Grounding the Cloud

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The undersigned, appointed by the Doctor of Design Program, have examined a dissertation entitled

Grounding the Cloud

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Grounding the Cloud

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Abstract

This dissertation explores the dynamic relationship between material formations of data and the processes of data-driven urbanization within an increasingly planetary context. In this pursuit the project articulates the deeply territorial operations of tech corporations such as Google and frames their spatial footprints and urban projects within an inherently expansionist logic. In developing a contextual-spatial understanding of the landscape of data, this work addresses the grounded materiality and geographic specificity of data infrastructures on one hand, and the influence of the centralizing logic of "the cloud" on practices and processes of spatial production on the other hand. This work is enacted through three main lines of investigation: First, deconstruction of the ideologies, concepts, and politics underlying the sociotechnical construction of "the cloud," as an emerging global organizational model that operates through platforms of data extraction and mediation. Second, clarification of the role of accidents, errors, and disruptions in unearthing the hidden forms and agendas of global infrastructures of data, as well as a historical contextualization of this hidden form within the long process of under-grounding urban infrastructure since the turn of the 20th century. And third, tracing the inherently global geography of data that materially, socially, and territorially grounds the forms and processes of data extraction and monetization of urban data within processes of advanced capitalism. These investigations bring together perspectives and methods from media studies, communication geography, critical urban studies, cartography, urbanism, and architecture to bear upon some of the most pressing issues facing cities and their citizens as they transition towards emerging paradigms of cloud-driven urbanism.

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For Ghazal, Simin & Hassan

LIST OF FIGURES

All figures by the author unless otherwise noted.

INTRO-DUCTION

The cloud is widely known as a powerful, yet largely invisible, technological platform for the outsourcing of computational tasks such as processing or storage of digital data. However, this thesis argues that the concept of the cloud has outgrown its technological shell and has become an organizational model for the society at large. The cloud has come to represent many things at once. It is simultaneously a marketing image, a political ideology, and an economic model for centralization of resources. The cloud is thought to be amorphous. It is everywhere, all the time. It is scalable and for everyone. However, beyond the marketing image of the cloud lies a global empire of data that centralizes computing resources, hence the power and capacity of production within an information economy, for a handful of corporate platforms.

The work undertaken in this dissertation is informed by a series of questions about the concepts, forces, actors, and geographies that contribute to, and are in turn constructed by, the emergence of the cloud as a global organizational model. First, to better grasp the emerging understanding of the cloud, this thesis asks, how can the cloud be redefined to acknowledge its growing role and capacity within the dominant information economy? What are the precise contours of the new understanding of the cloud as an organizational model? This line of inquiry is followed by articulating the agencies that underlie the sociotechnical construction of the cloud. If not solely a technological platform, what other forces (social, political, environmental) and actors (corporations, governments, individuals) contribute to the continual construction of the cloud and its growing societal footprint? Understanding the cloud as inherently geographic, a third line of inquiry asks, how is the cloud, as an organizational model, manifested territorially and grounded spatially? What material geographies lay at the base of the cloud? What are the sites in which the hidden form of the cloud finds its grounding? And finally, this thesis speculates on emerging power dynamics between new forms of corporate platforms and their users, upon whose data the system is dependent. What new power relations are enacted through the territorially grounded and socially mediated apparatus of the cloud?

In response to these questions, this dissertation will critically examine the predominate notions of fluidity, emancipation, and democracy that have characterized the emergence and growth of cloud computing over the past two decades. I will argue that the cloud is far from friction-less and revolutionary. In fact, as I will show through examples and case studies, the operational logic of the cloud is inherently territorial and entails a massive material geography that is historically preconditioned, and which mediates the cloud's global expansion. Furthermore, contrary to dominant belief, cloud computing is not inherently democratic. It does not operate above capitalist logics. Instead, this thesis will argue that the cloud is emerging as a global organizational model for data corporations based on principals of infinite territorial expansion, continual regeneration, and operational fluidity, closely following capitalist corporate logics. This has created an uneven global empire of data. And as empires do, the cloud is constructed on ideologies and territories. The cloud's dependency on data as a resource opportunistically grounds it in the very material conditions of its extraction, storage, processing, distribution, commodification, and delivery. Each of these moments are constructed in response and in relation to social, cultural, economic, political, and environmental dynamics of the context in which it is operating. Hence, tracing the outlines of the cloud entails mapping both its foundational ideological constitution, as well as the material geography of its construction.

Scholars from various fields have recently attempted to come to terms with the cloud as a major driving force within contemporary society. Vincent Mosco, for example, has articulated the cloud as an engine that powers informational capitalism in his 2014 book *To the Cloud*. Mosco's reading goes beyond the technical descriptions of the cloud to critically assess and conceptualize it as a socially and culturally constructed platform promoted through myths and marketing.[1] Tung-Hui Hu, on the other hand, has mapped an alternative genealogy for the cloud that finds its origins within the computing experimentation of the 1960s and 70s. By articulating the cloud as historically preconditioned, Hu has challenged the dominant narratives promoted by the tech industry that attempt to position the cloud as a revolutionary technological platform which has only emerged in response to recent growth in societal data demands.[2] In *The Stack: On Software and Sovereignty* (2015), Benjamin Bratton has introduced the cloud as a layer within a "model for the design of political geography tuned to this era of planetary-scale computation," a model which he has conceptualized as the stack.[3] For Bratton, the cloud layer is built up of computational infrastructures as well as legal and territorial codes of control that mediate the relationship of the other layers of the stack to the earth layer from which the cloud extracts energy and other natural resources.

In building upon these works, this dissertation conceptualizes the cloud as an organizational model for the centralization and allocation of computing resources (data centers, fiber optic cables, expertise, etc.) that mediate and govern the relationship of contemporary society to the data it produces. Instead of defining it as layer or a technical apparatus, the cloud in this dissertation emerges as a hybrid organizing force. One which is coded into the spaces, economic models, and behavioral patterns of everyday life in the contemporary information society. The cloud's logic of extraction organizes territories and populations through controlling the means of production within the dominant information economy. The space that the cloud entails is also characterized by hybridity, existing as both material spaces of computing resources and extra-material spaces of regulations, codes, and ideologies. However, this hybrid spatiality of the cloud remains understudied within current literature and hence forms an important aim of this dissertation. By spatializing the cloud in this manner, this work begins to ground the sites, actors, and ideologies that have contributed to the construction of the cloud as a sociotechnical organizational model, and which are tied to larger sociopolitical and environmental dynamics that are not captured by technical descriptions of the cloud.

In pursuing these lines of inquiry, this dissertation hopes to contribute to the expanded field of design in which urban forms and processes are articulated as expressions of societal, political, and environmental agencies. Within this articulation the corporate-driven organizing force of the cloud can be contextualized as the latest in a long series of neoliberal strategies which have privatized the public spaces and practices of urbanization. Hence, the study of the cloud presented here fits within a model of critical urban analysis of the forms and processes that contribute to global spatial production. The work conducted here also aims to contribute to larger discussions around the reciprocal relationship between technology and society, especially the role played by information and communication technologies in bringing about new paradigms of seeing, understanding, and acting on the world.

In articulating the cloud as a global organizational model this dissertation draws on a number of disciplines and perspectives to construct an interdisciplinary and telescopic framework for the grounding of the cloud. Hence, this work employs methodologies and theoretical perspectives drawn from political economy, urban political ecology, critical urban geography, media studies, and the history and theory of architecture and urbanism, to construct the grounds for the interdisciplinary analysis of the operational landscape of the cloud.

From political economy the works of David Harvey, Manuell Castells, and Saskia Sassen have set the foundational basis for the analysis of mediated spatial logics and capitalist time-space compression strategies, as well as the role played by the connective networks of communication.[4] Economically, the cloud's relationship to capitalism (as an underlying logic for its expansion and territorialization) has been contextualized within emerging concepts of "platform capitalism" and "surveillance capitalism," developed by Nick Srnicek and Shoshana Zuboff, respectively.[5] While each concept has introduced a new modifier for capitalism, both have analytically approached the extractive practices of data corporations which have for the most part formed the basis of their business models and their territorial expansion. These concepts have contributed to the critical engagement of this thesis with the corporate strategies and the economic actors involved in the sociotechnical construction of the cloud.

The criticism of the constructed distinction between society and nature in recent work from urban political ecology has enabled a hybrid and more inclusive conceptualization of spatial production as mediated through both social and natural processes.[6] The inherent methodological complexity of urban political ecology has provided a useful precedent for studying the multifaceted and multiscalar contexts of the cloud's operational landscapes. The power relations that underlie these processes and the relations of human and non-human actors and their spatial configuration generate an uneven and complex geography, which cannot be articulated through purist disciplinary avenues of study.[7] Hence, urban political ecology's inclusive and hybrid methodologies of analysis and its socio-environmental conception of spatial production in the works of Erik Swyngedouw, Matthew Gandy, and Timothy Luke have been instrumental in articulating the socio-technically extended landscape of the cloud as it commodifies urban environments and exerts new power relations through the mediation of urban data.[8]

Equally productive in constructing the dissertation's theoretical framework have been recent attempts from media studies that critically engage the myths of immateriality, which have historically plagued information and communication technologies. These works have contextualized communicative media within centuries of processes that continually ground these technologies within the spaces and materialities of everyday life. Emerging studies on media archaeology and media infrastructures, exemplified by the work of Jussi Parikka, Lisa Parks, Shannon Mattern, and Nicole Starosielski, have been useful in materially grounding the forms and processes of media within narratives of use and construction informed by social, cultural, and environmental dynamics of their times and places.[9]

In parallel, within critical urban geography, recent work has rearticulated global urbanization as a complex set of relational processes which not only inflict traditionally defined centers of agglomeration, like cities, but also the sites and geographies that have historically laid outside of the conception of the "urban." This move beyond the city-centric conception of urbanization to study "the powerful forces that emanate from agglomeration" has formed the basis of a new set of studies concerned with various forms of global spatial production. Concerned with the limiting conceptions of city-centric urban discourse, the theoretical framework of planetary urbanization has attempted to articulate an alternative vision of urbanization as a set of relational processes that extend beyond the confines of the traditional city, and which increasingly encompass the entire globe.[10] Building on

Lefebvre's global urbanization hypothesis, the main discourse of planetary urbanization is based on the understanding of the urban as a "concrete abstraction" in which,

> "the contradictory sociospatial relations of capitalism (commodification, capital circulation, capital accumulation, and associated forms of political regulation/ contestation) are at once territorialized (embedded within concrete contexts and thus fragmented) and generalized (extended across place, territory, and scale and thus universalized)."[11]

This understanding of urbanization as both concentrated (territorialized) and extended (generalized) lies at the core of the consequent critique of the "urban age" discourse and its inherently one-dimensional focus on agglomeration and cities as the de facto sites of urbanization.[12] In this regard, planetary urbanization aims to go beyond the urban/non-urban dichotomy of urban studies and to situate global urbanization processes within the dialectic interrelationships of moments of concentration and extension, which are influencing the patterns of uneven spatial development at a global scale. The new analytical frameworks generated by these lines of inquiry have extended the critical gaze of urban research into the globally expanded operational landscapes of urbanization that lie beyond cities, but effectively influence their economies, forms, and governance. For the study of the cloud, these frameworks have enabled the extension of the critical spatial lens of the extractive practices of the cloud to the machinic info-industrial complex that makes up the hidden form of the cloud beyond digital screens.

And finally, from within architecture, urbanism, and design a wide range of works on the extended field of design have helped to contextualize the social, political, and environmental dynamics of the forms and expressions of technological networks and infrastructural systems. The nuanced historical grounding of the impact of information and communication technologies on urban and architectural practices in the works of Antoine Picon;[13] the analysis of the operational narratives of infrastructural space as it commodifies urbanization in the works of Keller Easterling;[14] and the deep sectional cuts into organizational structures that operate as infrastructures of spatial production globally, exemplified by the recent work of Pierre Belanger;[15] have been especially helpful in developing a spatial analytic lens for the investigations of this dissertation.

Given the various scales in which the cloud operates, the variegated moments of concentration and extension that it generates, and the territorial agencies that it mediates, between corporations, users, and governments, a single method of analysis would not be able to capture the intricacies of the global organizational model of the cloud. By combining the various methodologies and perspectives drawn from the fields mentioned, this dissertation essentially operates through a hybrid methodological framework. In doing this, the work attempts to go beyond the pervasive technical narratives of the cloud to map its socially, culturally, and spatially grounded forms and processes. Tech companies have traditionally been tightlipped with regards to their aims and trajectories. Therefore, the work of investigative journalists has been extremely valuable in this pursuit as they unearth the dynamics of the cloud that tend to remain out of sight, shielded by trade secret protections. This dissertation equally builds off of news articles, announcements, press releases, and public document releases which tend to hint at new markets, trajectories, and directions of growth for cloud corporations. Talks, interviews, and conferences have also been invaluable as they provide rare moments where the marketing force of the cloud and the personal ideologies of its actors are assembled and made accessible. In this thesis, the spatiality of the cloud is traced through critical cartography that maps the sites and territories of its materialization, as well as tracing the company structures and the corporate contours of the cloud companies as they territorialize new geographies within their empires of data. Strangely, the cloud enables the dissemination of much of the material analyzed here. So while this dissertation is about the cloud, it is also partly mediated through it.

The multivalent arguments of this thesis are illustrated by a deep mapping of Google's data empire. As a major player within cloud computing, the company's operational logics, its spatial footprints, and the complexities and frictions of its global expansion are important vignettes for articulating the general outlines of the cloud. And although within this dissertation the cloud is understood as a *global* organizational model, to fully articulate the territorial dimensions of its operations and more precisely trace its contours this work has mainly focused on North America, where the concept of the cloud and its driving ideologies were initially born.

Following the case studies and groundings presented here, this dissertation argues for a hybrid understanding of the cloud as a global data empire that operates through centralization of computing resources and commodification of data enabled by an ever expanding material geography that opportunistically mediates its capitalist thirst for expansion. The aim is to ground the cloud as an ideologically constructed and territorially mediated apparatus, which operates through tried and tested neoliberal strategies of undermining regulatory systems and stockpiling privatized resources built on public data. Hence, this dissertation ultimately conceptualizes the cloud as an organizational model for the centralization and allocation of computing resources that mediate and govern the relationship of contemporary society to the data it produces.

To ground the cloud, this dissertation is organized in five sections. The second section, following this introduction, is titled *The Cloud*, and traces the strata of the cloud's cultural and sociotechnical construction, the actors involved, and the sites of its commodification. The cultural construction of the cloud actively hides the extensive material geography upon which it is built, instead diverting attention towards city-centric commodification of data which has in turn entailed new data-driven paradigms of urban management. However, even natural clouds cast shadows. Section 3, *Shadows*, hence problematizes the clean, secure, and frictionless image of the cloud. By pointing to the sites and moments where infrastructural systems poke their head above ground, this section positions the hidden form of the cloud as part of a historical process of undergrounding technical infrastructures since the turn of the 20^{th} century. Accidents, disruptions, and errors emerge as important agents in unearthing the cloud and its hidden topography. *Shadows* will essentially act as a bridge between the cloud and the ground parts of this dissertation. Section 4, *The Ground*, will present a deep sectional view of the extended material geography of the cloud and the contextual dynamics that contribute to, and are triggered by, its construction. Section 4 therefore complicates the prevalent smooth ideologies of the cloud's construction by mapping its constitutive sites in relation to local complexities, environmental dynamics, and spatial frictions. Finally, section 5 presents a set of concluding remarks and suggests further avenues of research for the societal agency of the cloud as an organizational model for the contemporary information society.

Notes

1 Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder, Colorado; London, England: Paradigm Publishers, 2014).

2 Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge MA: The MIT Press, 2015).

3 Benjamin Bratton, *The Stack: On Software and Sovereignty* (Cambridge, Massachusetts; London, England: The MIT Press, 2015).

4 See: Saskia Sassen, *The Global City: New York, London, Tokyo* (Princeton, NJ: Princeton University Press, 1991); David Harvey, *The Urbanization of Capital: Studies in the History and Theory of Capitalist Urbanization* (Baltimore: John Hopkins University Press, 1985); and, Manuel Castells, *The Rise of the Network Society* (Chichester, West Sussex; Malden, MA: Wiley-Blackwell, 2010).

5 Shoshana Zuboff, “Big other: surveillance capitalism and the prospects of an information civilization,” *Journal of Information Technology* 30 (2015): 75-89; and, Nick Srnicek, *Platform Capitalism* (Cambridge, UK: Polity Press, 2017).

6 Combining the insights of historical geographical materialism, some major aspects of Actor-Network Theory, and the work of Haraway, urban political ecology views contemporary spatial production as “a process of fusing the social and the natural together to produce a distinct ‘hybrid’ or ‘cyborg’ urbanization.” In, Erik Swyngedouw, “Circulations and Metabolisms: (Hybrid) Natures and (Cyborg) Cities,” *Science as Culture* 15, 2 (2006): 106.

7 Erik Swyngedouw, “The City as a Hybrid: On Nature, Society, and Cyborg Urbanization,” *Capitalism, Nature, Socialism* 7, 2 (1996): 69.

8 See: Erik Swyngedouw, “Circulations and Metabolisms: (Hybrid) Natures and (Cyborg) Cities,” *Science as Culture* 15, 2 (2006): 105-121; Matthew Gandy, “Cyborg Urbanization: Complexity and Monstrosity in the Contemporary City,” *International Journal of Urban and Regional Research* 29, 1 (2005): 26-49; Timothy Luke, “At the End of Nature: Cyborgs,

‘Humachines’, and Environments in Postmodernity,” *Environment and Planning A* 29, 8 (1997): 1367-1380; and, Timothy Luke, “Reconstructing Nature: How the New Informatics are Rewrighting the Environment and Society as Bitspace,” *Capitalism, Nature, Socialism* 12, 3 (2001): 3-27.

9 See for example: Jussi Parikka, *A Geology of Media* (Minneapolis, MN: University of Minnesota Press, 2015); Lisa Parks and Nicole Starosielski, *Signal Traffic: Critical Studies of Media Infrastructures* (Chicago: University of Illinois Press, 2015); Shannon Mattern, *Code and Clay, Dirt and Data: Five Thousand Years of Urban Media* (Minneapolis, MN: University of Minnesota Press, 2017); and, Nicole Starosielski, *The Undersea Network* (Durham and London: Duke University Press, 2015).

10 See: Neil Brenner and Christian Schmid, “Planetary Urbanisation,” In *Urban Constellations*, ed. Matthew Gandy, (Berlin: Jovis, 2011), 10-13; and Neil Brenner, “Theses on Urbanization,” *Public Culture* 25, 1 (2013): 85-114.

11 Neil Brenner, “Theses on Urbanization,” *Public Culture* 25, 1 (2013): 95.

12 Neil Brenner and Christian Schmid, “The ‘Urban Age’ in Question,” *International Journal of Urban and Regional Research* 38, 3 (2014): 731-755.

