agendas. While much of the focus was on processors, this same drive for speed and power drove the development of other subsystems. Storage interfaces were speeding up to match the processing capabilities of these newer systems. This meant data could be stored and read at faster speeds which ultimately enabled the creation and modification of sound and video media and opened the PC market to software that was specifically focused on media creators. This gave independent creators a lot more options and opened new possibilities for audio and film production to those who previously could not afford the resources necessary to participate in those spaces.

This shift in focus for hardware development firms left open a new area of development, software. Prior to the 1980s most software development was done in-house or by those firms who were developing the hardware. As their focus narrowed, a new class of developer arose. These developers, using the advances of the previous decade as a template, focused their attention on application level software. As they did so, they quickly found operating systems that were not always designed for widespread application level deployment. This gap created an opening for hybrid developers who would

[5] Enterprise systems are hardware and software systems designed for large-scale corporate and government use.

take existing hardware and craft operating systems for it; the best known of these were Microsoft and Apple. From the start, each company took a different approach to its development practice. Paul Allen and Bill Gates focused their development on existing hardware platforms. Microsoft BASIC was designed for the Altair 8800. This practice continues even today where Microsoft's focus continues to be on applications and operating systems for prebuilt hardware platforms; although in, the shift in how software is distributed and managed, Microsoft has begun to make some steps into creating its own hardware. As I will discuss later, this transition is an inevitable condition of much earlier practices. From the start, Apple's focus was a bit more low-level. They took existing hardware components and built them into workable hardware and software systems. This holistic approach allowed Apple to control every part of the design process enabling a tighter integration between software and hardware components, but it also meant that Apple would always be one step behind in terms of system power and capacity as it redesigned its systems. Microsoft's applications and operating systems could potentially take advantage of new hardware almost as soon as it was released.

As these early competitors became more popular, other software developers began to develop tools and applications for their software platforms. These development tools and packages helped to expand the reach of computers and their applications. While Moore's Law remained a hardware level law, the impact it had on software development was just as profound. Software development arranged itself to meet the increasing system capabilities that new processors had to offer. This was mutually beneficial for hardware and software developers. New software required new systems to run. This meant that users could not rely on using older machines for any more than a few years. Corporate and home users began an ongoing rotation of machines, trading out systems that were cutting-edge only a few years before, but were now unable to keep up with the growing demands of more powerful software.

Considering the explosion of possibility that these new computer systems and their software offered, it is not surprising that they were often portrayed as objects of liberation. They were certainly sold that way. Far removed from the industrial concerns of the previous decades, these new personal computer systems were just that, personal. The monstrosities from Mr. Whipple's factory were replaced with small clean boxes that sat beneath a desk. These small systems which gave everyone who had them the power of the mainframe in their own home and under their control. That sense of power and control marked a very different tone than that of previous decades. People no longer worried about what those in power might do. Instead, through these machines, they saw themselves as the wielders of that technological power. Ridley Scott's now iconic Apple Macintosh ad, which aired during the 1984 Superbowl, brilliantly demonstrated this breaking free of those digital shackles of that large techno-industrial complex. The ad depicting a woman in white and red running through a desaturated landscape while the people listen to a speaker reciting the following lines:

> Today, we celebrate the first glorious anniversary of the Information Purification Directives. We have created, for the first time in all history, a garden of pure ideology—where each worker may bloom, secure from the pests purveying contradictory truths. Our Unification of Thoughts is more powerful a weapon than any fleet or army on earth. We are one people, with one will, one resolve, one cause. Our enemies shall talk themselves to death, and we will bury them with their own confusion. We shall prevail! (“Apple’s Macintosh Commercial" 1984)

This advertisement was ostensibly a push back against what Steve Jobs considered to be IBM's dominance in the early PC market (Gallo), but it also captured the public’s broader imagination about what PCs could become. The ad reframes the PC as a tool of the individual in opposition to broader industrial and military control. In the ad, the personal computer stands with the individual in resisting the dehumanizing automation that so concerned previous decades. Linking imagery of strength and individualism in opposition to the oppression of uniformity, Apple's ad suggested that the modern PC, the new consumer and creator focused Macintosh in particular, was as a tool of self-expression and empowerment. In the climax of the advertisement the woman throws a sledgehammer into the large screen of the speaker ostensibly shattering the over-speaker's control and freeing the viewers. In the background a voice tells the viewer that the Macintosh computer will help make 1984 very different from Orwell's version. The Macintosh and its early competitor the Amiga specialized in expanding the creative power of early PCs. As they did, the creative power of the individual user also expanded. Suddenly, a person in their own home could create a small film with digital effects that, while not yet ready to rival large development studios, could still compete with local media channels. With Moore's Law firmly pushing growth and development, these technologies were improving at a rapid pace. Soon, the digital media creation capabilities of the modern PC would come to rival those larger studios. These tools, once only available to the wealthy and powerful, were suddenly far more affordable and accessible. Theorists and early PC enthusiasts imagined a new public sphere in which PC enabled individuals could create new and complex works with one another opening up what had become an increasingly controlled and managed space of media communication focused less on distractions and "unified thoughts" and more one a shared space of communication. While many doubted this communicative potential (Habermas; Postman), hobbyists and counter-culture thinking suddenly found themselves on the side of digital technology. As I will discuss later, however, this creative expansion was extremely limited in focus and carried with it attitudes of liberation that worked against broader forms of inclusion. Indeed, the impact of the PC-user partnership in developer and hacker culture continues to drive many of the issues we see today.

While processor and storage capacity helped to make PCs a growing staple in the home, perhaps the most beneficial push for modern digital technology was the advance of what was, in the early 80s, a far less common piece of digital equipment, the modulator-demodulator or modem for short. Modems convert digital data into an analog signal. Using a modem allowed users to encode the digital data from their PC in an analog signal that could then be distributed via those analog systems already in place throughout the country, most notably Plain Old Telephone Service (POTS). While PCs were useful tools for creative work development, they were also bound to their physical location. The portable disks of the time were either incredibly expensive or limited in terms of storage. The was no practical way to distribute digital technology without returning to already existing distribution channels that were under the control of government and industry. For early hobbyists, many of whom had now taken on the name of hackers, this was unacceptable. Digital distribution methods were needed, and the dial–up modem offered one such method.

Modems also offered something else, a sense of interconnection and place. In the mainframe era of the decades before, users were all collected into a single system. While this helped to fuel the lack of power many users felt with a mainframe, it also allowed the users to communicate. Early messaging was developed, in fact, to facilitate this type of communication. As network technology expanded with the development of ARPANET, these messaging applications became necessary for research. In the 1980s, separate from the rise of modem and BBS culture which formed long POTS lines, the early Internet took shape along a variety of University, industry, and government-built networks. As the Internet became more popular with researcher, messaging systems expanded. Email became more robust and Internet wide message-boards distributed via USENET grew in popularity and scope. In the 1980s, however, these early Internet spaces were primarily the domain of the researcher and developer. While open, in one form, the level of knowledge and access required to connect and use these systems provided a sort of self-selecting closed system of interaction.

The BBS offered access to a different audience but developed a similar sense of culture and design. Early BBS software was counterculture by design. As John Markoff (2006) relates in *What the Dormouse Said: How the 60s Counterculture Shaped the Personal Computer* the first BBS precursor, *Community Memory*, appeared in 1973 as an offshoot of Resource One a shared computing space for researcher and activists hosted on an SDS-940 mainframe in Berkley (Markoff 2006,199). As the site of an early form of digital collaboration software, NLS, the SDS-940 and the Resource One project space were precursors to the Internet boom. It also highlighted the growing interconnections between the research community and larger more activist oriented digital hobbyists.

While these were early steps in the development of online communities, there were several barriers that modems still had to address before they could really be viable in consumer system. Early modems were painfully slow. Digital to analog conversion took time and early modems converted data bits into a set of tones transmitted via phone lines. The copper wire that ran through much of telephone network at the time could handle voice calls, but the quality of lines needed to decode digital data were not always available. This meant that modems were exceptionally error prone, and data checks were a necessary part of the transmission process. This secondary system of confirmation further slowed down communication. At their best, modems could deliver short messages via text. While this limited the capacity, users quickly found ways to adapt using text to generate images in the form of ASCII art, and creating who forums and gathering spaces built around text.

The modem also provided a necessary link between the communities of hobbyists and researchers. While projects like Resource One were interesting, they were understandably limited in their reach. BBSs, on the other hand, ran on personal computers. A systems operator, or sysop, as BBS admins were typically called, could install and manage a BBS with relative ease. All one needed, was a computer and modem. As BBS became popular throughout the 80s, these systems grew. In 1994, EXEC-PC, one the largest BBSes in the country had over 280 phone lines dialing into its system (Richtel 1998). BBSes like EXEC-PC also provided access to users outside the traditional research hubs at major Universities. EXEC-PC was in Milwaukee, WI. As it grew in popularity it was able to connect with the

Internet research community as well as a series of consumer-based digital platforms that had come to prominence.

Quite often these platforms are thought of as the big three of early Internet telecommunications: CompuServe, Prodigy, and AOL. Of these, CompuServe was by far the oldest, founded in 1969 as a time-sharing system similar to that of Resource One. As it moved into consumer grade communications in the 1980s, it was joined by Prodigy in 1984 and AOL in 1985. All three of these systems sought to use modems and digital technology to provide new services and products to a growing user base. In terms of the consumer-level culture, these platforms dominated the early digital sphere. Essentially operating as large-scale BBSes the provided their users with what were, at the time, cutting edge features.

While BBSes and these large online platforms provided a way for users to connect and interact they were, at least in the mid-to-late 80s, walled gardens. A user who logged in to a BBS was logging in to a single machine, maybe in someone's garage. Just like the early timesharing systems that CompuServe and Resource One offered in the 60s and 70s, the users were bound by the physical dimensions and system capacity of the machines hosting the communication platform. This limited what users could do and, more importantly, it limited distribution between these systems. BBSes like EXEC-PC were known as shareware repositories, but the distribution of that shareware often required users to copy data to a tertiary system before moving it elsewhere. Because many of these users were using modems for their connection needs, these transfer speeds were quite slow.

The Birth of the Cloud and the Growing Abstraction of Digital Power

If the 1980s tell the story of the modern PC, the 1990s tell the story of the Internet. During the 1990s, BBSes, large scale digital consumer platforms and the research spaces that had made up the majority of the Internet all seemed to converge. As BBSes and consumer platforms looked for ways to share and communicate, the Internet provided a ready place. For the government and industry, the Internet made sense. Indeed, the Internet was a welcome reprieve from the Wild-West approach to BBSes that had dominated the 80s and were still a major force throughout much of the early 1990s. BBSes were problems for government agencies because of their transient nature and lack of centralized monitoring. This is, in part, why early hacker groups used BBSes as their centers of operation.[6] The systems were entirely self-contained and access, if wanted, could be tightly controlled. This made surveillance and tracking of early hackers difficult. Furthermore, software and media firms were becoming more and more concerned with the growing prevalence of copyright infringement that was happening on these platforms. Copyright protection was becoming a dominant concern for many software and hardware companies as the popularity and power of the application they designed increased. Bulletin Board operators often operated across state lines and sometimes international lines. Case law was also slow to catch up. In the United States vs. LaMacchia, the US District in Massachusetts ruled that current copyright law required "profit motivated infringement" before it was a criminally actionable ("United States v. LaMacchia, 871 F. Supp. 535 (D. Mass. 1994)" 1994). Because LaMacchia, like many other BBS sysops, sought no money for his sharing of copyrighted software he was able to escape punishment. This resulted in Congress acting in 1997 to no longer require a profit motive for criminal penalties. Chairman Coble on the Subcommittee on Courts and Intellectual Property summed up his position quite clearly in a meeting on the No Electronic Theft Act:

> I guess the lesson we would learn from this, folks, is that there are a good number of Americans who enjoy stealing. Thievery, larceny, fraud, piracy, call it what you will. It is in

[6] In an interesting sign that these imaginaries and their publics still have some resonance in modern culture, the current 2020 Primary Democratic presidential candidate Beto O'Rourke acknowledged his role in Cult Dead Cow (cDc) a hacker group that managed a series of BBSes across the United States in the 1980s (S. Gallagher 2019).

> their blood, and even in some instances, even when they do not realize remuneration or gain from it. Just the thrill of stealing (Coble et al. 1997).

It is interesting to note that while The United States vs. LaMacchia was about a BBS, Coble was combining BBSes with the larger category of the Internet. This assimilation was no accident. In 1991, Congress passed the High Performance Computing Act which brought together industry, university and government researchers with the goal of creating a National Research and Education Network (NREN) that would "provide for the linkage of research institutions and educational institutions, government, and industry in every State" (Gore 1991).[7] This network was designed in part to accomplish specific goals with concern to copyright and network access. It would:

> (4) be designed, developed, and operated in a manner which promotes research and development leading to development of commercial data communications and telecommunications standards, whose development will encourage the establishment of privately operated high-speed commercial networks;
>
> (5) be designed and operated so as to ensure the continued application of laws that provide network and information resources security measures, including those that protect copyright and other intellectual property rights, and those that control access to data bases and protect national security;
>
> (6) have accounting mechanisms which allow users or groups of users to be charged for their usage of copyrighted materials available over the Network and, where appropriate and technically feasible, for their usage of the Network; (Gore 1991)

[7] Gore's claim to constructing the Internet was somewhat self-aggrandizing, but not as far off as many would have claimed. This bill established the basic structures upon which the modern Internet runs. While it is certainly true that Internets existed before Gore, this centralizing legal structure, for better and worse, was certainly designed with his influence.

The High Performance Computing Act was the first step by the United States Government in encouraging the development and creation of a unified Internet. This development was an intentional act to unify what had become a growing collection of individual systems and networks all of which operated in very different ways and many of which were able to avoid broad industry and government control. While the HPCA set the groundwork for the modern Internet, it did with the express intention of centralizing and controlling threats to the growing economic power of software manufacturers and the already powerful media conglomerates who saw the Internet as a potential threat in terms of distribution and control.

Evolution of Technological Change

What we see then is a shift not just in the technology, but in approaches to that technology. As software and hardware became more connected to people's daily lives, the critical perspectives surrounding them changed. Moving from those early days of the mid-20th century where large scale computer infrastructure was considered with general suspicion and viewed as a dehumanizing tool of political power and control, digital technology had now become a tool of liberation and resistance (Turner 11-13). This idea was fostered and embraced throughout the 1980s as computers become household tools of empowerment enhancing an individual's capabilities and expanding their possibilities. In the 1990s, the growing network capability of the Internet was promoted as a way of bringing people together past the political boundaries that kept them apart. This positive outlook continued throughout much the 90s and early 2000s as Internet activity exploded on a global level.

Today, however, the role of digital network technology has come under heavy critique. Concerns are growing over the explosion of digital control within our daily lives and the influence of that technology on our society and culture. The diminution of privacy rights, the limitations of free speech, and growing political unrest are all viewed as potential evidence of a system that is out-of-control. The very networks that were supposed to bring us together now stand accused of isolating us from one another, resulting in growing mistrust and placing us even more at risk. As this concern grows, so too do the questions. In order to understand how we arrived at this point, many are looking back to better understand how we got here.

In setting the stage for this story, it is easy to paint the past in black and white. Using our current time as a lens, we look back and create a narrative of heroes and villains that offers up a simple, if incomplete, explanation of how we have come to face the challenges of today. For some, the same technological determinism that once deemed digital network technology a social good now paints it as a social ill. This determinism feeds a black and white narrative where technology was always taking us to where we are today. This view is short-sighted. It misses that within this complex social narrative technology and publics are intermingling and working together to create as, Charles Taylor and, later, Shiela Jasanoff would suggest, a set of practices surrounding a contested vision of what this world should be. The result then is not a world or set of conditions that pits technology versus the human being but rather one that the evolves out of a shared co-constructed reality formed through the interaction of humans and their machines.

In the next chapter I will address the link layer of the model. In linking the organization and movement of sociotechnical imaginaries to the network model, I will highlight how they connect and change. I will also identify three publics: the implementors, the vendors, and the users. These three publics, defined in RFC 1122, have helped to give rise to the sociotechnical imaginaries of our modern day. As I trace their development, I will examine how our co-constructed reality arose from these different publics' and their practices, which are then reflected in their texts, ideas, and technologies. In other words, practices that are firmly grounded in their imaginaries.

Chapter 2: The Link Layer

Publics and Network Technology

A computer on its own is just a box filled with a few bits of plastic, silicon, and a variety of metal. When power is applied to the correct assemblage of these components, it becomes capable of providing calculations that can be used for any number of things. That capacity, however, is still trapped inside of that box. However, a sort of magic happens when two of these boxes are connected to one another and they are able to share their information and their capacity. They become something more than the sum of their components, they merge into a network of computation and communication. For John Gage, one of the founders of Sun Microsystems, this network is the true computer (Reiss 1996). The box of metal, silicon, and plastic is just a node in a vast architecture linking people, machines, software, and ideas.

In order for these boxes to talk, there must be a set of rules that govern their interactions. The most basic form of this communication occurs between systems that are linked together by a physical cable or network (hence we'll talk about the "link layer" that enables this). Communication across these physical connections are managed via *applications* and *protocols* on the link layer. The link layer enables *discovery* (finding a port), *communication* (exchange of data), and *confirmation* (a meta-process showing that exchange has been accurate) for hosts along the same link. While the systems may have different functions (examples), they all must meet the same network requirements. As we shall see, the requirements necessary to make this networked system successful prefigure in some ways the kind of communication that can take place.

In using the TCP/IP model as a metaphor, we begin with the layer stack. In the layer stack of the model, the lower level layers provide the groundwork and establish the structures through which upper level protocols interact. A protocol can be thought of as a "formal rule of behavior" (Hunt 2002, 4). In terms of digital networks, protocol establish rules for different forms of communication. The TCP/IP network model provides a hierarchy within which different protocols exist and interact. The first layer of this model is called the link layer. In network terms, protocols and systems that operate at the link layer work to provide means of identification, determine transmission parameters along physical lines, and establish links between connected hosts and gateways. The link layer can be thought of as sitting upon another layer of hardware left out of the initial TCP/IP model.[1] Beginning one step above the physical layer allows the TCP/IP model to remain hardware agnostic -- it requires no specific hardware recommendations to support the requirements of the model. This ability to run and be adapted to a variety of hardware structures is part of what made TCP/IP so powerful and flexible. It is also what allowed TCP/IP adoption to grow and build upon already existing network implementations. The link layer and its protocols establish pathways of transmission and circulation of data, which may include hardware access protocols and functions that enable networks to communicate across physical lines, link control and addressing protocols that allow for the creation of logical connections between network cards, as well as protocols and functions for low-level data encapsulation and error correction. As the foundation of the network model, the link layer reconfigures machines and transforms a series of static and separate computers (hosts and gateways) into a broad interconnected mesh, which in turn enables the formation of the structures, systems, and applications that ride upon it. The simplicity of link layer protocols belies the effectiveness of their application, since they somewhat invisibly allow a new conception of a network to emerge. The network, itself, is an almost epiphenomenal structure, existing beyond the components that constitute it. No one machine establishes a network. Rather the network is the result of the link layer itself. Hosts and systems may move in and out of a network, but it remains all

[1] Other models, including the Open Source Interconnect (OSI) model do identify a hardware or physical layer.

the same. This is not to say that networks are eternal. Networks can cease to be, but that cessation only occurs when a network no longer connects hosts and gateways.

Imagine that the telephone system had evolved like sets of walkie-talkies, where you could only talk to people who had equipment (pre-)connected to yours. Each time you wanted to call someone, you and that person would have to buy a set of connected devices. The limitations of this scheme seem obvious in retrospect, but we have to notice something beyond the convenience factor of creating a network of telephones which can all be connected to each other, this structure (whose link layer was originally operators–usually women–taking requests and plugging cords in to a large board). This technological structure creates a new thing, the network, which has properties and possibilities beyond the possibilities of the devices that compose it, and it is these possibilities we need to account for.

The Network as a Public

In a real way a digital network can be a circulation mechanism for publics, in Michael Warner's terms, a "social totality" incorporating all who are connected and have access (Warner 2005; Farmer 2013). The link layer provides the mechanisms for attention, distribution, and circulation that help power the public and give it shape. It limits the structure and format of the messages while modifying and remediating the messages and ideas that are sent(Grusin and Bolter 2000). The link layer and its components help them to co-create not just the passive structures that provide for public engagement, and hence are participants in the discourse.

Why consider the network in such a manner? Thinking of the network itself as a public helps to refigure how we think about a digital sphere where these more systemic hardware and software elements are often hidden from view. In this view the network is more than a medium. It is not a static space through-which and in-which a public gathers. The network is constitutive part of a post-human or cyborg public. Its software and hardware can direct attention, limit attention, and adapt focus and distribution both in accordance to others' actions and in response to network actions, needs, and priorities. As such, its systems, applications, and structures are themselves constituent elements within that public.

To be certain, the word *public*, as Michael Warner (Warner 2005, 65) notes, is an overloaded term. In *Publics and Counterpublics,* he identifies three different forms of what a public is. The first form is what Warner calls "the public," a sort of "social totality" that represents a predefined, and often relatively large, group of people (2005, 65). The second, to further paraphrase Warner, is that of a specific set of people who are bound together in some way that connects them on a local level, usually via an event or a space, (2005, 66). This second form is often smaller in size and more limited in terms of time and scope. Warner's goal, however, is to identify the last form, what he terms "a public." This form of a public is not as well-bounded is as the previous forms. As Warner explains, this form "comes into being only in relation to texts and their circulation" (2005, 66). He then identifies seven properties or rules that define a public:

1	A public is self-organized
2	A public is a relation among strangers.
3	The address of public speech is both personal and impersonal.
4	A public is constituted through mere attention.
5	A public is the social space created by the reflexive circulation of discourse.
6	Publics act historically according to the temporality of their circulation.
7	A public is poetic world-making.

Table 2: Seven Properties of a Public (Warner 2005)

We'll discuss each of these in turn.

Self-Organization

At first blush, it may seem difficult to claim that a network is self-organized. After all, a network is set up and designed. It is always an established and arranged construction, and yet it is always organized and designed for itself. This is what Warner means when he says that a public is self-organized. A public exists because of the texts that it circulates (Warner 67). A network exists solely to connect and transmit the information that makes it a network. From the basic SYN-ACK messages that establish connection at the TCP level to more complex application-level messages that carry web, voice, video, and image to an ever-growing number of devices, the network exists to transmit data across the network. If transmission stops between a device and the network, in other words if a device stops listening or paying attention, that device is no longer on the network. As such, a network only exists to maintain and transmit data across itself.

In fact, Warner's description of self-organization goes one step further in highlight how networks are publics. Like publics, networks can be divided in smaller and larger networks. The Internet famously is just that, a collection of networks of different sizes and forms, many of which can be further divided in smaller networks and connections. As network applications adapt, so too do the nature of the networks that form within and upon other the larger networks that contain them. Network structures, then, while often well-defined and established through a series of protocols, give rise to publics through interactions that rarely remain static in form and operation.

Stranger Relations

When a device connects to a network, it does not need to know who or what is on that network. In a certain sense, it never does –it only knows what is circulated back to it about that device. This basic tenet of network design remains incredibly important to how our modern networks operate. Devices in networks can routinely "lie" about what they are. Different devices may pretend to be the same in order to provide redundancy and increase transmission efficiency, or a single device may present itself as multiple devices in order to support more applications and users. Regardless, a networked device can only address devices that are engaged in the network. As Warner claims, "[a public] openly addresses people who are identified primarily through their participation in the discourse and who therefore cannot be known in advance" (Warner 2005, 75).

Certainly, it is possible to limit network access and shape network interaction. In the same way, it is possible to limit a public's ability to circulate texts and prevent others for engaging with that public. Like all publics, digital networks and their constituents are still subject to broader socio-structural rules. In fact, like counterpublics which form in resistance to dominant publics (Fraser 1990, 61), new digital networks often arise as alternatives to the dominant networks and their methods of discourse. Peer-to-Peer networks, for example, arose as a response to limits, both social and technical, that were placed on traditional network structures.

Personal and Impersonal Speech

If you connect a protocol analyzer to a network, you realize just how noisy a network is.[2] The conversations never stop. For devices, those conversations are personal. They must process each message, decide what messages to listen to, and which to ignore, and finally they must respond. That response, even when aimed to a specific machine on a network is impersonal. It is sent along the wire received by a wide variety of different devices who may only process small pieces of the whole. When a device first connects to a network, it broadcasts itself to anyone listening. We like to think of a network as a direct connection, but in reality, any number of devices are listening and acting on the messages a system sends.

[2] Protocol analyzers are tools designed to monitor how network devices are communicating. They collect the often-hidden messages that network systems use to communicate and display them for administrators for troubleshooting and analysis.