13 Antoine Picon, *Digital Culture in Architecture: An Introduction for the Design Professions* (Basel: Birkhauser, 2010); and, Antoine Picon, *Smart Cities: A Spatialized Intelligence* (Chichester, West Sussex: Wiley, 2015).

14 Keller Easterling, *Enduring Innocence: Global Architecture and its Political Masquerades* (Cambridge, MA; London, UK: MIT Press, 2005); and, Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space* (London, UK; Brooklyn, NY: Verso, 2014).

15 Pierre Bélanger and Alexander Arroyo, *Ecologies of Power: Countermapping the Logistical Landscapes and Military Geographies of the U.S. Department of Defense* (Cambridge, MA: MIT Press, 2016).

THE CLOUD

Constructing a Global Organizational Model

VISIONS

What is the cloud? Definitions of the cloud have emerged from fields as diverse as computer science, cultural and media studies, social sciences, and political science. However, these definitions have not been able to capture the massive role of the cloud as an organizational model operating at a global scale. This part contextualizes the emergence of the cloud within the larger ascent of data as a primary resource within the dominant information economy. This section will conclude in a new working definition for the cloud that will guide the rest of the investigations of this dissertation into the spatial and urban agencies of cloud computing.

The Age of Big Data

Every new computing paradigm has introduced its own way of seeing and acting on the world. The growth of scientific knowledge and accumulation of data in the 19th century, the emergence of the computer and electronic communication systems during and after the Second World War, the rapid rise of the internet at the end of the 20th century, have each introduced new analytic technologies, technical expertise, and spatial conceptions that have reframed urban processes and our relationship to them. To spatialize cloud computing we need to situate it within the spatial trajectory of communication systems and the role that information technology and data processing have played in the emergence of new spatial and urban conceptions.

It is worthwhile to remind ourselves that the importance of data and the overabundance of information is not a new phenomenon. In fact, we can articulate the contemporary condition as the second era of "big data." The first occurring in early 19th century with the "avalanche of numbers," and the explosion in data collection and processing capabilities of the emerging scientific methodology.[1] While the data gathered and processed during the first big data era was not necessarily spatial in nature, the practices of social ordering that emerged in response to them were highly influential in developing spatial ordering principles. Themes of control and ordering of complex systems like cities that emerge through cybernetic theories of communication would essentially translate the scientific methodologies of mathematical modeling, data visualization, indexing, and categorizing into urban environments.

In this context, It would not be an overstatement to claim that our contemporary understanding of the world has become dominated by, and gradually mediated through, data and its apparatus of collection, analysis, and storage. Increasingly, how we act upon the world is also predicated on data. The still-young 21st century has seen the ascendance of data as a fundamental raw material. The extraction and management of this raw material has constituted the growth of a new form of capitalist economy centered around data, its collection, management, analysis, and distribution.[2] Although one can argue that data has always been part of economic production and societal dynamics, the weight put on it through the primacy and incorporation of digital technologies into every aspect of economy, society, and culture, places data as a central contemporary resource.

This is partly due to the sheer amount of data that is now available for use. A condition which has been called *Big Data*. How big? According to IBM 2.5 quintillion bytes of data are generated every day.[3] However, it is not only the volume of the data that has increased. Big Data also represents the growing complexity of the data generated. While data in the past had been structured, or neatly organized in databases, the majority of today's data is unstructured, generated from all kinds of digital interactions, from emails and text massages to YouTube videos and Instagram images, and through various mediums, from smartphones and personal computers to sensors and scanners.[4] Advances in communication technologies and proliferation of sensors and monitoring devices embedded in objects, buildings, and the environment mean that the speed by which this data is collected and transmitted has increased drastically as well, to the point that 90% of the world's data today has been generated in the last two years alone.[5]

Although it is very difficult to define the exact parameters of this new condition, Big Data has certain distinct characteristics that set it apart from previous rounds of data engagement. Rob Kitchin's work over the years has attempted to articulate these characteristics: First of all, Big Data denotes an increase in the volume of data collected and stored; the velocity by which this data is created is also significant, taking place in almost real-time; the variety of the data produced is quite diverse, and composed of a mix of structured and unstructured data; Big Data is exhaustive in scope, attempting to capture the entirety of populations or conditions; it is fine-grained in resolution, creating highly detailed readings of situations; Big Data is relational in nature, creating opportunities for the conjoining of a variety of data sets; and it is flexible, meaning that it can easily be added upon or be scaled up.[6]

What is also significant about the current paradigm of big data is that through a procedural feedback loop, more data is continually generated about data and the efficacies of the systems through which it is operationalized. In cyclical fashion, the volume and the speed by which this data is generated necessitates the emergence of new technologies of extraction and analysis which produce yet more data in their wake. The commodification of this data and the extractive, analytic, and storing capacities that have emerged in response to it have ultimately led to the emergence of new economic and political models wholly based on and dependent upon data and its management.[7] In other words, the massive amounts of data and the growing arsenal of tools of engagement with big data have enabled the growth of data-centric economies and disciplinary mechanisms. What is interesting is that far from being an alternative to capitalist economy—as they are usually touted to be–new economic forms operating through data still operate along the same capitalist lines of controlling the means of production and raw resources. In a sense, data mining has followed in the same path of traditional mining and oil industries. The only difference is that the raw material of its operations is different. Following this logic, if we consider data to be a raw material that must be extracted, refined, and commoditized through outlining various new uses and markets for it, then the activities of the users (whether individuals or collectives) are the natural sources of this material.[8] Hence, the emergence of this new data-driven economic condition entails the creation of new organizational models that will in turn set the ground for the extractive operations of a new breed of corporate actors.

Emergence of the Cloud

Cloud computing is one such organizational model which has emerged in the wake of the ascendance of data within contemporary societal forms and the emergence of new economic models which treat data as a raw material. Cloud computing, which finds its roots in the time-sharing technologies of the 1960s, operates based on the centralization of computing resources in charge of the storage, processing, and management of the massive amounts of data generated on a daily basis. "The Cloud"—as the massive apparatus of global cloud computing is generally referred to—has grown rapidly in recent years to become one of the dominant models for the allocation and management of computing resources. What is troubling is that while cloud computing presents obvious economic advantages to companies of various size by relieving them of the cost and burden of managing their own computing resources, it nonetheless consolidates the means of production within an information economy—in which data and information are viewed as resources—in the hands of a very small group of technology corporations. This concentration of computing resources and power has highlighted a number of concerns about the cloud computing model, which among others include ownership of data, data surveillance, and computing scarcity. In response to these concerns recent years have witnessed increasing critical engagements with the cloud, as evident by the growing literature on the subject.[9] However, with a few exceptions, most current discussions around the cloud have remained largely technologically oriented and have not engaged with the nuances of its sociospatial complexities. This chapter of the dissertation attempts to articulate the cloud as an emerging organizational model and will map the narratives, actors, and agencies involved in its sociotechnical construction.

Like clouds of the water vapor kind, the digital cloud might feel natural, effortless, and therefore appear devoid of design and construction, almost as a fact of life. This dissertation, however, posits that while it promotes an image of a friction-less, always-available, light, and efficient platform through its on-screen interfaces, the cloud also actively hides the dirty, heavily material, vulnerable, laborious base upon which it is constructed. So even though the use of the image of the cloud as a metaphor for how the cloud may feel has been quite successful, it has also clouded the sociotechnical processes and forms that constitute this image of liberation, transcendence, and supersession. To engage with the cloud spatially we need to understand it critically. Especially since the idea of the cloud "has exceeded its technological platform and become a potent metaphor for the way contemporary society organizes and understands itself."[10]

As scholars Lisa Gitelman and Geoffrey Pingree have suggested, any new media enters a period of "crisis" when it is first introduced, in which it defines its usability for society through conflict with the older media it is supposedly replacing. This crisis is ultimately resolved "when the perceptions of the medium, as well as its practical uses, are somehow adapted to existing categories of public understanding about what that medium does for whom and why."[11] In other words when it becomes naturalized in society. The digital "crisis" of the 1990s has given way to an all-out embrace for digital technology. They are commoditized and fetishized. They are the material of everyday existence. So there is little doubt that the contemporary networks of digital information and communication have now been entirely naturalized. However, unlike previous media, digital communication does not replace so much as it absorbs older media. In doing so it influences the way we engage with various media, and the extended geographies of their production, in tackling socio-technological issues.

The proliferation of digital information and communication has prompted new ways of thinking about computing. Various models have attempted to enlist the distributed computing power of digital networks to respond to complex tasks.[12] Yet neither have been as encompassing and far-reaching as cloud computing. Finding its technological roots in the time-sharing of mainframe computers in the 1960s, cloud computing has become a rapidly growing multi-billion-dollar industry dominated by a handful of technology corporations. Using the cloud has become so effortless to everyday life that we seldom associate our activities on it with an infrastructure. In a sense the cloud has become naturalized. Not unlike other critical infrastructure like water, sewage, electricity, and transportation, the mediation of the cloud takes place in the background actively hiding the global machinery of its operation behind user-friendly screens and interfaces. So much so that in a recent survey of more than 1,000 adults in the United States the majority of respondents still associated the cloud with weather and climate more than a network of computers. And while 54% claimed that they had never used the cloud, in reality 95% actually do through a whole host of daily activities.[13]

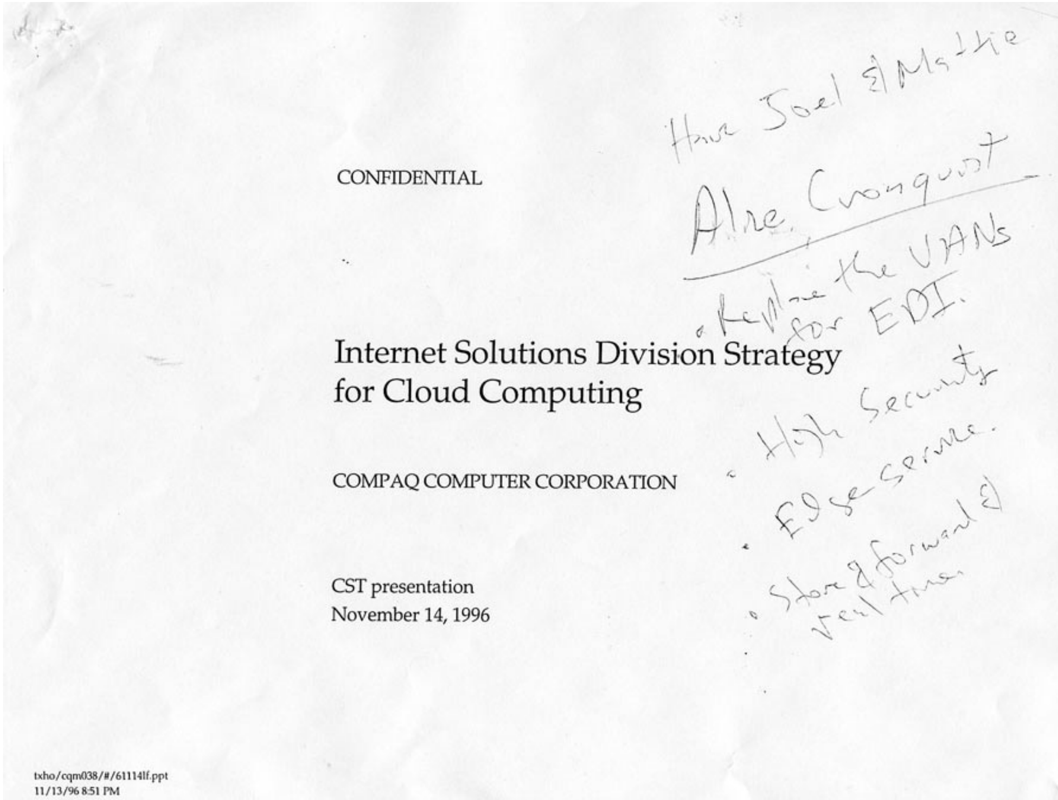
On the surface the cloud is a new model for the on-demand elastic distribution of computing resources. Upon a closer look however it represents the ultimate centralization of global computing resources in the hands of a few corporations. As the dominate computing model of the 21st century, a young century dominated by digital information, cloud computing presents a new, more centralized, more commoditized way of seeing, archiving, processing, and acting upon the world through data. As the continual construction of the cloud produces abstract macro representations that effectively hide the means of its production, to fully comprehend the cloud this research employs a telescopic analytic lens in hopes of expressing the interrelated macro and micro agencies that contribute to the construction of the cloud. The aim of this chapter is to construct a new understanding of how cloud computing, as an organizational model, has been both socially and technically constructed, as well as to map the actors involved in its construction and and commodification. This work is informed by the general understanding of the cloud as less of a predetermined condition and more as an organizational model that is actively constructed through historically dependent sociopolitical and technological practices. As such, understanding these practices and their historical trajectory in relationship to the construction of the cloud forms a significant aspect of this work.

To start, we can argue that with all the influence it is exerting, the cloud holds little meaning beyond the technical descriptions that have come to dominate most discussion about the cloud. The next section is an attempt to move the discussion beyond technical descriptions by making sense of the cloud as an organizational idea.

Defining the Cloud

Attempts at understanding what the cloud is and what it does have been matched by efforts to map its lineage and the coinage of the term. The idea of a global computer utility extends back to as early as the 1960s and the establishment of early time-sharing capacities for mainframe computers.[14] But while the coinage and ideation of centralized computing resources predates the internet and the digital revolution of 1990s, the popular utilization of the cloud, as both a model and a metaphor, is quite recent. For most people the cloud appeared in their general consciousness through Microsoft and Salesforce.com's ad campaigns of late 2010 and early 2011. However, the genesis of the use of the cloud to describe the next generation of computing goes further back. In 2006 Google's then CEO, Eric Schmidt, introduced the metaphor at an industry conference. Outlining the massive potential of the cloud model, Schmidt mentioned that the idea of the cloud "starts with the premise that the data services and architecture should be on servers. We call it cloud computing—they should be in a 'cloud' somewhere."[15] However, the earliest documented usage of the cloud dates back to 1996 in the working reports and white papers of Compaq, a hardware company which at the time was debating whether or not it should increase its investment in servers and internet hardware systems.[16]

What we now refer to as the cloud has been varyingly defined over at least the past decade. As a complex multi-layered network of connections, storage capacities, and processing capabilities which is founded on the massive amounts of data produced globally, the cloud is understandably difficult to pin down. This difficulty is reflected in the many attempts of corporations, government institutions, and scholars alike in defining what it is, as well as what it does. The most official definition for the cloud comes by the way of the U.S. National Institute of Standards and Technology (NIST). When U.S. government agencies were mandated by Vivek Kundra, the first ever Chief Information Officer of the United States, to move their operations to less expensive cloud services, NIST was tasked to define cloud computing amidst wide confusion about what counted as cloud computing.[17] What they offered was a "special publication" and short of an official standard, but rather a "guideline" and a "baseline for discussion" geared towards "system planners, program managers, technologists, and others adopting cloud computing as consumers or providers of cloud services."[18] NIST defines cloud computing as



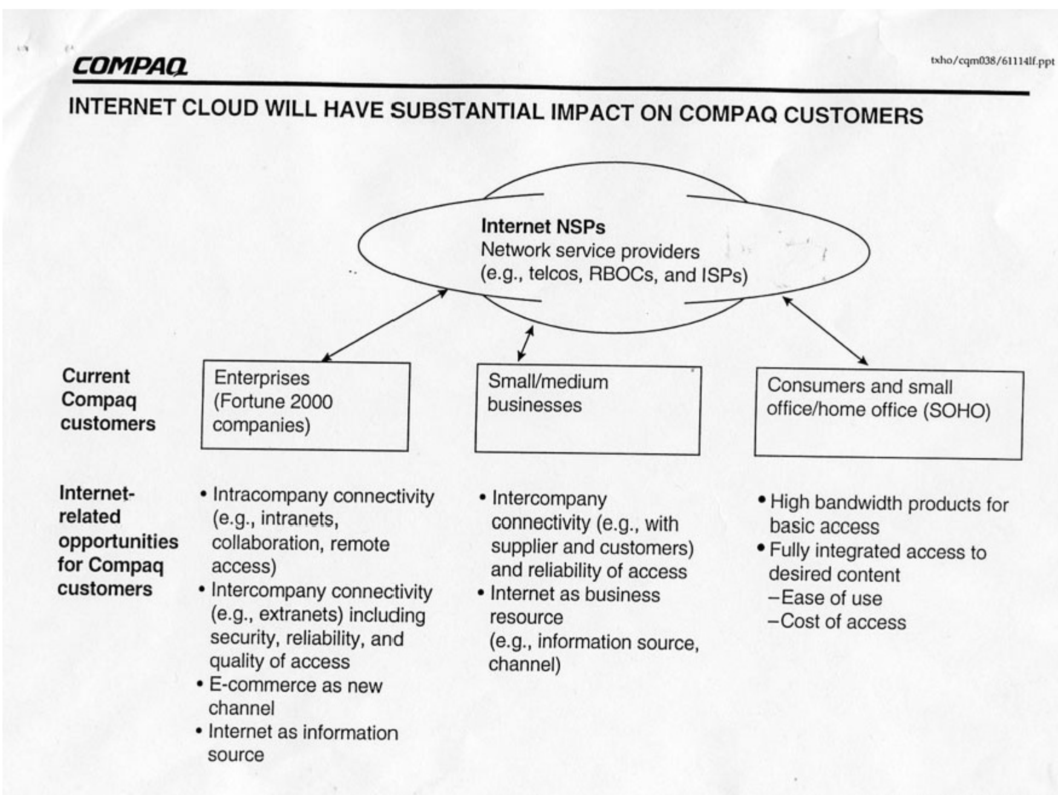


Figure 2.1: Pages from a print out of a 1996 Compaq business plan. The document is the earliest known use of the term “cloud computing” in print.

> “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”[19]

While this definition has been widely adopted within the industry, other perspectives coming from social and cultural studies have significantly expanded our understanding of the cloud in association with the multi-faceted social, environmental, and political relations that underlie ubiquitous computing.

Benjamin Bratton, for example, has described the cloud as “a vast discontiguous apparatus,” a “terraforming project,” and an essential layer of his geopolitical theory of “the Stack”. Bratton’s cloud covers the globe in “subterranean wires and switches and overhead satellite arrays, simultaneously centralizing and decentralizing computing and data storage and the social relations that depend on them (and vice versa).”[20] The simultaneous centralization and decentralization of the cloud is an important aspect of its construction and perception. The cloud’s demands for energy and water continually extend its footprints to geographies of extraction and landscapes of production, and its stockpiling of computing resources coupled with faster and higher bandwidth connections mean that every person, thing, car, plant, or even animal would eventually be linked to computing platforms. However, as Bratton maintains, this decentralization of connections also produces an economic and political centralization, since it “allows each such end User to perform or contribute to otherwise impossible calculations, all of which further centralize the platform’s economy of uses, effects, and profits.”[21]

Orit Halpern, a media and technology historian, has defined the cloud as “a sort of field of immersive information from which patterns can be deduced, optimized, and analyzed.”[22] In this sense the cloud takes on a rather atmospheric quality that reflects the global fulfilment of human desire to connect. “Scaling from individual e-mails to massive automated supply chains, there appears to be a new ephemeral and invisible but still an emotional and sensory infrastructure of computing.”[23] Going beyond the material requirements of moving, storing, and making sense of bits, this expression of the cloud projects it as media, as an “extension of man,” as the continuation of the belief that “if we could see more and know more, we would also be more free.”[24] This libertarian belief in the agency of technology forms an important layer of the sociotechnical construction of the cloud.