Attention

A network is more than a connection between two devices. Linked hardware systems have a potential for network communication, but the network only exists when one device is listening and another is communicating. In other words, a network exists when devices are paying attention. That communication is not always human-accessible or useful. Human attention, in this case, is not required. In fact, the vast majority of network messages are meant for the devices, not the people. That doesn't preclude the fact that these devices form a public. Rather, these messages are happening outside of what most people will see, and yet they directly impact how those people use that network. The discourse that is shared by a network, however, is always influenced by the people who wrote methodologies of that network. In much the same way a public operates through the reflection and circulation of discourse that inevitably establishes a series of conventions that other publics (counterpublics) push against, so too do these networks help to establish a set of rules on how digital networks are utilized.[3]

Social Space

These rules are often hidden from view in part because of the role that networks play in establishing virtual space. Like publics, networks function to provide spaces of interaction. They provide the tools needed for communication and sharing across a wide space. As hybrid constructions, networks enable and link this sort of access at the machine level and at the human level. It is nearly impossible to separate the two without losing some part of the discourse along the way. As Grusin and Bolter (2000, 5) have argued, any digital system remediates that texts it transmits. Remediation is a two-fold process. In one part, the digital structures disappear to suggest a sort of immediacy of access to a product. As

[3] While the structure of these rules is guided by a protocol, network hardware and software only use these protocols as guides to determine the structural guidelines for their network. Thus, the protocol may establish limits and approaches to network communication, but the applications and hardware negotiate the terms of connectivity and communication.

they do, they reshape the object itself ultimately renegotiating its role in a public's discourse (Grusin and Bolter 2000). Digital networks are a part of that remediation process. They create a space for communication and transmission while disappearing from view. When a network is working, its functions and its systems are invisible. This creates that sense of immediacy. A person can video chat with a friend half-way around the world without any consideration to the hundreds of systems that are working to maintain that communication. This is the social space created by a network. At the same time, the rules and messages that are being shared at that lower level dictate how the speakers interact and share. They provide a set of affordances and constraints that end up remediating the speakers and their messages.

Temporality

In discussing temporality, Warner directly mentions the Internet and its impact on circulation, "the absence of punctual rhythms may make it very difficult to connect localized acts of reading to the modes of agency that prevail within the social imaginary of modernity. It may even be necessary to abandon "circulation" as an analytic category" (Warner 2005, 97). Warner's concern was that the circulation of text and the response to that circulation which feeds a public's discourse would somehow become diminished in an online world where a text can exist seemingly forever. In the thirteen years since, the value and importance of circulation has not diminished. Today, circulation is an incredibly important part of the Internet and the power of that circulation remains a distinct concern for people and their governments. Networks enable the rapid circulation of text. As they proliferated, the rhythm of that circulation quickened. Today, publics and their texts may appear entirely time-locked, existing in increments that measure in days and hours where they used to be measured in weeks and months. If anything, creators of texts live in a space of near constant circulation where potential publics rise and fall in mere moments. Other publics remain on the edge of a constant stream of content that is constantly evolving, but even in these constant streams there are those inevitable ebbs and flows. While the rhythm of circulation may become more frantic in a digital context, it remains a critical part of on the modern social imaginary.

Poetic World Making

We struggle to think of a network, a jumble of machines and wires, as something poetic. For Warner, the poetic aspect of a public is performative (2005, 114-115). Publics want to express and define themselves. Networks, by contrast, appear devoid of this desire. Yet, the systems and structures that come to share these networks all form their own ideals and their own shapes. The very idea of sharing and circulating information requires a sort of shaping of that information. Even at lower levels, networks negotiate with the viewers, they alter form and direct traffic according the whims and desires of the machines, the developers, and the users. The network is a complex public that builds itself according to specific philosophies of access and sharing. Indeed, the protocols themselves convey a sense of openness. They allow for the creation of a public. Unlike older protocols that demanded permanent static connections between machines, these protocols encouraged connection and adaption, fostering specific forms of growth. This is not to suggest that these protocols are not without their own ideological underpinnings, far from it. It is to suggest that these network help to shape an imagined world (think of massively multi-player role games, and how their role-based narratives rely on the specific capacities of networks). These imagined worlds give a public its power. As Warner adds, "It required the category of a public – an essentially imaginary function that allows temporally indexed circulation among strangers to be captured as a social entity and addressed impersonally" (2005, 144). While not his original intent, this definition is perhaps one of the best distillations of the modern Internet that I have read.

Benedict Anderson proposed similar concepts as the basis of national identity (Anderson 2006) and Charles Taylor saw as the formulating structure of the broader *social imaginary* (Taylor 2003). It is the imaginary that interests me here. I suggest that an imaginary (or set of them) constitute the boundaries of these link-layer networks; the imaginary becomes the interconnected mesh that draws them together. The network as a public reinforces the imaginary, the texts they produce and circulate respond to that imaginary through and with an everchanging variety of sociotechnical systems. In other words, a they are part of an evolving sociotechnical imaginary (Jasanoff 2004) .

The sociotechnical imaginary extends and builds on Taylor's social imaginary by connecting the imaginary to sociotechnical theory. Sociotechnical theory has a long and complex history dating back to Trist and Bamforth's (1951) article "Some Social and Psychological Consequences of the Long Wall Method of Coal-getting" which identified how the social and psychological experiences of coal miners were transformed as new mining techniques were introduced. For Trist and Bamforth this system of interconnections between people and their technology helped to better explain how people lived and worked with their technologies and the social challenges those technologies posed. A sociotechnical system, as Pasmore et. al. explain, "contends that organizations are made up of people that produce products or services using some technology, and that each affects the operation and appropriateness of the technology as well as the actions of the people who operate it" (Pasmore et al. 1982, 1182). For many of these scholars the focus was on how to optimize these systems of interaction whether that be for technical efficiency or human equity. In either case, sociotechnical systems theory still has the tendency to position the technology as a black box. The change results from the introduction or application of the technology to the social system.

In one sense this contextual move is quite useful as it highlights how technologies create and shape their users as much as the reverse (Woolgar 1990). In Steve Woolgar's article, "Configuring the User: The Case of Usability Trials," he playfully flips the pre-assumed roles of the machine and its user.

Doing so demonstrates how these interconnections between human and machine help to refigure constructions of agency while pushing on the boundaries that divide them. Woolgar's article is now nearly 30 years old, but the assumptions he challenged remain, in part, because we continue to acknowledge a tacit division between the human and the machine as separate and often unequal participants in the construction order. While sociotechnical theory helps to connect the users to the machine, that division between user and machine is still very evident. The term itself acts as a term of delineation: on one side, the technical and on the other, the social. As I suggested in the first chapter, this division is arbitrary at best. Technology is social just as the social structures in which we live are always technological creations.

This co-creation is what makes Shiela Jasanoff and Hyun San Kim's work on the sociotechnical imaginary so intriguing. In evoking an imaginary, Jasanoff does more than just reposition technology in the construction of our society—she makes it a critical player at every point in the process of that construction. Technology becomes our way of creating and understanding the world, shaping our texts and our behaviors, but also permanently tied to those shifts. The social and technical, in this context, are not two separate forces standing in opposition to one another; instead they are co-processes in the construction and performance of the reality that we create and inhabit (Jasanoff and Kim 2015).

In the rest of this chapter, I will examine how these interconnections, at the link layer, of hardware, software, and humans (both social and technical,) in the digital network began to reshape our understanding of the technology and the Internet itself. I will show that the connections between these systems, human and machine, were refigured by the modern socio-technical imaginary of the Internet, as it evolved in coordination with the socio-technical imaginaries of the differing publics engaged in building it (I'll refer to this whole configuration as the "co-production" of technologies and their discourses). As these imaginaries evolved, the Internet and its users changed, diverged, and sometimes merged. I will show how the software and hardware created by and through these imaginaries instilled in both users and engineers a sense of what networks *should* do and how they *should* be used. As those ideas and norms were shaped into machines and interfaces, they became part of the structure of the modern world, helping to shape and reinforce the dominant socio-technical imaginary that guides our present day.[4]

The evolution of norms didn't come smoothly. As the imaginaries of different publics collided there was sometimes fierce argument and conflict, producing winners and losers. Understanding how different groups and the technologies negotiated those conflicts is necessary to understanding how we arrived at the system we have today. In examining those conflicts, I will look at how the affordances of different forms of hardware and software contributed to expansion of these imaginaries, advancing a new understanding of the digital sphere. As digital architecture standardized, so too did our concept of the Internet. Indeed, even when these technologies were by used by others in an attempt to subvert the imaginaries that built them, they, quite often, only served to help strengthen the power of the dominant imaginary in the minds of more and more people.

RFC 1122 and 1123: The TCP/IP Network Model and its Audiences

By the end of the 1980s, digital network architecture grew in complexity, size and density. Companies around the country were already using it and becoming more and more reliant on network connectivity to conduct business; however, there was no standard for developing network technology. Instead, companies had to choose among competing network technologies and architectures. IBM was one of the earliest pioneers in this area. In the mid-70s they developed Systems Network Architecture (SNA) which was originally designed to enable communication between IBM mainframes and their peripherals (IBM Corporation 2014). Because of IBM's popularity in the business market, SNA was one of the more

[4] That is the sociotechnical imaginary that has becomes as Jasanoff explains "fused in practice" in the present time (Jasanoff and Kim 2015, 322).

popular architectures of the 1980s. One of IBM's main competitors at the time was Digital Equipment Corporation whose PDP series minicomputers had proved to be a significant competitor to IBM's larger and more expensive mainframes. DECNet, Digital's answer to SNA, consisted of both hardware and software components that enabled communication between Digital systems (Digital Equipment Corporation 1983). In additions to these more dominant architectures several others were also competing for space in the growing digital market including Honeywell's Distributed Systems Architecture (DSA) and Data General's XODIAC network management systems (Flores, Penninga, and Weinmann 1985). These technologies were specifically designed for the company that built them and were often incompatible with one another, making maintaining and developing software and hardware for networked systems difficult, costly, and time consuming; imagine 3 or 4 separate telephone technologies, where you could only talk to people on your own network and features differed between networks. At the same, the growth of the PC and consumer market has increased people's interest in digital technology and interconnectivity. Without some form of standard network technology, developing a communications infrastructure for these new users would be all but impossible (very different from the early telephone networks, which used exchanges compatible with any type of phone).

In October of 1989, the Internet Engineering Task Force (IETF) Network Working Group released two Requests for Comments (RFCs) on a proposed specification for Internet communication and transmission that would provide a set of standards to guide developers as they designed new network hardware and software. RFCs were themselves an outgrowth of early ARPANET developments in which suggested ideas for protocols, research practices, networks, and system specifications were presented to the development community for response and consideration.[5] This allowed broadly distributed researchers a chance to see and respond to proposed changes to the early proto-Internet and became

[5] ARPANET was an early prototype for the Internet development (Abbate 2000, 43-44)

the standard for decision making with regard to the structure and nature of the Internet and its technology (Braman 2011, 297). Specifications are essentially descriptions of how a protocol (software plus hardware) should function, and the requirements it must meet in order to be considered compliant. As such, these specifications are often subject to significant scrutiny from stakeholder communities, particularly when the specifications are meant to help link broad sections of a widely disparate, and often conflicting, set of systems and machines.

The RFCs entitled *RFC 1122: Requirements for Internet Hosts -- Communication Layers* and *RFC 1123: Requirements for Internet Hosts -- Application and Support* outlined the TCP/IP network model.[6] As I noted in Chapter 1, the TCP/IP model consists of a limited subset of the International Standards Organization's (ISO) larger Open Systems Interconnect (OSI) model that, after being adopted in 1983, become one of the early standards of software and network design (Flores, Penninga, and Weinmann 1985). TCP/IP sought to move away from system specific architecture and establish a set of standards that would call for the "arbitrary host interoperation across the diversity and complexity of the Internet system" (Braden 1989). The meant that TCP/IP was open to any type of system or machine, not just the enormous Unix driven industry and military mainframes. If their hardware and software could meet the specifications set forth in the RFCs, any computer could connect and communicate with each other and with different systems. In the TCP/IP world, a small personal computer could connect and share data with the most powerful of mainframes. This gave system and software developers an incredible amount of options and opened the possibility for even more interaction across the early Internet. It is this openness that has helped to make TCP/IP so enduring as a standard.

[6] TCP/IP refers to the Transmission Control Protocol (TCP) and Internet Protocol (IP) which are two of the core protocols within the TCP/IP model. The IP is the primary protocol of the Internet Layer (layer 2) and the TCP is one of two protocols at the Transport Layer (Layer 3).

Although it has evolved somewhat over time, the TCP/IP model remains the foundation of modern Internet technology. In examining the RFCs more closely, however, an intriguing point about the nature of the publics engaged in the Internet is revealed. The RFC specifically states that it exists to provide guidance to three specific communities or audiences, "These documents are intended to provide guidance for vendors, implementors, and users of Internet communication software. They represent the consensus of a large body of technical experience and wisdom, contributed by the members of the Internet research and vendor communities." (Braden 1989). In highlighting the three publics of vendors, implementors, and users, the working group was acknowledging the reality of the time: that was a growing divide between these different development communities, a divide that authors of the RFC were hoping to bridge.

This divide was in part a symptom of the growth and popularity of digital computing and network architecture. Throughout the 1970s and 80s the number of people working with and developing network technology outside of academic, government, or industrial interests rapidly increased. The rise of consumer BBSes are an excellent example of this. By the end of the 1980s hobbyist forums and BBSes had grown from a small handful at the start of the decade to number in the thousands. The USBBS list which provided an index of BBSes in the United States and Canada had over 1800 BBSes listed by late 1991, and this marked only a small subset of the number of the total number of BBSes in the country, since the list only required BBSes to self-report (Frierson 1991). Many of these new developers started as hobbyists or as technical experts interested in exploring new facets of technology in their free time. The rapid reduction in price for many digital components provided a space for creative access and development without requiring a massive capital investment. Taking note of the increased demand for the new systems, many of these hobbyists began to develop their own products and some eventually set up companies; by 1989, some of those companies (Apple and Microsoft as two such examples) would be major players in the PC hardware and software market. While the growth in the popularity of network technology outside of usual research interests was beneficial for the expansion of the early Internet and a boon for many researchers, these new users and the companies and organizations that served them had considerably different approaches and ideas about what Internet technology should be and how it should operate.

While many of these differences were framed as technological debates, they were often the result of more fundamental differences in approaches, interests, and goals. Vendors, including companies like IBM and Digital Equipment, had spent a lot of time and money developing network architectures for their hardware. While they desired interoperability and often worked to create bridges to these developing standards, they were primarily interested in protecting and growing their own investments. Even the more consumer focused vendors like Apple and Microsoft, which had developed their own network solutions in Appletalk and Microsoft's extensions to NetBIOS, were interested in ensuring that these new standards would not leave them out. But this was not a concern for early implementors. Indeed, most early implementors were funded by the government. In 1986 the IETF (an organization of implementors) held a meeting consisting of a small group of individual and scientists who were completely funded by the US government (Gross and Bowers 1989, 7). As members of the IETF, they were interested in research and in improving internetworking technology and its capabilities independent of vendors. This was an important element of the IETF in that by operating outside of vendor control, they could provide planning for broader interconnected networks and their management (Gross 1986, 10). The final public, that of the users themselves, those people who were interested in and circulating information about these technologies, were also impacting development. The users bridged the gaps between the Vendors and the Implementors and leveraged the tools of both to create ad-hoc networks, BBSes, and as they did they increased the amount of information and content about this growing Internet.

By 1989, the IETF meeting had grown to well over 200 attendees. While many of these attendees were still working in government research programs, a growing number were attending as vendor representatives for companies like Hewlett Packard, IBM, Cray, Apple, and Cisco (Gross and Bowers 1989, 21-39). As the organization that drove the standards that would make the modern Internet, the IETF became the epicenter for the collision of these three imaginaries. The RFC process, established in RFC 3, was simple. As RFC was a note on the progress of an IETF working group. It existed to open dialog and "to promote the exchange and discussion of considerably less than authoritative ideas" (Crocker 1969). RFCs acted as a transparent stream of work, and current RFCs are actually assigned to streams within the IETF. They allow researchers to understand and review how standards came about and evolved. As such, RFCs act as the tracked history of Internet technology, and provide an interesting and unique look into how the technology changed.

Others have examined these RFCs as foundational documents for "the internet." Sandra Braman did significant work in analyzing discourses and policy within the RFCs themselves (Braman 2011). Her focus was on the RFCs as text objects, their role in the creation of Internet policy and the merging of that policy with broader socio-political issues. I will use her work in conjunction with that of Jasanoff and others to look at the IETF, RFCs, and the broader structures of policy and publics that surrounded them. The IETF, its proceedings, and the RFCs it produces are fascinating objects in their own right but, as Braman suggests, they point to a much larger conversation (Braman 2011, 37).

More specifically, they point to an ongoing struggle for legitimacy and dominance between different publics' imaginaries that played out on a variety of socio-technical platforms. In the 1980s, the different publics, implementors, vendors, and users, engaged with digital technical technology each had their own "imagined" sense of what the Internet should be and how it should be used.[7] The "Internet"

[7] The Internet as a unified structure would not become fully defined until the 1991 High Performance Computing Act.

of the 1980s was quite different than today – it was a collection of different networks, loosely (if at all) connected. These systems were far less unified in form and structure consisting, instead, of a group of digital networks that served to meet the needs and promote the sociotechnical imaginaries of the different publics that built and used them. But by the late 1980s, with network and technology growing significantly in popularity, these imaginaries were colliding with one another – the networks were becoming interlinked enough that the conflicts between differing purposes and norms were becoming a serious issue. The collision of these imaginaries resulted in a broad series of rhetorical conflicts that were played out in USENET forums and bulletin board systems, IETF meetings, corporate board rooms, and even in the halls of government. As I will show, the imaginaries helped to guide software and hardware development and the rules; the collision of those imaginaries and the resulting consequences changed what the Internet was and what it could be. As vendors, implementors, and users all vied to shape the Internet to their imaginary, the hardware and software responded to these debates and adapted, creating new sets of constraints and affordances which shaped their imagination and debates. What we can see then, in the technology itself, is the rhetorical conflicts and tensions between these different imaginaries.

To be sure, **vendors**, **implementors**, and **users** were not the only publics involved in the development of the Internet (clearly, e.g., there was a regulatory public). Certainly, other people, publics, and organizations had their own ideas about what a burgeoning Internet should become. I ground my historiography in these three publics and their imaginaries for several reasons. First, they dominate the majority of network development and the arguments that surround it, as documented in the RFCs. The fact that they are identified so clearly in the RFCs and in other discussions helps to establish these imaginaries and their publics as critical to any examination of the larger debate they participated in. Second, the broad nature of each public allows it to lay claim to a variety of different people, and their associated groups and organizations. As these publics circulate texts, they influence the structure of the imaginary. If we think of the link layer, the publics are the applications and the protocols defined by the layer and structured to help further define the broader network. The network itself operates as a public that connects with vendors, implementors, and user. As the network is constructed through and reflects a merging socio-technical imaginary that arises out of the three previous publics. The hardware and software developed within and through a specific imaginary is then realized via the network and its affordances. A network only exists in its interconnectivity. It has no structure or presence save what is reinforced through its hosts and systems–its members and their attention.

As Jasanoff notes, there are many different sociotechnical imaginaries that are shaped by the people and their understandings, beliefs, and interactions with technology. Every member of a group doesn't share in the same sociotechnical imaginary, nor do publics. What can be claimed, though, is that sociotechnical imaginaries draw in groups and publics who act to discursively reinforce the very nature of the imaginary through their interest in and recirculation of the material that imaginary produces. They perform the social interpretation of the technology which reinforces their vision of the social order (Jasanoff and Kim 2015). In the case of the Internet, those materials are codes, protocols, legal arrangements, hardware, and software all shared, revised, and remade by developers and engineers, reflecting their visions of what a network was and could be. While the three I highlight may not be the only possibilities they were certainly instrumental in the development of the Internet and an examination of how those imaginaries connected, merged, can provide ample information to what gave rise to the Internet of today.

The Implementors: Imagining Meritocracy

The implementors, the computers scientists and engineers, whose job it turned out to be laying the groundwork for the modern Internet, did the day-to-day work of coding and mechanical troubleshooting that kept networks and internetworks functioning. They had always been there, even when they were primarily government funded researchers. While large technology companies paid for technology research, most of that research focused on processing power for their business and research ventures. Work on network infrastructure, per se, was primarily government funded. The original ARPANET research project, for example, was a Department of Defense project to enable and maintain military communications networks in the event of a major attack or loss of communication nodes (Abbate 2000). As development continued, projects at UCLA and Stanford established the first network connections and very quickly began to grow by adding new nodes throughout the West (Campbell-Kelly et al. 2013).

Unsurprisingly, then, that the very first RFC was written by Steven Crocker, a researcher at UCLA, for a very different Network Working Group. His RFC, “RFC 1: Host Software,” was published on April 7, 1969, twenty years before the publication of the TCP/IP network model. In this sense, then, the RFC structure mirrored the ideas that implementors took with them in developing the Internet. For implementors, Internet development flowed from a vision of broad forms of interconnected research and knowledge sharing. These researchers came to the development of the Internet not as business professionals or even as users looking to communicate. They came as researchers seeking a pathway for shared data constructed through collaborative practice.

The nature of the early RFCs highlighted the sharing process. As documents, RFCs were open to view, accessible, and contained named authors. Interaction, response, and consideration was expected and desired. While Crocker’s original RFC was a summary of the work done by the network working group, he is identified as the author and primary point of contact. Including a named author, instead of abstracting the author behind a shield of anonymity, invites response and dialogue. Furthermore, the RFC is, after all, a request for communication; the authors are looking for feedback and debate. The first RFC includes a series of open questions that help to open points of discussion and dialog, an important move in the Implementor’s imaginary. In the Implementors imaginary, the Internet is not just a conduit ("a series of tubes" in Senator Ted Stevens' phrase), or a means of transmitting information, it is also dialogic (Flusser, Ströhl, and Eisel 2002). This makes sense for researchers accustomed to a "closed world" model of research in where every individual is working toward a centralized set of goals and ideals (Edwards 1997, 13-15). In the Implementors imaginary, they are all on the same side and all working for the same thing. Most were working for the United States and most involved in Department of Defense work. In this context, there was an implicit trust in the online community. The imaginary of the implementors is one that establishes itself as a sort of meritocracy that promotes those ideas that lead to this greater success and celebrates a value in the ongoing revision and discussion of those ideas towards those centralized ends (Turner 2008). For many early implementors, these ideas were firmly based in military expansion and power (Edwards 1997, 111).

Of course, the ideal of a meritocracy, in this context, ignores the fundamental politics and issues of the time. Furthermore, it requires us to ask who is defining what the "best" ideas are. The closed nature of early network research limited its ability. Most of the work done in the RFCs of the 70s is attributed to white men. This mean that interests of women, minorities, and other groups who did not have access were completely disregarded. Even when they were involved in the development of the work, they were often hidden or erased from the record, and the consequences of that disregard and erasure continue to this day (Eubanks 2018; Noble 2018).

The implementors linked their imaginary to academic and research excellence, and to an ongoing dialog that required open access to information and collaboration. That open access, though, presupposed a closed system in which those who had access to the network had already proven themselves to be an acceptable part of the community. Much of the software these individuals built encouraged that form of communication and sharing. For the implementors the Internet was a small town in which everyone knew each other. There was very little concern or thought about system intrusion or protection. Everyone left their doors open and encouraged connection and communication. This was a world was protected not by systemic measures but political and social ones.

Users: From Hobbyist to Hacker to Genius

The PC's movement, from corporate tool to personal device, reshaped the general public's relationship with technology. In the implementors' world, users were elements of larger system / structures – agents attached to a larger set of agents (Zaw-Sing and Postel 1982). For the users, and the new batch of vendors thinking about those users, the computer was becoming an extension of personal capacity. "You need a versatile, sophisticated machine that is as limitless as your imagination" claims a 1980 advertisement for the Compucolor II (*Byte Magazine Volume 05 Number 01 - Domesticated Computers* 1980, 63). No longer was the computer a device locked away in the vast datacenters of large governments and corporations. Now, the power of the computer was in the hands of the individual.

This user-centric imaginary was enabled by a growing array of self-reinforcing media representations. Television, books, and movies of the time played with both the positive and negative aspects of that. In one view, the PC was a beneficial genie of sorts, granting almost magical power to its users who were often portrayed as marginalized and oppressed while simultaneously having considerable economic resources. In these stories, there is a continual presentation of the smart and relatively wealthy young man as the outsider in a society that only values beauty and strength. The computer becomes the tool through which the awkward white male gains equality and superiority. The 1985 film *Weird Science* is perhaps the best example of this form of the "PC-as-a-genie" perspective, and its message and format distinctly highlight how perspectives of computer culture in the 1980s still resonate, in some negative sexist ways, today. In the film, two white high school boys, Wyatt and Gary, use a computer to create their idea of the perfect woman, Lisa. After she is created, Lisa acts as the boys' genie granting them access to clothes, parties, cars, and clubs. As she does, she makes them popular and empowers them romantically and socially. It is interesting to note that in the movie and in others like it (*Wargames*, 1983 and *Real Genius*,1985, for example) computer technology is always represented as a networked structure.[8]

I use movies and magazines to frame the imaginary for a specific reason. Digital publics and counterpublics and their imaginaries do not exist solely in a digital context. I start with this distinction in order to illustrate an important point, the publics surrounding digital network technology formed before many within those publics had access to that technology. The crucial elements here are attention, discussion, and circulation, not just access to the network or the machine. While the people who made up these early publics in the mid-to-late 70s and early 80s were often unable to access or use the technology on a daily basis, they were interested in what that technology would become.

That interest can be seen in media representation and in the discussions and speculation in a large number fan and amateur computing magazines that had become popular at the time *(BYTE, Compute!, Amiga Computing Magazine, Macworld*) . Science fiction magazines like *Analog* would often include articles on new developments in modern technology mixed in with their usual fare of science fiction pulp. This interest encouraged early digital entrepreneurs, precursors of the Vendors, to take advantage of the increasing power and the smaller size of digital hardware in order to develop digital systems for these publics. Individuals could buy these smaller digital systems that were limited imitations of the large-scale systems in use by research universities and corporations. While these hobby systems were still expensive, they were drastically more affordable than their larger counterparts (Berger 1976). These systems provided enthusiasts with the ability to craft and build their own digital

[8] *Tron* (1982) is a notable exception. The ENCOM system is a mainframe and the MCP is the control for that mainframe.

systems. This group of hobbyists, early hackers, often brought with them a Do-It-Yourself (DIY) perspective that influenced much of their early discourse.

As these new systems came into existence, they extended and changed the nature of the publics that were engaged with them. Encouraged by early Vendors' work at reshaping the imaginaries surrounding computers, individuals whose only experience with a computer was typing into a terminal at work were suddenly buying the machines for their homes. The explosion of affordable hardware mixed with the promise of a useful modern tool drove interest and increased the adoption of this technology well beyond the normal hobbyist and hacker groups that dominated the early 80s. The perception spread that this availability shifted the nature of the Users, and that computers were not just the playthings of technical specialists. This was *Time*'s suggestion in its 1983 cover which highlighted the computer as the machine of the year, but the truth was that computers were still only available to a small set of people.

While these digital platforms were available to a larger public of people who saw a new world of opportunity opening behind a keyboard and a screen, the group of actual owners represented a small and very privileged subsection of society. To these privileged few, the Internet felt like a new land open and free to redefinitions of identity and culture. The anonymity provided by the screen allowed them the opportunity to be anyone or anything. It also blinded them to their own uniformity in terms of identity. The anonymity of the screen provided an illusion of diversity in the face of that uniformity which became a part of these users' imaginary. As they shared that view with others who did not yet have access, that imaginary grew in scope and power. The public that formed around those users was one that bought into that idea of personal autonomy through digital machines despite the fact that the structures they were connecting to were predicated on the development of implementors working in government systems and vendors providing hardware and software. As the imaginary proliferated, so too did the software and hardware evolve to meet that perception.

While some argued that this lack of self-awareness was a danger in this new virtual space (Rheingold 1993), others actively sought to obscure the problem. In this sense, networked technology could reinforce the imaginaries of the Users who had taken over its space. Stewart Brand's idea of a digital agora proved influential, with its vision of equality and shared access to information, a vision born in the imaginaries of the Implementors (Turner 2008); Brand promoted the idea of a digital utopia that existed outside of traditional political and social structures. While, in hindsight, such ideas seem almost quaint in their tacit ignorance of the role of the government in enabling the development and creation of the Internet and the power the government ceded to Vendors in the *High Performance Computing Act* (which actually put many of these Users online in the first place). The imaginary, however, remained blind to this change. In the imaginary, the structures that linked the machines and created the network disappeared behind a wall of creative chaos that thrilled many early Users. The wholesale adoption of digital technology by the counter-culture heroes of the 60s and 70s helped to cement the role of the Users' Internet as something that challenged the status quo while, simultaneously, reinforcing it.

Vendors: Innovation and Destruction

If Implementors saw networks and the burgeoning Internet as a small town, Vendors saw it as a series of tightly controlled island nation-states in which individual users were regulated and managed to a specific end. In a Vendor's imaginary, the network is its own managed space reliant on Vendors for management and support. This is the central tenet of both DECnet and IBM SNA which promote a highly centralized version of network control and management based on very specific hardware and software configurations. Ideas about the role and power of the user versus the role and power of the developer highlight a central division in these imaginaries. Vendors, however, frame their technologies as ongoing forms of advancement made through progressive cycles of cause and effect. The narrative is itself an economic one, framed on a Schumpeterian model in which technological innovation drives economic and social advancement, which then requires the destruction of the old and its replacement with the new (Lakomski 2002, 148). This narrative contends that developers and engineers identify and shape technical solutions to societal problems, which then result in social change that ends up altering the relative needs and interests of the culture. Shifting cultural needs and interests make certain technologies obsolete, creative disruption being a primary requisite of the Schumpeterian model (Lakomski 2002, 156), while simultaneously creating new problems which require new technical solutions. With each iteration and technological advancement, the cycle repeats. Positioning cause and effect as a central driver in the relationship between society and technology has shaped modern perceptions of and discussions surrounding these technologies, focusing on “change” and “drivers,” which are obviously important if you are trying to see where the next profit will be. Technology in these stories inevitably results in change and disruption. We are accustomed to speaking of "digital revolutions," while Silicon Valley entrepreneurs champion technological disruption as a business model, and politicians worry about and seek to control the impact of digital communication and media on how we think and act. Technological histories framed as stories of great change, for better or for worse, perpetuate these very same perspectives. What makes these stories particularly fraught is a sort of built-in acceptance that we cannot know the benefit or cost of the change until it has already happened. Technology, this model argues, cannot help but bring change.

This narrative of change undergirds the imaginary of the vendor. One key difference between vendors and implementors is interested in solving social needs, the “problem solving” mentioned above. The implementors’ focus was mostly narrower, more focused on their closed world of network access and administrative control. ARPANET’s was never intended for a global audience, but to solve a specific original problem, and the problems that rolled out of that solution. While the potential opportunities for greater interaction and collaboration may have excited early developers, the primary focus was always a space isolated from the rest of society. In some sense, this positions the vendor as a sort of Promethean figure, albeit with a specific financial motive. In adopting an implementor's technology and retrofitting it for public use, the vendor's "innovation" opens up the locked world of the implementor.

Because the imaginary of the vendor is entangled with the imaginaries of the user and the implementor, it creates overlapping boundaries where the rhetorical struggle between the imaginaries begins. Note that in the figure below, the overlap between the Vendors and the other competing imaginaries is much greater than that of the overlap between Users and Implementors. This is, in part, because the worlds of the Implementors and the Users were kept heavily separated. There were consumer-grade digital networks available in the 1980s. Fidonet, for example, connected over 6500 different bulletin board systems by 1989 and would have over 20,000 nodes by 1993 (R. Bush 1993). This was an active Internet, that operated on rules very different from the traditional ARPANET model that was slowly coming to prominence and which would leap to the fore with US investment in 1993 that would act to merge the interests of the Implementors and the Vendors as I will discuss in chapter 4.

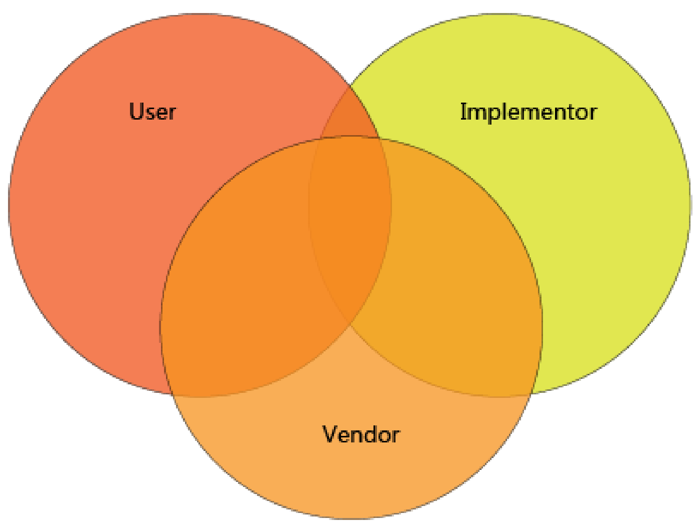

Figure 1: Overlapping Internet Imaginaries (1980s)

For Vendors, digital technology was about selling change. This change followed the model they had adopted early in the 20th century. IBM's first models of mainframe offered a world of change to business and businesses bought into that idea. Technological innovation, Vendors claimed, provided control and efficiency of business processes, which precisely discomfited hobbyists and workers who viewed this approach to technology as alienating and disempowering. For Vendors interested in courting this new user audience steeped in the user imaginary, the shift in message was far subtler that it appeared in the advertising. The vendors adopted the language of the user imaginary to feed the perception of user autonomy carefully crafted in the vendors' shops. Apple positioned itself as the liberator of the common user while locking its systems down. PC manufacturers positioned their products as ones that added to personal power and efficiency and suggested that without those tools the user was going to drift further behind the times. They did not minimize the power of the corporate computing infrastructure, rather they elevated that structure and offered users access to that same power (*Compute! Magazine* 1985). The innovation they offered was not a new structure or a new idea, it was simply a repackaging of the vendor imaginary in the language of user liberation.

Publics, Change, and Internet Imaginaries

Technological change, like any form of change, is rarely a simple iteration of cause and effect. To position technology in such a role demands two false assumptions. First, it must assume that technology is created outside the social shifts it is generating. Technology, in such a perspective, is only political in its application and not its creation. So too, the engineers and developers working on the digital solutions must, supposedly, have no interest in the social changes that these solutions are creating. Many of our technological narratives reinforce this idea of positioning engineers and developers, our Implementors, as neutral parties seeking only the best solution to the problem. Engineers and developers are portrayed as social outsiders, half savant and half social fool. In reality, technology and technological production is always political (Noble). While Implementors may not be focused on the public, the technology they built fundamentally changed the social imaginary of the public. Technology is used and crafted to create and maintain social change. The development of technology, like the technology itself, builds from a conscious or unconscious need for responding to forms of social change. In terms of the Implementors, social change was a military need for better communications. That need expanded much faster than they expected into the broader society.

The relationship between change and technological development is symmetrical. To assume that innovation drives social change is to ignore fact that these elements are always in mutually reflexive relationships, co-building one another in real time (Hayles 1999). Innovation also assumes that obsolete technology disappears. It doesn’t. Creative destruction in terms of technology is rather rare, in fact. Certainly, some technologies do eventually disappear, but even then that disappearance is often temporary (this is particularly true for old forms of media which often find new life later). Rather, technology rebuilds and reformats itself based on older versions. For Bolter and Grusin, the form of digital recreation was evident in remediation of new media, but the same form holds true for the hardware and software that remediate that media (Grusin and Bolter 2000). New technologies are not cut from whole cloth; rather, they build and rely on the development and foundation of these older, supposedly obsolete, technologies. In the case of digital technology, these forms don't really disappear as much as they are overwritten. Much of our current digital network architecture exists on top of older forms of technology and its protocols. In such cases, technology is not so much replaced as it loses popular attention and focus. This is a significant difference because it means that these earlier imaginaries are not gone. There are still hosts and gateways there, they are simply idle and waiting for reconsideration.

When we talk of attention, we talk not of technical skill or expertise but of social perspective. Digital technology and its progress are driven less by practical exigence, and much more by an understanding of what technology means to the larger community. For Charles Taylor, these "social imaginaries" extend well beyond the technical realm. They pervade every aspect of how people think themselves to be in a society (Taylor 2003). The social imaginary then exists as a sort of shared perception of who a people are and how they consider their relationships to one another (Taylor 2003). For Sheila Jasanoff, these understandings are often performed and reshaped through technological development and creation (Jasanoff and Kim 2015, 7). The "sociotechnical imaginaries" result from the development of technology to fit the social imaginaries in which they are crafted. As Jasanoff notes, early discussions of Taylor's work identified the fact that social imaginaries are plural in form and scope; the same is true for socio-technical imaginaries (Jasanoff and Kim 2015, 8). As an imaginary catches hold within the larger public, it and the technologies that have been shaped by and through it find themselves in the center of the public imagination. Technologies that do not coincide with the broader imaginary are often hidden from view. The evolution of technological progress then is not a loop where innovation drives social change, cause and effect, but a co-creation of competing socio-technical imaginaries where each one struggles to find relevance and hold within the broader social milieu.

The struggles of these imaginaries help to explain the paradox of our ambivalence surrounding socio-technical change. There is no question that we value our technology. It is an essential element to who and what we are. Digital technologies have extended our capacities and become integral to our societies. At the same time, the growth of digital technology and its increasing importance rightfully concerns many. We may value our technology, but we also fear it. We wonder if it will replace or isolate us. Our fictions repeatedly echo our own digital-born nightmares in which we become machine-processed versions of ourselves, morphing into tools for use by others with more power. The expression of this fear has evolved over time, but it has remained a constant in the story of our technological progress. Much of our modern fears focus on the expanding reach and power of digital technology and the blurring of the lines between the personal and the digital. In less than half a century, digital technology has moved from an institutional object, a curiosity reserved for researchers and large organizations, into every aspect of our daily life. We are, in effect, post-digital. Every facet of our world has been and continues to be impacted by the proliferation and implementation of digital technology and the networks that drive it (Berry and Dieter 2015). As this technology has become ubiquitous, it has also become suspect. We are becoming aware of the unexpected risks posed by this technology, and it scares us. Algorithms, once thought of as powerful tools for modern expansion, are now viewed as threats and potential dangers to personal autonomy (Noble 2018). These new tools and systems have taken on a greater importance than we anticipated. Digital technology has become the foundation of our modern world, and, for many, there is a palpable concern that that world has not been able to keep up. In some ways, there is a reasonable basis for our technological fears. The impact of digital technology, in particular, computer and network technology, on social structures, economic systems, and on the very ways that people communicate and understand each other and the world, has been profound. Many of our social and economic systems have come to rely on these digital architectures, and we do not, yet, have a solid grasp on the varied consequences of that reliance. We are still finding our way through this new social reality in part because we are always in the process of constructing it.

While the scope and risk implied by the growing demand for digital networked systems demanded a transition, the nature of this transition was not preordained. The shape and structure of the technology we use today has been developed, in part, as the result of an intense and ongoing political and social debate, a debate that is often held on the boundaries of sociotechnical imaginaries. As Janasoff, Rheingold, and Noble have noted, technology does not sit passively within that debate. The tools we use are not silent and neutral subjects. Instead, they are active co-participants in those arguments. The shape of technological discourse is not determined by the formation of a certain technology but on the way the people and that technology, or set of technologies, interact. These interactions, like the technologies that are a part of them, are not static. As Hayles and Haraway both suggest there is reflexive co-creation occurring between technology and the culture it inhabits (Haraway 1997). Tracing that creation and its pathways can tell us the story of our technological age. It is a story told in two parts: one of textual creation and one of rhetorical reinvention. We write technology, and in that writing we give it power and opportunity. Digital technologies and the infrastructure and algorithms that guide them have been designed to respond and adapt. We write them into existence, and as our social and political realities shift so too do the nature of the technologies we create. Our technological infrastructure, the structures upon which much of our modern world thrives, arose out of a very particular set of social and political exigencies constructed to suit a very specific imaginary of how and why technology should operate the way it does.

These technologies survive and change as the ideas of the imaginary circulate through publics with very different sociopolitical aims. Those technologies that found a way to keep the attention of those publics thrived by accommodating the features of the sociotechnical imaginary. As the conversations and debates that drove these imaginaries changed over the past 50 years so did the structure and form of the technologies they created and used. Technologies and their rhetorics were reinvented, revised, and re-imagined again and again in order to fit the goals and interests of the dominant imaginary. Our modern digital infrastructure and the software that powers it exists as a chronicle of those struggles in which these older technologies, created under very different situations, are now co-opted into new political realities.

And yet, there remains in each of these technologies an echo of the past. Much like physical architecture, digital architecture is built on the structural foundations of these older technologies. These new digital instances and the rhetorics that drive them cannot completely overwrite these older foundations. There are gaps and glitches in every new implementation. These glitches are ghosts in an imperfect and often contentious system, and yet they provide valuable information into how and why these technologies operate the way they do. They also provide insight into alternative approaches to our technological infrastructure. Over the past 50 years we have seen technology take on a wide variety of political and social possibilities. As we move forward, these possibilities will only become more entrenched. Navigating the broader structures that drive our technologies and the conversations that we have about, with, and through them requires that we better understand the sociopolitical elements that drove the creation of that technology.

Chapter 3: The Internet Layer:

Implementor Publics and the Rise of the User Imaginary

The Rise of the User Imaginary

We saw in the last chapter that the technologies that constitute the internet shaped and were shaped, dominantly, by imaginaries and their corresponding publics: the Vendors, the Users and the Implementors. The force of the analysis set up the possibility that the discursive environment responded to technological advances, but also could help shape them, since the technology would tend to develop in the direction of its imagined uses. Jasanoff positions sociotechnical imaginaries in the mid-ground between the vast social imaginaries first theorized by Anderson (2006) and later by Taylor (2003) and the more abstract systems of interactions between people and their technologies (Jasanoff and Kim 2015, 19-20).[1] In taking that middle ground, Jasanoff and Kim find themselves inevitably examining and describing large-scale sociotechnical imaginaries. Their work offers a comparative examination of different national imaginaries and how those imaginaries shift and diverge (Jasanoff and Kim 2009, 120-122). Much of the work that *The Sociotechnical Imaginaries Project* focuses on remains centered on national differences ("Sociotechnical Imaginaries Project"). This focus on an overarching national imaginary is important. It allows us to connect the dots between sociopolitical structures and the technologies that undergird them. Even more importantly, it highlights how we, as a society, talk and think about our technology. While researchers have, for quite some time, been examining and challenging the consequences of the sociotechnical imaginaries that inhabit network design and architecture (Rheingold 1993; Lanier 2014; Noble 2018; Eubanks 2018), there is very little work that helps us understand how these imaginaries take shape within a national–and sometimes transnational–context.

[1] Jasanoff specifically looks to STS research and Actor Network Theory as a description of these systems of networks (Jasanoff and Kim 2015, 19)

Using publics to help contextualize competing imaginaries and their rise to dominance helps us to trace these movements. A cultural public, as Farmer argues, is one that relies on a repositioning of existing tools and systems, a repurposing of systems and devices to meet a specific need or end (Farmer 2013, 33-35). As more people engage with these bricolage structures, the structures themselves take on an imaginary. Farmer calls the bricoleurs of these publics "mythmakers" (Farmer 2013, 34). This bricolage is work that forms new imaginaries. In her opening to *Dreamscapes of Modernity,* Jasanoff would seem to reinforce this notion stating that the imaginary is not merely a fantasy but a building collection of practices and work (8). For Farmer, the public sits at the heart of this work. It is the consistent movement, appropriation, and re-appropriation that reshapes our modern cultural contexts. These contexts are always positioned within systems of technology, people, and practice.

Publics are temporal in nature. They exist through the attention they generate, and that attention is a tenuous thing. Attention requires the maintenance of interest that can be easily lost or diverted when the availability of texts become too static or limited. Thus, there is an ongoing need for a public to circulate and generate new content that remains familiar enough to still reinforce the publics interests and desires (Lampel, Lant, and Shamsie 2000). Yet, that desire for novelty allows some slippage in the texts, which in turn are either accepted by the public in recirculation or dismissed as they lose attention and fade from interest and use. The texts and objects that capture the focus of a public's attention continue to shift as the imaginaries that surround them evolve to reflect the content of the material that interests them. It is in this movement that we can begin to tease out the processes through which sociotechnical imaginaries rise and fall, and the social, political, and rhetorical influences that helped to shape our current sociotechnical imaginaries. By following the movement of publics and their texts we can begin to see how sociotechnical imaginaries work and have worked in these modern digital network constructions and the imaginaries born from and through those publics have grown, changed, and expanded.

Connecting publics and sociotechnical imaginaries also helps us to better understand and push back against nationalized narratives of science and technology research. A nationalized narrative of technological advancement is quite often ensconced in the mythology of technological determinism, embodying a whiggish and overly linear historiography. This tendency is quite prevalent in the US, with its bias toward seeing the inventor as a sort of capitalist hero. In this story, the inventor sees a need. He then constructs a tool or machine to meet that need. Once constructed and developed, that technology is then delivered to the people. Success, in this narrative is one of adoption not effectiveness. If the people adopt a technology, it succeeds. If they don't, it fails. The superior technology is not the better technology, it is the technology that survives. In this narrative, the technology that is introduced is empty of agency or access, barely more than a static object. The technology is a pre-determined solution to a pre-determined problem. As such, many modern technologies are presented as single objects, black boxes,[2] which exist as produced texts made available to an audience who cannot or who are not expected to edit or reshape it.

This is, of course, where the narrative stumbles. The public engaging with technology is always refashioning that technology both in practice and function. When it comes to digital systems, this refashioning is even more apparent. As a public uses digital technology, they also create that technology. The way they use that technology informs development and further use. In their use and in their sharing of those new uses, they provide new ways of using and thinking about a technology and its output that may not always meet the original intention or may revise that intention in some way in order to meet the publics need or demand.[3] These are acts of digital remediation on an application level that reshape cultural understanding of the technology that is engaged and the potential of its

[2] As technologies become smaller and more narrowly focused, the individual components that make then run are simply absorbed into the audience's perception of the larger object.

[3] These are often tactical interventions (Kimball 2006; Hallenbeck 2012), but that is not always the case. A public can have an impact at a corporate level as well. Employees of corporations operate both as agents of the company and as actors within the publics they participate in.

output. These elements are always intertwined. As Grusin and Bolter note, “The events of our mediated culture are constituted by combinations of subject, media, and objects, which do not exist in their segregated forms. Thus, there is nothing prior to or outside the act of mediation” (Grusin and Bolter 2000, 58).

In such a context, the engineer and the scientist can often be thought of as bricoleurs (Certeau 2011, 122) themselves. Engineers and scientists use, adapt, and assemble a variety of tools drawn from different areas and reshape and distribute them–they mediate them.[4] As they do, they contextualize their work within their own sociotechnical situations. They build according to their understanding of the problem they seek to address and the technologies they have available. The technologies they released, however, never hold shape. Instead, those technologies modulate with their users. It is these users, especially those without broad and easy access to technological tools, who often take a far more tactical approach to their technological work. These researchers, with whom I would include certain do-it-yourself developers and Maker Space hackers,[5] are often masters of hardware and software bricolage, assembling components and structures from pre-existing systems that were never intended for the uses to which they were now employed. In recrafting these technologies, these tactical developers help to push the boundaries of the present sociotechnical imaginary. As they do, they often require a response from the initial developers of the technology. These users push engineers and scientists to either accept the new imaginary or to develop a better response to its demands. The national imaginary, then, may be the dominant imaginary that channels financial, social, and political will into the ongoing formation, and

[4] In many cases, this form of mediation requires the same movement from visible to invisible. The developer remains hidden behind the technology.

[5] The texts and software generated by these Maker groups are excellent examples of tactical engagement both in the creation of digital tools and in the creation of texts to explain and show how to use those guides (Kimball 2006).

co-production, of technology and culture (Jasanoff 2004). That dominance is tenuous, and always subject to the potential for redefinition given enough movement and growth.

Power and Control

To understand how imaginaries changed, let us begin with a better understanding of the imaginaries that surrounded technology prior to the 1970s and 1980s. The 20th century began in the explosion of a second industrial revolution or what Vaclav Smil called "The Age of Synergy" (Smil 2005). This era following the end of the Civil War in the US and the start of World War I gave witness to an massive amount of technological growth and innovation that reshaped how the world worked and thought (Smil 2005, 22-24). While these advancements helped to change how science, government, and industry worked, the changes they produced were beyond the control and influence of the average user. For many, the power of these new discoveries was distant and inaccessible. As Smil comments, "Many epochal inventions appeared to be just fascinating curiosities, legerdemains of scientists and engineers with little practical importance for poor families" (304). For many of these families, technology was imposed from the top down, mimicking the narrative of nationalized sociotechnical imaginary. Scientists and engineers would develop new inventions that would then find their way into more generalized use. In some cases, these transitions were embraced while in others, they were resisted (Smil 2005, 303-305). In either case, however, the imaginary of the technology, its function and concept in the sociopolitical landscape, was an external creation of the organizations, engineers, and scientists developing the technology. While the user public could respond to and adapt to that imaginary in different ways, it appeared to have very little capacity to fundamentally impact or reshape the technology or the imaginaries it served. The power of the user imaginaries was only becoming evident in their re-adaptation of tools and machines that were in their personal possession. Unlike the broad shifts in infrastructure and construction that seemed so beyond the users' control, these were the physical objects and technologies that they could access and reshape.