The tech elite have consistently persisted that the revolution in cloud computing has emerged in response to the urgent need for storage and analysis of the massive amount of data produced globally in the past decade or so. Yet others like Tung-Hui Hu, a former network engineer and currently a Professor of English at the University of Michigan, have challenged the perceived historical trajectory of the cloud by mapping a historical genealogy that extends back much further than the digital revolution of 1990s.[25] This remapping of the history of the cloud challenges the solely utilitarian notion of the cloud and productively engages the historical processes of ideological, social, and technological construction of global cloud computing. In this vein, the social scientist Vincent Mosco has partly attributed the cloud's rapid rise to the massive marketing and promotional apparatus which has prompted a general move towards the cloud and has accelerated its general diffusion globally.[26]

More recently, media theorist Shannon Mattern has expressed the cloud as "a nebulous conflation of information, capital, and geography."[27] The nebulous condition of the cloud, while being a defining factor, also permits multiple readings and expansions upon the conceptual and analytical limits of its "field," continually establishing and reestablishing what it means to live, work, or occupy the cloud. This expansion of the field has at the same time resulted in the emergence of new modes of analysis and practice within art and design. From "drone spotting to algorithm forensics to global infrastructure expeditions," these emerging practices have complicated and challenged the rudimentary definition of the cloud offered by NIST.[28]

The writer and artist James Bridle sees cloud computing as "the full spectrum deployment of computational thinking to the world."[29] At the base of this computational thinking lies the deep-rooted belief that through the collection and aggregation of empirical and objective data alone we can make sense of the world around us. The proliferation of vast networks of communication, which connect machines to each other and to terrestrial and atmospheric networks of sensors and devices, enables computational thinking to go beyond a philosophical idea to become "architectural and infrastructural."[30] In other words, the cloud enables a progression from understanding to agency, from observing the world to controlling it. As George Dyson writes in *Turing's Cathedral: The Origins of the Digital Universe*,

> "[a] fine line separates approximation from simulation, and developing a model is the better part of assuming control… Google sought to gauge what people were thinking, and became what people were thinking. Facebook sought to map the social graph, and became the social graph. Algorithms developed to model fluctuations in financial markets gained control of those markets, leaving human traders behind."[31]

In becoming the dominant model of computing—storage, processing, and expression of data—in a world where "sense-making makes power," the cloud has been positioned as an organizational model, as the means of control and distribution of power within an information society.

The cloud's power, however, is far from stable. In assembling a machinic apparatus of sense-making, which supposedly produces actionable knowledge about the world, the cloud has also become "a geopolitical machine, erasing some geographies and producing others, forming and destabilizing territories in competitive measure."[32] In a sense, the project of global coherence and sense-making on which the cloud is constructed has already failed. The state of continual crisis is the new stable reality. And while the cloud remains an operative model of the world, "it reveals not the deep truth at the heart of the world, but its fundamental incoherence, its vast and omniferous unknowability."[33]

A New Definition

Much of this recent effort in expressing what the cloud is, or what it does, stems, in some way or another, from disciplinary needs for identifying and relating to the current condition of information hyper-abundance. In a sort of disciplinary perspectivism each expression of the cloud is imbued by positional subjectivities that expand and at the same time obscure our understanding of it. However, what each of these recent expressions cogently hint at is the need for the accommodation of conditions that may lay outside of NIST's limited definition of the cloud, and which need to be included in any general understanding of it. What we associate with the cloud expands well beyond the provision of computing resources and the terms of their use. The cloud has become a way of life; a way of seeing the world; and a way of acting upon it. Hence, the cloud cannot be delimited unless one considers the complex social, cultural, environmental, and technical apparatus through which it is constructed. Even then we may still be confronted by a hazy, nebulous, amorphous, protean "conflation of information, capital, and geography." Characteristics that I would argue are essential aspects of its construction, and foundational to its understanding.

Even if we think of the cloud as a metaphor for the global apparatus of collection, archiving, processing, and monetizing data, metaphors are often socially and culturally constructed. The technicalities of the global apparatus are also constructed, commoditized, marketed, and controlled. Hence, to fully articulate the contours of the cloud we need a new operative definition for it. The cloud can be defined as a global organizational model constructed from the amalgamation of ideologically driven techno-solutionism and material stockpiling of computing resources that ultimately concentrate and territorialize the means of production and power for a few data-driven firms who have increasingly positioned themselves as influential political and economic agents within the contemporary information society.

Hence, the very first step in a critical-spatial understanding of the cloud is to map the ideological basis of its sociotechnical construction and to trace the actors involved. Understanding the construction of the cloud, the actors involved, and the emergence of new organizational forms are important initial steps in mapping the transference of this organizational framework to the rest of the society. The next three sections will address three fundamental layers of the sociotechnical construction of the cloud: Its cultural and technical representations which have created the dominant narrative for the cloud's commercialization; the actors involved in the cloud's commercialization; and the ways in which it has become commodified in society.

Notes

1 Hamish Robertson and Joanne Travaglia, "Big data problems we face today can be traced to the social ordering practices of the 19th century," *LSE Impact Blog*, October 13, 2015, http://blogs.lse.ac.uk/impactofsocialsciences/2015/10/13/ideological-inheritances-in-the-data-revolution/.

2 Nick Srnicek, *Platform Capitalism* (Cambridge, UK: Polity Press, 2017), 39.

3 "What is Big Data?," IBM, https://www-01.ibm.com/software/data/bigdata/what-is-big-data.html.

4 Matthew Wall, "Big Data: Are You Ready for Blast-off?," *BBC News*, March 4, 2014, http://www.bbc.com/news/business-26383058.

5 "What is Big Data?," IBM, https://www-01.ibm.com/software/data/bigdata/what-is-big-data.html .

6 Rob Kitchin, "Big Data, New Epistemologies and Paradigm Shifts," *Big Data & Society* (April-June, 2014).

7 Two prominent models, Surveillance Capitalism and Platform Capitalism will be discussed in the "Corporatization" section of this dissertation. See also: Srnicek, *Platform Capitalism*; and Shoshana Zuboff, "Big other: surveillance capitalism and the prospects of an information civilization," *Journal of Information Technology* 30 (2015).

8 Srnicek, *Platform Capitalism*, 40.

9 Some recent examples include: Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge MA: The MIT Press, 2015); Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder, Colorado; London, England: Paradigm Publishers, 2014); and Benjamin Bratton, *The Stack: On Software and Sovereignty* (Cambridge, Massachusetts; London, England: The MIT Press, 2015); among others.

10 Hu, *A Prehistory of the Cloud*, xiii.

11 Lisa Gitelman and Geoffrey Pingree, *New Media, 1740-1915* (Cambridge, MA; London, UK: The MIT Press, 2003), xii.

12 Examples of these models include: Distributed Computing, Ubiquitous Computing, Internet of Things (IoT), among others.

13 "Americans Still Unclear about Cloud Computing," *Forbes*, November 13, 2012, http://www.forbes.com/sites/thesba/2012/11/13/americans-still-unclear-about-cloud-computing/.

14 The idea of the computer utility and its impact on the emergence of cloud computing will be discussed in more detail in the "Commodification" section.

15 Eric Schmidt quoted in, Antonio Regalado, "Who Coined 'Cloud Computing'?," *MIT Technology Review, Business Impact* (October 2011): 27.

16 Regalado, "Who Coined 'Cloud Computing'?," 28.

17 Regalado, "Who Coined 'Cloud Computing'?," 27.

18 Peter Mell and Timothy Grance, *The NIST Definition of Cloud Computing* (Gaithersburg, MD: National Institute of Standards and Technology, Information Technology Laboratory, Computer Security Division, 2011): 1, http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

19 Mell and Grance, *The NIST Definition of Cloud Computing*, 2.

20 Bratton, *The Stack*, 115-116.

21 Bratton, *The Stack*, 116.

22 Orit Halpern, “Cloudy Architectures,” *Continent* 4.3 (2015): 36, http://continentcontinent.cc/index.php/continent/article/view/205.

23 Halpern, “Cloudy Architectures,” 36.

24 Halpern, “Cloudy Architectures,” 40.

25 Hu, *A Prehistory of the Cloud*.

26 Mosco, *To the Cloud*.

27 Shannon Mattern, “Cloud and Field,” *Places* (August 2016), https://placesjournal.org/article/cloud-and-field/.

28 Mattern, “Cloud and Field.”

29 James Bridle, “Cloud History, Cloud Thinking,” Cloud Index, 2016, http://cloudindx.com/history/.

30 Bridle, “Cloud History, Cloud Thinking.”

31 George Dyson, *Turing’s Cathedral: The Origins of the Digital Universe* (New York: Pantheon Books, 2012), 303-314.

32 Bratton, *The Stack*, 110.

33 Bridle, “Cloud History, Cloud Thinking.”

RE-PRESENT-ATIONS

This section will trace the role that narratives and representations have had in creating an ideological basis for the sociotechnical construction of the cloud as a global organizational model. Hence, this section goes beyond the technical definitions of the cloud—which have for the most part articulated the cloud as a technological phenomenon—to instead express it as a sociotechnical construction. The cloud, following the definitive efforts of the previous section, will be imagined as a global assembly of various media, infrastructure, and ideologies that operate at multiple scales (from minerals to planetary atmosphere), and through numerous actors (from the unassuming smartphone user constantly logging his or her location, to the multinational corporations managing the vast computer resources that lie at the heart of the cloud) to centralize and control the distribution of computing resources. In this view, the cloud is a global organizational model which operates through the collection, storage, distribution, and commodification of data.

Cloudy Images

In 2009 Kevin Kelly, one of the cofounders of WELL and the long time executive editor of Wired magazine, asked his followers on the web to draw their interpretation of the internet and to identify their home within it. Since then more that 220 submissions have been collected and uploaded to Kelly's Flickr page.[1] The submissions range from simplistic to highly-detailed representations of the internet from people of varying ages and occupations. However, a cross section of all submissions reveals the overwhelming abstract conceptions of the internet that dominate most of these maps. In fact, clouds or cloud-like forms are prevalent in the submitted drawings. What may explain this cloudy representation of the internet? What makes clouds the standard stand-in for the complex interwoven private and public networks of the internet?

A possible explanation could be found in the very meaning of the word "cloud"; Not so much the direct expression of condensed mass of water vapor, but more the metaphoric notion of cloud that is interested in opacity. Cloudiness is in general symptomatic of uncertainty, confusion, or lack of clarity. To cloud something (water, air, judgment) is to make it murky, unclear, and confused. As clouds, including fog, generally mean limited visibility (to the sky or of the road ahead), the cloud-like maps of the internet stand in for the uncertainty and the hidden complexity of the networks that underlie it. The internet is a highly complex network of computers, servers, cables, switches, and routers. And that's only some of its *physical* layer. This infrastructural complexity coupled with the ease and efficiency by which we access data through it has resulted in an opaque reading of the internet; a *blackboxing* of sorts. In other words, our understanding of the internet and its interworking has become cloudy, as opposed to clear or transparent. And as clouds are recurring natural phenomena that appear as only the visible forms of a set of natural processes and formations (for example precipitation, evaporation, climate, and topography), the ubiquity of access to information and the relative ease by which data is transmitted on the screen side of the internet belies the complex but hidden network forms and social relations that underlie its diffusion.

Clouds, of the water vapor type, are amorphous. They do not take on clearly defined shapes or forms. They are in a state of constant flux, changing shape and direction based on changes in temperature or wind. To represent a cloud is to abstract its amorphous nature, to freeze its continually changing form

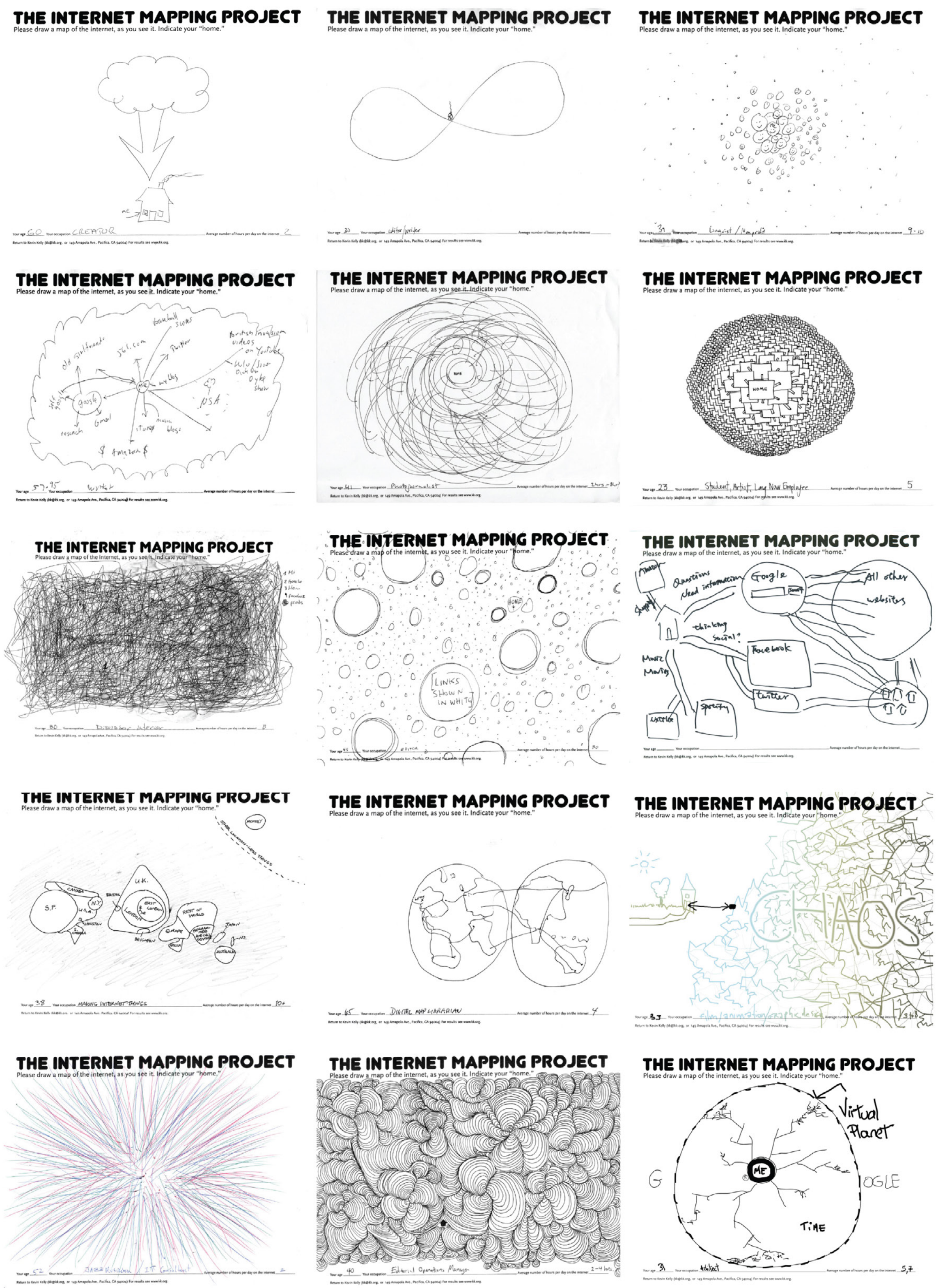


Figure 2.2: A sampling of maps submitted to Kevin Kelly's Flickr page.

in time and space, an abstraction which is necessary for its representation. However, this does not make clouds immune to representation. The challenge of classifying and systematically representing clouds was taken up at the beginning of the 19th century as western societies were swept by a "quantifying spirit." This quantification of the the most protean elements of the sky was not without oppositions. There were claims that the confinement of clouds into a "rigid order and classification" would damage their expressive potential.[2] But then again the shifting and amorphous characteristics of clouds and their disposition as natural phenomenon are somehow embedded in the abstract representations of the cloud atlases of the time. The phenomenon of the clouds moving and changing shape is natural to the human experience hence representations of clouds are still able to convey these shifting qualities. The same logic of abstraction seems to be at play in reference to the cloud of the digital kind. However, we can argue that in the case of the cloud the representational simplification tends to hide the complexities, the labor, the materiality, the waste, and the vulnerabilities that make up the global network of computing resources, and instead renders them as singular, virtual, flexible, and efficient.

Another possible explanation for the cloudy representation of the internet could be found in the technical network drawings of the 1970s when the cloud symbol was used to represent unspecifiable or unpredictable communication networks. Early examples of the use of the cloud graphic appear in the technical network drawings of the time that attempted to map the shifting physical conditions of communication networks as amorphous forms.[3] Articulating the genesis of the cloud as a symbol, Tung-Hui Hu suggests that the amorphous image of the cloud allowed an operational simplicity to the understanding and the performance of the network:

> "The cloud icon on a map allowed an administrator to situate a network he or she had direct knowledge of—the computers in his or her office, for example—within the same epistemic space as something that constantly fluctuates and is impossible to know: the amorphous admixture of the telephone network, cable network, and the Internet. While the thing that moves through the sky is in fact a formation of water vapor, water crystal, and aerosols, we call it a cloud to give a constantly shifting thing a simpler and more abstract form. Something similar happens in the digital world. While the system of computer resources is comprised of millions of hard drives, servers, routers, fiber-optic cables, and networks, we call it 'the cloud': a single, virtual, object."[4]

While the internet and the cloud are not synonymous, the cloud's logical base is built on the

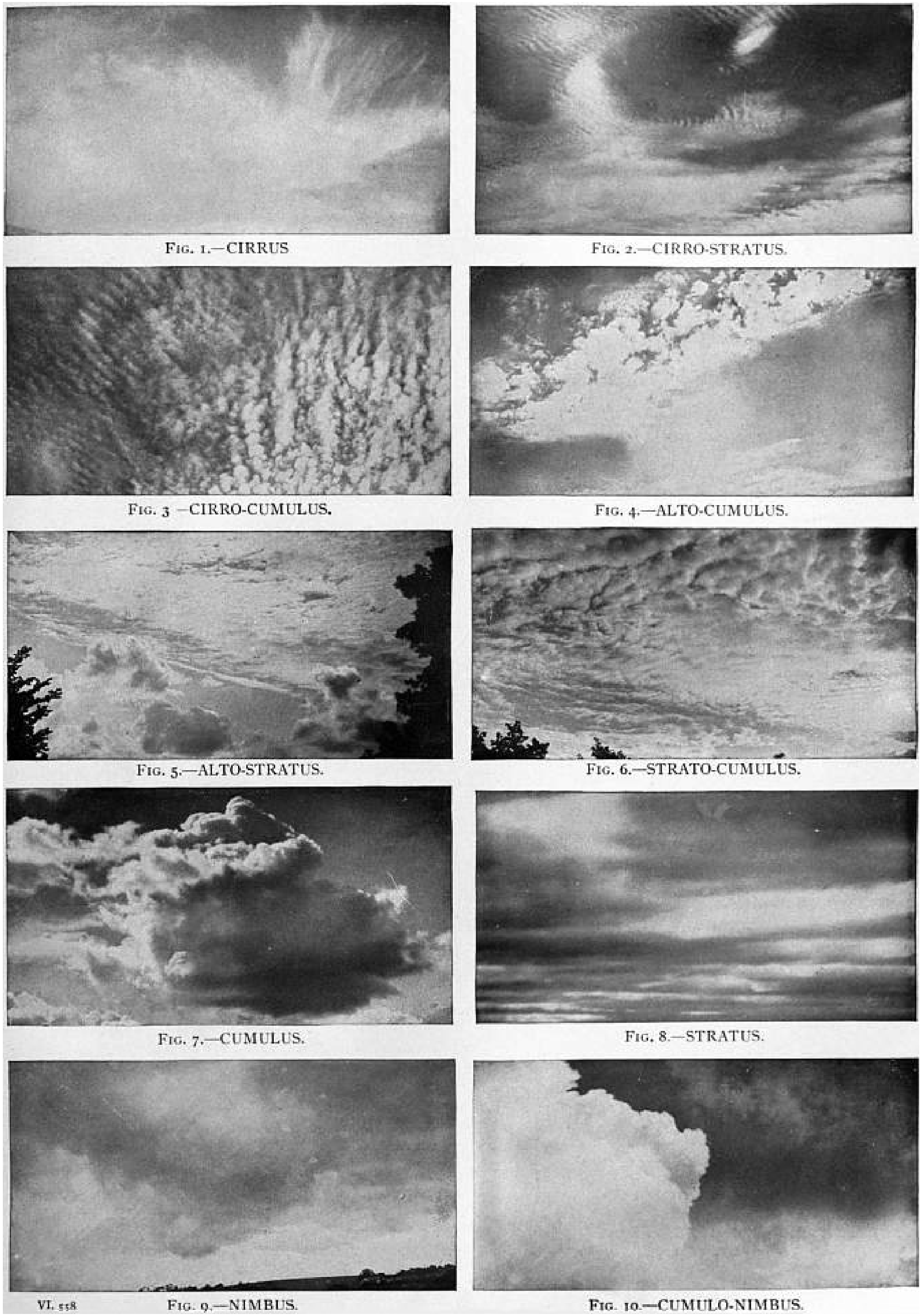


Figure 2.3: Illustrations of various cloud types from the 1911 Encyclopædia Britannica.

internet's distributary networks. Hence, it is likely that the cloud, as an emerging confluence of media, infrastructure, and ideology, would inherit the basic DNA of the internet. In this regard, the representational abstraction of complex networks and relationships, which is prevalent in global networks like the internet, runs parallel with the virtual and singular representations of the cloud. The singular vision of the cloud introduces a wholeness to the vast and uneven techno-industrial complex that forms the cloud and establishes its assumed stability and security. Virtualization, on the other hand, abstracts the availability of computing resources so that they can be shared among multiple users. Both ideas lie at the core of the contemporary representations of the cloud.

A Single, Virtual, Object

In the words of a leading expert in cloud computing, virtualization of computing resources "is a foundational element of cloud computing and helps deliver on the value of cloud computing."[5] But what does it entail? Virtualization can be understood as both a technical and a socio-cultural process, both of which have greatly influenced the contemporary understanding of the cloud. Technically, the process of virtualization generates an abstraction of computing resources with the aim of efficiently sharing them among multiple users. By so doing, it enables the cloud "to distribute, meter, and charge for these computing resources in highly granular and flexible ways while allowing for continuity with legacy software designs."[6] But the concept can also more generally be understood as "a technique for turning real things into logical objects," hence abstracting their relationship to a material base.[7] However it is defined, virtualization is not a new concept. In fact, virtualization, much like the cloud it enables, finds its origins in the time-sharing of mainframe computers in the 1960s. Time-sharing was an operational concept for sharing and extending the utilization of mainframe computers through virtualizing their processing power. Users were able to access the computing power of mainframes through off-site terminals which acted as input/output devices. In doing so, time-sharing forever altered the economics of computing. "By allowing more users to extract more usage out of the most expensive component of a computer (its processor), institutions were able to make the most out their (increasingly large) capital investments."[8]

With the emergence of personal computing at the end of the 20th century and the growing popularity of the internet, the economic case for centralized computing resources shifted towards providing hardware and software products for individual end-users. However, the growth of broadband communication networks and the increasing computing power required for performing highly complex tasks has enabled the reemergence of centralized computing resources as an economically viable solution for both individual and organizational users. Exacerbating the condition is the rapid growth of mobile computing which "has emerged in symbiotic relationship with the Cloud."[9] The limited processing power and storage capacities of most mobile devices as well as their limited energy resources means that portable devices such as smartphones or tablets must rely on the cloud for the provision of much of their computing resources. Essentially, today's mobile devices and even most personal computers (at varying extents) operate as terminals for accessing the virtualized computing resources that are increasingly centralized within a handful of cloud service providers.[10]

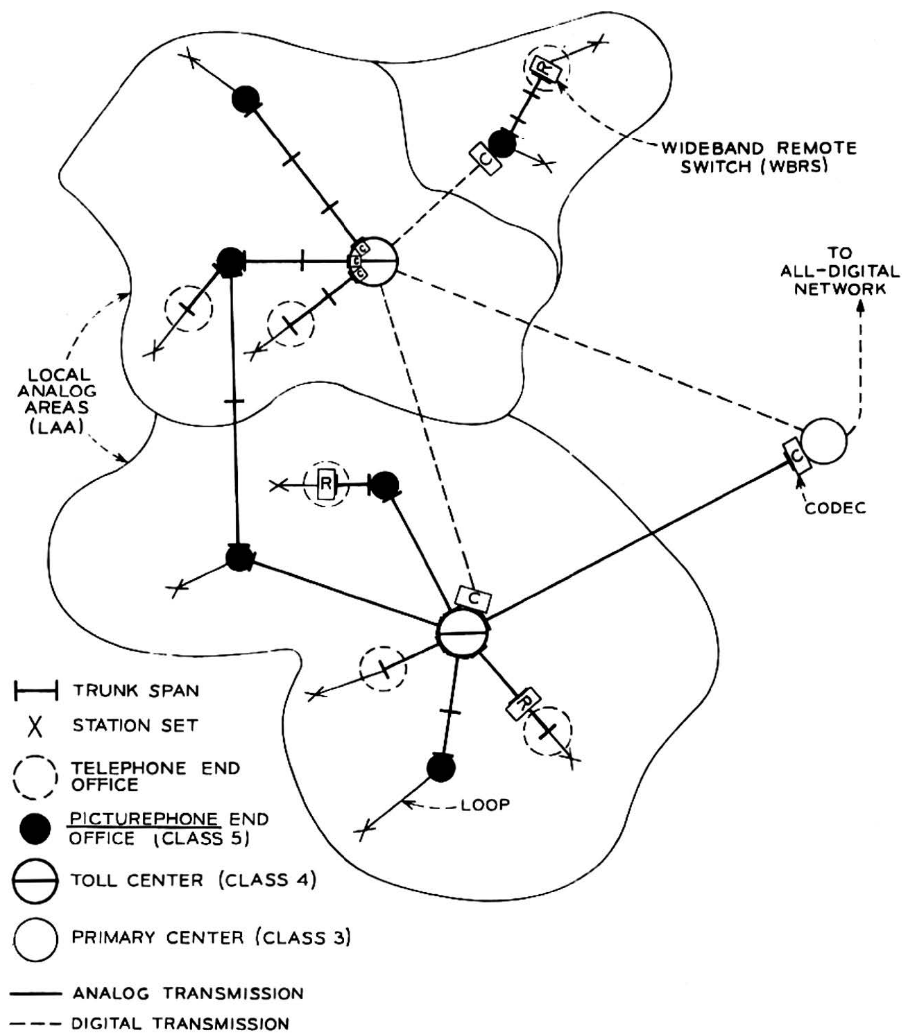


Figure 2.4: Illustrative local area configurations.

On the other hand, virtualization has also generated a wider discourse around the fluidity of economic, social, and cultural flows enabled by digital technologies. To the point that virtualization has now become the de facto representational condition of the digital age. Virtualization of money, communication, and space are only a few conditions that are symptomatic of the general reconfigurative effect virtualization has had on society. This condition persists in the use of the image of the cloud. The cloud icon represents the virtualization of the material basis upon which it is constructed: while it manages to capture the ease, the security, and the familiarity of the operations of the cloud, it concurrently blurs the actual effort, vulnerability, space, and infrastructure of its delivery, as well as the extended geography and the environmental degradation it entails. As Hu has articulated,

> "The word 'cloud' speaks to the way we imagine data in the virtual economy traveling instantaneously through the air or 'skyway'—here in California one moment, there in Japan the next. Yet this idea of a virtual economy also masks the slow movement of electronics that power the cloud's data centers, and the workers who must unload this equipment at the docks. It also covers up the Third World workers who invisibly moderate the websites and forums of Web 2.0, such as Facebook, to produce the clean, well-tended communities that Western consumers expect to find. By producing a seemingly instant, unmediated relationship between user and website, our imagination of a virtual 'cloud' displaces the infrastructure of labor within digital networks."[11]

In images of the cloud, labor, energy, wires, servers, capital, and even the users are all virtualized. In this regard, the image of effortless virtual manifestation of human activity engendered by the cloud has its roots in the ideologies of spatial transcendence associated with early imaginations of the internet, further intertwining the history of cloud computing with that of the internet. The internet as a system of delivery for the cloud has spurred a number of ideological myths that have remained fundamental to the contemporary representations of the cloud. While the cloud and the internet are not the same things, they are nonetheless linked together in the historical development of information and communication technologies. The myths of immateriality, effortlessness, freedom, democracy, and accessibility which have been instrumental in generating a certain image of the internet, continue to dominate the representations of the cloud. A process which is driven by the social imaginary associated with the virtualization of computing resources.

Virtualization, as both a technical process and a representational practice, has hence enabled the imagination of a parallel, more data-driven, spatial condition to that of "real" space. Global cloud computing aims to provide "no less than a computational mirror of the whole world, a global simulation that would augment its physical counterpart so as to make it more predictable and more amenable to manipulation."[12] What is blurred by virtualization is the inherent imbalance in the supply and demand of computing resources. Citing the inexhaustible demand for computing resources, Jean-François Blanchette has introduced the lens of "computational scarcity" as a productive alternative to the exceptionalism which is associated with digital technologies and the cloud. "The consequence", Blanchette claims, will be that "the rate of growth of digital data will in all likelihood continue to exceed the available material resources to manipulate, store, and move about this data for the foreseeable future."[13] Which will undoubtedly heighten the disparate accessibility to these resources for different groups, and will reconfigure the structure of power within the information economy towards a more centrally controlled organization that operates through the distribution of virtualized computing resources. Similarly, the physical limits of how much information can pass through fiber optics and other channels of communication may lead to the emergence of "new economies of bandwidth scarcity, prioritization, and pricing."[14] A condition which may ultimately mean that cloud providers will increasingly be inclined to construct their own networks.[15] The current trend for cloud providers is to bypass other actors and construct complete end-to-end networks which include browsers (software), devices (interfaces), fiber lines, and data centers, so that "information retrieval, composition, and analysis are consolidated and optimized on private loops."[16] Google is a case in point: the company's Chrome browser boasts a commanding 55% share of the browser market;[17] It has rolled out its fiber service in 8 cities with 4 more cities in the works; It has rapidly expanded its cloud services, and while it accounts for a small share of the global cloud market, relative to Amazon Web Services (AWS), it has had a growth rate of 108% and is among the top five cloud providers;[18] Google's Android mobile operating system dominates the smartphone OS market with over 80% share, and the company just introduced its Pixel phone, the company's most recent entry into devices.[19]

The virtualization of this uneven geography of information has, in turn, enabled the emergence of a singular vision for the cloud. The very term "the cloud" denotes that there is only one cloud, sweeping under the rug the multiplicities of network forms and the dynamically competitive world

Figure 2.5: Screenshots from a Google image search on “cloud computing,” which returns pages of abstract cloud forms and cartoonish cloud icons.

of cloud computing which boasts a large variety of actors, services, and user types. This singularity is also reflected in the images of the cloud. A Google image search for cloud computing returns an array of similarly shaped, abstract, cartoonish depictions of clouds, sometimes with wired or wireless connections to digital devices. The results reflect the dominance of the icon in all aspects of technological representation, from marketing images to network diagrams. It also portrays a general ambivalence in what the cloud actually is or what it does. It is only after persistent searching that we come across an image of a data center, or even one of communication wires. However, even these images are stylized versions of the actual complex network of wires, servers, and devices that make up the physical layer of cloud. The image of a singular cloud-form dominates representations of the cloud.

Since both enterprise and personal users of cloud services have come to expect a secure, light, effortless network environment, the complexities of the cloud which underlie its vulnerabilities, environmental and labor costs, and the risks associated with its use, must be neutralized. One way this is done is to construct a singular image of the cloud. A single object is finite; it can be secured; it can be controlled. The structure of an object is clear; it can be understood and communicated. An object can be mastered and naturalized, hence becoming a tool of advancement. An object can be fetishized, hence marketed and sold. Not all of these can be done if the cloud was represented as a complex, infinitely expandable collection of networks of varied devices, protocols, and connections. This singular vision of the cloud does not however only condense the multiplicities of its uneven geography, it also “reflects a universalist world view that tracked closely with American political ideals as they developed through the 1950s on: that the cloud would stand in for a ‘free’ Internet and liberal civil society.”[20]

In some ways the info-industrial complex has always relied on metaphors for marketing and popularization of its projects in the absence of clear technical or easily digestible representations. However, it is important to understand that the virtual and singular representations of the cloud are always infused by inherent politics of space that effectively extend the scope of information technologies beyond technological platforms and into the power structures and biopolitics that transpire through the hidden forms and logics of the cloud.

Notes

1 The drawings have continued to be collected on the page since March 2009. The most recent entry, at the time of writing, was April 2016. See "Internet Mapping Project," Kevin Kelly's Flickr page, March, 2009, https://www.flickr.com/photos/kevinkelly/sets/72157613562011932/.

2 Shannon Mattern, "Cloud and Field," *Places* (August 2016), https://placesjournal.org/article/cloud-and-field/.

3 Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge MA: The MIT Press, 2015), X.

4 Hu, *A Prehistory of the Cloud*, X.

5 Mike Adams, director of product marketing at VMware, quoted in: Sara Angeles, "Virtualization vs. Cloud Computing: What's the Difference?," *Business News Daily*, January 20, 2014, http://www.businessnewsdaily.com/5791-virtualization-vs-cloud-computing.html.

6 Jean-François Blanchette, "From Digital Exceptionalism to Computational Scarcity," *New Geographies* 7 (2015): 26.

7 Hu, *A Prehistory of the Cloud*, X.

8 Blanchette, "From Digital Exceptionalism to Computational Scarcity," 25.

9 Blanchette, "From Digital Exceptionalism to Computational Scarcity," 25.

10 The "Mines" section of this dissertation further expands on the role mobile computing devices play in expanding the footprint and agency of the cloud.

11 Hu, *A Prehistory of the Cloud*, XII.

12 Blanchette, "From Digital Exceptionalism to Computational Scarcity," 26.

13 Blanchette, "From Digital Exceptionalism to Computational Scarcity," 26.

14 Benjamin Bratton, *The Stack: On Software and Sovereignty* (Cambridge, Massachusetts; London, England: The MIT Press, 2015), 117.

15 More on the cloud providers' foray into network construction in the "Pipes" section.

16 Bratton, *The Stack*, 118. The end-to-end ecosystem of the cloud will be unpacked in much more depth in the Ground chapter of this dissertation.

17 "Desktop Browser Market Share," NetApplications.com, October 2016, https://www.netmarketshare.com/browser-market-share.aspx.

18 "AWS Remains Dominant Despite Microsoft and Google Growth Surges," Synergy Research Group, February 3, 2016, https://www.srgresearch.com/articles/aws-remains-dominant-despite-microsoft-and-google-growth-surges.

19 "Smartphone OS Market Share, 2016 Q2," International Data Corporation (IDC), 2016, http://www.idc.com/prodserv/smartphone-os-market-share.jsp.

20 Hu, *A Prehistory of the Cloud*, XXI.

CORPORAT -IZATION

This part maps the actors involved in the construction of the cloud and their expansionist territorial strategies. While painted in a different revolutionary light, these corporations still operate within the logics of capitalism, which contrary to their underlying ideologies, grounds them in both space and time. Within this context, emerging concepts of "platform capitalism" and "surveillance capitalism" will be useful in critically engaging with these corporate strategies and the actors involved. Here, cloud platforms will be articulated as extractive practices that operate on data as a raw resource.