In terms of our three publics and their imaginaries, the user public and the vendor public, starting in the Age of Synergy and moving throughout much of the 20th century, often seemed to act in response to an implementor public. Implementor publics, seemingly distanced from the other two, developed the engineering and scientific innovations. Those innovations were then slowly adapted and put in place by a vendor public. The vendor's interest was in the resale and adaption of an implementor's work. They looked to the user public and worked to fashion the implementors' work to provide that novel yet familiar experience. They were interested in packaging the implementors' works into innovations that could be sold. One early example of this is in Smil's *Age of Synergy* is the invention and sale of wireless radio technology. For the public of the time, the father of radio was Guglielmo Marconi; it was his product that was sold and used in the early tests and transmissions. Marconi's work, however, is merely a re-adaptation the work done by Nicola Tesla (Smil 2005, 251). It was Tesla, operating as a member of the implementor public who created the technology.[6] It was Marconi, a vendor, who brought that technology to the user public. "Being first to package, and slightly improve, what is readily available, being aggressive in subsequent dealings, and making alliances with powerful users can take an entrepreneur and his company a lot further than coming up with a brilliant new idea" (Smil 2005, 253). It was this ability of the vendor public to create and drive the imaginaries that then infused the user publics that made them so successful. The imaginaries, as such, moved in a similar way. Implementor publics shaped systems and technologies according to a specific set of imaginary structures: increased efficiency, certain forms of social order, capitalist expansionism, scientific enlightenment. Vendors, in turn, repackaged and sold these technologies to users reinforcing these

[6] The courts would affirm this fact, according to Smil, a few months after Tesla's death in 1943 (251).

same imaginaries. If a user public had a different imaginary and could offer resistance, they would do so in conflict with a vendor public.[7]

The vendor public, then, often stood as both barrier and bridge between the implementor and user publics. User imaginaries rarely impacted the implementor publics. By operating as the go-between between the implementor and user publics, the vendor public took on a significant share of power. In deciding what implementor technologies will pass-through to the user public and what implementors will continue to be receive funding, the vendor public could often control the ultimate direction of the sociotechnical imaginary. Such control was made even more apparent in the way that vendor leveraged existing legal and cultural controls to respond to and modulate attempts of technological re-inventions by a growing user public.

Government and the Vendor Publics

It is impossible to mention the importance and power of the vendor public and not acknowledge the role of governmental oversight and management. As an entity the government is not a public. It is organized and structured. It exists beyond the circulation of texts that help to drive it. Instead, the government tends to respond to and address different public imaginaries, reinforcing some and working against others. In many ways, the government is engaged by members from each of the publics.

In supporting and developing research projects the government becomes a key provider of content – results -- for the implementor public. Government agencies indirectly develop technical infrastructure through economic and resource support and providing the legal guidance about what that infrastructure is allowed to provide. Note here that the legal structures in these cases are restrictive, not

[7] As noted earlier, we see an example of this in Sarah Hallenbeck's (2012) article "User Agency, Technical Communication, and the 19th-Century Woman Bicyclist" where women bicyclists work against and adopt a different imaginary from those of bicycle vendors.

expansive. The legal boundaries to technological use exist primarily to limit that use, not enable it. As Katsh discusses in his 1993 article "Law and Cyberspace," the growth of digital network technology inevitably removed many of the practical constraints that limited, as he terms them, the "interpersonal and informational relationships" within the legal profession and beyond (Katsh 1993, 452). These legal structures, however, are part of the same imaginary. In that same article, Katsh acknowledges that technological change occurs faster than institutional change.

I would suggest that the delay in institutional change is not related to the speed of technological development but instead responds to the demands of new imaginaries. Laws may not respond to technological advancement in isolation. Faster network transports speeds per se do not create legal problems. Rather, what does demand a legal response is the use of superior transport speeds to transmit copyrighted material over international distances increases the amount of available content, leading to a general devaluation of all copyrighted content. Yet these elements can be separated: the dream of the faster network and its impacts are part of the same imaginary. The law, however, does not (or should not) deal with the hardware alone.[8] In each case, the technologies developed are employed toward a specific sociotechnical imaginary that existing institutions must then consider, advance, or seek to limit. Those approaches are always mediated through existing socio-technical relationships.

While implementor publics are often heavily invested in government decisions and practices surrounding technology, they are only one part of the role the government plays. Quite often, the government works to serve the benefit of the vendor public by making technologies available to user publics, especially through the creation of infrastructure networks that support these vendor technologies; Google and Facebook became possible through an internet "backbone" created and

[8] When it attempts to deal with the technology and not the imaginary, the law fails. Much of the content battles over copyright law have been legal attempts to limit technology without contending with the imaginaries those technologies are a part of. This has simply led to the development of new technologies that reinforce the power of the imaginaries in easy defiance of the law.

supported by the government. Without government involvement and support, our power, communications, and media infrastructure would never have evolved to where it is today. As the government works with vendors in distributing technology, it also works to advance the vendor imaginary. This is one way that vendors often respond to potential challenges from the user imaginary.[9] With the advent of digital network technology, vendor power has grown considerably. It is not surprising then, that vendor publics would utilize their economic and political power to dictate a good portion of modern government policy. In response to vendor public interests, the government operates as a conduit of distribution, providing economic incentives for technological development, training, and use. As the government works to enable and promote user access, they also reinforce existing vendor narratives about the use of technology and its value, narratives that take for granted government support. We see this in the funding of network expansion and the encouragement of digital technology through laws like the High-Performance Computing Act (HPCA) of 1993 which ostensibly repositioned Internet technologies as a tool for economic advancement for companies.[10]

To be sure, there are cases where the government operates as a potential barrier to vendor publics. This is particularly true in those instances where the user public interest is broad enough to have a large impact on other avenues of government power, or where vendor counterpublics may exist or come into conflict. As monitors of the user public, the government is tasked with support and protection of user interests. Unfortunately, the government's response to these issues often ends up positioning it as an enforcement arm of the dominant vendor public. Quite often, the question is not one of public benefit, but of which vendor imaginary should take precedence.

Tim Wu maps this interaction throughout the 20th Century in *The Master Switch: The Rise and Fall of Information Empires.* In an early section of the text, he shows how radio in the United States

[9] In such a case, the vendor operates as a dominant public while the user is a counterpublic (Warner 2005, 118)
[10] I will discuss this in detail in chapter 4.

moved from a user driven imaginary, one in which users adapted and built on implementor technologies directly, to one dominated by vendor publics (Wu 2011, Ch. 9). In essence, what Wu describes is a shift in which radios were kit built systems, designed and maintained by hobbyists who used radios to create and transmit content and media as well as receiving that same content and media to one in which users' radios were employed as receivers of content for specialized broadcasters who were owned and managed by the same vendors who managed the transmission structure (Ch. 5).[11] For Wu, this is the result of an economic policy that often is at odds with the goals of a democracy. Where the US political system fundamentally distrusts a centralization of power within any one political entity, the US economic structure repeatedly encourages the massive centralization of economic power through deregulatory action only to have to eventually respond when that economic power becomes too onerous for the public to tolerate (Ch. 21).

Wu's interest in highlighting this oscillation throughout the 20th century is to show how government policy is complicit in reinforcing vendor interests. As he does, he exposes how imaginaries collide and are reimagined. In his discussion on the fall of AOL-Time Warner, Wu notes that the collapse of the early network juggernaut was exactly the failure of the company to adapt to the push of a Neutral Internet (Ch. 19). This push, which was first an implementor need, then a user demand, ran counter to the imaginary that many vendors worked under. Yet, the push for that neutrality, which was implicitly and explicitly supported by the FCC until 2018 fed into other vendor imaginaries. The rise of Facebook and Google can be directly connected to the stability of the neutral internet that does not block or limit access to other sites or services (Wu 2011, Ch. 19). In this case, the vendor imaginaries shifted faster than AOL could – or would -- adapt. As the story of AOL and the subsequent moves by the FCC (to allow

[11] Wu's discussion on the rise of NBC (Ch. 5), a jointly-backed venture of AT&T and RCA, feels eerily familiar in the modern context.

network providers to break Net Neutrality rules) remind us,[12] government policies surrounding technology respond to the different sociotechnical imaginaries that drive technological production and use.

Wu's interest in *Master Switch* is to push back against the idea that what happened with digital network technology from the mid-70s forward was something new in American society. For Wu, the oscillation between open technological advancement and the growing centralization of technological power is a perennial issue of American economic policy. He concludes *Master Switch* by highlighting his growing concern about the appearance of content diversity hiding a growing centralization of that content. More content, even different forms of content, do not necessarily mean that more voices have access. In centralized systems, where content in large amounts is funneled through a few small vendors, many voices can still be lost or ignored.[13] For Wu, the drive toward centralization is the creation of a system predicated on the rise (and inevitable fall) of, what he terms as information empires, a monstrosity of a problem created by government inaction and vendor ambition (Wu, Ch. 21). That may be. Because his focus is on the economic and political systems that help to drive such oscillations, Wu focuses on the "politics of technology" and is less interested in how technology helps to co-produce these same systems of imbalance. As he notes, "Most of the federal government's intrusions in the twentieth century were efforts at preventing disruption by new technologies in order to usher in a future more orderly, less chaotic" (Wu, Ch. 21). In its action, the government is responding to specific ideas about what a society is, how it should operate, and how the technology in that society should function. Those ideas are not external to the technologies they inform, rather they are a part of them.

[12] These providers which include Time Warner Internet which is now owned by Spectrum
[13] Apple's App store has over 2.2 million apps (Goode 2017) and yet it often block and limits apps it consider to be obscene or "politically charged" (Hestres 2013).

What we see in rise of modern computing and network technology in the 70s, 80s, and 90s is a movement in the nature of the technologies that are advancing new imaginaries for both user and implementor publics.

User and Implementor Alliances

In examining the connections between implementors and users we can look back to remnant of the do-it-yourself ham radio industry of the 1960-70s.There is a deep link between early computer hobbyists and radio. Many of the earliest users of consumer-grade microprocessors were part of the ham-radio community (Green 1975; Campbell-Kelly et al. 2013, 233). This community already had the technical experience and knowledge to work with this relatively new technology; often they were engineers and scientists themselves. More importantly, they had the resources to purchase and experiment with these new hobby technologies; ham radio systems required investments of both time and money. Developing and building early computer systems required a similar investment. In his article in the inaugural issue of *BYTE Magazine*, Wayne Green explicitly linked the two user communities. Green was known as the publisher of *73*, a ham-radio interest journal and he helped to establish *BYTE* in response to ”the surprising response I received from the readers of 73 Magazine (amateur radio) every time I published an article involving computers” (Green 1975, 9).

BYTE was first published in September of 1975. Earlier that same year that the MITS Altair 8800 was released with much fanfare through a series of articles in *Popular Electronics* which claimed

> The era of the computer in every home- a favorite topic among science-fiction writers- has arrived! It's made possible by the POPULAR ELECTRONICS/MITS Altair 8800, a fullblown computer that can hold its own against sophisticated minicomputers now on the market (Roberts and Yates 1975, 33).

In this one sentence, the promise of the technology is made abundantly clear. The Altair offered users access to the same technology that industry was using at an affordable price, while also transforming the computing imaginary. The remote, expensive, and monolithic mainframe systems that had dominated the imaginary suddenly made way for smaller systems that could be extended and modified by a much larger class of people. The Altair was no mainframe. Campbell-Kelly et al. note that it was, in many ways, a limited device that was designed to get a response from the hobbyist community (Campbell-Kelly et al. 2013, 235-237). That, of course, was the point. Its strength came not from the initial system, but from the ability of the user to purchase, modify, and extend that system.

Cooperative modifications and extensions are a recurring element in the narrative of computer networking and I would suggest were the first real connection between implementor and user imaginaries in terms of computer networking. For implementors, building on technological discoveries was a part of daily practice. The collaborative atmosphere that was provided through sheltered and funded spaces allowed scientists and researchers to build off each other's findings. The Altair, as a device, brought that same level of interaction into the user space. Campbell-Kelly et al. note the increase of expansion boards and software that helped drive the Altair's popularity and, inadvertently, gave rise to Microsoft. In that acknowledgement, they hint at this shift, terming it "computer liberation" (Campbell-Kelly et al. 2013). Yet this, crucially, is not the liberation of the computer so much as the development of a new imaginary which the personal computer inhabits. In a sense, agency is reversed; users enable the machine rather than it enabling them. Instead of purchasing components and assembling them into a realized machine, the users of the Altair could do something entirely new: They could assemble the components into a machine of their choosing (Roberts and Yates 1975), providing the user a unique sense of ownership and control over microcomputers that had not existed earlier, and opened the possibility for even more development and collaboration.

As it did, the user and implementor publics suddenly found themselves engaging and working with one another, sometimes in concert and sometimes in opposition. As Carl T. Helmers, editor of *BYTE Magazine,* concludes in the close of his article in the *Proceedings of the 3rd ACM SIGSMALL Symposium and the First SIGPC Symposium on Small Systems:*

> In the narrow definition of "our" as the type of person in this room, the effect of microcomputers is thus clear: improved popular awareness of the concepts of computing will lead to greater understanding of what it is we do. In short, we will find it easier and easier to communicate with the more general public how it is that various computing concepts fit in with life in our civilization (Helmers 1980).

Helmers' understanding of the new user public that was forming around computer and network technology came, in part, from his position between these two publics. His work had afforded him a ringside seat to watching the growth of a new public formed through and with their interactions with machines.

The Expansion of the User Imaginary

As these new computers grew in popularity and power so too did the possibilities for communication. Networked communication was already happening prior to the rise of the Altair. As I discussed in Chapter 1, CompuServe, founded 1969, and Resource One, 1973, were both alive and active services. These services, although revolutionary, maintained a version of a centralized control structure. Users could log in and access the machine, but they were always separate from it, in the sense that they could not replicate or build their own system or shape it to their own ends. The systems they were connected to were not available for the reinvention that was promised in the imaginary. This idea of control becomes synonymous with freedom and power in the growing user imaginary. As Chun suggests, this is a reimagining of freedom not as liberty but as control (Chun 2008, 8-9). The user has the control, but that control comes through the power of the machine and the users' ability to manipulate that power. The result is a social power from a comingling of human and machine, the figure of the cyborg. While her language is different, Haraway argument is that the user and the user public are not separate from the machines they use. The technology and the user publics are contingent structures (Haraway 1997). The user public exists because of the machine and the machine, an assemblage of the user, cannot exist otherwise.

This rise of a user public could not happen without the personal computer. The Altair and its descendants reshaped how the user imagined their technology and their relationship to that technology. It is within the linking of the machines and users that the user imaginary takes on a greater power and shape. An imaginary does not exist purely through the technologies it helps to create, however. Publics demand and circulate materials that reflect those ideas. By the mid-70s a whole cadre of new texts and groups arose to help advance the growing digital user imaginary. Publications, local user groups, and fan 'zines were all moving to fill in gaps for the user public to generate and share content. These 'zines and publications from *Byte* magazine to *2600* shared and distributed information about the technology, and more importantly they created a common language for hobbyists and hackers that extended beyond the machine. As they did, a new imaginary emerged where even the terminology became more evocative and powerful. The computer hobbyist of early 1970s had transformed into computer wizards and hackers by the start of the 1980s.

While these texts were useful and important for changing perspective on computer use and the imaginaries surrounding that use, they did not provide for machine-to-machine level connection. In most cases, users were unable to use their machines to interconnect. Such a constraint is a problem for an imaginary that positions itself as one of empowering a user who could then shape their machine to fit their needs. It was also isolating. These users had grown comfortable expressing themselves through the machine but were still often unable to use that machine in the discursive practice with one another.

While large scale networks did exist, there was very little access to these networks for users beyond specific labs and universities. The user was disconnected.

Communication and circulation are a necessity for a public's survival and a major part of how a cultural public transmits its imaginary. The user imaginary, like the vendor and implementor imaginary, is not just a human construction, however, but a hybrid creation of people and the machines and systems they use. The implementors and vendors of the time had their network structures that enabled human-machine communication for them. The users did not. At best, they could hitch short rides on systems controlled and managed by other publics. If a home computer could be configured to help users communicate with other users, the user imaginary would have an invaluable distribution medium. It didn't take long for users to discover the solution. All that was needed was a modem that connected the computer to a standard phone line, a phone number, and someone to develop software.

The BBS and the Locus of the User Imaginary

In the November 1978 issue of issue of *BYTE Magazine*, Ward Christenson and Randy Suess outlined "The Computerized Hobbyist Bulletin Board." The project conceived and developed over a month allowed members of the Chicago Area Computer Hobbyist's Exchange (CACHE). CACHE was a user group of computer hobbyists in Chicago. These user groups acted as one of the primary points of circulation of hobbyist text and ideas. As such, Suess and Christenson were looking for a way to connect their group to information and communication outside of planned meetings. Christenson and Suess bulletin board system (BBS) offered a major shift in user public communication practices.

Bulletin Boards remain unique constructions in the network world. In essence, they are user constructions developed literally through bricolage (Certeau 2011). Christenson and Suess built their bulletin board system out of spare parts and deals on equipment coaxed from their local network. "My objective was to get the most functions at the least cost" (Christenson and Seuss 1978). These systems were not professional grade structures; the very informal nature of the development and programming was baked into the structure of most BBSes. It also highlights the very limited divide between the owner or system operator (Sysop) of the board and the board's community. Most sysops and staff were a part of the system they built. They were active users who were a part of the community they were creating. Even in BBSes with multi-state reach, the sysop and staff were often accessible to users. This meant that a lot of BBS development was participatory. At its core, a BBS is a server that provides a series of custom applications to its connected users. These applications provide communication function, games, file sharing, and a variety of other services. The applications the BBS and its developers, the sysop and staff, delivered were subject to immediate input and feedback. Even the prepacked BBS software was designed to be customized and modified by BBS hosts.[14] This highlighted a significant shift away from earlier models of software development. In the cases of BBS software, the software was designed to be modified in response to community needs and requirement. This open development practice also came to be a major part of many BBS software platforms which were either open or freely accessible and modifiable or provided low-level customization to the sysop to craft the system to meet the needs of the community.

Community marked the second major factor of these bulletin board systems. BBSes provided a localized anonymity. In contrast to the modern Internet in which anonymity is provided and maintained, in part, by distance or the illusion of distance, most BBSes were bound to local area codes. The expense of long-distance calls helped to create a vibrant local community of BBSes. At the same time, one could use an alias in a BBS.[15] This meant a user could explore their community without the burdens of their

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[14] This model continues in the development of MUD platforms (see below) which provided the basic mechanisms for designing games and social online spaces but expected that developers and users would create and extend the system to fit their needs.

[15] This was frowned upon in some BBSes. In the original BBS, there appeared to be a tacit assumption that real names would be used in line with implementor concepts of openness and sharing that many user groups attempted to mimic.

“real-world” community-derived identity and without the penalties for breaking that identity. Very quickly, BBSes became spaces for those privileged enough to have access to a personal computer, but who still struggled with issues of identity and fear of discrimination often over ideas surrounding, e.g., religion, gender or sexual orientation.

The impact of the BBS on the user imaginary was profound. The machine transformed from a personal work device to a tool for safe and open communication with a community of others. BBSes became safe spaces, seemingly outside of the control of vendors or the state. This openness and “wild-west” atmosphere drew in many from the counterculture community. They imagined a world of interlinked BBSes providing space for discussion and sharing for the communities that gathered there. The notion of interlinked BBSes was raised by Ward and Christenson. In their article, they theorized that “Bulletin board systems could become nodes in a communication network” (Christenson and Seuss 1978, 150). There is a subtle difference, though, between a BBS and an Internet node. The BBS is a self-contained system, in that it connects to users, but does not rely on Internet applications for users to manage it, in its own space outside of the other Internet servers. This is, in many ways, transformational, breaking down the idea of the computer as a terminal and setting up users as the arbiters of their own digital space. The user and the user’s community are, in such an imaginary, jointly in charge of their data and the hardware and software, choosing limits and what is acceptable.

Openness and customizability were extremely popular with the user public. Soon, thousands of BBSes began to spring up.[16] Different systems and software allowed for and provided different experiences for users. These experiences in turn changed how users imagined the BBS and networked communication platforms. Where early bulletin board systems worked by hosting a single phone line into a system, soon multiline systems allowed more users to connect and communicate in real-time.

[16] Again, Chun would remind us that freedom in this space is a form of control. The user is free because they have control, and this is attractive to the user (Chun 2008).

Real-time chat and communication altered how users could interact and share in these spaces while also altering the nature of online etiquette and behavior. In the traditional 1-line systems, access was limited. For every minute a user stayed logged in they were preventing other users from accessing and using the system. This slowed communication, and forced users into an asynchronous model–where everyone took a turn to communicate ("Ethics for BBS Users"). The later multiline systems emphasized connection and online engagement over this asynchronous functionality. The DLX system software for example could support up to 32 phone lines at the same time (Gillman 2014).

These shifts heralded the ongoing merger of the user and their technology. The technology as a tool of customization and control now became the center of the community for the user. There is, of course, a division between the imaginary ideal and the reality of the BBS subcultures. While early BBSes often offered anonymous access and protection, they were also spaces that could allow and protect abuse. Anonymity provided criminals with an avenue of access to people in ways that a physical public space did not (Sherwick 1988). For others, BBSes provided a way to gather and partner with like-mined indviduals who were interested in exploiting this new infrastructure. Reasons for the interest varied, for some it was a technical problem, others were interested in crime and profit, and some were just interested in fomenting chaos (M.I.A 1991). Whatever the reason, BBSes became centers for criminal activity. The Wild-West concept of an open digital frontier carried with it the very real consequences.

Tensions with the Vendor Imaginary

In response to problems caused by users, BBSes tried different solutions, including hierarchies and structures. Some BBSs required payment, others demanded real names, and others operated as spaces where access was granted in a sort of barter system. In the original systems that Suess and Christenson had imagined and built, the BBS offered a space for collaboration and resource sharing between hobbyist developers. Developers and engineers would share hardware and software schematics as they worked on systems that were essentially laboratories for hobbyists.

This became problematic for vendors who often saw their applications, meant for sale, end up on these sites free of charge. In part, this was due to a specific difference between how hobbyists approached the technology and how vendors believed they should approach technology. For vendors, technology was a product to be packaged and sold. Vendors developed hardware and software solutions, and then provided those solutions to users who were expected to use the technology in intended ways. This was not how new users from the world of BBSs approached vendor technology. For the neophyte computer user, the machine (hardware and software) was *meant* to be modified and designed. The computer and its hardware and software represented potentials not concrete realities. The user of the day expected to be able to tear apart their machine and code it as they needed. They expected to have access and power. This limited the vendor options. If a vendor supplied a machine, it had limited control over how a user adapted that machine or the ends to which the machine would be used. This meant that specialized systems that were once high value to vendors and users were now becoming cheaper and easier to access. In addition, most users were comfortable sharing their discoveries and their technologies with one another even when those discoveries involved using the vendors proprietary hardware and software.

Carl Helmers does an excellent job of outlining the problem in his 1975 opening editorial in *BYTE.* He argues that hobbyists often viewed computer technology as a function three different aspects: hardware, software, and applications (Helmers 1975). Notice the division between software and application. For hobbyists, software was architectural and experimental. Software provided the structure through which applications would run. In modern parlance, the software that Helmers mentions can be thought of as the kernel or operating system: those elements that provide hardware level access allowing for specific applications to run.

Even in these early days, most of the software provided by vendors was "locked down," or designed for a specific hardware system with limited compatibility which was meant to encourage users to buy specific products and features. Hobbyists had to do custom work to get the software to run and often this required specific hardware and software adjustments. These "hacks" were often shared on BBSes allowing other hobbyists to share and build on the work being done. For vendors, this sharing broadly wasn't an issue. Increased usability meant that more users were using their applications and that usually meant more sales. It didn't take long, however, before those hacks would become a problem for vendors.

After all, if hacks and modifications could be shared, so too could the software itself, especially as modems increased in transmission speed and new protocols for data transfer were developed. All of a sudden, the BBSes that vendors saw as useful, at best, and harmless oddities, at worse, were becoming centers for the transfer of copyrighted software. Indeed, many of these BBSes often operated as dead drops for software, where access was managed through a barter system in which a user would deposit a piece of software and, in return, receive access to the archive. Very quickly, the vendors began to realize that their role over the sociotechnical imaginary had shifted. Users no longer thought of technology as a sort of delivered package. Instead, they imagined themselves as implementors, customizing their technological experience in ways that they saw fit even if that meant co-opting and exploiting existing vendor applications to do so. In fact, the user community of the 1980s and early 90s often celebrated these exploits by portraying them as rebellious acts against the larger industrialized and centralized vendors.

The Rise of MUDS and the User as Creator

If the BBS was the center of transmission and distribution of the user's sociotechnical imaginary, the MUD was the creative heart of the process. The first MUD was developed in England at almost the exact same time as Suess and Christenson's BBS. Developers Roy Trubshaw and Richard Bartle were computer science students at the University of Essex in England. Their original goal was to create an online multiplayer version of *Zork,* but they quickly realized that the multiplayer mechanics offered by the technology altered the narrative flow of the game significantly. (Bartle 2010). For Bartle, this meant a shift from narrative to world. The puzzle and problems that Zork offered a single player become trivial in multiplayer contexts. What mattered to players, in Bartle's perspective was their ability to interact with and develop their identity within this virtual world. For these developers the MUD extended beyond the game, "Bartle in particular saw the need to create a new form of gameplay for *MUD* as a means of giving people freedom to be – and become – their real selves" (Bartle 2010). Because MUDs were primarily multiplayer, the BBSes that powered much of the early user imaginary was distinctly separate from the MUD communities. For BBSes, a series of turn-based roleplaying games were dominant. These games were often turn-based strategy games pitting players against each for top ranking and position. These games were very different from the world creation that MUDs offered. MUDs were fascinating pieces of software in that they attempted not only to replicate a game experience, but they provided structure for reshaping and forming a digital world. Trubshaw and Bartle would release the code into the public domain in the mid-80s. In so doing they would spawn a series of new virtual worlds. Again, in the early-to-mid 80s, most of these worlds were still located in England and still primarily confined to university computers which limited the access of the MUD worlds to other participants.