Surveillance Capitalism

Even as we have begun to articulate the emergence of a new informational condition—that of big data—we still have not clearly defined its relationship to the social and economic logics that have emerged in the wake of rapid developments in information and communication technologies after the popularization of the internet. According to Shoshana Zuboff, instead of defining big data as a consequence of technological change, or as technology itself, we must understand it as the constitutive component in “a deeply intentional and highly consequential new logic of accumulation” which she has called “surveillance capitalism.”[1] For Zuboff surveillance capitalism is an emerging market form which operates through the collection, analysis, processing, storage, and reselling of data to produce “a radically disembedded and extractive variant of information capitalism.”[2]

Data extractive corporations like Google operate through a “formal indifference” which values the quantity of data over quality. The more data their users generate the better their predictive capabilities will become. Hence, it does not matter what their users actually do or say, as long as they do or say it in a way that can be captured and transformed into data. In Google’s case, the data is then aggregated, analyzed, and sold to advertisers who are the actual customers of Google’s extractive services. Extraction is a key concept here for two reasons. First, extraction implies a one-way process through which the daily activities and intimate subjectivities of populations are translated into objectified data that is then aggregated and sold. Second, this extractive logic tends to erase the structural reciprocities that have historically existed between firms and their populations, as the user is no longer the costumer in the cloud. Furthermore, these extractive processes represent a break with the past logics of capitalist accumulation—mass-production corporate capitalism or financial capitalism, for example—and have formed the basic components of surveillance capitalism as a new market form and the default business model for most cloud providers and startups.[3]

Consequently, the data extractive market form of surveillance capitalism has begun to transform the dominant power relations and regulatory systems within contemporary information society. For Zuboff the emergence of the new market form of surveillance capitalism is accompanied by “a new universal architecture existing somewhere between nature and God,” what she names *Big Other*. However, I would like to argue that, despite some slight semantic differences, Zuboff’s invocation of the concept of Big Other bears striking similarities, both aesthetically and conceptually, to the notion of the cloud as defined in this dissertation. Zuboff goes on to define Big Other as "a ubiquitous networked institutional regime that records, modifies, and commodifies everyday experience from toasters to bodies, communication to thought, all with a view to establishing new pathways to monetization and profit."[4] That seems to map directly onto the definition of the cloud within this dissertation, as a global organizational model constructed from the amalgamation of ideologically driven techno-solutionism and material stockpiling of computing resources that ultimately concentrate, and in turn territorialize, the means of production and power within an information society in the hand of a few data-driven firms. Hence, the cloud and Big Other can be viewed as conceptually, aesthetically, and economically interchangeable. My reading of Zuboff's concept of Big Other has been conditioned by this proposed interchangeability. Hence, when she declares that "unlike the centralized power of mass society, there is no escape from Big Other," the cloud can as easily be substituted for Big Other. There is no escape from the cloud. It has generated through its global, yet hidden, form, a simultaneously concentrated and distributed form of power that "can no longer be summarized by that totalitarian symbol of centralized command and control," like Big Brother, or even the panopticon.[5]

Through its distributed mechanisms of power the cloud demands a certain level of conformity—a buying-in, an opting-in, or registration—from its users, that in turn regulates their behavior based on the protocols coded into the logic of the cloud. Users sign in with their Google account to be granted access to the company's free services, knowing fully well that their actions and activities are tracked and mined for data. So, they adjust their online activity accordingly. To save a few dollars on auto insurance drivers submit to a tracking program that tracks their speed and driving habits to ensure safe driving behavior. Zuboff has captured this submission of behavioral control eloquently:

> "If power was once identified with the ownership of the means of production, it is now identified with ownership of the means of behavioral modification… The result is that human persons are reduced to a mere animal condition, bent to serve the new laws of capital imposed on all behavior through an implacable feed of ubiquitous fact-based real-time records of all things and creatures. Hannah Arendt treated these themes decades ago with remarkable insight as she lamented the devolution of our conception of 'thought' to something that is accomplished by a 'brain' and is therefore transferable to 'electronic instruments'."[6]

The instrumentalization of thought and behavioral control through the globally expansive apparatus of the cloud, with its demand for conformity and platform lock-ins, is among the most important aspects of the sociotechnical construction of the cloud. However, the lack of regulatory means to control the cloud's expansionist march have also been key contributors to its rapid global dominance. Cloud companies often operate within a milieu that lacks any sort of meaningful public oversight. In fact, technology companies, like many other corporations before them, actively lobby for limiting regulations and legal burdens. Google spends millions of dollars every year lobbying in Washington D.C. and is on track to become the top corporate lobbying spender in the U.S. for this year.[7]

For cloud companies like Google rapid roll out of new initiatives is not solely a market play. These corporations actively use speed and muddy regulatory environments as expansionist strategies to stake new territories. Zuboff has articulated Google's *modus operandi* as "incursion into undefended private territory until resistance is encountered." Having followed multiple court cases and formal complaints against Google, Zuboff concludes that the company "simply takes what it wants. Google then exhausts its adversaries in court or eventually agrees to pay fines that represent a negligible investment for a significant return."[8] This is a process which the cultural historian and media scholar Siva Vaidhyanathan has called "infrastructural imperialism."[9]

Platform Capitalism

With their domination over data, businesses like Google have come to provide the basis of operation for other sectors and businesses. In doing so they have instigated the emergence of a new model of capitalist corporate entity organized around data: the platform. Nick Srnicek argues that in the 21st century advanced capitalism has been reoriented toward the extraction, management, and operationalization of a new raw material, namely data.[10] Instead of existing outside of capitalism, platform firms (like Google, Amazon, Apple, and Microsoft) have reoriented capitalism towards digital data. While platforms often emerge from internal needs of handling data, they quickly become an "efficient way to monopolise, extract, analyse, and use the increasingly large amounts of data" that are generated and collected.[11] While platforms seem to be different from traditional capitalist economies they still operate within capitalist parameters. So even though they are "asset- and employee-light, low on liability and high on upside," platforms "aspire to monopoly, often unapologetically, and have been instrumental in rehabilitating the concept."[12]

In *The Stack* (2015), Benjamin Bratton analyses the power and function of platforms beyond only economic agencies. For him platforms bring together technologies, sociopolitical processes, and aesthetics into "temporary higher-order aggregations," that ultimately add value to both the platform itself and its constitutive parts. In their simultaneous capacity as "organizational forms that are highly technical, and technical forms that provide extraordinary organizational complexity to emerge," platforms "take on a powerful institutional role, solidifying economies and cultures in their image over time."[13] In their basic role as technical infrastructures, societal armatures, and organizational forms, platforms prepare the ground for actions, and hence prompt conformity to their rules, limits, and politics. Platforms are at once, and inherently, concentrative and expansive.

> "Platforms centralize and decentralize at once, drawing many actors into a common infrastructure. They distribute some forms of autonomy to the edges of its networks while also standardizing conditions of communications between them."[14]

And while economically platforms exude neoliberal values and operations, as sociocultural armatures their origin story lies as much within the experimentations of the Californian counterculture, the utopian megastructural experiments of 1960s architecture, "and many other systems of sociotechnical governance, both realized and imagined." So even if they do have a heavy economic footprint, platforms still "rely heavily on aesthetic expression and calibration. A platform's systems are composed of interfaces, protocols, visualizable data, and strategic renderings of geography, time, landscapes, and object fields."[15]

The cloud can be considered a platform. Or rather, the idea of the cloud is constructed of the intermingling of a number of platforms. But in essence the operations of the cloud and its growth is dependent upon data. By providing the basic infrastructure of data mediation in the digital economy, cloud platforms not only enable themselves to extract more data from user interactions (from individual users to organizations), but also increasingly control and govern the politics and rules of these interactions. Since every aspect of contemporary economy is imbued with digital data, ownership over the infrastructure of data mediation places the cloud in an exceptionally powerful position. As Srnicek has maintained, "far from being mere owners of information, these companies are becoming owners of the infrastructures of society."[16] A condition that in turn centralizes the profits, power, and territorial agencies that the cloud generates.

From Exhaust to the Cloud

Whether it is surveillance or the platform, these modifiers to capitalist strategies have been successful partly due to the redefinition of the character of the data that Google, and other cloud companies, collect and operationalize. In a 2010 special report on Google, *The Economist* outlined the ways in which cloud companies profit from internet data. Speaking specifically about Google, the article details the various ways in which the company exploits the by-product data generated from millions of user interactions on the web. The article calls this "data exhaust."[17] While this may not be the first instance of the usage of data exhaust to refer to the digital footprint of web activity, it is conceptually and operationally significant. First, by not granting any value to digital footprints Google positions itself as a pioneering company that is generating value and profit out of nothing; Almost as an alchemist would do. Second, as Shoshana Zuboff has articulate, "once the data are redefined as waste material, their extraction and eventual monetization are less likely to be contested."[18] The extractive logic of the cloud and its global apparatus, operating in the regulatory vacuum of contemporary information economy, are key components of the emergence of surveillance and platform capitalism as a new market forms and modifiers for 21st century advanced capitalism.

While platform capitalism and surveillance capitalism each present a specific reading of the corporatization of data within an information economy, in the cloud both models are combined into a complex corporate system. However, the underlying resource for both models is data, and its collection, storage, processing, and distribution. The rule of the game is domination. By combining horizontal and vertical integration logics cloud companies like Google are positioning themselves to have a presence in all facets of daily life in which data is generated. From online activities captured through cookies and website tracking, to traffic and commuting patterns extracted from navigation tools like Google Maps, Google is in the data-mining business.[19] However, to dominate Google does not necessarily need to own the data. As long as it has exclusive access to data it can create economic value through predictive modelling or organizing and structuring that data and reselling it to advertisers and its other customers.

In this sense, data becomes a protean value generating entity without having inherent value itself. To extract value from data the cloud needs certain infrastructural footing. In the same vein as a utility company which is reliant on dams, power grids, and monitoring devices to generate value from electricity, Google's global data empire is also grounded in its infrastructural networks. However, as it will be shown in the Ground section of this dissertation, Google cloud's data mediation is not only limited to data centers or distribution networks. Increasingly the company is investing on devices, automobiles, and hardware that exponentially expand its extractive empire and extend it into the most personal facets of daily life. Google's Pixel line of phone and personal devices, its Waymo subsidiary which is in charge of the development of autonomous cars, Calico the company's biotech arm, all speak of a push for domination. What binds them together is the global apparatus of data and the organizational model of the cloud. The corporatization of data through the extractive apparatus of the cloud paves the way for its commodification within the larger society, which will be discussed in the next part.

Notes

1 Shoshana Zuboff, “Big other: surveillance capitalism and the prospects of an information civilization,” *Journal of Information Technology* 30 (2015): 75.

2 Zuboff, “Big other,” 81.

3 Zuboff, “Big other,” 80

4 Zuboff, “Big other,” 81

5 Zuboff, “Big other,” 82

6 Zuboff, “Big other,” 82

7 Jonathan Taplin, “Why is google Spending Record sums on Lobbying Washington,” *The Guardian*, July 30, 2017, https://www.theguardian.com/technology/2017/jul/30/google-silicon-valley-corporate-lobbying-washington-dc-politics.

8 Zuboff, “Big other,” 78

9 Siva Vaidhyanathan, *The Googlization of Everything* (Berkeley, CA: University of California Press, 2011).

10 Nick Srnicek, *Platform Capitalism* (Cambridge, UK: Polity Press, 2017), 39.

11 Srnicek, *Platform Capitalism*, 43.

12 John Herrman, “Platform Companies Are Becoming More Powerful – But What Exactly Do They Want?,” *The New York Times Magazine*, March 21, 2017, https://nyti.ms/2nvlSHm.

13 Benjamin Bratton, *The Stack: On Software and Sovereignty* (Cambridge, Massachusetts; London, England: The MIT Press, 2015), 41.

14 Bratton, *The Stack*, 46.

15 Bratton, *The Stack*, 46.

16 Srnicek, *Platform Capitalism*, 92.

17 “Special Report: Clicking for Gold,” *The Economist*, February 25, 2010, http://www.economist.com/node/15557431.

18 Zuboff, “Big other,” 79.

19 “Special Report: Clicking for Gold,” *The Economist*, February 25, 2010, http://www.economist.com/node/15557431.

COMMODI-FICATIONS

While the representation and corporatization of the cloud have been instrumental in its construction, the commodification of data as a resource and the fetishization of the computer utility through progressive ideology, language, and marketing have been equally fundamental. In parallel, emerging paradigms of "smart" urbanism have created a new market for the operations of the cloud within cities. The cloud's move into the city represents the ultimate commodification of urbanization. Collection, processing, and reselling of data generated about everything, from individual human activities to the flow of water and electricity, mediated through the apparatus of the cloud, commodifies the very processes that make up urbanization and positions cities within the neoliberal territory of the cloud.

Marketing the Cloud

Vincent Mosco, who has been researching and writing about information and communication technologies for years, has articulated the marketing campaigns of the cloud as an important aspect of their material construction. For him the "materiality of the cloud is not limited to data centers, computers, software, applications, and data. It is also embodied in campaigns to remake the prosaic stuff of engineering into the compelling aesthetic of the cloud."[1] In this regard the representations of the cloud are constructed and articulated through "the labor of those who design, build, and operate it and by the language we use to describe and imagine it. More formally, technology results from the mutual constitution of objects, labor, and language."[2]

The language of the cloud is then promoted and popularized through a diversified field of activities that market and outline its use for individuals, governments, and corporations. This promotive field of actors and actions has a large role not only in generating the popular image of the cloud, but also, and perhaps more importantly, in supporting the technological hype around cloud computing. In essence, the marketing power behind the cloud forms "the bedrock of seemingly unchallengeable beliefs that influence not only how we think about cloud computing, but about technology in general and our relationship to it."[3] So although the cloud represents a radical shift in power dynamics of global computing through the centralization of computing resources, the spin machine spits out an image of the cloud that is smooth, effortless, and secure. The wrinkles of economic risk, data security, information privacy, system reliability, data ownership, and other concerns that are raised by the cloud model are effectively ironed out by the global info-industrial complex and its massive marketing machine. A machine that includes conventional ads aimed at individual and business users; blogs; private think-tank and consulting firms like Deloitte, Forrester, and Gartner; global research organizations like the World Economic Forum (WEF); trade shows and expos; and a growing political lobbying effort.[4]

Computer Utility

But can we map a trajectory of the commodification of the cloud that moves beyond its present promotive machine? Where does this machine find its precedent? What constitutive agencies may we trace within the historical development of cloud computing?

One possible clue may be found in the dramatic shift in the overall conception of computing in the 1950s and 60s. The growth of cybernetics after the Second World War and the study of information processing and communication systems brought about a general shift towards thinking of information as a resource, not unlike water or power. With this shifting conception came ideas about an information utility. The rapid development of computing technology after WWII supported the emergence of a new industry based on the sharing of computing resources which at the time were very expensive and limited. Among many contributions to this emerging field, the work of MIT's Project MAC in the early 1960s was very influential. Building on John McCarthy's work on interactive time-sharing, Project MAC was instrumental in developing early technology for the advancement of time-sharing, which itself became the foundation of the idea of a computer or information utility.[5] These early conceptions were built on the availability and reliability of the computer system in processing multiple computing tasks at the same time. But the underlying principle was, at least in the beginning, for computing to "someday be organized as a public utility just as the telephone system is a public utility.... The computer utility could become the basis of a new and important industry."[6] What we see then is an early attempt at the industrialization of information and computing resources. A condition with would evolve into the cloud as its ultimate model.

By mid-1960s the idea of a computer utility, and its viability, was shared by both practitioners and scholars alike and exerted a larger sphere of influence. In an essay titled "The Computers of Tomorrow" published in 1964 for The Atlantic, Martin Greenberger outlined the potential usefulness of an information utility for a variety of fields from banking to insurance. For him the information processing service provided by computing had "a kind of universality and generality not unlike that afforded by electric power."[7] Greenberger was less concerned with whether the information utility would become a reality, as it was already on its way. For him, the most important concern was "the legal matter of government regulation. Will the information utility be a public utility, or will it be privately owned and operated?"[8] Citing high initial capital cost of computing equipment, massive communication networks necessary for the delivery of the information utility, and the "possibility of programming waste from having too many entries in the field," Greenberger saw the balance tipped towards a regulated public monopoly. However, he also viewed "the stimulating effect of free enterprise and competition" as a foundational prerequisite for the establishment of an information utility. This would alone be a convincing reason for the private model. And yet whichever model would be adopted, it was clear for Greenberger that the information utility would be dominated by very few players, foreshadowing the centralization of computing resources by the cloud. In his own words, "whichever way the balance tips, it is clear that information utilities will be enterprises of considerable size. If they form an industry of private companies, then the industry probably will be dominated by one or two firms of giant proportions."[9]

In 1966 these ideas were formalized in Douglas Parkhill's influential book *The Challenge of the Computer Utility*. In the book Parkhill outlined five key characteristics of a computer or information utility: First, the system must allow for the simultaneous accessibility and use to many remote users. Second, an information utility must be capable of running a number of different applications or programs simultaneously. Third, the remote stations that connect to the central computing resource should have the same range of computational capabilities as the user would expect from a private computer. Fourth, pricing would be based on a flat service charge and a variable charge per usage.

Figure 2.6: Cover of Douglas Parkhill's *The Challenge of the Computer Utility* (1966).

And fifth, the system must have the capacity for infinite growth, allowing for unlimited expandability as customer load increases.[10] The similarities between Parkhill's characteristics and NIST's "essential characteristics" of cloud computing are quite striking.[11] Out of five NIST characteristics of cloud computing four explicitly find their precedents in Parkhill's characteristics of computer utility. "Broad network access" may translate to the accessibility of an information utility for many users simultaneously. "Resource Pooling" relates to the concurrent running of multiple applications and programs by different users on centralized computing resources. "Rapid elasticity" is essentially describing the infinite and on-demand expandability of the system. And "Measured service" sets the ground for fixed and variable pricing structure of the services being utilized. While information and communication technologies have advanced much beyond the technology available in 1960s, it is enlightening to see the reemergence of the fifty-year-old ideas of information and computing utilities within the contemporary discourse on cloud computing. As Vincent Mosco has articulated, "we are now more likely to ask if a system is scalable rather than if it has the 'capacity for infinite growth,' but new terms should not mask the striking conceptual similarities."[12] The similarities map an alternative trajectory for the cloud. The socio-technical construction of the cloud is much more an evolutionary process, continually building on the technological and conceptual ideas of the past, than the dominant revolutionary representation of the cloud we are presented with today. The organization of the global apparatus of the cloud as a private utility dominated by a few massive corporations has paved the way for the commodification of the data that it manages.

Fetishizing Technology

Yet another aspect of the commodification of the cloud lies in the lengthy history of the fetishization of urban technologies and networks. Seeing technological networks as constitutive components of the urban, Erik Swyngedouw and Maria Kaika have analyzed the emergence of this fetishistic perceptions of urban technological networks. For them, "[t]he use value of networks dwells exactly in their capacity of and role in facilitating the process of socioenvironmental transformation and metabolization; the networks permit exactly the urbanization of nature and the fetishization of the commodities it carries."[13] While connection to urban technological networks suggests acquiring the use value mediated by the utility, it also implies taking part in the longstanding ideals of progress and technological advancement.

> "This belief lies at the heart of the fetishization of networks during early modernity and of their magnification to the point where they 'subsume and mystify the underlying relations of production.' They become abstractions, 'cease to be a product controlled by human beings', take a 'phantom like objectivity and lead their own lives.'"[14]

The abstracted condition of technological networks, their hidden forms and representations, manage to effectively obscure the means and relations of their production as well as the power dynamics that are instituted through them. In essence they become "autonomous embodiments" and "material supporters" of the ideologies of technological progress and human emancipation through technology. Early modernity saw the establishment of a "modern infrastructural ideal" in which development of and connection to massive urban networks of electricity, water, and communication automatically entailed a more democratic, egalitarian, and just society.[15]

As Kaika and Swyngedouw have articulated, during early modernity "[t]he fetish role of networks and the emphasis put on the new and the innovative masked the underlying relations of production and social power relations, which remained symptomatically the same."[16] So ideological social progress did not translate to actual progress. The society was still marred by immense social inequality and the exploitation of the means of production by those who exerted power through technological networks. The contradictions of capitalist modernization highlighted the maintenance of the very hierarchical power structures that technological progress and innovation were meant to overcome. The very presence of Infrastructural spaces of urban networks and their "cathedrals of progress" in the urban realm were now sore reminders of the failure of the emancipatory project of modernity. As a response urban networks moved underground, which further concealed and abstracted their relationship to both their extended generative landscapes and their productive power structures. However, high modernism's project of concealment—the aesthetic purifying of the urban realm from irrationality and the messiness of urban networks—which would be in full swing by 1930s, only exacerbated the fetishization of urban technology and their networks of delivery. By being out of sight and out of mind, utility networks now delivered their commodified contents as if by magic. The decontextualization of urban infrastructural networks in this manner was to some extent intensified through emerging practices of civil engineering and planning, whose emphasis on utility and efficiency stemmed from technological determinism and technocratic control of urban technological networks underlying the growing cities of the West.[17] Modernist planning especially would be a key ally for pushing technocratic agendas of social progress through infrastructural and technological development.[18]

By the 1990s a new techno-utopian ideology was in full effect; this time driven by rapid advancements in digital information and communication technologies. As Stephen Graham elaborates, the mystique which was attached to electronic (and later digital) communication technologies between 1960s and 1990s was such that “ICT-mediated shifts away from place and city-based lives were often uncritically assumed to automatically also involve shifts towards more democratic, egalitarian, decentralized and ecologically sensitive societies.”[19] Commentators from diverse fields as geography, business, philosophy, technology, and architecture rallied around the idea that the emerging instantaneous communication technologies and the digitization of media would entail a radical collapse of cities and the dominance of physical urban exchange.[20] In most of these visions, the tyranny of distance with all its frictions and messiness would be overcome by the smooth and democratic space of digital communication and its connective fabric.

Interestingly, these techno-utopian visions of progress achieved through technology persist to this day and are continually being internalized within cloud computing. Through explicit advertising or more implicit marketing techniques, cloud operators like Microsoft, Salesforce, Amazon, and Google project these techno-utopian ideologies onto public consciousness. The progressive and technologically mediated ideals of cloud computing are clearly at work in their advertisements. During the 2011 Super Bowl, arguably the most expensive timeslot for television advertisements, Salesforce presented its version of the cloud to the general public through two adverts that introduced its Chatter service. Cartoon versions of will.i.am and other members of the Black Eyed Peas rave about how the Salesforce cloud helps them connect and more effectively perform their tasks, which includes staying up to date about tour dates, “DJ gigs,” and “fly shoe designs.” The Salesforce cloud as presented by the “baby peas” is above all “private” and “safe,” which should alleviate any concerns that the audience might have about how their data is being stored and who can have access to them. In a second follow-up spot the Salesforce cloud creates work for the homeless, makes manufacturing more economically sustainable and more environmentally friendly, helps an overweight man lose weight, and solves political conflicts between the Republicans and the Democrats. All with the premise of “what we can do in 15 seconds.” So not only the cloud is capable of doing it all it is also quick.

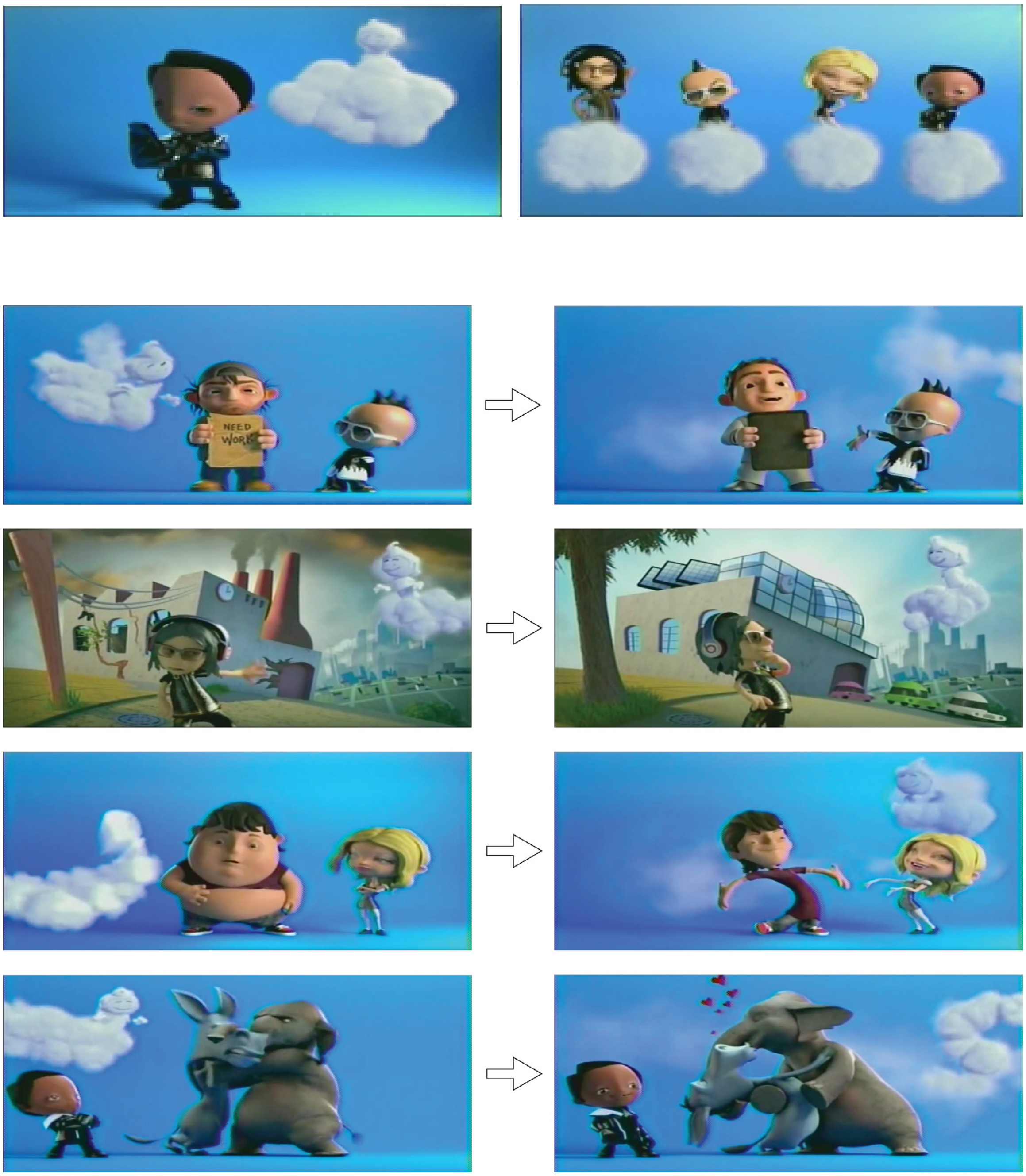


Figure 2.7: Stills from Salesforce.com's 2011 Super Bowl ads promoting its Chatter service.

Microsoft's cloud is equally capable. In an expansive marketing campaign with much more presence that the Salesforce Super Bowl spots, Microsoft presents its cloud as the basis for empowering business and social agencies to work more efficiently and quickly to solve global economic and social problems. Voiced by the socially conscious rapper Common, the ads tell us that "technology empowers us to achieve more. It pushes us to go further." Beginning during the 2015 Super Bowl, Microsoft's "empowerment" campaign has touched on the Special Olympics, emerging banking models in developing countries, cybersecurity and cybercrime investigation, social activism, and business management. In all instances the power of the cloud empowers individuals and organizations to be more effective and efficient.

As observed through these campaigns, the cloud is infused by similar technologically progressive ideology as the techno-utopian visions of the past, complete with the invisibility of the means and the generative landscape of its production. By hiding its sociotechnical construction, the cloud is automatically assumed to be agile, flexible, and available to everyone at all times.

While the socially and technically progressive and utilitarian visions of cloud computing, as well as its applicability and presumed wide societal need, place it within the same realm as other large utility networks such as water and electricity, there exists a major and critical difference: the cloud is becoming the de facto command and control model for all other utility. If information is thought of as a resource, it can be found everywhere; From water usage information on a public utility to traffic congestion data of a municipality. However, the extraction, processing, and storing of this information is performed by the cloud. Information is given its added value through the cloud. This marks a critical movement beyond the internet's capacity as the network of networks, and into understanding the cloud as the utility of utilities. In this sense the cloud becomes an operating system for the world. It has become not only the cognitive model for understanding the world at large, but also a way of acting on it through its organizational ordering of utilities and institutional agencies.

Urbanizing the Cloud

Increasingly the progressive and utilitarian vision of the cloud is finding alliances in cities and urban environments. As articulated in previous parts of this dissertation, an important aspect of the sociotechnical construction of the cloud are representations, images, and imaginations that

Figure 2.8: An illustration from a 2016 ad campaign on the Atlantic website promoting Microsoft Cloud to the building industry.

communicate and distribute its ideologies. These representations and narratives have increasingly taken on a more urban tone. So while ideas of effortlessness, sustainability, stability, and comfort are still very much at the core of these representations, increasingly they are being complemented by notions of dependence, social agency, and urban innovation, which position urban services as an important layer of the commodification of the cloud.

Advertisements are a massive part of this project of commodification. Microsoft for example has recently initiated a marketing and advertising campaign that is aimed at further expanding its cloud services into the urban field. The company's "sponsored content" on the Atlantic website are part of this campaign. In a graphically rich sponsored article, titled "Making Our Skylines Smarter," Microsoft pitches that the design and construction of skyscrapers that are "smarter, safer, and energy-efficient" is not only critical to the growth of cities but that it would be "virtually impossible" without the cloud.[21] The ad suggests that Microsoft's cloud will have a critical role in almost every aspect of skyscrapers, from design and construction to maintenance and performance-monitoring after construction. Seeing skyscrapers as the outcome of the world becoming more urban, Microsoft believes that they make huge demands on resources, time, energy, and data. But there is no need to panic because "the cloud is meeting each of those demands." The article was part of a larger campaign called "Made in the Cloud," that included stand-alone ads for the retail industry, banking, healthcare, and the automotive industry. In all cases the cloud is "revolutionizing our most vital industries and meeting the needs of the 21st century consumer."[22] In a follow-up campaign, "City in the Cloud," Microsoft's urban intentions are heightened and more directly articulated. The campaign posits that as cities grow the amount of data that they produce also grows. Organized as a website, the campaign outlines how the cloud "enables city agencies to improve the ways they serve and connect with their constituents."[23] A cartoony map of a city forms the background of a number of animated articles that explain how the cloud can improve the management of various aspects of the city, from water and transportation, to education, health care, and public safety. In all these articles various case-study initiatives (both public and private) use the power, stability, and flexibility of Microsoft's cloud to rollout, monitor, and manage the efficient distribution of city services and mediate their relationship to data.

Together these representations of the cloud's urban potential are expanding upon its technological

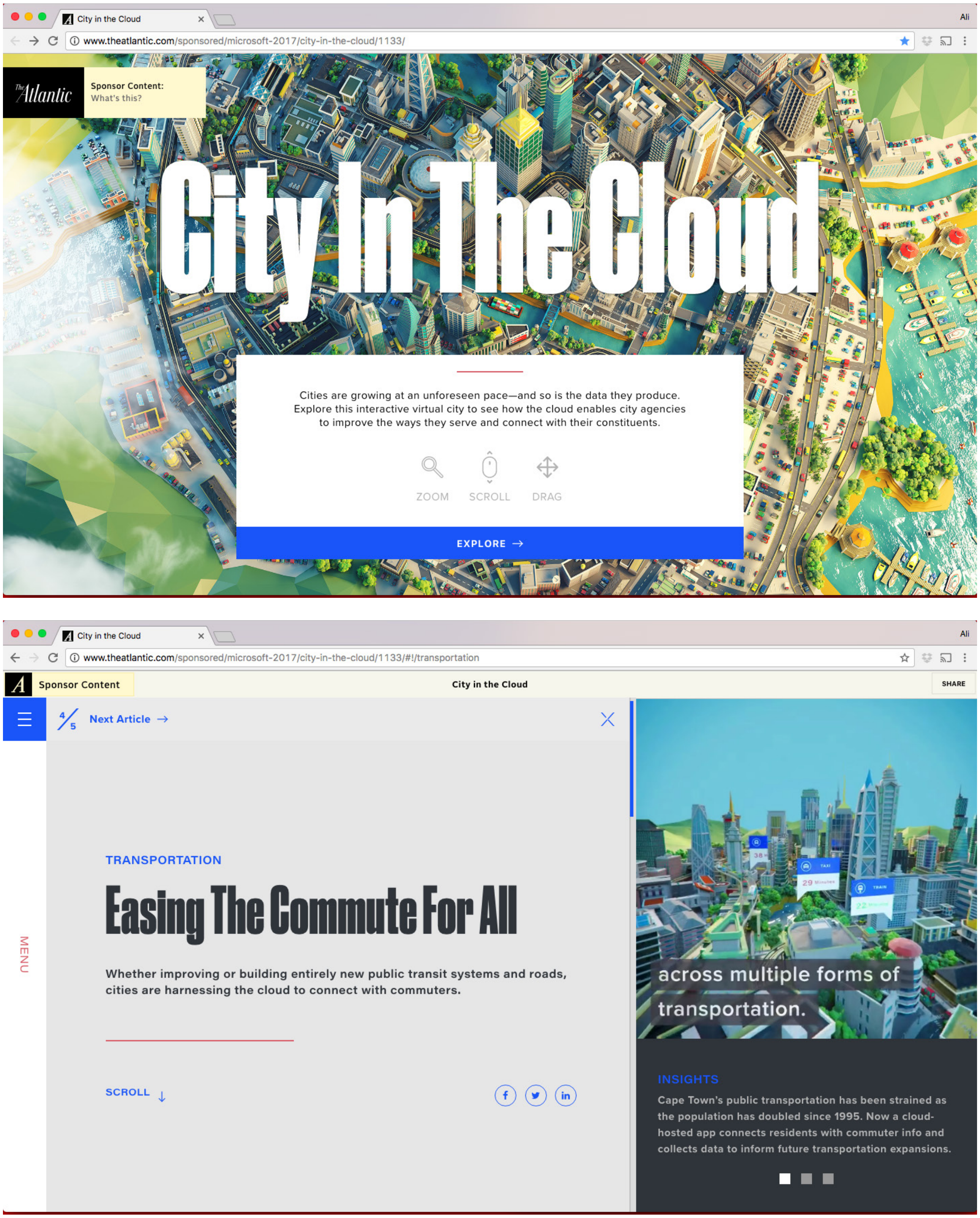


Figure 2.9: Screenshots from Microsoft Cloud's 2017 ad campaign on the Atlantic, titled "City in the Cloud." The ads were presented as a standalone website.

platform to market the cloud and its services towards a new market. What makes the cloud unique within the history of capitalistic extractives industries, is the re-emergence of the city, or agglomerations, as productive sites of value generation through data extraction, as opposed to the extraction sites of other resources outside the city. The cloud is naturally gravitated towards the city as the ultimate site of extraction and application of data. In the wake of the cloud's move to the city new urban management paradigms have emerged. Data mining and application of data platforms to urban management and planning have run parallel to the emergence of the city as a commodity, packaged through gathering, analysis, and application of urban data, largely driven by cloud platforms. Among these paradigms the notion of "smart" cities has found great traction globally and is worth briefly unpacking here.

To the City: Smart Urbanism

What is a smart city? While the hype surrounding the concept of the "smart city" has grown to a fever pitch, there is still plenty of ambiguity about the exact parameters of this "smart" turn in urbanism. In the face of increasing investment in urban intelligence and the growing smart city market, urban scholars have attempted to articulate the contours of this growing trend. The term "smart city" has gained massive traction not only in business and government circles, but increasingly within academia where the aims, projections, and processes of urban intelligence are hotly debated. But what makes the city "smart" in these technological visions of our urban future? Rob Kitchin, an expert in the field of urban intelligence and smart urbanism, has put forward a dual reading of the notion of a smart city. On the one hand, a smart city entails the integration of pervasive and ubiquitous computing and networked monitoring devices and sensors into built environments. On the other hand, a smart city can be understood in terms of its relationship to the development of a knowledge economy in which economy and governance are driven by "innovation, creativity and entrepreneurship, enacted by smart people."[24]

In his book, *Smart Cities* (2015), Anotine Picon has articulated the smart city as both an ideal and a process. As an ideal the smart city is a city in which the proliferation of digital tools entails the optimization of the efficiency, functioning, and sustainability of the city and enables a certain quality of life for its inhabitants. The role of fictions and narratives is important here. The ideologies of the smart city can be thought of as "self-fulfilling fictions," as they create desires that are to be fulfilled by technological innovation. As Picon suggests, the narratives of the smart city must be taken seriously:

> "They convey expectations and desires that constitute, more than in other domains, one of the driving forces behind innovation. Because it infiltrates everyday life and social relationships much more than traditional technologies have done, digital technology involves desire as well as the narratives that shape it. The latter dictate the direction it takes as well as the objectives that are assigned to it. In other words, the fictional universe that develops around and about digital technology possesses a strongly self-fulfilling character. In the case of the smart city, it allows in particular the adjustment of its two dimensions: the ideal, and the concrete process of transformation."[25]

The smart city is also a process through which urban environments are becoming more intelligent through the influence of a number of economic, technological, and social transformations and the actions of human and non-human actors who are increasingly entangled within complex technological interrelationships.[26] The new sensory capacities of urban environments mediated by digital tools and information and communication technologies enables a sentient reading of the city in which sensorial monitoring networks are complemented by sensations in creating a self awareness, a kind of embodied intelligence, for the city. For Picon, this emerging understanding of the city touches on a more fundamental shift in the conception of cities: the advent of urban intelligence is leading to a transition from the networked city to the event-city. In this conception events and occurrences play a more significant role in urban experiences and the management of cities. Picon suggests that,

> "while the networked city that progressively emerged with the industrial era accorded absolute priority to flow management, the latter often tends to fade into the background behind the perception of the dense web of events that take place in cities and the plan to control their evolution in order to construct ideal development scenarios. Flows themselves are more and more systematically perceived from the viewpoint of the events that give them rhythm or disrupt that rhythm."[27]

The growth of events and occurrences signals the growing importance of scenarios and narratives for the management of urban dynamics. Scenario planning is rapidly replacing master planning as the main form of large-scale engagement with cities. An important aspect of scenario planning is the generation of simulations and models which heavily rely on real-time data streams. Tech companies like IBM have effectively positioned themselves as the providers of the technological capacities of modeling and simulation which form a fundamental aspect of this scenario planning. Hence, the ascendance of tech companies within urban management and planning parallels the growing significance of data within every aspect of urban environments, and their management.

The role of data, its collection and analysis, is heightened as an essential aspect of any smart city initiative. Data streams in from sensors, RFID tags, chip readers, and increasingly in the most granular form, from smartphones, tablets, and personal devices that have pervaded our everyday activities. The massive data collection capabilities embedded in cities have at their core one goal: "the centralized capture of the soundings produced by all of a city's connected devices and the application of advanced analytic techniques to the enormous volume of data that results."[28] The ultimate aim of this city-scale apparatus of data collection and analysis is touted to be the optimization of the material and informational flows of the city, hence improving its management, and ameliorating the quality of life for its inhabitants. While this does not necessarily have negative connotations, the role that corporate interests play in the development and growth of data-driven and computerized management of urban environments presents a troubling trend. This brings us to another underlying ethos that connects the various understandings of the smart city: the inherent neoliberal tendencies that lie at the basis of these strategies. These tendencies tend to prioritize market-driven solutions and technological innovation for the development, management, and governance of urban environments.[29] These efforts are led by big tech companies like IBM, CISCO, Microsoft, Intel, and Google, who "on the one hand, are pushing for the adoption of their new technologies and services by cities and states and, on the other, are seeking deregulation, privatisation and more open economies that enable more efficient capital accumulation."[30]

Data is produced in massive quantities by urban activities. From tracking of personal devices and climatic sensors, to satellite imagery and heat sensing, structured and unstructured data streams through the fiber optic networks laid underneath cities and into the data centers of the cloud. The supercomputing apparatus of the cloud with its centralized power organizes the data collected and presents it in neatly categorized aggregations that are then algorithmically analyzed and fed back into the urban systems of decision making for a price. Cloud companies have begun to position themselves at various points along this cyclical process, from collection, storage, and analysis, to management, marketing, and distribution.