Bartle gave credit for the expansion of MUDs to Alan Cox, who developed AberMUD at the University of Wales. Cox finalized his version of AberMUD in the language C, allowing it to run on the Unix systems that were becoming more and more popular as research tools and machines. Unlike the BBS, the MUD is an implementors technology that embraces the user imaginary. Early MUDs ran primarily on university computers. They required connection via a growing Internet which was still primarily ran and managed by implementors. I would argue, though, MUD technology represents a user imaginary, or more completely a growing synergy and merging of the user and implementor imaginaries that would push well into the 90s. As I note earlier, this was, in part, because many of the hobbyists and users were also implementors. The systems they built and worked with were also the systems they played with and used for hobby work. What we also see in the development of MUD software (and later certain protocol and application platform work) is the focus of the implementor not on the construction of larger centralized systems, but on applications and architectures that emphasized the user and the user individuality and control.

This focus on users was certainly a part of the DNA of MUDs. MUD architects could literally create anything they could code, allowing for textual worlds that operated in entirely unique ways. A MUD developer could create entirely new worlds and species. They could alter the structure and framework of the economy and the way in which the users responded to the world. Developing a MUD as Sherry Turkle explains, "is something of a hybrid between computer programming and writing fiction" (Turkle 2011, 184-185). It also allowed the user immense power in developing and playing their avatars, textual representations of their online persona. Concepts of race, gender, and species could be fluid and dynamic. Users could experiment with entirely new roles and concepts of being. Indeed, as MUDs evolved, users took on more power in customizing the system, developing their own local instances of actions and creations. While some MUDs maintained traditional fantasy settings complete with swords and monsters, others become places of shared social exploration.

Yet much like the imaginary of the BBS, the MUDs were not ideal. Julian Dibbell's description of an assault in LambdaMOO is a constant reminder that the blurring of the online and offline can have concrete effects (Dibbell 1993). If Bartle is correct about MUDs offering a path to people finding their true selves, then those selves are just as vulnerable to exploitation and emotional harm. Indeed, these issues continue to plague our understandings of online and offline life even today. Here we can see how the user imaginary evolves to accommodate the expectation of violence, as well as the link between the system and platform architectures and the user imaginary that inevitably helps to enable that violence and risk. For both BBS and MUD designers, the focus appears to be on the individual; Bartle is quite specific about this. The individual's growth and experience are presented as the most important feature of the system. Yet, the real focus of BBS and MUD technology is not the individual but the community. What Christenson and Suess developed was not a platform for individual control. Why would they? The personal computer was already that. Users imagined something more; they wanted connection and community. BBSes and MUDs offered users a methodology through which online and virtual communities can be developed. At the same time, the stated focus on individuality and self-empowerment over the community destabilizes those same goals. It is this break, between the desire for individualized control, or personal freedom, and the desire for community that helps to create a wedge through which vendors can reposition themselves as purveyors of individual power without the requirement of individual action. Where, previously, user power was often expanded by building on top vendor supplied systems in coordination with a community of digital users (BBSes, Implementor communities, User Groups, 'Zines), by the late '90s the vendors had moved in to assume that role. As we will see in the next chapter, it is this break that will help to undermine the user imaginary in the early 00s.

Chapter 4: The Transport Layer

Restructuring the Network Imaginary

The Stack, Redux

The Data Link layer of the TCP/IP protocol suite, by design, constructs the network by linking hosts to one another and providing an architecture upon which upper layer communication (e.g. email and web) can occur. Once the nodes are connected and attached, the Internet layer then provides the protocols that enable the hosts to effectively communicate with one another. In terms of publics and their imaginaries, we can think of the Data Link and Internet layer as the imaginaries within which and through publics can and do interact. In the last two chapters, I have explored how these imaginaries helped guide development of technology and how they respond to one another. Yet the actual act of response of conversation and movement of information through discourse requires an effective "means of transport." The internet is a "packet-switching network," meaning that unlike a phone system, data doesn't go directly from point-to point, but instead is broken in pieces, or packets, which can travel completely different paths before being reassembled into (e.g.) your email. The Transport Layer contains protocols that can determine if those packets have been reassembled accurately, arrived at the same time, double check accuracy with the source, and much more.

In this chapter, I will use the Transport Layer of the TCP/IP network model to explain how socio-technical imaginaries move between publics and how that movement often results in the merging or assimilation of counterpublic imaginaries into the dominant imaginary. As this happens in a sociotechnical imaginary, it literally changes the technologies that are a part of that space, since the capacity and capability of the software and hardware, as they are endlessly updated and upgraded, are redesigned to engage in the new imaginary. Think of how cell phones evolved to emphasize the screen as texting become as much communication as talking and made the availability textual data just as important as talking. Yet the change goes the other direction and is also social. Our ways of interacting with and through the technology requires changes in our communication practices and those changes open up new options (e.g., video chat and photo-sharing) while de-emphasizing others (voice). As these options change to reinforce social and political expectations so too do our relationships with the technology and its infrastructure.

To move and manage these higher-level messages, the Transport Layer works in concert with the layers beneath it. The relationship between these layers is a necessary part of the network communication process. I start then with a brief return to the Internet Layer and its relationship to the Transport Layer. The Internet Layer is a set of protocols that enable network communication across connected nodes. At the heart of the Internet Layer is an older protocol, the Internet Protocol (IP). The Internet Protocol, the "IP" in the TCP/IP, was originally defined in RFC 791 posted in September of 1981. RFC 791 was an adaption and distillation of the earlier DARPA-defined Internet Protocol for the ARPANET network (the original packet-switching network). The Internet Protocol embodies standardized rules through which hosts in a network could exchange data with one another. Standardization was a – maybe *the* – key problem in the early days of networking where most companies were designing their own network rules and structures (Pouzin 1975). The Internet Protocol would eventually help companies design products that could interconnect and communicate, becoming the basis for the development of a single protocol "stack," viz. a single interlocking set of programmable rules. These rules could be standardized into a set of development libraries that developers and engineers could use to add network capability to their applications without actually having to write the code from scratch.

The Internet Protocol (IP) defined in RFC 791 has greater complexity than the more generic TCP/IP protocol suite defined in RFC 1122 and 1123. This may suggest one of the reasons for the IP's adoption within the TCP/IP RFC. Adopting IP allowed the IETF's Network Working Group to provide specific instructions on how to design network communication by building on what was, at that time, well over a decade's worth of IP design experience. Despite its complexity, the Internet Protocol does three basic things:

1. It specifies how to break up large amounts of data into smaller packets for transmission and reassembly.
2. It establishes an addressing scheme for network hosts which enables a simulated form of direct one-to-one (host-to-host) communication even while transmitting content through multiple routers and hosts.
3. It defines methods and structures for network routing and design.[1]

In a basic IP network, the sending host breaks down information into "blocks of data called datagrams" (Braden 1989) and then transmits those datagrams along the network. In doing so, large amounts of data can be easily split up and transferred across a network with less risk than trying to transfer one contiguous stream of data. When data is streamed as a single block there is an increased risk of corruption, since a single glitch or disruption may result in the entire transfer being lost or garbled. A network that transmits datagrams, reassembled on the receiving end, can better handle potential glitches and slowdowns, since it can build in redundancy. Transmission of the datagrams requires giving each host a unique address, that matters only to the destination, or listening, host. At the Internet layer, the sending host never checks to see if the address it is sending to is live or listening. The sender doesn't care. All that it does is transmit the datagrams along the network and attach the destination address to the IP datagram. Every system on a local network then receives that message. The destination hosts then determine what information is meant to be passed up to higher level applications, by comparing the destination address to their own, and deciding which information to

[1] These include the creation of system address (IP addresses) and for the development of routing procedures and tables for moving packets from one address to another.

ignore or drop. After transmission from a source host to a destination host, these datagrams are reassembled and passed to higher level applications on the destination hosts.

While this standardization was helpful in developing network software and hardware, it was not enough to ensure successful network communication. Indeed, IP explicitly does not guarantee successful communication, “There are no mechanisms to augment end-to-end data reliability, flow control, sequencing, or other services commonly found in host-to-host protocols” (Postel "RFC 791 - Internet Protocol" 1981). In other words, as a protocol, IP only provides a means of transmission, it does nothing to determine the effectiveness or success of that communication. If a developer only uses IP, they have no way of ensuring that a message that is sent is ever received unless they write those rules themselves. End-to-end host management (i.e., a continuous loop between hosts) is critical for many applications, especially those that demand synchronous communication. While code can be written for each application to ensure its communication is successful, it once again places developers in the place of having to custom write code for each application which limits interoperability and access. For a protocol stack to be successful in the growing Internet space, implementers knew they would need a standardized transport protocol that would provide end-to-host host and network transmission management.

Transmission Control Protocol (TCP) was a general solution to fill that gap. The scope of the protocol is explicit: “The TCP is intended to provide a reliable process-to-process communication service in a multinetwork environment” (Postel " RFC 793 - Transmission Control Protocol" 1981). The TCP operates as a manager for network traffic utilizing the IP, the traffic cop relying on lights and stop signs. This allows higher level Application Layer protocols to focus on specific applications (programs), instead of managing basic network communication and access. In its role as a transport protocol, the TCP often acts to connect disparate networks merging them into larger networks (Postel " RFC 793 - Transmission Control Protocol" 1981). It is in this merging that we can again see an analog to the development of sociotechnical imaginaries in which one public's imaginary is connected to and merged into a larger dominant imaginary.

The merging and standardization of networks offers significant benefits. The development of a standardized protocol stack is a critical moment in the development of the Internet. A well-tested and standardized stack freed developers from the challenging and cumbersome task of choosing between buying into a specific company's existing network structure, which then tied them to that hardware and software, or going out on their own and developing a whole new network structure, like choosing between toll roads and paving your own. It takes a lot of work to build a successful and useful protocol stack. If engineers were forced to develop network rules and structures for every application, they would lose valuable time that could be spent developing other parts of the application that addressed the problems they were trying to resolve.

Development libraries, existing collections of off-the-shelf code, allow developers to standardize lower-level programmatic needs. These libraries make development easier; they also aid in cross-application communication and development. Applications that share libraries have shared interfaces that may be able to communicate far more easily than two different libraries. As libraries standardized, they helped to increase application and network stability, while inevitably limiting variety and creativity. Because they acted to resolve and effectively hide complex programming problems, development libraries have become incredibly useful while also becoming one of the first points of network obfuscation.[2]

In a TCP/IP network, communication is always a process of identification, deconstruction, and construction. Information is broken down, divided, and addressed. Datagrams merge and break apart in

[2] This invisibility is not without its danger. Many of the most dangerous risks to software and network security can be found hidden in libraries that were never updated or checked.

an ebb and flow between those systems engaged in communicative processes. As they do, they become invisible, lost in the background, but always there and their construction and access remain as important today as they did in 1981.

The Protocol Suite as Political Space

In considering the evolution of sociotechnical imaginaries, and their reflection and transmission between people and publics, it is very possible to see a similar form of transport activity in play. Just as the Transport Layer adds reliability and management to a network where the Internet Layer has established the addressing and structure of network data, so too must the development and transmission of the texts spawned by these imaginaries be managed, broken down, addressed, and transmitted. If the Data Link Layer provides the means of connection and communication through the movement of digital machines into publics and their imaginaries and Internet Layer shows us how those imaginaries come to collide, interconnect, and share, the Transport Layer shows us how those interconnections are managed and evolve. The Transport Layers exposes how imaginaries respond to and negotiate those collisions and connections.

The TCP/IP model reflected in RFCs 1122 and 1123 is a creature of its time. The power of the RFC is in its temporality, and the narratives that it temporality brings out. RFC 1122 and 1123 build on the past; like the entirety of the RFC collection they are part of and connected to the history of the Internet itself. No RFC is ever deleted, they are only obsoleted and amended by later RFCs, opening avenues of investigation for historians of technology and researchers in technical communication. From these documents we can construct the story of the Internet and see the traces of its publics. The TCP/IP model, as a descendant of earlier versions of the Internet Protocol, helps to constitute a narrative on how technologies and networks should operate. Like all narratives, these earlier versions carry with them the weight of their time and creation subject to the social and socio-technical imaginaries of those who created them. The DARPA project which helped spawn the first Internet Protocol was a military-driven enterprise, but the evolution of those technologies did not remain locked in DoD clean rooms. The technology -- and its story -- spread. Systems geared for military use soon found themselves entering new contexts, and they seemed ill-equipped to meet the challenges of these new spaces. Many of those who now used and designed these technologies held very different ideas from the user public about what that technology should do or see.

As a result of this expansion, those new ideas spawned by new users and new ways of treating these systems became a part of the conversations and ideas that these publics were having. These ideas were focused more of the sharing and use of information than in protection of the network (Abbate 2000, 100). Information was shared and transmitted in a variety of methods and formats and as time moved on that information was directed to different publics, audiences, and ideologies. How these publics dealt with the messages varied, but that response was secondary to the movement of the message in the public's space. While the goals or messages were different, everyone agreed that the network existed to enable these practices. Once this idea was a part of the imaginary, it became a part of the textual machinery that publics used to communicate and share. This is the metaphorical dance between the Internet and Transport layers. The Internet Layer does not protect the messages it sends out.; it is entirely disseminative. It does not know how those messages will be received or in what order, nor does it concern itself with what the hosts may do with information once it is received; and yet, it would be a mistake to think that the mechanisms for the interactions between these imaginaries do not prefigure and structure the interactions that comprise communication on the Internet. James Brown Jr. uses Derrida's concept of the laws of hospitality to illustrate this, suggesting that there is both an invitation to users on the network to interact and a simultaneous need and requirement to filter access and information (Brown 2015, Ch. 1). For Brown, this hospitality is evidenced at both the protocol and application level (Ch. 2). In terms of the protocol stack we can think of the Internet Layer as the layer that enables the invite and connection. The Transport Layer, on the other hand, allows the host, process, or user to filter, confirm, and limit access as needed. Brown's investigation of ethical programs and hospitality tends to focus on a one-to-many scenario. He wants us to understand how a user navigates, interacts and manages the digital space. Yet the application of Derrida's laws of hospitality do not necessarily end there. Publics, as Farmer would remind us, have their own reflections in these laws of hospitality in which objects and ideas are circulated and drawn into the public and then filtered, accepted, or rejected (Farmer 2013, 57-59).

It is those rules, those protocols, that become important in examining the rise of the digital network and its imaginaries. Protocols are a critical part of network management and development. They not only help to maintain network coherence but to drive and regulate the very nature of network communication. These protocols, then, define the nature of the network at every layer of the TCP/IP model. The protocols for the communication and transmission of sociotechnical imaginaries between publics is less developed than that of the network protocol. Within the development of the structured Internet protocols, however, we can begin to reverse-engineer and glimpse a potential way in which these protocols of the socio-technical imaginary may operate.

The Importance of (a) Protocol

How protocol became the organizing structure for distributed networks is a major part of Alexander Galloway's analysis in *Protocol: How Control Exists after Decentralization.* For Galloway, protocol becomes something more than an agreed upon set of rules, instead he defines protocol as "a language that regulates flow, directs netspace, codes relationships, and connects life-forms" (Galloway 2004, 74). As a language, though, they are equally subject to re-interpretation, re-definition, and remediation through the technology that they themselves are a part of and contingent in. This is, as Katherine Hayles notes, a reflexive relationship where reflexivity is defined as "the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates" (Hayles 1999, 8). Protocols are part of the network they make possible. They can be thought of, as Galloway suggests, the language through which these systems communicate. Yet, they are not alone in the space.

Sandra Braman, in her work on analyzing the structure of RFCs and the IETF notes that there is a decidedly political element at play within all of these protocol definitions (Braman 2011, 297). Braman's identification of the political element that suffuses the construction of the RFCs and through them, the protocols themselves, suggests that there is more at play here than the technical demands of the protocol itself. *Rather, the language of the protocol is part of a broader socio-political conversation*. To be sure, these same political elements exist in and replicate through the network, as well. Galloway looks at the network as a political system that hedges between open distribution, where anyone can potentially connect, and hegemonic control, the passive and active privileging of some forms of traffic and data over others (Galloway 2004, 75).

These characteristics are not something unique to protocol, however. They are, ultimately, the nature of our social and political systems. After all, social interaction and communication demands a certain level of openness to access and receive information. Without a willingness to share in the communicative act, even if only to reject it, there is no real opportunity for interaction. Openness alone, however, is not enough. Communicators must always decide what elements of those interactions to privilege in their communicative acts and which aspects to ignore or minimize.

Because they are forms and products of language, protocols are never static. Indeed, the very function of the IETF process provides for the continuous redesign and restructuring of these protocols.[3] The TCP/IP model and protocols that we are discussing in RFC 1122 and RFC 791 have been updated

[3] The IETF calls these types of ongoing revisions "streams." (Daigle and Kolkman 2009)

multiple times since their creation. When thought of in this way, the protocol's operation as a tool of hegemonic control can be directly linked to the developers, engineers, and vendors who are shaping the Internet to fit their imagining of what this technology should be and do. Here, too, the reflexive nature of protocol takes shape: protocol participates in and shapes how engineers and developers think about their technology while at the same it shaped by and subject to the same system it creates. What is intriguing about this, is how the same thing can be said for the publics engaging in these systems. Be they users, implementers, or vendors, each public becomes part of, shaped by, and subject to the networks they build. Haraway's cyborgs are not just people and machines but their publics as well (Haraway 1997). Let's explore what this means.

Cyborg Publics

The nature of the human-and-machine hybrid that Haraway theorized has moved well into broader research paradigms. Theorists have long considered the challenge of a public sphere consisting of humans *and* their machines. While quite often these are framed as discussions of virtual spaces and spheres, the connection between very real people and equally real machines is always evident (Papacharissi 2002; Woolgar 2002). Woolgar's introduction to *Virtual Society* does an excellent job in highlighting how the virtual becomes the real. In it, he pushes back against the idea of an abstracted form of the virtual linking the virtual network to the very real actions and activities it enables and enhances (17). In connecting the virtual to the real, the machine(s) to the human(s), the cyborg is formed.

Cyborg formations often become the stuff of nightmares. For Hayles, the cyborg was the dangerous apotheosis of the Information Age (Hayles 1999, 22). The cyborg, for her, was the disembodied human separated into information bits and bytes all packaged and delivered without any consideration for was lost in the process, the body. It represented a tie to the physical that was no longer needed. We see elements of this allegedly dangerous dehumanization repeated in various forms of creative and critical thought throughout much of the last half-century, if not before. If popular media reflects the fears of the time, then certainly the cyborg was a part of that fear. The fear of a machine hive mind,or entities like *Star Trek: The Next Generation's* Borg, continually reflect our own fears of becoming too interconnected and reliant on the new machines as if, in that movement, we may lose a part of ourselves and our autonomy. *The Matrix*, similarly, reflected the notion of the virtual replacing the real. That virtual space is only possible because of the deeper level of physical connection between human and machine. The resulting interconnections result in very real changes for both.

The fear of the cyborg, then, would seem to be a fear of lost autonomy, individuality. This assumes a level of autonomy that never existed. If anything, publics are entirely dependent on the technology available. The texts that circulate through a public require forms of distribution and production, and we could think of these as outside elements, or infrastructure, beyond the public itself. Yet, the public's use of that technology always links it, in practice, to the public. A printing press, for example, may produce texts for many different publics, and it certainly has no capacity to actively read a text, at least as we currently consider the practice of reading. In much the same way, the distribution channels engaged by book and magazine publishers are often designed to reach multiple publics, just by delivering pieces of paper. Technological advancement in shipping and logistics may increase the public distribution of text, but those technologies are not outside the construction of those texts. A public's use of a technology, be it for creation or distribution, is enmeshed with the identity of that public.[4] Thus, while publics are not autonomous, relying on the technologies of production and distribution, the technologies they use may be used and refigured in other publics.

[4] Farmer's 'zine culture existed in part because of the distribution channels and creative opportunities. Modern "influencers" on Youtube and Instagram use the technological tools in those spaces to generate new publics of attention in much the same way. In each case, the technology use is a contingent part of the public (the public does not exist without it).

That said, there is a type of technology that is core to the formation of any public: the technology of the text itself. Quite often, research on publics tends to abstract the text into a sort generic object. Warner (2005) and Fraser (2014) consider texts as circulatory structures but they don't refer to specific texts or technologies. Frank Farmer's work in *After the Public Turn* takes on this issue directly. In defining cultural publics and counterpublics, Farmer suggests that a public can be thought of as a culture or as a rejection of certain cultures (Farmer 2013, 25). These cultural publics rely on and shape themselves via specific texts (Farmer 2013, 19). The texts that a public circulates, then, directly shapes the form of its culture. This is true of form as much as content. A book is different from a movie or a magazine. Each form of a text takes on different levels of importance and values within different cultural publics. Farmer's interest is 'zine culture and how different fan-zines challenged and defied professional publications (Farmer 2013, 33). This rejection of the gloss of publication was a part of fan-zine culture, and in turn those elements contributed to the cultural and political identity of the public that formed around those texts.

Computers and their networks occupy a sort of double-space in this regard. On one hand, they are tools of distribution and production. Today's computers can become a printing press, a radio station, a photo and art studio, or even a full-fledged video production platform. The modern network has transformed the way we share and distribute content. So much so, that the modern internet is nearly drowning in available content. Yet this is only one part of our relationship with these technologies. Publics form around technologies in the same way they form around texts. Many vendors seek to operationalize this sense of cultural affinity. In other case, the associations form from work and design needs.

The Internet Engineering Task Force (IETF) RFC process itself operates in such a way. The first step for many RFCs is the creation of a Birds-of-a-Feather (BOF) session during an IETF meeting. As the name suggests, the BOF session calls together interested parties for discussion and sharing on a topic of interest. One of the first recommended steps in setting up such a meeting is the creation of a mailing to "gauge how much interest there really is on a topic" (Nartem 2009). The public attention, awareness, and circulation on one of these topics pushes IETF engagement. This engagement is established and measured by different networked machines. They gauge the public's size and interest in an Internet topic or problem. These cyborg publics directly shape the way that Internet problems are addressed and resolved. Computers and networks, in this case, are not purely vehicles of production and distribution or tools of creation. Rather, they are active agents engaged in sharing, creation, and attention.

The Robustness Principle

Attention requires a sort of tenacity (Webster 2014, 7) . This attention is required for a public to exist (Warner 2005), and the maintenance of attention is necessary for a public to survive. In other words, publics must be attentionally robust (Lanham 2007, 152). They are constantly moving in a flow of texts, receiving more than they send. What that public sends, i.e. what remains in circulation, guides the nature of and the imaginaries within that public. The more capable those texts are in maintaining attention, the more likely a public will continue to grow and thrive. Computer networks are not so different. Braden opens his discussion of the Internet layer in RFC 1122 with a brief discussion on the value of the "Robustness Principle." This principle which Braden defines as "be liberal in what you accept, and conservative in what you send" is an excellent way to think about how publics operate and consider how the three publics identified in the last chapter evolved and changed, because it captures the insight that if production exceeds consumption, then chaos is the likely result (a result, ironically, the internet has made possible); attention requires an asymmetry between production and consumption of texts.

In RFC 1122, the robustness principle is applied to the network devices transmitting and communicating information. These are machines, software or hardware, that continuously pay attention to the world around them. In one sense, they are privileged to a conversation that occurs out of most human attention, and yet that conversation is set by and shaped by humans in a wide variety of ways. Humans developed the language that these machines speak and they arranged the algorithms by which these machines pay attention. Humans also generate the need and desire for the formation of these cyborg publics.

The three publics that were considered in the last chapter (implementors, vendors, and users) have not remained static over time. A static public is not a robust public. The circulation of texts requires something new to encourage redistribution. Without some form of reinterpretation, remediation, or revisioning, a public's texts stagnate, and the public disappears. The dynamic nature of robust groups demands a sort of ongoing evolution in the imaginaries that shape that public. Understanding how those imaginaries changed can provide insight into how the Internet itself has changed. In what remains of this chapter, I want to build on the notion of protocols and cyborg publics to examine how different publics and their imaginaries impacted and changed one of the most important protocols of the modern Internet.

The Hypertext Transport Protocol

The method for accessing and connecting to the modern world wide web is a protocol interaction, but it so ingrained into our daily lives that we forget everything that is underneath. We type in "http://" followed by an address. Magically, it seems, a two-way pattern of digital communication results in the nearly instantaneous loading of the site, and the distinction between our being "on" the site and it being "on" your browser is apparently erased (Galloway 2012, 25-27; Grusin and Bolter 2000, 6). But the ease in facility of this transaction conceals the vast underlying problems of connectivity on the inter-net, the system of connected networks. My point, as always, is that these problems are political as well as technical.

Let me start by acknowledging what may seem like a glaring error. The Hypertext Transport Protocol (HTTP) is not a Transport layer protocol. HTTP sits at the very top of the TCP/IP stack, in the Application Layer. As an application protocol, it utilizes the Internet and Transport layers for communication and transmission and then provides an additional layer for application level work and communication. My interest in HTTP, however, is not in the protocol's function but in its evolution. HTTP is arguably one of the most important protocols designed for the Internet. Not only does it drive the largest and most active part of the Internet, the World Wide Web, it also sets up structures that define most other application level protocols. HTTP was the first protocol to define the Uniform Resource Locator (URL) and the more generic Uniform Resource Indicator (URI). These two resources, components of HTTP, are critical components in most forms of Internet programming and development. While each of these are now separate RFCs, our programming environments and structures would be radically different without them.