The City is Not a Computer

The turn towards smart urbanism is driven primarily by tech corporations and comes with a specific relationship with data that portrays it as objective and given. As others have commented recently, there is an inherent danger in this as it runs the risk of essentializing or depoliticizing data.[31] Smart urbanism decontextualizes the production, storage, and processing of data, which is as politicized and charged as any other action within the urban realm. The dependence of contemporary urbanism on data and the cloud's role as the dealer, banker, and distributer of this data runs the risk of in turn depoliticizing the very practice of urbanism. In the span of the past 40 years we have gone from defense intellectuals to tech entrepreneurs as agents of major change within the discourse of urbanism.[32] But can the technological, data-driven, and neoliberal basis of the cloud form an appropriate response to the issue facing urbanization?

Furthermore, the finite and "objective" images of cities conjured up through data-driven urbanism present an oversimplified representation of the aims, the means, and the processes that are involved in the complex practice of urbanism. The success that these metaphors have enjoyed is at least partly due to the fact that the technical solutions offered by the cloud for the social issues facing cities tend to capture the promise of social and political order over the complexity and disarray of urbanization.[33] These metaphors frame "the messiness of urban life as programmable and subject to rational order."[34] But in essence, this constructed sense of order is an oversimplification created through a visual language of colorful generalization and infantile explanation of the massive complexity of urban environments and their political, social, and environmental dynamics. The reality masked by this oversimplified image of the city is that the citizens and businesses of the smart city will be increasingly surrounded by networks and circuits of service that essentially create "bubbles of control." Rem Koolhaas's 2014 question from some of the leaders of the smart city movement still holds critical importance here: "Where is the possibility of transgression?"[35]

The metaphoric representation of "city as a computer" has the tendency of treating transgression as error. As a negative disruption that exists outside of the finite model of urbanization constructed through data sets. Therefore, any disobedience or transgression is abstracted as an externality and is controlled through the algorithmic apparatus of the cloud. As Shannon Mattern has eloquently articulated, “the metaphors give rise to technical models, which inform design processes, which in turn shape knowledges and politics, not to mention material cities.”[36] And the “smart cities” that the cloud generates will ultimately become a vehicle for its neoliberal and profit-driven aspirations, leading to the commodification of not only spaces, but behavioral patterns, politics, and relationships; everything that urbanization is built upon.

The operations of cloud companies are increasingly masked by the hidden form of the cloud itself, only discernable through disruptions, accidents and errors. This highlights the important role of transgression as a critical analytic tool for tracing the aims and logics of the Cloud. The next section highlights the importance of the hidden form of the cloud in its sociotechnical construction and will contextualize it within a long history of under-grounding urban infrastructures driven by ideals of progress and modernization.

Notes

1 Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder, Colorado; London, England: Paradigm Publishers, 2014), 77.

2 Mosco, *To the Cloud*, 78.

3 Mosco, *To the Cloud*, 5.

4 Mosco, *To the Cloud*, 77-122.

5 Simson L. Garfinkel, *Architects of the Information Society* (Cambridge, MA; London, UK: The MIT Press, 1999): 1-20.

6 John McCarthy speaking at the MIT Centennial in 1961, Quoted in Garfinkel, *Architects of the Information Society*, 1.

7 Martin Greenberger, "The Computers of Tomorrow," *The Atlantic*, May 1964, http://www.theatlantic.com/past/docs/unbound/flashbks/computer/greenbf.htm.

8 Greenberger, "The Computers of Tomorrow."

9 Greenberger, "The Computers of Tomorrow."

10 Douglas F. Parkhill, *The Challenge of the Computer Utility* (Reading, MA: Addison-Wesley Publishing Company, 1966), 51-52.

11 The National Institute of Standards and Technology (NIST) outlines five essential characteristics for cloud computing. These are:
"On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.
Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service." See, Peter Mell and Timothy Grance, *The NIST Definition of Cloud Computing* (Gaithersburg, MD: National Institute of Standards and Technology, Information Technology Laboratory, Computer Security Division, 2011): 2, http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

12 Mosco, *To the Cloud*, 21.

13 Erik Swyngedouw and Maria Kaika, "Fetishizing the Modern City: The Phantasmagoria of Urban Technological Networks," *International Journal of Urban and Regional Research* 24, no. 1 (2000): 124.

14 Swyngedouw and Kaika, "Fetishizing the Modern City," 124.

15 Stephen Graham and Simon Marvin, *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (London; New York: Routledge, 2001).

16 Swyngedouw and Kaika, "Fetishizing the Modern City," 130.

17 Pierre Bélanger, *Landscape as Infrastructure: A Base Primer* (New York: Routledge, 2016).

18 See, Marvin and Graham, *Splintering Urbanism*.

19 Stephen Graham, *The Cybercities Reader* (London; New York: Routledge, 2004), 8.

20 See for example: A. Pascal, "The Vanishing City," *Urban Studies* 24, (1987): 597-603; Bill Gates, *The Road Ahead* (New York: Viking, 1995); Frances Cairncross, *The Death of Distance: How the Communications Revolution Will Change our Lives* (Boston, MA: Harvard Business School Press, 1997); Paul Virilio, *Open Sky* (London; New York: Verso, 1997); Nicholas Negroponte, *Being Digital* (New York: Knopf, 1995); William J. Mitchell, *City of Bits: Space, Place, and the Infobahn* (Cambridge, MA: MIT Press, 1995); Martin Pawley, *Terminal Architecture*

(London: Reaktion Books, 1998).

21 “Making Our Skylines Smarter,” Microsoft, http://www.theatlantic.com/sponsored/microsoft-2016/making-our-skylines-smarter/870/.

22 “Made in the Cloud,” Microsoft, http://www.theatlantic.com/sponsored/microsoft-2016/.

23 “City in the Cloud,” Microsoft, http://www.theatlantic.com/sponsored/microsoft-2017/city-in-the-cloud/1133/.

24 Rob Kitchin, “The real-time city? Big data and smart urbanism,” *GeoJournal* 79 (2014): 1-14.

25 Antoine Picon, *Smart Cities: A Spatialized Intelligence* (Chichester, West Sussex: Wiley, 2015), 32.

26 Picon, *Smart Cities*, 29-30.

27 Picon, *Smart Cities*, 51.

28 Adam Greenfield, *Against the Smart City* (New York: Do Projects, 2013).

29 See: Kitchin, “The real-time city?” and Greenfield, *Against the Smart City*.

30 Kitchin, “The real-time city?,” 2.

31 Shannon Mattern, “A City Is Not a Computer,” *Places* (February 2017), https://placesjournal.org/article/a-city-is-not-a-computer/.

32 Jennifer S. Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore; London: The Johns Hopkins University Press, 2003).

33 Hannah Knox, “Cities and Organisation: The Information City and Urban Form,” *Culture and Organization* 16:3 (September 2010): 187-8.

34 Mattern, “A City Is Not a Computer.”

35 Rem Koolhaas, “My Thoughts on the Smart City,” *European Commission*, September 24, 2014, http://ec.europa.eu/archives/commission_2010-2014/kroes/en/content/my-thoughts-smart-city-rem-koolhaas.html.

36 Mattern, “A City Is Not a Computer.”

SHADOWS

The emancipatory ideology of the cloud is largely enabled by its hidden form. This section will contextualize this hidden form of the cloud within the 20th century ideals of progress driven by infrastructural development, as well as the undergrounding of technical infrastructure since early 20th century. The role of accidents, disruptions and errors in temporarily, but effectively, unearthing the material geography of the cloud will also be discussed. This part will essentially serve as a bridge between the Cloud and the Ground sections.

HIDDEN FORMS & ACCIDENTS

The server farms that house public and private data, the vast global network of fiber optic cables, the hundreds of millions of smartphones and gadgets that interface between data networks and the individual, all form a critical part of the territorial domination of the cloud. These material geographies often generate urban metabolic linkages to the so-called "grounded" infrastructures (water, electricity, transportation) that form the basis of their local spatial production. In the case of data centers, the quintessential building typology of the information age, access to inexpensive sources of energy is required to feed the power-hungry servers and equipment.[1] The availability of immediate sources of water is also essential, as the equipment needs to be kept cooled. The installation, expansion, and servicing of data centers require reliable access to transportation infrastructure. Local tax incentives and inexpensive land prices round out some of the basic prerequisites of tech company investment in a community. Physical geography, local politics, infrastructural accessibility, and location in relation to major markets of information consumption and production, each plays an essential role in where and when the cloud hits ground.

The process is inherently geographic, essentially linking the materiality of the cloud to the larger environmental systems and socio-political relationships that govern processes of energy generation, land use planning, water management, and capital production. However, this material geography and its underlying socio-political relations are often concealed by the buried conduits of global communication and the invisible electronic signals of information. Relegated to the underground and the atmosphere, tucked in the sleepy corners of the world, and secured behind concrete and defensive urban design, the "hidden form" of the cloud has to a large extent escaped our critical gaze. This section will contextualize the hidden form of the cloud within a long history of under-grounding urban infrastructures which has created an occult perception of the socio-political and material-spatial relationships that continually construct and are in turn enacted through the variegated spatiality and materiality of the cloud.

Hidden Forms

The process of under-grounding or blackboxing is not unique to the cloud and is symptomatic of other infrastructural networks. As Maria Kaika and Erik Swyngedouw suggest, urban infrastructure's move out of sight during the second half of the twentieth century greatly contributed to an occult reading of the social relations and power mechanisms coded in and manifested though these urban networks and the flows that run through their pipes, cables, conduits, and electronic signals.[2] However, the origins of the process go further back to at least the beginning of the 20th century, when a range of interconnected ideological, technological, and managerial ideals began to transform the nature of urbanization in the Western societies. Faced with a problematic urban condition at the turn of the new century, a modernist regime informed by rational and scientific planning principles and enabled by new technological advances in transportation, sanitation, and communication, took on the task of urban reform. As Simon Marvin and Stephen Graham have clearly articulated, notions of societal progress, ubiquity of access, and emancipation through technological development were to legitimize the growth of "single, integrated, and standardized" infrastructures of circulation (roads, water, waste, energy, and communication) between about 1850 to 1960.[3] In parallel, planning and civil engineering emerged as drivers of the rational and scientific expansion of the ideals of progress towards "unitary, coherent, emancipatory cities" through rational and comprehensive planning of infrastructural systems. The rise of planning and engineering—with their philosophical belief in

Figure 3.1: The old Stockholm Telephone Tower. The tower served as one of the main junctions in the telephone network of Stockholm in Sweden from 1887 to 1913. After decommission in 1913, the tower served as a local landmark until being torn down in 1953 as a result of a fire.

science, technology, and standardized infrastructure—coupled with the growth of a consumption society mediated through grids of power, water, transportation, and communication, eventually would lead to the development of what Graham and Marvin have called "the modern infrastructural ideal."[4] This "progressive" ideal was essentially built on four overlapping pillars: the strong ideological belief on the positive transformative power of technologies and modern science; expanding agency and growth of modern urban planning; the emergence of mass production and consumption in western societies between 1920 and 1960; and a state-supported shift towards regulated near-universal access to networked infrastructures.[5]

The hidden form of the cloud, and in fact the majority of urban technical systems, is rooted within this "modern infrastructural ideal." As Eric Swyngedou and Maria Kaika have clearly articulated, the infrastructural networks of modernity would take on fetishistic characteristics in early modernity. In addition to carrying the commodified flows of water or electricity, these networks and their infrastructural nodes "embodied the promise and the dream of a good society. The cathedrals of progress represented, displayed and celebrated the aestheticized dreams of tomorrow's utopia."[6] While Urban networks became 'urban fetishes' during early modernity, materially and culturally supporting the modern promise of progress, they would begin to disappear underground during high modernism as they failed to deliver on their promise of societal progress:

> "It became abundantly clear that, although the networks did deliver the promised material in the form of commodified goods, they somehow failed to deliver in their wake a better society. The fetish character of the networks and technological artefacts collapsed under the weight of unfulfilled promises."[7]

The urban monuments of the modernist infrastructural development, these symbolic and material shrines of progress, celebrated as glorious icons, carefully designed, ornamented, and prominently located in the city, started to lose their mobilizing powers during the twentieth century and began to disappear from the cityscape.

This going underground of infrastructural systems was especially true for communication networks of the time. As materiality is closely associated with presence and visibility, the move underground of urban technological networks constituted a divide between the urban imaginary associated with them and the tangible, costly, and heavily-contested politics of their development. For information and communication technologies this invisibility would become a defining factor as the infrastructures of delivery were increasingly privatized and separated from the marketed imaginary of these technologies, leading to a sort of blackboxing of the material footings of ICTs.

Technological Transcendence

This separation of the hardware and the software of communication technologies would reach its peak through the information age discourse of late 20th century, epitomized by Nicholas Negroponte's famous declaration about the general societal move "from atoms to bits" in his 1995 book *Being Digital*.[8] The book perfectly captured the prominent ideology of a society that was witnessing a general move towards the digital. Advances in digital communication technologies were believed to eventually replace much of the physical circulation in cities. Influential writers, academics, and the business community rallied around a notion of urban transcendence, the constructed belief that digital technologies were finally able to transcend space and time, to go beyond the physical restraints of urban landscape, in effect creating a frictionless space of interactions, commerce, and democratic agency. The mystique which was attached to digital communication technologies between the 1960s and 1990s was such that, as Stephen Graham has suggested, "ICT-mediated shifts away from place and city-based lives were often uncritically assumed to automatically also involve shifts towards more democratic, egalitarian, decentralized and ecologically sensitive societies."[9]

By the end of 20th century, as Antoine Picon suggests, a number of parallel theories had emerged within spatial disciplines regarding the impacts of digital technologies on the future of the city.[10] In response to the rapid growth of digital communication systems and information technologies, and having evolved from the spatial ideologies of cities and technology of 1960s, these theories implied, in some way or another, an end to the city as we know it. William Mitchell, for example, hypothesized that advances in digital communication networks and information technologies would eventually replace much of the physical circulation in cities. Advancing the longstanding concept of digital tools as extensions of human body, Mitchell believed that many of the urban exchanges would eventually become redundant by digital information and communication technologies.[11] Commentators from diverse fields as geography, business, philosophy, technology, and architecture rallied around the idea that the emerging instantaneous communication technologies and the digitization of media would entail a radical collapse of cities and the dominance of physical urban exchange.[12] The public rollout of the internet in 1996, itself growing out of the Defense Department's creation of the ARPANET in 1969, only exacerbated these claims.[13]

Since the late 1990s a number of scholars have attempted to address the complexity of the interaction between technology, society, and space. While acknowledging the transformative sociospatial processes brought on by new information technologies and communication networks, these scholars have gone beyond these "fantasies of transcendence" to articulate the frictions, complexities, and nuances that are embedded in the relationship between communication and space. Understanding space as socially produced, these scholars have been able to show that although some urban exchange has been replaced by digital communication technologies, processes of global metropolitanization and regionalization have granted a renewed importance to highly concentrated cities and their wider regional footprints as command and control nodes within the global networks of production, consumption, and logistics.[14] Through these discussions ICT-mediated urbanization is articulated as an uneven geography of urban polarity driven by underlying social and political relationships that continually mediate our perception of both urban spaces as well as information and communication technologies. These discussions effectively disrupt the spatial models of technological dispersal developed during the first three quarters of the 20th century. For instance, observing "the facilitative effects of the revolution in information and communication technologies" as one of the major forces driving the regional process of urbanization, Edward Soja identified a "filling in" of the decentralized urban forms and suburban developments of the metropolitan era, in effect expanding the concentrated form of urbanization to a regional scale.[15] Or, as Graham and Marvin have suggested, not only have cities not disappeared, but in fact they have grown; and the resulting urban spaces are highly fragmented and of unequal infrastructural development and accessibility.[16]

Even more recently, attempts from media studies have taken on the myths of immateriality of ICTs head-on, and have contextualized them within centuries of processes that continually ground these technologies within the spaces and materialities of everyday life.[17] In parallel, within urban studies, recent work has rearticulated global urbanization as a complex set of relational processes which not only inflict traditionally defined centers of agglomeration, like cities, but also the sites and geographies that have historically laid outside of the conception of the "urban."[18] The new analytical frameworks generated by these new lines of questioning have extended the critical gaze of urban research into the globally expanded operational landscapes of urbanization and the machinic info-industrial complex that lies beyond cities and digital screens.

The hidden form of the cloud obscures on one hand the labor and material cost of the construction of its planetary-scale computing apparatus, and on the other hand the extended geography of resources and processes that continually feed into and are affected by this construction. The lack of visibility of information and communication infrastructure in everyday life mediated through the marketing images of the cloud have in turn perpetuated the myths of immateriality and virtuality which have long plagued the discourse around digital technologies. The proliferation of mobile devices and embedded, even wearable, information technology only sustains and heightens these myths. What gets lost in the techno-hype is the reality that these devices cannot possibly contain the computing resources required for the processing of complex computational tasks and the storing of all the data generated. The power lies in the cloud, as it quietly hums in the background, enabling and mediating the interaction of these devices with its vast network of computing resources amassed by global corporations.

The Real Apple

By going beyond the screen, a new grounded understanding of the cloud emerges which questions the predominantly smooth images and progressive ideologies that surround the discourse of cloud computing. Take the case of Apple for example. The company was among the first corporations to embrace the cloud with its myCloud (later iCloud) and iTunes applications. Steve Jobs himself understood the significance of the cloud as early as 2008, and in 2011 announced that Apple would be "going to demote the PC and the Mac to be just a device and we are going to move the digital hub into the cloud."[19] Although the company's cloud services are mainly geared towards the individual user, the massive proliferation of its devices, the market share they command, and the popularity of their brand makes them a major player in the cloud.