The story of HTTP has been told many times (Abbate 2000; Berners-Lee 2000; Campbell-Kelly et al. 2013). I do not intend to give a complete history of the development of the protocol, rather I want to trace the threads that will help us discover the publics and the socio-technical imaginaries of the people involved. How does HTTP both respond to and recreate the Vendors, Users and Implementors? I will begin with creator of HTTP, Tim Berners-Lee, and trace the creation and development of HTTP. Next, I will examine its rise and growth, and finally note how the structure and form of the RFC has changed from initial implementation to the modern day. As I do, I will highlight the publics involved, their influence, and how they have shaped and were shaped by this new technology.

The Origins of HTTP

To understand the hypertext transport protocol, we must begin with hypertext. Hypertext (a more apt coinage might have been "metatext," but this is the one that stuck) was coined by Ted Nelson who, in coordination with Andries Van Dam and Walter Gross, developed a system at Brown University in which texts could be tagged and linked to allow a user to travel to key texts or points within texts with relative ease (Theodor Nelson 1972, 252). Hypertext, as Nelson defined it, was decidedly opaque and generic. The best current definition of hypertext, over quite a broad range of types, is “text that cannot be conveniently printed” in linear form (253). Hypertext, as an idea, was a continuation of an imaginary device, the Memex, described by Vannevar Bush, who created the most sophisticated mechanical computers before the electronic period, and later envisioned the National Science Foundation. The Memex was the product of a hopeful and speculative imagination, and it was essentially a single-screened desktop into which microfiche subjects were loaded. An additional cover allowed the user to annotate the texts as needed. Other segments of the screen could then be folded or moved out to allow the user to pull up other texts. The user could then connect those texts together to create a series of links or trails (V. Bush 1945).

Bush designed this as an analog device (digital computing was at least a decade away), but as a product of a socio-technical imaginary, it very clearly reflected the concerns of Bush and others in the public of the 1930s. In a world that seemed poised to drown in information, how could we develop ways to catalog and traverse – control -- complex sets of information? The goal of the Memex was to make life easier for researchers and analysts. It was a research tool. While Bush does link the Memex to encyclopedias, it is apparent that his interest is more scientific than mainstream. The Memex is a kind of prosthesis, a tool that compensates for the limitations of human memory and attention.

Nelson followed in the spirit of Bush, but his imaginary was different. Nelson and his team crafted the hypertext system for the very use that Bush hoped, research and analysis. Nelson, though, had a larger interest in mind. His vision had grown, and in it he saw the cyborg. But Nelson’s cyborg did not herald an era of lost autonomy; instead, it aided the user in establishing their independence. In a conference a year after his article on the “Xanadu Hypertext System” was published, Nelson described his framework for the future, "This paper is not about everything between man and machine, but about man-machine everything, that is, the desirable future condition where most of our information and tasks are attractively and comprehensibly united through nice man-mechanisms" (Nelson 1973). There is, certainly, within this framing of the cyborg a continued focus on productivity and information as the primary methods of independence and power. That power, however, is personal. Nelson's paper presents a detailed and glowing vision of technological optimism. It is filled with descriptions of a technical future that are remarkably prescient. What it highlights is that Nelson, like Bush, was emerging from a digital field that was based in development and growth through research and collaboration. Nelson, as part of the implementer public, was sharing in what is a nearly utopian view of this new digital space. For Nelson, the emerging computer infrastructure that he was contributing to had the potential to open participation into research and creative activities that were beyond their reach (34). Hypertext, like the Memex before it, are systems of democratization designed to give anyone "genius" abilities, to make reading and writing operate, on a massive level, more like, the authors suspect, how the human mind works.[5] In developing such a connected text, they assumed that more people would be able to use and contribute to this new and evolving system, and those increased contributions would add to the growth of knowledge and information (Theodor Nelson 1972).

Nelson's vague definition of hypertext remained a stumbling block for early researchers. There was no clear idea what was hypertext and what was something else. Nelson seemed reluctant to add more definition beyond working on the construction of a hypertext system, named Xanadu, that he thought would illustrate his ideas (Nelson 1977). Other than these systems, there was no real guide for

[5] Here, too, we see evidence suggested by later scholars that these early researchers were making vast assumptions about how the human mind works and seeking to standardize systems by ascribing and defining technologies to respond to existing assumptions about gender, race, and orientation (Noble 2018; Eubanks 2018).

developers and users to create and write hypertext or develop standardized systems for hypertext.[6] This may be one of the reasons Tim Berners-Lee was not familiar with hypertext in the first stages of his own work on developing and information tracking and retrieval systems.

In 1980, seven years after Nelson published his work at Brown, Tim Berners-Lee was hired to work as a software consultant for the European Organization for Nuclear Research (CERN) (Berners-Lee 2000, 4). For Berners-Lee, this was an exciting opportunity. From its origin, less than a decade after the end of World War II, CERN had grown into one of the most important research centers in Europe, operating as a jointly funded research center supported by its member states. Today, CERN has 22 member states who contribute a set amount of funding to the organization every year ("Member States | CERN" 2019). This provides CERN with a stable form of funding while also keeping it firmly outside of the political control of any one state. Stable funding is a rarity, especially in times when political concerns can limit or shape research budgets ("BBC Radio 4 - Big Bang Day: The Making of CERN, Episode 2" 2008). CERN's relative immunity to such concerns allows it to operate as an institute whose primary interest is experimental and theoretical work. For an engineer, like Berners-Lee, this meant that he was invited and encouraged to experiment with new technologies in order to help share, communicate, and facilitate research and project data.

Unlike the United States, where early Internet development was heavily funded by military concerns, CERN's technological interests were driven by the desire to better share information between engineers and scientists. As Berners-Lee notes, however, his initial work was not so nearly focused on the broader organization of CERN. Instead, he was interested in developing a tool that would allow him to track and manage the people, information, and projects that he was working on (2000, 4). He named

[6] I should note that Hypertext refers to the actual information, the text, being written and transmitted. Nelson is clear on this. Hypertext is text, nothing more. As discussed later, it will not be until after Tim Berners-Lee develops a transport protocol (HTTP) for hypertext than an actual hypertext markup language (HTML) will be developed.

his software *Enquire* (“ask”). The *Enquire* software package consisted of a series of files that linked together different nodes of information into a web of data. The software itself appears to operate as a sort of concept map with a text interface. In his documentation, Berners-Lee imagines a set of modules or nodes connected together via a series of relationships (Berners-Lee 1980). The application allows a user, ostensibly Berners-Lee, to traverse these connections and search for particular elements of data along the way. At this point in time, Berners-Lee is completely unaware of the work of Vannevar Bush and Ted Nelson. His application is not designed to build on any other project. It is purely a production of personal vision.

Thus, one of the of the most important protocols in the modern Internet was born not from an implementer requirement or a vendor application, it arose in the development of a flash-in-the-pan application written for personal use. More importantly for our purposes, it also highlights the very real elements of how different publics and their imaginaries collided and reformed as HTTP grew in power and popularity. Perhaps the most important part of this story is in the role that Tim Berners-Lee played as a member of a public. In 1980, Tim Berners-Lee was not an implementor. He was not interested in or actively working on developing network technology and structures. Most of his time was spent working as a software engineer for Plessy Telecommunications (Berners-Lee 2000, 4). Plessy had developed a capability-based hardware system that differed from the traditional time-share systems of the time. The Plessy System 250 offered broad multi-processing capabilities that were difficult for other systems to replicate. This made them invaluable for real-time operating systems and telecommunications (Levy 2014, 65-66). Plessy, as a vendor, was working to create systems that enabled customer lock-in. Plessy wanted its users to only buy Plessy hardware and software and its technology reinforced that initiative. Plessy computers, it appears, were not designed to interoperate or share data beyond their own platforms. In his role at Plessy, Berners-Lee operated as a member of that vendor public, focused on developing tools for customers that would enable Plessy to grow as a company. Yet, in his consultant role at CERN, he was not interested in advancing Plessy systems. In *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web*, Berners-Lee gives us some insight into how he imagined himself in these moments. He talks of building his own computer, "with an early microprocessor, and old television, and a soldering iron" (2000, 4). He makes special note to clarify that his work on *Enquire* was written "in my spare time and for personal use" (2000, 4). In other words, Berners-Lee wasn't part of the implementor public or the vendor public when he set out to develop *Enquire*. In many ways, Tim Berners-Lee was the epitome of the early 1980s user.

I note this to reiterate an important point from Chapter 2: the user public, and its sociotechnical imaginary, of the 1970 and the 1980s is drastically different from the user public that took shape in the 1990s and 2000s. While one reason for this shift is the explosive growth in the user community. As a public expands, it begins to fracture around smaller sub-collections of texts, protocols, and networks. Certainly, the size and structure of the user public grew drastically during the 1990s. It also significantly changes as member of those publics move into other publics fundamentally reshaping how those new publics think about and consider their technologies. As we will see, the development of HTTP will move Berners-Lee from a user to an implementor. It will also highlight how those publics themselves begin to shift and change. The story of HTTP and its publics becomes the story of the Internet and its publics. The imaginaries that form these publics collide and ultimately, one imaginary appears takes hold.

In some sense, Berners-Lee takes the quotidian route that many in the user public did in the early 80s. In his book, he describes working in garages and playing with new technologies in rough backroom labs. These impromptu development sessions, his early user explorations into software and hardware creation, invariably helped other users build systems and technologies that would make some of them vendors in their own right. For Berners-Lee, the technological utopia promised by Nelson and other implementors became a sort of assumed promise, a vision built into what they thought they were doing. The promise that was hidden inside a vast architecture of presumptive wealth and privilege, but was one through which new worlds could be explored (Berners-Lee 2000, 12-14).

On his return to CERN in 1983, Berners-Lee was tasked with developing a system for documentation sharing that was acceptable to several different groups of researchers. By combining his personal, user public software with hypertext, Berners-Lee drew two imaginaries together. The *Enquire* software was meant for personal empowerment, it was designed as part of an imaginary that saw technology as a tool for personal exploration, achievement, and growth. What Berners-Lee did was bring this system into the implementor space. The implementor imaginary is collaborative and open. Information sharing and access is valorized. For Berners-Lee, these connections between implementor and user collided most clearly when he connected the idea of the Internet, and its standardized protocols, with the concept of hypertext.

By 1989, Berners-Lee had developed a proposal that he submitted to CERN. This proposal was not focused on anything but sharing information within CERN. In some sense, it was almost a vendor style approach. There was no discussion on greater plans or goals. The proposal was purely about information management at CERN (Berners-Lee 1989). At the same time, however, the user in Berners-Lee was sharing on USENET forums. In these spaces, users and implementors would often share data and findings. What we begin to see is that Internet users of the 1980s would often switch between user publics and implementor publics even while reviewing the same information.[7] An implementor public shared data for further elaboration or design whereas the user publics were interested in adding to their knowledge and expanding their personal systems, capabilities, and reach.

[7] Internet users are a very small group of users in comparison to BBS and personal computer users in the 1980s. Having Internet access usually meant that the user was also involved, in some way, in university, government, or vendor research work.

HTTP began as a server at CERN. It was an information gateway, but it was also the test of an information tool. As the software grew more powerful, Berners-Lee notes that there was a need not only to standardize the transport, but the structures around that transport. Until this time, there was no single definition of hypertext. What Berners-Lee and other working with him realized was that some structure to the language was needed. This would come in the Hypertext Markup Language (HTML) specification (Berners-Lee 2000, 40-42). The markup language establishes how hypertext is written and designed. Cleanly written hypertext can be decoded and displayed for users with different output displays. With the creation of HTML, the transport protocol, HTTP, could provide a method through which hypertext documents could be stored and retrieved remotely from other systems.

This is the impact of the implementors imaginary on the user. Texts and technologies in the user public of the 1980s were dynamic, hodgepodge, and sometimes frantic. Berners-Lee's initial implementations of HTTP were just that, hodgepodge developments that once they entered into the implementor sphere were trimmed, locked down, and revised. In many cases, like HTTP, the result was a technology that was more useful for a larger number of people. There was a cost, though. For Berners-Lee, that cost was the slow loss of control coupled with growing levels of responsibility. Where the users' public was dynamic and active, moving at the speed of an individual's idea and capacity, the implementor's space moved much slower. Texts in the users' public were almost ephemeral, suffering revision or deletion often moments after posting. In the implementors' public the circulation of text was almost ritualistic. Indeed, there are RFC wholly dedicated to describing the appropriate method of circulation and tracking (Daigle and Kolkman 2009).

What we see with HTTP by the mid-90s is that the protocol had been absorbed by the implementor community, and with it, Tim Berners-Lee. The implementor was not able to fully escape the user imaginary that brought HTTP to light, however. The initial RFC released in 1996, almost seven years after Berners-Lee's first CERN proposal, documents this new challenge. HTTP was a protocol developed inside and reflective of a user imaginary that had already set it into practice. Implementors found themselves working to adapt a protocol that was already present and being used. The protocol defined by the implementors, therefore, was not a work of technical development but of collection, analysis, and assessment. “This specification describes the features that seem to be consistently implemented in most HTTP/1.0 clients and servers. The specification is split into two sections. Those features of HTTP for which implementations are usually consistent are described in the main body of this document” (Berners-Lee, Frystyk, and Fielding 1996). The IETF working group on HTTP, in this case, acted as a sort digital council of Nicea, deciding what elements of the specification were canon and which were heresy.

The Vendor Arrives

There in an interesting point in Tim Berners-Lee’s book where he seemed to realize that things had shifted. The implementors and users who so dominated the early chapters are lost and for the first time in the text, Berners-Lee himself appears to realize that something critical has changed. As the HTTP use grew along with the web, there was shift not in the user space, but in the implementor space. The users, in the mid-to-late 90s are still very much in their experimental phase.[8] The Internet was now a known entity, but it was also not a necessity. This made it an interesting playground for users. They adapted and revised technologies, wrote their own tools, or built on top of implementors systems. Implementors at this point were moving further back. The level of sharing between the implementor community and the user community was beginning to slow.

The reasons for this slow down are many, but one major issue was the rapid growth of the network communication platforms both in terms the Internet, a growing collection of University and

[8] The initial RFC for HTTP 1.0 was not released until 1996 even as the protocol was becoming more widespread.

Government systems that hearkened back to the early days of ARPANET and its related access, and its alternatives, BBSs and commercial online platforms like Compuserve, Prodigy, and AOL. This growth in popularity demanded more organization. The IETF meetings that had begun with only a handful of people in the 1980s had grown to over 400 in by 1992 and would only continue to grow. As user and vendor engagement in network platforms grew there was growing concern about the long-term funding of the IETF which essentially relied on government funding (Cerf 1995). In order to manage this additional layer of bureaucracy were created, the Internet Society (ISOC) and Internet Architecture Board–which becomes the Internet Activities Board (IAB) in 1994 (Huitema 1994), are established to help guide the work of setting Internet standards. These added layers diminish user access to what had previously been a relatively open environment in which users and implementors could interact, share, and build.

Instead, this growing user community begins sharing with a vendor public that has been rapidly pivoting to understand and engage a growing set of technologies that would, apparently, appear to be in contention with its own imaginary. There is a catch, though. This public that is now comprised of many of those who were a part of the user community in the 1980s. Their success was, in many ways, an affirmation of the user imaginary that drove the early users. *Wired* magazine, one of the early arbiters of online culture, was the self-appointed cheerleader for the rise and success of these new entrepreneurs, heralding them as expanding the options and possibilities for users everywhere (Brainard 1995). Power and self-fashioning through digital technology might have been a tool for community growth and connection, but more importantly to many of these early users it meant that someone skilled in these technologies could become wealthy and powerful. The mid-90s were filled with books that offered to tell people how they could leverage the Internet to make money (Resnick and Taylor 1995; Vince Emery 1996). Just as the computer users of the 1980s saw the personal computer as a way to access tools and features that were once only available to large organizations and governments, the growing Internet was aimed at providing that same access on an economic level. You didn’t have to wait for IBM to understand your business and design something for it – you could do it yourself.

> This book is for anyone who wants to make his or her business more efficient and profitable. Whether you're a home-based startup or a Fortune 500 company, a computer-savvy network administrator or a marketing VP who has never gone online before, there's something in this book that can either make you money or help you save it (Resnick and Taylor 1995, xvii).

This new and revised vendor public wrapped itself in the language of the user public. Nowhere was this more apparent, predictably, than in vendor advertising. In 1994, Microsoft asked users, “Where do you want to go, today?” This positioned them not as a vendor seeking to control users use and access, but as a facilitator for user exploration. In a *New York Times* article on the campaign, Liz King, the Microsoft marketing director in charge of the campaign, states this explicitly noting that their goal is to replace the “mystery of technology” with “a sense of discovery.” "Software or computers don't change the world," added Ms. King, who was in New York to offer a preview of the campaign. "People change the world. All we can do is provide them with the best, most liberating tools for them to do what they want to" (Elliott 1994). Apple, was one of the first to embrace this form of user-centric language first established in its 1984 commercial and later in its “The Power to Be Your Best” slogan that ran throughout the mid-to-late 80s (Business Insider 2017). By the 90s, Apple’s advertising moved to ideas of empowering the user more directly with its technology. In its advertisement with George Clinton, Apple declares that “Power is Originality, Power is Individuality…Power is the ability to reinvent yourself” (*Macintosh George Clinton TV Ad 1994* 1994).

The implementors find their real strength in replacing the vendor, though, particularly in the free software movement. The free software movement is a comprised of software and hardware engineers, developers, and designers who believe that the source code–the recipe for the machines and their software–should be freely available to the users to modify, share, and distribute. It is this ability, they argue, that empowers the user. "The idea of the Free Software Movement is that computer users deserve the freedom to form a community" (Free Software Foundation, Inc. 2014). The free software movement was born in the world of the implementors. When Richard Stallman established the free software movement he did so as a user claiming the ground of an implementor. He linked himself to his work at MIT, noting that he left academia as an act of solidarity with users (Stallman 1987). This partnership between the free software community and the evolution of HTTP and the world wide web is also touched on by Berners-Lee (107). Yet by the late 90s, though, terminology shifts. Vendors are rapidly adopting "free software" ideas and terminology and moving them into their discussions. Much to Stallman's dismay, Free software is eventually rebranded a]s Open Source software with licenses more amenable to vendor needs (Stallman 2007).

The impact of this move, from free software to open source is arguably one of the most powerful elements of the influence of the vendor imaginary in the user space. This is quantified in the Esther Dyson's (1998) article "Open Mind, Open Source" in which she suggest that open source practices helped to set the foundation of the Internet. This claim is one that Open Source activists (including this author) continue to repeat. In attempting to prove her point Dyson notes that the IETF lists and planning processes are open to all: "Anyone who comes has a voice {but if you haven't done your homework, or have a partisan agenda, you're likely to be ignored or shouted down)" (Dyson 1998). Here, in the midst of claiming a connection to the open access of the Implementor imaginary, Dyson illustrates the very reason why such openness has always been a part of a politicized imaginary. In order to submit and work with IETF, members must already have enough knowledge and access to make them a part of that community. They must also adhere to a set of implicit rules about how technology acts and what it should do. Within the guidelines of the imaginary, then, there can be debate, but any challenge to the core imaginary results in exile for the technology and its supporters.

As the Free Software Movement became the Open Source Movement, the role of the legal structures that existed also had to change. The original license, the GNU General Public License (GPL), was developed as a sort of anti-license. It contained what many Open Source activists called a "viral clause" that required all software that used the GPL code to also release their source code under a similar license (Hamerly, Paquin, and Waltin 1999). This was a problem for vendors who wanted to use code developed by Open Source developers but not share the code they developed. For many vendors the Berkeley Software Distribution (BSD) License was an ideal solution. The creation of the BSD license was the result of a series of legal clashes between the US Government, IBM, AT&T, and other software companies (Montague 2013). Unlike the GPL which existed to protect software development and hacking at the user level (Stallman 1987), the BSD license was meant to protect software companies from future lawsuits from other software companies. Where the GPL was a born from Stallman's embrace of the user imaginary, the BSD license was a legal product of the vendor imaginary. As the Open Source movement continued to evolve a whole series of licenses would evolve around these conflicting imaginaries. With open source software powering the majority of the modern Internet technology at an infrastructure level this is a struggle that continues today.[9]

Government's Role in the Imaginaries

The legal structures that lie at the heart of the Open Source discussion inevitably draw us back to the role that the US government played in influencing and embracing specific imaginaries. The Internet

[9] According to the 2017 Linux Kernel Development Report, Linux and Linux-powered software " runs 90 percent of the public cloud workload, has 62 percent of the embedded market share, and 99 percent of the supercomputer market share" (Corbet and Koah-Hartman 2017).

began because of the US government. The ARPANET program was ostensibly a military program. Yet, as the network technology that was designed within the program moved beyond the confines of government research and into the hands of other users, the understanding of that technology changed.

It should be noted that the impact of the vendor imaginary was not missing for the implementor and government space prior to the rise of network technology in the 1980s. In his first chapter of *Democracy, Inc,* David Allen provides an excellent overview of how corporate influence had been reshaping scientific understanding throughout the 20th century (Allen 2005, 23-25). Allen's focus in *Democracy, Inc.* is to show corporate influence on, or its rationalization of, the public sphere. In tracing these different ways that corporate structures have changed, and often damaged, engagement in a public sphere, Allen illustrates a shift in the imaginaries surrounding those concepts. This is particularly evident in his discussion on the rise of professions in the public life. Allen notes the that modern understanding of profession arises only in the 19th century and evolved significantly into the 20th century (Allen 2005, 52). Professionalization helped to shift the rules of who could do certain types of work. Again, we can think of Esther Dyson's comment on open access and who will be listened to and who will not. As Allen continues, the role of professionalization was the "control" of particular areas of work under the "sanction" of the wealthy and powerful (Allen 2005, 53-54).

I highlight the professionalization section of Allen's discussion because the emergence of a guild mentality is exactly what occurs in 1991, with the creation of the High Performance Computing Act. As noted in Chapter 1, the High Performance Computing Act, championed (but perhaps not invented) by Sen. Al Gore, marked the government's first real attempt to address the growing importance of digital networks in a holistic manner. It provided avenues for collaboration between government organizations who were using or developing disparate networks, provided funding for the development of the National Research and Education Network (NREN), a public inter-net-work that enabled access for educational and private institutions, and developed strategies for encouraging private development of this new network (Gore 1991).

Yet the bill, perhaps unwittingly, also set in motion a framework that pushed the User out. The open development atmosphere of the 1980s that enabled user development and control were rapidly replaced by experts who provided the technology, pre-packed in vendor-managed chunks, to the user. This shift comes at the exact time that computer science and computer engineering hit their stride as academic disciplines with the production of PhDs (Jones 2013). The High Performance Computing Act set aside money specifically for the professionalization of the computer industry including encouraging more money for engineering and computer science programs (Gore 1991). As this professionalization occurred, the power of the user–still touted by the vendor–was only available in and constrained by the products the vendors provided. If users sought to resist that authority, what would eventually be termed “jailbreaking” by users, new laws and structures were being rapidly created that would punish or penalize users for attempting to exert control over their software or hardware. What was once seen as a public benefit had become a criminal liability (Zieminski 2008 292-293).

In 1998, the Digital Millennium Copyright Act was passed. This act significantly limited what users could do with their technology and, more importantly, it limited how much they could share about their technologies. In particular, the DMCA included a clause that forbade users from designing, building, and sharing methods of reverse engineering their software and hardware in order to change its functions or its capacity (“jailbreaking”). Only individuals authorized by the vendor could legally provide that information or develop for those products. In one fell swoop, the law pushed aside the software and hardware revolution born in the later 70s and early 80s, where tech development was in synch with an imaginary that envisioned a fluid interplay between Implementors and Users. In the post-DMCA era, the hackers and developers who had retroactively extended system functionality and capability and helped bring into existence the networked computing world, were relegated to a counterpublic whose imaginary was in direct conflict with a growing population of users. As such, they were often branded as thieves and villains.[10] The technology was firmly in control of the vendors.

For Users of the late 90s, this shift was almost invisible, because it *seemed* to fit their imaginary; they were already buying into the vendor-provided world of technology customized only for them. Even as vendors continued to centralize control and new titans (Amazon, Google, and Facebook) arose while others (AOL, Netscape) faded, this new area of the early 00s positioned the user as the center of a media universe. The power they commanded was no longer tied to the machine. Instead, it was what the platform and the software could do. The machine only mattered if it could connect the person to the platform. As Time's 2006 cover story for their person of the year announced, "The new Web is a very different thing. It's a tool for bringing together the small contributions of millions of people and making them matter" (Grossman 2006). What Grossman missed, and what we may only be beginning to realize now, is that the imaginary within which this "new Web" was formed was not the result of a user imaginary which positioned users as those in control of their technology. Instead, it was the development of a vendor imaginary that positioned users as consumers of pre-packaged capabilities and sold under the illusion of user agency with the vendor always keeping a steady eye.

What we see then is that web and the technology that power it become a battleground for vendors who first move into the implementor space, either through invitation or fiat, while working to partner with users in driving implementors' focus and attention to the issues that most mattered to the vendor. This dual movement enables the vendors to adopt the role, texts, and languages of the implementors and users while shaping them to fit the needs of the vendor. In essence, the vendor

[10] Interesting to note here that vendor success was often the product of such practices. Microsoft would not be where it was if Bill Gates had not co-opted CP/M from Gary Kildall at Digital (Wallace and Erickson 1993, 174).

imaginary re-positions itself as the dominant social imaginary while relegating the remaining imaginaries to their relative counterpublics.

The move from public to counterpublic was not an easy one. Many early advocates of the networked and online world continue to express a sense of betrayal (Rushkoff 2019; Turkle 2016; Brooker 2018). There have been and continue be challenges to the vendor imaginary. One of the most famous examples of this is John Perry-Barlow's (1996)"Declaration of the Independence of Cyberspace." Barlow's declaration is less important for its veracity than it is for its embrace of an imaginary that was already disappearing by the time Barlow wrote it. By 1996, the Internet was a public construction project that funded vendor control of a centralized network. For Barlow, a founder of the Electronic Frontier Foundation (EFF), which was created to help defend Bulletin Board Systems from government intrusion ("A History of Protecting Freedom Where Law and Technology Collide" 2011), the Internet and its vendor-managed infrastructure meant that independence was already lost. The "Wild West Days" of the early 'net were gone and with it some of the color and potential of the networked world.

Yet, the value of the imaginary is that it is dynamic. Public imaginaries may change slowly and reluctantly, but they do change. It is easy to look at and critique the current system and its problems, but it is not enough. There is a wonderful sense of hope in the acknowledgement that the sociotechnical imaginaries of moment can and do change for good and ill. The directions we head in are still open to possibility and influence. Understanding how these imaginaries may change and the rhetorics that drive those changes offer us an opportunity to track the past and consider the future. Part of what we must consider, in a changing imaginary, is what values and ideas those future imaginaries may possess. In the next chapter, I will consider what the modern imaginary has produced and consider a few potential directions on where we go from here.

Chapter 5: The Application Layer

Sociotechnical Imaginaries and the Evolution of Digital Culture

Application Layer

The Application Layer is the topmost layer in the TCP/IP Network model, the one visible when you sit down to the keyboard. As such, it is the layer in which the content and texts created in coordination with the other layers are presented for engagement to the different agents and actors within the networked public for sharing, response, and analysis. For most people, this is the part they care about ("Did the page load? Did the graphics render correctly?"), and they are content to be ignorant about the understructure. Yet the evolution and future of the internet's surface, as I have argued in previous chapters, depends on a complex interplay between people, things, ideas, arguments and institutions, In this chapter, I will shift my gaze forward and consider how the current sociotechnical imaginary is positioned, the challenges it faces from newer imaginaries, and outline three potential imaginaries that could arise as digital network technology and the communities it serves continue to grow and evolve.

My primary tool for this analysis will be the sociotechnical imaginary, which can help us better understand the potential course development, since the imaginaries seem to me to be more in play right now than the technologies.[1] I am not interested in either prescribing or foretelling. Most of the analyses of sociotechnical imaginaries are historical because it is far easier to analyze and discuss a sociotechnical imaginary in terms of a past or present context in so much as we have concrete elements to draw on and describe. The use of an imaginary, or the potential reshaping of an imaginary, then would seem to almost result in a form of speculative analysis that cannot even be considered beyond the limitation of the moment. And yet that is precisely the point. In the past chapters of this dissertation, I have shown how the imaginaries of a given time helped give rise to the succeeding

[1] We appear to be at where our use and re-definition of technology is growing faster that actual advances in the capacity.

imaginaries. The centralization of computing power in the sociotechnical imaginary of the early 1950s and 1960s created a desire for that power and capability. Computers enabled the development of new forms of creative power from science and business to music and art. Users fulfilled that desire with the creation of personal systems made available through new and readily available technologies. In so doing, they broke the power of these centralized regimes. This rise ofhobbyist technologies became the focus of user-centered imaginaries of the 80s and early 90s which precipitated the vendor co-option of those imaginaries, as a re-assertion of their centralizing power, in the development of the modern Internet. In every shift, the current imaginary influenced the shape of the imaginary that followed. This is not a causal story, since it is made up of complex and overlapping layers; like history in general, the course of an imaginary is not a set path. I will attempt to use the imaginary to consider different approaches and responses to the imbalances to our current setting, in the hopes of better understanding why we are where we are today, and better establishing a course for a more equitable future.

Into the Modern Imaginary

Let us begin this exploration with a brief outline of the current arc of the modern sociotechnical imaginary to better understand where were today. The modern Internet is a place of incredible power and opportunity. Computing power and storage are made freely available for those who can find a way to connect. Our messaging tools are broad and expansive. I can communicate across the world with image, text, and video. Our sharing is instant and global. Yet there are growing concerns. We are only beginning to understand what an always-connected world looks like. With a growing reliance on connection comes a slow realization that the processing power and storage that we are using is not our own. The world of the free Internet is not nearly as free as we expected. We are beholden to companies who provide our access and maintain our data. While some may complain or raise concerns, the reality is that we have bought this imaginary. We believe in our Amazon and Google and Facebook. We are happy to spin up new servers and storage on infrastructure platforms like DigitalOcean and rely on apps, games, and music from hosted content platforms like Spotify and SoundCloud. We believe it is easier for us and more secure. After all, the vendor has much more experience and financial capacity that we do when it comes to supporting and maintaining their systems, and there certainly a truth to that. Our modern imaginary is heavily steeped in centralizing power in the hands of the vendor. We have witnessed over the past two decades of the 2000s the slow rise of the vendor imaginary into the dominant sociotechnical imaginary in the US and throughout much of the world. This movement has resulted in the development of our modern Internet ecosystem. As I outlined in chapter 4, the vendor imaginary positions vendors, companies and organizations, as the providers of enhanced human capacity through technological innovation. The users, those enabled by the technology, benefit by using that technology. In this imaginary, the vendor controls the technology. They create and shape it to provide a certain set of features and functions. Users must learn how to use a technology in accordance to the limitations determined by the vendor.

The rise of social media exemplifies the outlines of this new imaginary. Social media platforms proliferated following a massive growth in user-generated content that exploded in the early 00s. The most obvious rise of this type of content could be seen in the growth of online web logs or blogs. Many early blogs were independently hosted web sites. As an outgrowth of the user imaginary, these blogs were developed as independent user communities which enabled users to provide and share information outside of traditional, and often strictly vendor-controlled, platforms. Initially, software vendors sought to work with users in advancing that cause. Like the BBS developers before them, they developed software applications that users could use to manage their own sites. These tools and application platforms have grown in size and scope and today dominate much of the web content industry.

The role of the web content platform, however, shifted with the evolving imaginary. Vendors began to realize that instead of selling applications they could provide the infrastructure enabling users to produce content while also keeping those users tied to their platform. Web-based content management systems moved from software to service. In one sense, the rise of hosted content platforms was a boon to early users. Hosted content platforms and their networks provided easy methods of sharing and collaboration, leaving the complexities of maintaining the lower level systems to experienced and knowledgeable administrators, enabling users to focus on creative content and publishing. Many of these social media sites first arose around blogging networks. Sites like Livejournal, Blogspot, Typepad, and Xanga all offered users the ability to blog and share with one another. These early networks soon gave way to more media focused venues, such as YouTube and Blip.tv and the development of more real-time networks like Twitter.

What resulted from this massive proliferation of user-content sharing sites was the similarly massive influx of data and information. For some, like Andrew Keene, this was evidence of the great decay of modern society. “For today's amateur monkeys can use their networked computers to publish everything from uninformed political commentary, to unseemly home videos, to embarrassingly amateurish music, to unreadable poems, reviews, essays, and novels” (Keen 2008, 3). Keen’s critique, at a best a pretentious swipe against what he perceived as low art, was antiquated even before it was published. This growth in content was not a user-led revolution; the apparently democratized arrangement in fact reflected a tactical approach by vendors to control the growing independence of the networked user, whose content-creating behavior was difficult to monetize. In short, Keen was wrong: users were not using their networked computers to publish and view new content. They were using vendor-supplied hardware and software tools to produce and manage content. Once the content was created, they then uploaded that content to vendor-controlled computers and networks for publishing, viewing, and sharing.

At every step of the way, the vendor was in control of the content. Richard Nash, a longtime content strategist and publisher who ran Soft Skull Press, highlighted the value of this approach in a presentation to publishers at BookNet Canada in 2010. In his talk, he acknowledged that the usual methodology for publishers to control content was in the management of supply (Nash 2010). Publishers acted as the gateway to deciding what content was supplied to the broader public. As members of the vendor imaginary which portrayed companies and organizations as the filter through which tools and information pass on their way to their audience and users this made sense. The same philosophy is what drove the vendor public of software development companies to resist early open source attempts. The fear of Keen's "cult of the amateur" was always one of a fear of lost control of the content. For Nash, by 2010, that battle had been lost.

In a sense, that battle was lost by the middle of the 1980s. The imaginary that founded BBS culture and other cultures of creative expression that arose around new hardware and software technologies drove much of the excitement around digital technology in the 1990s. With the capacity to create media equivalent to that available from existing vendors, users thought they had the ability to create whole new cultural and social worlds online. While Keen may have bemoaned this, others saw it as an opening for creative expression (Allocca 2018). For Nash, the next step for vendors was clear. If they couldn't manage the supply of content, they would need to manage the demand (Nash 2010). This meant creating and driving demand for content, content platforms, and creators themselves. In creating hosted platforms that drove demand and interest, vendors continued to exert control and power.

The development of YouTube illustrates this point. The video-sharing site that is now a dominant power in the development and creation of modern video. YouTube personalities exist because of the platform, yet the platform has a lot of power in determining what videos are successful and how creators are forced to present themselves. Virality is a simple product of viewership. Creators customize their approaches to increase their funding and viewership in a variety of evolving ways to meet the changing platform (Gruger 2013). While content may be growing, it is now primarily under the control of the content vendors and their platforms.

The centralization of content was only the first step in the vendors' movement to reassert control. It did not take long for similar trends in platform control to begin to move down the layers into storage, application and processing power and in relation to the computer itself. In 1998, IBM began offering businesses on-demand CPUs and storage systems that were managed and tracked via a application that reported to IBM for billing (Zhu et al. 2007, 7–9). These initial forays laid the groundwork for generalized cloud computing architecture.

The goal of IBM's OnDemand platform was simple and desirable to modern businesses. Application requirements, company growth, and systemic needs were changing quickly for system and network administration teams in the 1990s and early 2000s. The rapid change was a problem for IT development projects which often exceeded their anticipated system needs. When the systems were fully taxed, the applications failed and the businesses lost money. IBM's OnDemand solution was an answer to this. Instead of scaling to specific CPU requirement, companies could buy systems with more CPUs than needed. These CPUs were provided at a lower cost than the usual systems and would only activate when they were needed.

There were a couple of benefits to this from an IT perspective. First, IT could add in the OnDemand requirement during the initial capital requirements for the project when money was being made available. This meant they didn't have to go back and ask for more if there was a problem. Second, the OnDemand manager provided much more granularity in terms of tracking CPU and resource use. This worked for IBM as they were charging based on the CPU allocation. The tracking also allowed IT to shift the billing to those internal business units who were using more power. They could connect which applications and services were being heavily used and use that to chargeback to the business units as needed.

IBM was not the only company experimenting with this approach. Storage vendors and providers were looking to develop large-scale network attached storage (NAS) clusters that provided redundant storage to an entire group or organization managed via centralized nodes. In addition to NAS, storage area networks (SAN), groups of network-connected disks and servers, began to grow in popularity as network speeds grew to rival the speeds of many system internal storage connections.

Cloud computing, in a broad sense, takes these concepts and moves them from the corporation to the Internet. Our personal data, storage power, and CPU power are now a part of vast corporate networks like Amazon Web Services (AWS), Microsoft Azure, and others. Cloud computing returns us to the centralized mainframes of the past, though Mainframes still maintained a sort of independence as separate islands of computing power unto themselves. Indeed, in the vast cloud architecture of the modern Internet, these mainframes are also centralized under the control of a very select set of vendors.

Cloud architecture is designed to essentially replace all levels of the personal computer with vendor-controlled services (Youseff, Butrico, and Silva 2008). In order to do this, cloud computing architecture replaces the functions of the personal computer and personal networks into a series of components that can be purchased as needed, rented and accessed rather than owned. The components are broadly outlined by Youseff et al. (2008) into six service categories:

1. Software as a Service (SAAS)
2. Platform as a Service (PAAS)
3. Infrastructure as a Service (IAAS)
4. Data Storage as a Service (DAAS)

5. Communications as a Service (CAAS)

6. Hardware as a Service (HAAS)

The explosion cloud architecture is changing how modern developers approach software management and distribution. In the "as-a-service" model users never have to – or are allowed to! -- purchase hardware or software. They purchase a timed-bound segment of hardware and software capacity, which has some advantages. By centralizing software, network, and system management, the developers and users are able to gain access to a more robust platform with potentially greater availability and uptime. In a pattern more akin to the days of the early time-shared proto-BBSes of the 60s and 70s, today's users connect to a few large-scale systems that host the majority of the applications they use.[2] While this approached simplifies access and management for users and developers, it also requires that they surrender control of the management and distribution of their applications to the vendor. This allows the vendor to control pricing and availability in ways that were not possible in previous incarnations of the Internet.

The power of the dominant sociotechnical imaginary is in its capacity to persist even when publics advocate for different approaches. Even as Internet development practices change, they are absorbed into the vendor imaginary, which continues to hold sway even in circles that typically protest their independence from vendors and vendor influence. For example, the Open Source community, as discussed in the last chapter, often pride themselves on their technical independence. Yet, most Open Source products and development work exists because of vendor support in one form or another (Eghbal 2016, 46-52). Open Source technology has been embraced by the vendor public in the same way that content creation has been embraced. Rather than the vendor seeking to control the creation and publication of software and software libraries, the vendors are more interested in controlling the

[2] By 2016, Four companies (Amazon, Microsoft, IBM, and Google) controlled 51% of the cloud infrastructure market (Team 2016)

demand for those libraries. Vendors control this demand through a variety of tactics. Funding is perhaps the most obvious, but equally important is the inclusion and support of the software and its APIs into their applications and application platforms. By leveraging open content, infrastructure vendors have made Open Source technology the backbone of the modern internet. This means that the work of those developers, like the work of content creators, is always co-opted back into the vendor system. Even attempts to break that dominance often end up drawing users into similar structures.

The evolution of the Mastodon micro-blogging network is an example of this problem. The Mastodon distributed platform was designed as a free software platform alternative to Twitter, decentralizing the Twitter microblogging model (which relied on a centralized platform). Because of their centralized control, the Twitter corporation has final control over the content, allowing them to deny content and prioritize compensated content. This centralization of control does leads to a variety of challenges for any content provider and Twitter has been inundated with accusations of misconduct and abuse. In recent years, Twitter has been accused both of allowing hate speech to propagate across their platform (Matsakis 2018) and in censoring right-wing views (Victor 2019). Mastodon developers created Mastodon to better serve the user community instead of the vendor (Rochko 2017). Could that work out?

Mastodon operates as a federated system of independent servers who can choose to share content with one another. Each server hosts a collection of users with different interests and ideals because the servers can choose who and what they connect to, users can decide how much they want to share and with whom. The servers, of course, sit in a stack, and as I've argued, that is not without consequences. In the modern imaginary, the user is not expected to have to manage that. Thus, the majority of Mastodon instances, distributed collections of CPU, application, and storage power, are hosted on cloud platforms like OVH, a large European cloud computing company (Gameiro 2018). These vendor platforms all contain their own terms of service which dictate what users can and cannot do on their platforms. Certainly, datacenters like OVH have a required need to manage what is on their networks if only to maintain operation and the legal protection of their business. In addition, most of the instances are maintained by volunteers. This adds a level of instability for users who wish to join a server only to find that it has been shut down or mismanaged by its administrator. This pushes users into signing up for only a small handful of servers that have funding and are successfully run. Thus, the "federated" aspect of the Mastodon platform becomes moot, because the server with the most users defines the course and power of the federated structure. If servers decided to exclude–or are excluded by–the largest servers, they are effectively removed from the network of Mastodon users. Mastodon's vision is to interconnect a series of smaller instances in which users maintain and control their own technology. While this approach is somewhat reminiscent of BBSes in the 1980s and 1990s, there is an underlying imaginary that stresses interconnection across a single medium, the Internet. Mastodon users expect to be interconnected. What has happened instead is that the Mastodon userbase has centralized on five primary servers, two of which contain the vast majority of Mastodon users on a re-centralized platform. Despite Mastodon's development's best efforts, the imaginary in which their users exist still prioritizes these centralized platforms. The inability of user groups to move beyond those networks is a reminder of just how ubiquitous the vendor imaginary has become.[3]

Perhaps the most difficult part of dealing with the imaginary is its ability to infuse our understanding and engagement with the technology we use. Mastodon users believe that the Internet is a unified, centralized network. They use it as such. When they connect to their Mastodon instance, they expect that to be connected to the rest of the instances. To be disconnected is to be broken or, in some cases, punished. The fear of disconnection from Internet platforms is a growing issue as discussions about online abuse and hate grow. Every time a platform removes, or deplatforms, an individual for

[3] Unlike the 80s and early 90s, these are all primarily private networks controlled by vendors which explicitly lack the government protections that were originally provided to telephone users (Brodkin 2017).

violating their terms there is a growing chorus of complaint. Users claim that deplatforming is somehow a violation of free speech (Captain 2018). The linkage and assumption of the availability of free-speech in private networks–which is exactly what Twitter, Facebook, and other companies are–demonstrates just how ingrained the imaginary is to the modern user. Having seen the co-evolution of technologies, imaginaries and publics, what are the possibilities for the future? Starting from where we actually are, with Vendor's imaginary written into most of our technologies and models for using is, what are the possible paths forward? I would like to, as a thought experiment, explore three of these potential paths. The ability to engage these scenarios serves both as a test of my model (it should allow us to organize the chaotic elements of the current situation) and as guide to whether, in some relevant sense, things are getting better or worse.

Path 1: User-Imaginary 2.0: De-Centralization

In looking forward, one of the strongest avenues of resistance to the current vendor imaginary is connected to the growth of those developers calling for renewed decentralization of internet architectures. No less than Tim Berners-Lee has weighed in with the development of Solid, a decentralized suite of specifications for sharing over the existing HTTP connections ("Introduction to the Solid Specification | Solid" 2019).[4] In announcing the release of Solid, Berners-Lee took aim at a vendor imaginary that seeks to unify the network experience under a few corporate entities, "But for all the good we've achieved, the web has evolved into an engine of inequity and division; swayed by powerful forces who use it for their own agendas" (Berners-Lee 2018). For Berners-Lee, the Internet has gone astray due to the centralization of vendor power, a claim echoed in a wide variety of opinion pieces and articles (Bogost 2017; Sanger 2019; Brooks 2019). Multiple critiques reiterate the problem of

[4] These specifications each focus on a different element of the Solid ecosystem. One establishes a means of authentication, another data storage and tracking, and another data presentation and display. The modular of the Solid suite allows it to be extended ("Introduction to the Solid Specification | Solid" 2019).

centralization in theme and tone (Srnicek 2016; Eubanks 2018; Noble 2018). The most apt and insightful of these critical approaches are outlined by Safiya Noble (2018) who illustrates how Internet algorithms create narratives and structures of oppression. She shows quite clearly that socio-political attitudes and ideas about marginalized people are often reflected in the output of the digital systems we use (2018, 24). The danger of this in terms of the digital and online systems and algorithms is that they appear to be neutral when in fact they mirror the same inequities of the system that created them (Noble 2018, 25-26). In her analysis, she focuses on those large-scale vendors who supply and develop the algorithms that drive daily life. While Noble never mentions the idea of the sociotechnical imaginary, she absolutely recognizes its impact.

> Google's enviable position as the monopoly leader in the provision of information has allowed its organization of information and customization to be driven by its economic imperatives and has influenced broad swaths of society to see it as the creator and keeper of information culture online, which I am arguing is another form of American imperialism that manifests itself as a "gatekeeper" (Noble 2018, 86).

If the vendor is the gatekeeper, then developers like Berners-Lee want to tear down the gate and re-open the network to everyone. Once again, the user imaginary asserts itself in terms of user empowerment, as Berners-Lee (2018) alleges that, "Solid is guided by the principle of 'personal empowerment through data' which we believe is fundamental to the success of the next era of the web. We believe data should empower *each of us*." The nostalgic tone invokes the imaginary of the 80s and early 90s, which the BBS communities had a clear vision of a democratized techno-world with Users governing technologies and themselves. Yet, even in adopting the tone and structure of the User imaginary of the past, Berners-Lee reframes the locus of power away from computing sources and toward the creation of data. While the message of the early network computer systems relied on the idea of the computer as a tool of user power, the modern reforming of that expression still works to keep the devices that is constructing the data away from the user. I would suggest that, while the appeal to nostalgia is admirable, the continued obfuscation of the mechanisms that create and distribute data is a part of Berners-Lee's own cooptation by the hybrid Vendor-User dynamic. The sheen of nostalgia disguises the reality that he neglects many of the issues that decentralization does nothing to address or worse exacerbates.

Of course, decentralization is historically central to the Internet. The origins of the Internet, even before the rise ARPANET were centered on developing a military communications strategy that was decentralized (Abbate 2000, 10). The concept of packet switching, in which data was broken down, assigned to a system address, and then transferred via a series of intermediary systems, emerged as part of a decentralized communications structure was one that could survive in the case of a military attacks which disabled some, but not all, nodes in the network (Abbate 2000, 10; Bolt Beranek and Newman Inc. 1981, III-5). By the end of the 1970s, the goal of the ARPANET project was less focused on decentralization as military strategy and more interested in the benefit of distributed computing in terms of efficiency in resource management and distribution (Bolt Beranek and Newman Inc. 1981, II-2-II-4).

Yet scaling networks required developing "backbones," massive nodes sponsored by the government and often located at research universities, leading to calls for greater decentralization of the Internet, beginning in earnest in the late 1990s and early 2000s. Many of the calls were reactions to the increased legal scrutiny of media sharing and the potential distribution of copyrighted works, which flourished in localized multiplicity of sharing sites and systems (Riehl 2000, 1763). These systems went well beyond the early distribution of the copyrighted programs and files that were popular in BBSes. These new systems were Internet enabled. USENET, an early distributed message board consisting of a hierarchical tree of different groups called newsgroups, had an entire tree dedicated to file sharing. Local file transfer sites soon evolved into more and more specialized platforms that prioritized user file sharing. The first major sharing system to become a widely-used national, if not global, platform was Napster (Rollins and Khambatti 2006). Napster enabled connected users to share music files across the Internet. While file sharing was a not a new idea or a new problem, Napster made the process infinitely easier by provided a centralized index of music content (Menn 2003, 34). What used to be a headache for copyright maintainers had suddenly become a nightmare. Conceptually Napster wasn't a complex application. It grew out of Shawn Fanning's (the 18-year old founder of Napster) experiences in internet relay chat (IRC) and early forms of file sharing via FTP (Menn 2003, 32-35).[5] In one sense, the Napster system was just a decentralized index, a distributed system which enabled a user to treat any other user's machine as a storage device. For Napster users it was like having access to millions of BBSes, all at once. As Riehl explains, "After the user connects, the server catalogs the user's MP3 files and makes the names of the files available to other Napster users" (Riehl 2000, 1768). Napster "itself" never uploaded or hosted the user's music. [6] It did, however, host a centralized index of that music. While the capacity of digital networks to enable copyright violation had been a concern since the rise of BBSes ("United States v. LaMacchia, 871 F. Supp. 535 (D. Mass. 1994)" 1994), Napster changed the size and scope of digital sharing, significantly. By the end of 2000, over 1.39 billion songs had been shared among nearly 70 million users (Riehl 2000, 1767). Not surprisingly, copyright holders sued the platform owners and the company that had been built around it. In the courts, Napster lost repeatedly (Menn 2003, 245; Riehl 2000, 1768-1771) and eventually ceased operations. For developers at the time, the legal response could be managed via a technical diagnosis and solution: In tech terms, Napster's problem was its reliance on a centralized index. While the data was held and transferred between user systems in a peer-to-peer connection, Napster kept track of the location of the files and the peers. This meant that authorities could isolate and target the index and as, a result, take down the entire system. In response

[5] IRC was another early Internet chat application that grew in popularity with the Internet in the 1990s.
[6] Napster was both a platform and a company. The company could claim they never uploading anything because the platform had no capacity for uploads.

to this a series of network applications were developed and released that distributed the search and tracking across multiple peers.[7] This meant that even if one index was removed, others would survive (Riehl 2000; Rollins and Khambatti 2006).

The imaginary of decentralization grows out of a libertarian political imaginary which presumes that everyone is an individual political agent, the problem of politics is how we manage to relate to each other (cf. "Declaration of Freedom in Cyberspace"). Networks are at once the problem and the solution. The User imaginary privileges decentralization, leading to a push to decentralize more and more of the modern sociotechnical structure–the system and support networks that manage and maintain the social and cultural infrastructure upon which our current society survives. With the rise of distributed databases like Blockchain and its related Bitcoin protocol and platform, the interconnection between socioeconomic control and the dynamics of the decentralization imaginary have been cemented. In the decentralization imaginary, centralization–government or corporate–represents an risk to the user community, "Accordingly, we believe that every human has the following financial rights which should not be impeded by governments, regulators, financial institutions or other humans" (The Bitcoin Foundation 2016). Decentralization, then, is a movement steeped in the imaginary of the user past. Its goal is to develop new software platforms that claim to return control to the users while escaping corporate or government oversight.

In this pursuit, however, most of those invested in this imaginary have sort of tacit acceptance of the existing vendor imaginary at the layers below the application level. Berners-Lee's Solid architecture runs on top of existing vendor networks. It does not replace or disrupt them. The same is true of Bitcoin and file-sharing protocols. The Solid architecture relies on vendor managed clouds in order to run and operate ("How It Works | Solid" 2019). Bitcoin's mining practices– which require

[7] Among these Gnutella and BitTorrent (Riehl 2000; Rollins and Khambatti 2006)

systems to run highly complex mathematical equations–demand infrastructure that can support the necessary computation and power needs (Rogers 2018). In addition, Bitcoin and the Blockchain it relies on are only available to systems connected via vendor-managed networks.

In their pursuit of decentralization, advocates missed the key structure which their imaginary had shaped in the Internet of the early 1980s and 1990s: a strong, well-managed and user-responsive set of implementors with a shared vision that highlighted interconnection and collaboration. The growth of User power of the 1980s was not possible without the collaboration of the Implementor core. In current and future networks, Implementors have merged with the Vendor public. There is little difference in their imaginaries. Consequently, decentralized has come to mean models like Mastodon, in which only a few servers provide the vast majority of information and content, so that decentralization is an illusion for users. In fact, decentralized protocols centralize power in the hands of other vendors, and Bitcoin proves the point. Transactions were not decentralized, but relegated to large and unregulated clearinghouses, large scale web and trading platforms that essentially took on the role of banks in a system that claimed it didn't need banks. The platforms that offered the service were often poorly managed leading to wholesale risk and potential loss (Beikverdi and Song 2015). Without an open infrastructure, one that prioritizes user ownership at every level from the hardware up, decentralization will continue to face the same problems well into the future. While the name of the vendor may change and the language around the imaginary may evolve, the core of the system that stresses a reliance on vendor-managed and vendor-controlled systems remains.

A decentralized future remains beholden to the dominant vendor-focused sociotechnical imaginary, with its shifting and unstable practices. Without the moderating influence of an implementor bureaucracy and its infrastructure,[8] user-driven solutions will rise and fall in rapid succession potentially

[8] Which has its own set of challenges and drawbacks including a heavy reliance on government funding and, as such, a vested interest in supporting national regimes and their policies. As vendors have learned as they attempt

adding to the growing levels of insecurity surrounding online activity (Smith 2018). Trust is further lost as economies of decentralization driven, in part, by an imaginary of decentralization framed as sharing, taxes and bend centralized infrastructures and higher and higher levels (Martin 2016, 158).

Path 2: Vendor Dominance – The Internet of Walled Gardens

If the new path of the user-centric development seems to lead us right back into the vendor imaginary, then it may seem that there is no escape from the cycle of vendor enclosure that Tim Wu (2011) described in *Masterswitch*, exemplified in his account of the resurgence of AT&T. For Wu this resurgence was evidence that "would seem to prove the irrevocability of the Cycle of information empires, their eternal return to consolidated order however great the disruptive forces of creative destruction" (Ch. 18). In this scenario, the rise of the vendor behemoths does not necessarily predict a digital Armageddon that Berners-Lee and others steeped in the user imaginary of the early Internet would suggest. If anything, the growing centralization of vendor control could be seen as an illustration of a maturing technological infrastructure. Like radio and telephony, vendors must first contend with the disruptions of a new technology as they determine ways to package and sell that technology to their larger audiences.

The rise of technology titans like Google and Amazon highlight vendor effectiveness in repurposing the overall digital architecture for their customers (Al Gore may not have invented the internet, but they didn't either). This is not necessarily always a negative for the User, either. While technology companies are currently contending with large-scale concerns about user privacy and digital data rights, they have also managed to distribute network technology around the globe. In the past twenty years, the number of online users has grown a thousand-fold. ("World Internet Users Statistics

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to work with other governments , a global network is incredibly difficult, if not impossible, to manage in an open and equitable way(R. Gallagher 2019; Cope and Cardozo 2016).

and 2019 World Population Stats" 2019). Current network and applications providers now support just more than 56% of the world population ("World Internet Users Statistics and 2019 World Population Stats" 2019). Even with government support, the capital required to manage such installations also requires large scale corporate investment and management, leaving little opportunity for small user-level Internet Service Providers (ISPs) or application developers to develop the world-wide network that arose in the late 1990s and early 2000s.

In addition to the benefits of vendor networks, in terms of reach and access, there is an added benefit. A benefit that even those steeped in a counterpublic imaginary focused on decentralization often acknowledge, if inadvertently. Large-scale corporate vendors are liable to government regulation in ways that smaller, decentralized, groups are not. In the past three years, Google has been fined more than €8 billion by the European Union; Facebook and Amazon have also found themselves in treacherous legal territory as their power, reach, and influence has grown. Decentralized Internet structures escape, in principle (Napster is the counterexample) the accountability that these large-scale corporations can face. If one BBS was shut down, more could rise up spontaneously, but the same cannot be said for platforms like Google or Amazon. Vendors, after their outrageously profitable IPOs, have commitments to shareholders and legal oversight by regulatory agencies or watchdog organizations. While the government will may not always exist to hold these corporations accountable, it can and does have the capacity. Indeed, Wu's depiction of AT&T as a phoenix would suggest that this is precisely what occurs. Vendor power continues to grow until new structural limits are placed on the power during which vendors must adjust to and adapt to these shifting dynamics.

The questions that face the global vendor imaginary of the future are about limits and control. To be sure, something is lost when vendors become so powerful. The scope of vendor power becomes even more concerning when we think of modern vendors' capacity to control not just the means of production in terms of hardware and software, but the distribution as well. Not since the Gilded Age have we been in so stark a territory. In the next 20 years we will most likely witness the end of Moore's Law (Simonite 2016) and with it the steep curve of innovation in modern digital hardware. What will remain as the engine of innovation slows, especially with respect to large corporations that aren't as nimble in the face of disruption as they claim (Christensen 2013)? As such, these vendor imaginaries are no more static than other sociotechnical imaginaries. They must adapt to the changing tones of the world around them.

What we may be witnessing then is the limit of Nash's strategy of controlling demand. Nash's strategy depends on maintaining an increasing curve of demand for specific content. It is strategy that operates as a hedge against the swell of data like a dike that keeps the deluge at bay. Eventually, however, even these content barriers are overwhelmed, or the users just get exhausted.[9] For much of the past two decades, Nash's strategy has been a success. Vendors and publishers of the early 2000s sought to centralize users into "walled gardens," and they have, by-and-large, succeeded. Facebook has more than 2.3 billion active users (Popper 2017). Google manages seven services with over 1 billion users on each and Apple has more than 1 billion IOS devices in services (Popper 2017). These users are not tied to a distributed Internet. While they see themselves as Internet users, more often than not they are users of corporate content platforms, kept in place through efficient product and content management. Some never leave that platform.[10] As the vendors have added services and platforms, users have lined up to use them. There can be little doubt that this strategy of driving and managing demand for data and content has been a winning one.

Platform growth has continued the last few years, yet while ad spending (the economic engine for much of the modern network ecosystem) continues to grow, there is an increasing resistance in

[9] The massive rush and crash of niche Netflix-style video content platforms may be an example of this limit.
[10] A person who users their phone for messaging (WhatsApp), photos (Instagram), and social media (Facebook) can post and create all day and never leave Facebook servers, for example.

customer markets to mobile advertising and tracking ("Internet Advertising Statistics – The Rise of Mobile and Ad Blocking [INFOGRAPHIC]" 2017). Growing scrutiny of Internet vendor practices coupled with the resurgent power of network providers and mainstream media companies has heavily shifted the structure of the modern web. YouTube may have billions of hours of content, but many of the most watched channels are firmly under the control (either directly or through partnership) of mainstream media companies ("Most Views - Overall Creators" 2019). With the exception of a few outliers, the era of the independent digital creator has disappeared as the media vendors have reasserted control. Even on platforms like Instagram, heavily geared toward independent influencers, the primary goal of those influencers is to curry favor with vendors in order to drive advertising revenue through partnership and sponsorship deals. They are users who are bound to the Vendor imaginary. The power and capacity they have is entirely dependent on the actions of the vendor.

While media is coalescing on platforms that once catered to independent creators, there is a growing reliance on studio media properties to keep users engaged. Netflix, the destroyer of Blockbuster (Satell 2014), is finding that Disney is not as easy to defeat. Netflix's strategy for much of the early 2000s had been responding to content demand, collecting films and television shows developed by others and providing them to users, first as DVDs via mail and starting in 2009 through online streaming (Vena 2019). But Netflix didn't stop there. They became a development studio. Now Netflix is primarily a media production company that has a streaming platform, and others have followed suit in its wake. Disney, Amazon, ABC, DC Comics, CBS, and Fox all have a stake in or own their own streaming platforms. (Vena 2019).

The voices of those independent creators are missing, which perhaps explains why the nostalgia for the 1980s and 1990s (Doll 2012), when the Internet was a new platform upon which the promise of open access and sharing was possible, even if it was never fully realized. The barriers to access for modern creators are great, including growing legal barriers in terms of copyright and content laws. Even on sites which encourage user engagement, user content is rarely highlighted when sponsored content is prioritized. In addition, the labor of the users is often coopted by vendors to make the content more interesting and engaging, without any acknowledgement of the user involvement, "… platforms appropriate data as a raw material. The activities of users and institutions, if they are recorded and transformed into data, become a raw material that can be refined and used in a variety of ways by platforms" (Srnicek 2016, 56). At the same time these vendor platforms that keep users engaged also act to silence them, as Safiya Noble explains, platform vendors establish and control the shape of modern discourse by limited and controlling what is shared and how. "The development has deeply eroded free individual expression, a vital element of a democratic society" (Noble 2018, 153-154). Without an aggressive shift in the imaginary, it is unlikely this will change. What we are witnessing, instead, is a continuation of those vendor-centric power structures and the imaginaries in which and through which they survive.

If the walled gardens of the vendor managed world are not to become distracting prisons for the users, we must reimagine how to reengage user power into enabling them to better address their concerns and fears.[11] This means the broader sociotechnical imaginary must demand more attention and focus of user equity and protection, both as a function of the vendor service, the technology; in addition, empowering the role of oversight agencies and organizations that have, quite often, relinquished that role. We have seen in the past several years a growing reckoning for vendor imaginary of the present. While vendors can continue to assert control,[12] they must do so within the shifting social

[11] The avenue for this reorientation is the challenge. As with the High Performance Computing Act, it may require an equivalent action and support through legislative action. This can only occur if the imaginary allows for it, though just as the HPCA was only possible because of the imaginary the developed in the 1980s.
[12] Probably they will for the present period. The power of the vendor imaginary is firmly rooted in broader social imaginary of the country. These social imaginaries, as Taylor (2003) suggests, change slowly (30).

content of the present time. Of all the future options before, the only impossibility is that of the status quo.

Path 3: Toward a New Digital Imaginary

Let us assume for a moment that there is a third path that reasserts the values of the user-centered imaginary found in the development of the early Internet with the open support and management of implementors working toward a common network. What would be required to establish such an imaginary within the modern context? Our technology is so dominated by the vendor that such a possibility seems almost impossible. Yet connecting sociotechnical imaginaries and counterpublics would allow us to consider how counterpublics express and build new imaginaries and the technologies to support them. As I have shown throughout these chapters, sociotechnical imaginaries begin in counterpublic frames. The Altair 8800 was a not a part of a dominant imaginary. Rather it pulled from the dominant imaginary and grafted in aspects of its through technological innovation. A sort of tactical bricolage that eventually assumed a position within the dominant sociotechnical frame, if only for a time. The same is true of BBSes and Internet itself. There is a movement in these imaginaries from counterpublic to public. It is this movement that allows us to look at the rising counterpublics and consider how they might help to influence our current concept of the networked spaces we inhabit and give rise to a new User imaginary.

In the modern context, a new digital imaginary cannot remain at the application level. The attempt by developers to create user-empowering applications within vendor-controlled infrastructures is bound to fail.[13] What is required, then, is a rethinking of the computer from the hardware-level up. A rethinking that reduces vendor control and repositions that control in terms of user. In the small corners

[13] Developers who are often vendors, themselves.

of the online world there are people working on independent mesh network platforms that can connect local communities and neighborhoods to one another (“Neighborhood Network Construction Kit” 2019). These platforms run from the hardware and link layer all the way to the top of the protocol stack. They are local in the face of an Internet that is global, but like the BBSes that came before them they can leverage that local connection to their advantage (“Our Story | Detroit Community Technology Project” 2019). One example of this is the Detroit Community Technology Project (DCTP). The DCTP utilizes network and system architecture not in service to network vendors but to enable the community to share and communicate. Certainly, vendors are involved. The DCTP uses network and server hardware that have been primarily the domain of digital vendors. In doing so, they take advantage of an interesting and overlooked reality in modern digital infrastructure: it has become much more affordable. The trend toward lower cost and higher-powered network systems has not stopped simply because most people rely on the wireless router and their digital network provider. A wireless mesh network for a neighborhood block that might have cost several thousand dollars only a few years ago has now dropped to a couple hundred. While the pricing may exclude those with limited access, the ability of the community to combine their resources helps to make the network more affordable and accessible.

The DTCP is just one example of users rediscovering the power of hardware and personal networks and using those systems for public good. Within certain counterpublics, especially those focused on self-hosting, local mesh-networking, and do-it-yourself development,[14] there is a growing movement to re-engage with systems at a hardware level and a growing assortment of vendors, like the early Altair, who want to provide users with the hardware they need. Raspberry Pi, a small, portable, low-powered computer that is relatively powerful for its size, and adaptable to a variety of different use

[14] MakerSpaces are one outgrowth of these movements. They are publics, but definitely counter to the norm.

contexts and constructions,[15] has captured not only the imagination of tech enthusiasts and hobbyists, but of a larger creative community of people who see technology not as platform but as a tool for personal expression and empowerment (Raspberry Pi Foundation 2019).

These systems and communities I would suggest, hold within them the promise of a new sociotechnical imaginary that draws on the capacity of the user within the community. Unlike the user-has-the-power individualistic myth of the 1980s, this imaginary positions the user within a community of fellow builders, creators, and designers. There is no lone digital wizard, but there is a shared space of collaboration and creation that an individual contributes to and is considered a part of. To be certain, this is not a dominant imaginary. The community of these network pioneers who look ahead while drawing on practices now forty or more years in the past have not made up enough ground to move the giant vendors from their places of power. What they have done, however, is create small places of digital possibility where the dominant imaginary falls away revealing something more. As part of the counterpublics that shape them, sociotechnical imaginaries do more than merely give us a method of explanation. They also provide avenues of possibility and perspectives on paths not taken. This new digital imaginary may not be the path we, as a society, eventually tread, but it does gives me some hope for the future we may still discover.

[15] Raspberry Pis have been used for everything from media servers and video game consoles to robotic components, remote systems and camera control (Raspberry Pi Foundation 2019).

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CURRICULUM VITAE

Geoffrey Gimse

Education

Dissertation Title: Culture and Code: The Evolution of Digital Architecture and the Formation of Networked Publics

Northern Michigan University Marquette, Michigan

MA ENGLISH (ENGLISH WRITING AND PEDAGOGY) (May 2014)

- Masters Thesis: Shifting Spaces in Digital Rhetoric: Ephemera in the Age of Infinite Memory

University of Iowa Iowa City, Iowa

BA (HONORS) ENGLISH/CREATIVE WRITING TRACK (May 2011)

- Graduated with Distinction
- Honors Thesis: The Data Thief

University Teaching Experience

University of Wisconsin – Milwaukee Milwaukee, Wisconsin

GRADUATE TEACHING ASSISTANT - ENGLISH DEPARTMENT Fall 2014 - Present

Courses Taught:

- Speaking and Writing Technoscience in the 21st Century
- Business Writing
- Introduction to College Writing
- College Writing and Research

- Independently developed course materials, taught all sections, and provided final assessments.
- Successfully incorporated new technologies for collaborative editing into the classroom.
- Developed and conducted class in conjunction with the University's Brightspace Desire2Learn (D2L) and Canvas LMS platforms.
- Developed and designed the Business Writing Class for online delivery via UWM's D2L system.
- Adapted writing instruction materials and course structure for use in an Active Learning Classroom.

Northern Michigan University Marquette, Michigan

GRADUATE TEACHING ASSISTANT - ENGLISH DEPARTMENT Fall 2012 - Spring 2014

Courses Taught:

- College Composition I
- Technical and Report Writing
- Narrative and Descriptive Writing

- Independently developed course materials, taught all sections, and provided assessments.
- Built and taught using hybrid class models utilizing Moodle and Angel software.
- Incorporated a variety of multi-modal and digital composition components within each class.

Course Development Experience - Competency-Based

University of Wisconsin – Milwaukee Milwaukee, Wisconsin

FLEX DEGREE PROGRAM (Summer 2017)

Courses Developed:

- Project Management

- Independently developed course materials for online Flex Degree Program.
- Incorporated Agile and Waterfall elements into Project Management course structure

• Developed competency assessment exercises and projects for course completion.

Publications/Reviews

PUBLICATIONS

“PhronesisMOO: Reclaiming Aesthetic and Rhetorical Potentials within the Software Obsolete” (Forthcoming)

Computers and Writing 2018 Conference Proceedings (Summer 2019)
Co-Authored with Kris Purzycki (University of Wisconsin - Milwaukee)

“Empire and Resistance: Prelude to the Wars of the Three Kingdoms”

OneShot: A Journal of Critical Games and Play (March 2019)
Co-Authored with Courtney Herber (University of Nebraska - Lincoln)

REVIEWS

“Review of What Algorithms Want: Imagination in the Age of Computing”

Technoculture VOL. 7 - <HTTPS://TCJOURNAL.ORG/VOL7/GIMSE> (Spring 2017)

Conference Presentations

Platform Work: Critique, Practice, and Resistance in Digital Monopolies Pittsburgh, PA
ASSOCIATION OF TEACHERS OF TECHNICAL WRITING (ATTW) 2018 CONFERENCE March 2019

Decentering the Digital: Digital Rhetoric in Postdigital Contexts Minneapolis, MN
RHETORIC SOCIETY OF AMERICA (RSA) 2018 CONFERENCE May 2018

Exploring a Social Justice Approach to Teaching Technoscience Communication Kansas City, KS
ASSOCIATION OF TEACHERS OF TECHNICAL WRITING (ATTW) 2018 CONFERENCE March 2018
Co-Presented with Mary Clinkenbeard

Open Source in the Classroom: Availability, Access, and Practice New York, NY
MODERN LANGUAGE ASSOCIATION (MLA) 2018 CONFERENCE January 2018

Bridging the Gaps: Digital Humanities Labs as Spaces of Access and Engagement Orlando, Fl
HUMANITIES, ARTS, SCIENCE, AND TECHNOLOGY ALLIANCE AND COLLABORATORY (HASTAC) 2017 CONFERENCE October 2017
University of Central Florida

The User in Control: Software Filters and Online Communities Milwaukee, WI
HUMANITIES UNBOUND UNCONFERENCE April 2017
University of Wisconsin – Milwaukee

MUSAIC (Multi-User Shared Accessible Interconnected Community) Milwaukee, WI
MIDWEST INTERDISCIPLINARY GRADUATE CONFERENCE February 2017
University of Wisconsin – Milwaukee

The Distributed Machine and its Texts: Developing Network Literacies for the Cloud Menominee, WI
COMPUTERS AND WRITING CONFERENCE: TECHNOLITERACY IN(TER)VENTIONS May 2015

University of Wisconsin – Stout

Composition: Building a Digital Commons Milwaukee, WI
UWM/MARQUETTE PEDAGOGY CONFERENCE December 2014
University of Wisconsin – Milwaukee

The Myth of the Digital Native: Developing Creative Opportunities for Today's Students New Holland, MI
THE MICHIGAN ACADEMY March 2013

Research Experience
University of Wisconsin – Milwaukee Milwaukee, Wisconsin
GRADUATE RESEARCH ASSISTANT - PUBLIC ENGAGEMENT AND SCIENTIFIC COMMUNICATION (PESC) Spring 2017

- Developed online web scraping and data collection applications in Python and MySQL
- Transcribed notes from various focus group roundtables.
- Provided support and modified Python applications for operation in High Performance Computing environments

Grants, Awards, and Fellowships
James A. Sappenfield Fellowship Milwaukee, WI
UNIVERSITY OF WISCONSIN - MILWAUKEE Fall 2018 - Spring 2019
Amount: $1200

HASTAC Scholar
HUMANITIES, ARTS, SCIENCE, AND TECHNOLOGY ALLIANCE AND COLLABORATORY (HASTAC) Fall 2017 - Fall 2019
Amount: $300

Excellence in Education Grant Marquette, MI
NORTHERN MICHIGAN UNIVERSITY Summer 2013
"CONvergence: Media, Fandom, and Participatory Culture"
Amount: $1500

Guest Presentations and Workshops
Web Scraping and Online Data Collection Workshops Milwaukee, WI
DIGITAL HUMANITIES LAB WORKSHOP July - August 2018
UWM Digital Humanities Lab

MUDs, MOOs, and Why They Still Matter (Co-Presenter) Milwaukee, WI
DIGITAL HUMANITIES LAB WORKSHOP May 2018
UWM Digital Humanities Lab

Beyond the Save Function: Document Management, Review, and Version Tracking for Today's Scholars Milwaukee, WI
PREPARING FUTURE FACULTY AND PROFESSIONALS October 2017
University of Wisconsin - Milwaukee

Document Management and Workflow Using GitHub Milwaukee, WI
DIGITAL HUMANITIES LAB WORKSHOP April 2017
University of Wisconsin - Milwaukee

Git and GitHub: Version Tracking for the Humanities Milwaukee, WI
DIGITAL HUMANITIES LAB WORKSHOP March 2017
University of Wisconsin - Milwaukee

D2L Tips and Tricks Milwaukee, WI
ENGLISH DEPARTMENT FIRST YEAR COMPOSITION NEW INSTRUCTOR TRAINING April 2015
University of Wisconsin - Milwaukee

Beyond 8 ½ x 11, etc. Proposals for Multimodality and FYC @ UWM Milwaukee, WI
COMPOSITION INSTRUCTORS FORUM April 2015
University of Wisconsin - Milwaukee

Using EDUCAT (Moodle) in EN111 Marquette, MI
ENGLISH 509: TEACHING COLLOQUIUM August 2013
Northern Michigan University

Spoken Word Poetry: Bring the Noise to the Classroom. (Co-Presenter) Marquette, MI
CELEBRATION OF STUDENT RESEARCH, CREATIVE WORKS AND ACADEMIC SERVICE April 2013
Northern Michigan University

Service
Social Media Coordinator / Webmaster Milwaukee, WI
MID-AMERICA AMERICAN STUDIES ASSOCIATION 2016-Present

Web Editor Milwaukee, WI
cream city review LITERARY JOURNAL 2015-2018

Professional and Technical Writing Graduate Student Representative Milwaukee, WI
ENGLISH DEPARTMENT 2017-2018
University of Wisconsin - Milwaukee

UWM Global Game Jam Team Member Milwaukee, WI
2018 GLOBAL GAME JAM January 2018
University of Wisconsin - Milwaukee

Web Developer Teaneck, NJ
STEPHEN S. WEINSTEIN HOLOCAUST SYMPOSIUM 2015-2016
Fairleigh Dickinson University

FYC Multimodal Pilot Group Member Milwaukee, WI
FYC MULTIMODAL PILOT GROUP 2015-2016
University of Wisconsin - Milwaukee

Committee Member Milwaukee, WI
FIRST YEAR COMPOSITION READER COMMITTEE - ENGLISH DEPARTMENT 2014-2015
University of Wisconsin - Milwaukee

Web Designer/Editor Marquette, MI
Passages North LITERARY JOURNAL 2013-2014

Web Text Developer/Editor Marquette, MI
FOR "A CONVERSATION WITH KRISTINE L. BLAIR." BY DR. ELIZABETH MONSKE 2013-2014
Published in Kairos Vol 18.2 <http://kairos.technorhetoric.net/18.2/interviews/monske/index.html>
Northern Michigan University

Technical and Web Liaison Iowa City, IA
IOWA YOUTH WRITING PROJECT 2010-2014

Judge Marquette, MI
HOUSTON UNDERGRADUATE WRITING AWARD 2013
Northern Michigan University

Web Programmer/Digital Librarian Iowa City, IA
WIDERNET PROJECT Fall 2010
University of Iowa

Professional Memberships
Rhetoric Society of America (RSA)
Humanities, Arts, Science, and Technology Alliance and Collaboratory (HASTAC)
Modern Language Association (MLA)
Association of Teachers of Technical Writing (ATTW)
National Council of Teachers of English (NCTE)