Apple's cloud boasts data centers in Oregon, North Carolina, California, and Nevada. And that is only its North American data centers.[20] Its facilities in Reno are being built based on 25,000-square-foot modules, which the company calls "data clusters." So far it has built two data clusters with

Figure 3.2: Apple's Reno Datecenter in 2015.

another two under construction and four more in planning, bringing its planned Reno total to 200,000 square feet of data center space, or 3.5 football fields.[21] Apple has 345 acres of expansion space in Reno and it shows no sign of slowing down. In the words of a local senior planner, "[t]hey just keep plugging along… Apple keeps submitting plans… and it looks like they'll be expanding for a long time."[22] To accommodate its expansion in Reno, Apple has negotiated $89 million in tax incentives over 10 years, which include $73 million in tax breaks from the City of Reno for its purchase of data center equipment.[23]

On the European front, Apple is building two new data centers in Ireland and Denmark which will become operational in 2017. The two data centers will cost close to $1.9 billion dollars, will have 1.8 million square feet of space, and will power Apple's online services such as the iTunes and App store, iMessage, Maps, and Siri.[24] These developments only highlight a fraction of the company's cloud footprint. The more the company's presence in the world market grows, the more it will have to expand its cloud facilities to keep up with the computing needs of its devices. And more datacenters mean more energy, and more demand on the environment and space. By going beyond the devices that mediate our access to the cloud, this mode of inquiry maps an extended geography of the cloud

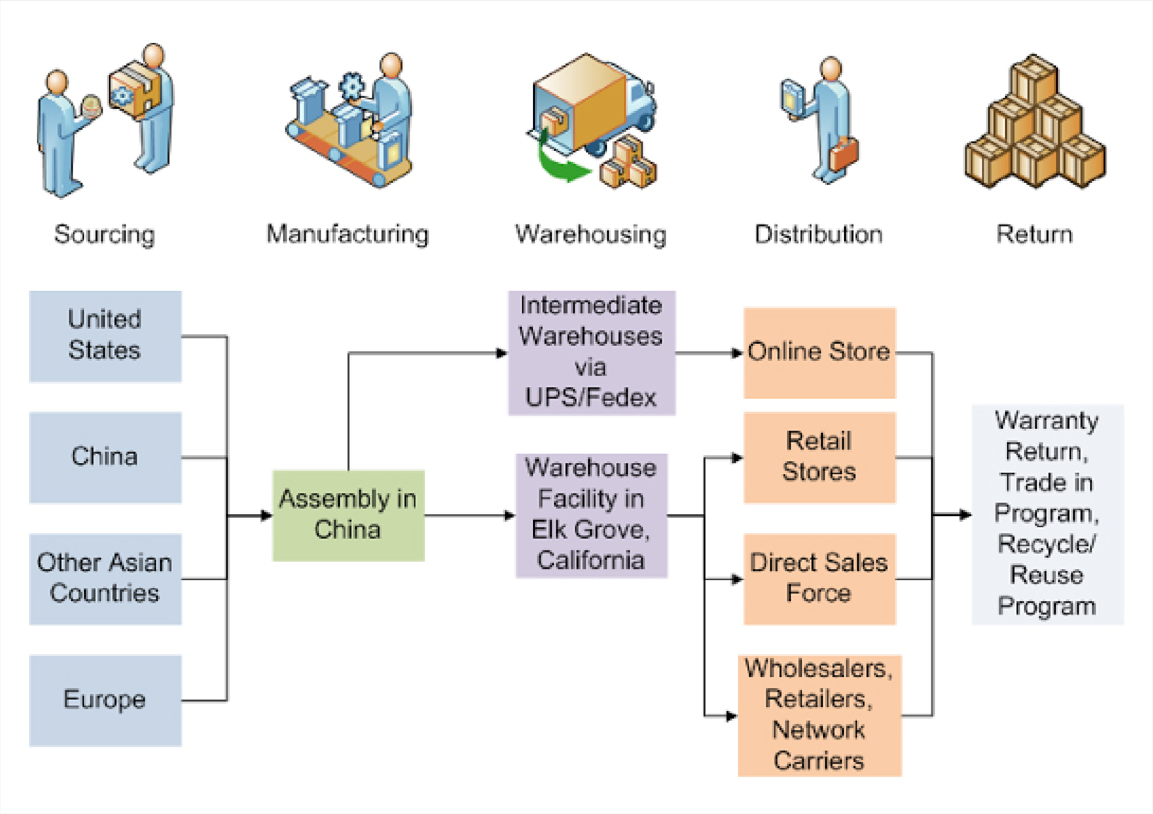


Figure 3.3: Apple's iPhone supply chain network. The diagram hints at the globally extended geography that lies beyond the screens of Apple iPhones, and which remains hidden to the cloud consumer.

that tends to remain hidden behind the screen. That is until something goes wrong.

Accidents, Errors, Disruptions

The tendency of the cloud to remain out of sight is only interrupted by accidents, disruptions, or systematic failures, which bring it back into the scope of our spatial consciousness. Disruptions do not only make the hidden form of the cloud visible, they also contribute to the continual regeneration of infrastructural networks and expose how they regulate the livelihoods of those dependent upon them.[25] The bursting of the dot-com bubble, the many cables cuts in the middle of oceans, damage to satellites from debris, loss-of-signal messages, disruption of essential regional and national communication networks from terrorist attacks, winter storms, earthquakes, or floods, are all examples of the sudden re-materialization of the cloud through disruptions. These moments destabilize the dominant representations of the cloud's stability by providing fleeting glances at its underbelly and the politics of its construction.

A prime example of this disruptive unearthing of the cloud was the leaking of the documents related to the National Security Agency's (NSA) PRISM program by Edward Snowden. The documents highlighted the expanse of NSA's surveillance activities and data gathering practices mediated through a direct relationship with some of the major cloud companies such as Microsoft, Google, Facebook, and Apple.[26] The leaks highlighted not only the extensive reach of the cloud with regards to personal user data, but also the territorial politics of ownership and access which were mediated through a close collaboration between the U.S. government and global data corporations. Such events problematize the near-instantaneous interactions of the user with the cloud which tend to infuse devices such as tablets and smartphones with "seemingly cosmic omnipotence," that occult their dependence on the centralized resources of the cloud. "[A]s if the computation and all the data it is based on were happening in the palm of [the user's] hand."[27] Instead, the extended geography of the cloud starts to generate an interwoven and uneven planetary-scale network of materials, processes, and practices that are imbued with power dynamics and control mechanisms that feed back into the sociotechnical construction of the cloud.

The sites where the cloud's apparatus is grounded are an important layer of its sociotechnical construction. However, as Tung-Hui Hu has cleverly articulated, the cloud represents an interesting paradox, "you can never see it by looking directly at it… Analyzing the cloud requires standing at a middle distance from it, mindful of but not wholly immersed in either its virtuality or its materiality."[28] It is only when the material geographies of the cloud are contextualized within the socio-political dynamics of their sites of manifestation that a comprehensive map of its hidden form emerges. The next part examines some of the major sites of the cloud's geography and will discuss the social, political, and environmental dynamics which have contributed to the territorial expansion of the cloud as a global organizational model.

Notes

1 A recently published report by Greenpeace estimates that a single data center can consume the equivalent amount electricity as nearly 180,000 homes. Based on current projections, the demand for electricity for the global IT sector is set to increase to an amount greater than the total combined electricity demands of France, Germany, Canada, and Brazil. See, Gary Cook, *How Clean is Your Cloud?* (Amsterdam, The Netherlands: Greenpeace International, 2012) http://www.greenpeace.org/international/Global/international/publications/climate/2012/iCoal/HowCleanisYourCloud.pdf.

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4 Graham and Marvin, *Splintering Urbanism*, 43-81.

5 Graham and Marvin, *Splintering Urbanism*, 43-81.

6 Swyngedouw and Kaika, "Fetishizing the Modern City," .ven al urban studies, recent work has rearticulatedhich have contributed to the territorial expansion of the cloud as an gloall130

7 Swyngedouw and Kaika, "Fetishizing the Modern City," 131-132

8 Nicholas Negroponte, *Being Digital* (New York: Knopf, 1995).

9 Stephen Graham, *The Cybercities Reader* (London; New York: Routledge, 2004), 8.

10 Antoine Picon, *Digital Culture in Architecture: An Introduction for the Design Professions* (Basel: Birkhauser, 2010), 172.

11 William J. Mitchell, *City of Bits: Space, Place, and the Infobahn* (Cambridge MA: The MIT Press, 1995).

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17 Jussi Parikka, *A Geology of Media* (Minneapolis, MN: University of Minnesota Press, 2015); Shannon Mattern, *Code and Clay, Dirt and Data: Five Thousand Years of Urban Media* (Minneapolis, MN: University of Minnesota Press, 2017); Nicole Starosielski, *The Undersea Network* (Durham and London: Duke University Press, 2015).

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19 Steve Jobs quoted in: Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder, Colorado; London, England: Paradigm Publishers, 2014), 54.

20 “The Apple Data Center FAQ,” *Data Center Knowledge*, http://www.datacenterknowledge.com/the-apple-data-center-faq/.

21 Yevgeniy Sverdlik, “Apple’s Reno Data Center Expansion Marches On,” *Data Center Knowledge*, August 8, 2014, http://www.datacenterknowledge.com/archives/2014/08/08/apple-data-center-expansion-in-reno-marches-on/.

22 Trevor Lloyd, Senior Planner for Washoe County, quoted in: Jason Hidalgo, "Apple expands Reno-area center; downtown location in limbo," *Reno Gazette-Journal*, August 7, 2014, http://www.rgj.com/story/news/2014/08/06/bigger-bite-apple-expands-data-center-downtown-location-still-limbo/13697679/.

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26 Barton Gellman and Laura Poitras, "U.S., British intelligence mining data from nine U.S. Internet companies in broad secret program," *The Washington Post*, June 7, 2013, https://www.washingtonpost.com/investigations/us-intelligence-mining-data-from-nine-us-internet-companies-in-broad-secret-program/2013/06/06/3a0c0da8-cebf-11e2-8845-d970ccb04497_story.html

27 Benjamin Bratton, *The Stack: On Software and Sovereignty* (Cambridge, Massachusetts; London, England: The MIT Press, 2015), 116.

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THE GROUND

Digging in the Cloud's Shadows

FARMS

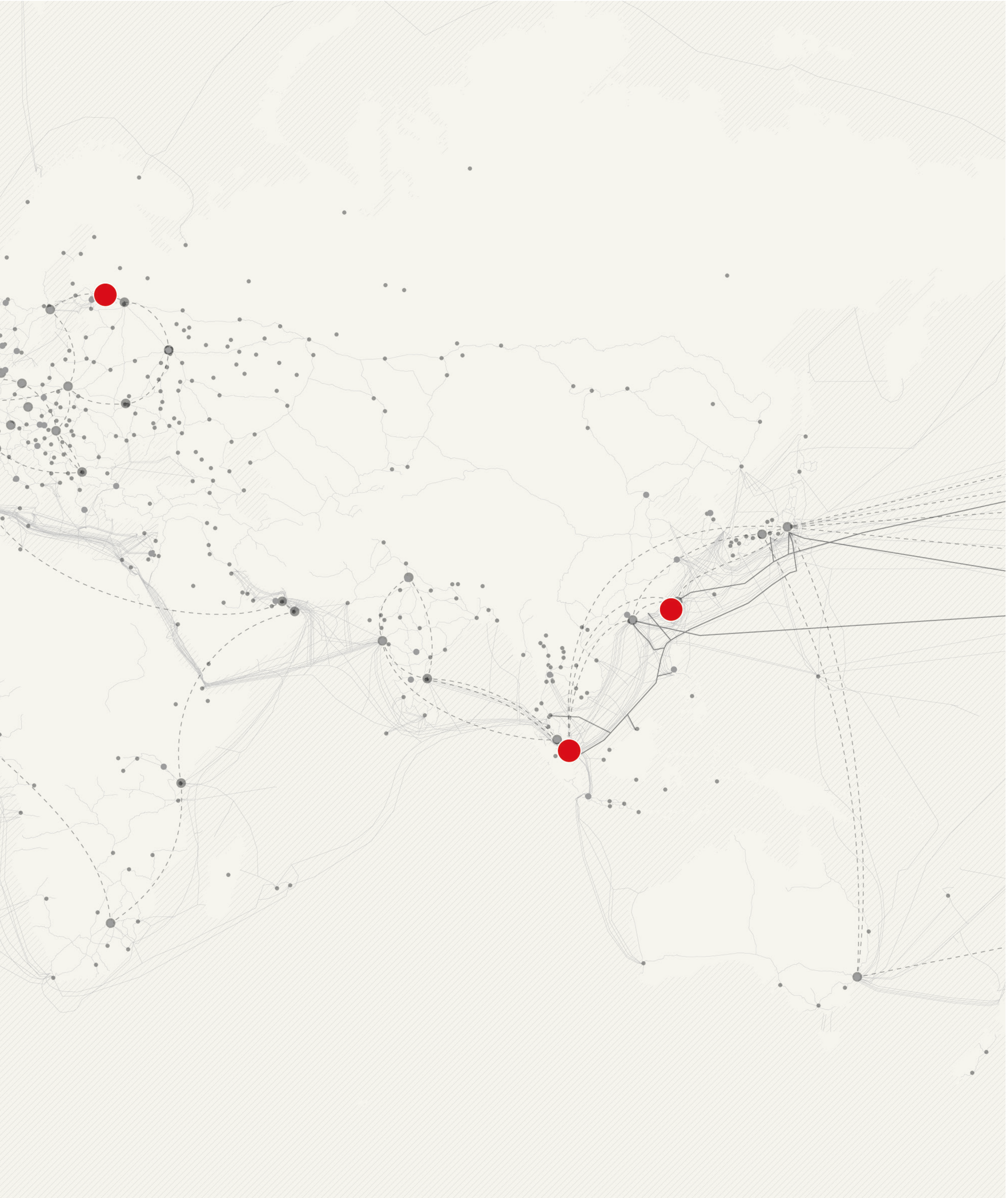
An essential, albeit obvious, footprint of the cloud is the massive data factories and warehouses that dot the globe. Datacenters have emerged as the quintessential building type of the information economy. If the factory was the architectural embodiment of industrialization, and the downtown tower stood in for finance economy, the datacenter materializes the contemporary data economy. However, the significance of datacenters goes well beyond the formal and the symbolic. The growth of datacenters as storage and processing epicenters of the cloud has enabled the massive rise of personal mobile computing. While our mobile devices (ex. smartphones to tablets) are increasingly powerful, they rely heavily on the computing power of resources centralized in datacenters to perform the complex tasks we demand of them every day. Belying the seemingly incredible power they put in the palm of our hands, the processing capacities of these devices are mainly directed towards input and output functions. The actual processing of complex tasks and the storage of the data happens in the server aisles of massive datacenters which host the apps that run on mobile devices. Broadband networks ensure the near-instantaneous communication of the results from the datacenter to the device. As a 1996 internal document from Compaq predicted, the real computing power is now centralized in the network. "Application software is no longer a feature of the hardware—but of the Internet."[1] This emergence of network as computing engine is mediated through, and enabled by, datacenters. In this regard, personal devices are more akin to the terminals of the timesharing mainframes than personal computers.

Our increasing dependence on mobile devices has translated into massive amounts of data generated on a daily basis, and in turn to a continually growing global network of datacenters. Cisco's Global Cloud Index forecasts that the amount of annual global datacenter traffic will grow three-fold from 2015 to 2020, reaching 15.3 Zettabytes per year by 2020.[2] (as a reference: 1 zettabytes = 1000 exabytes = 1 million petabytes = 1 billion terabytes = 1 trillion gigabytes) By 2012 the global number of datacenters was growing 15% annually.[3] And in 2011 it was estimated that there were 509,147 individual datacenters worldwide, occupying 285,831,541 square feet of space.[4] Given the rise of cloud computing and the growth of big data in the past five years, these numbers are undoubtedly on the rise.

Datacenters as Instruments of Territorial Expansion

While digital technology has introduced new dynamism and hypermobility to information, capital, and social interaction, this fluidity is continually materialized in the very physical infrastructure of connectivity that lies at the basis of the cloud. For scholars of spatial political economy, this spatial fixity is at the core of capitalism's tendency towards geographic and territorial expansion. David Harvey has suggested that global capitalism has a tendency—in fact, a need—to transcend the constraints of space and time through spatial fixity.[5] Central to this is the construction of massive infrastructural networks of transportation, water, energy, and communication across territories. The very act of building these infrastructural networks requires capital to be invested into pipes, wires, cables, roads, ports, airports and railways that underlie and connect moments of agglomeration; A process which "grounds" these infrastructural networks in the very space and time they are trying to overcome. Their fixity essentially embeds these networks in the social, political, and environmental processes of the localities in which they are placed. Hence there exists an essential contradiction in the

Figure 4.1: Map of Google's datacenters globally (large red dots)
Locational Data from Google.



process of global capitalist development: "the annihilation of space through time" (i.e. the creation of a frictionless, efficient conduit of capitalist production and circulation) necessitates investments into physical infrastructures of transportation and communication, often with transformative results. In other words,

> "[a] revolution in temporal and spatial relations often entails, therefore, not only the destruction of ways of life and social practices built around preceding time-space systems, but the 'creative destruction' of a wide range of physical assets embedded in the landscape."[6]

The current globalization of capitalist processes can be articulated within spatial terms as another round in the capitalist production of and reconstruction of space. Which "entails a further diminution in the friction of distance (what Marx referred to as 'the annihilation of space through time' as a fundamental law of capitalist development) through yet another round of innovation in the technologies of transport and communications."[7] In cyclic fashion these technologies come with forms and material geographies that espouse a parallel, but for-the-most-part hidden, spatiality to the rapid, frictionless, and privileged spatial construction they are accommodating.

This capitalist contradiction of enabling mobility through spatial fixity is inherent to the global expansion of data networks. Despite the weightless, frictionless, and smooth image associated with data and information networks, the infrastructural basis of the global data network is geographically grounded, materially built up, and capital-intensive; Factors which play a key role in making cloud firms globally competitive. Google has spent more that $30 billion on its global cloud infrastructure.[8] In comparison, Microsoft has invested $15 Billion on its global datacenter infrastructure.[9] Firms like Google, Amazon, and Microsoft are more than willing to spend the capital as competition over the $390 Billion cloud market becomes even more fierce.[10] To do this they will have to continually expand their network, which means more datacenters and more physical infrastructure. Competition in the cloud is driven by limitless expansion.

Given their importance in the operations of cloud providers, datacenters are considered mission-critical facilities. The downtime of each cloud platform is of great economic and analytical significance and is continually assessed and communicated to customers and analysts. Over the past month (of the writing of this), for example, Amazon Web Services (AWS), Google Cloud Platform

(GCP), IBM, and Microsoft Azure, have respectively had 21.07, 10.63, 34.72, and 9.9 minutes of downtime across their various services and regions globally.[11] Downtimes translate to loss of business and customer confidence for each platform. So reliability is an important factor in any cloud platform. Building up redundancies in the network through the creation of multiple regions and zones is an important part of making a platform reliable. This is also a spatial project as regions and zones of the cloud are materialized through datacenters which are in turn grounded in the specificities of geography and location.

The Cloudy Geopolitics of Location

Besides seemingly limitless capital, the grounding of the cloud through its physical infrastructure also entails a spatial logic based on a geopolitical cocktail of economic, political, and environmental incentives. The locative strategy of datacenters is based on a set of gold standards. Whether a region is earthquake-prone, bound to political instability, or climatically extreme, will be initial decisive factors. Energy reliability, good fiber optic connectivity, proximity to major target markets, low energy cost, access to plenty of water, plenty of inexpensive land, climate, and tax incentives each play an important role in where a cloud provider decides to plant its datacenters.[12] In locating its nodes, the cloud has followed in the footprints of previous rounds of capitalist spatial production. Specifically, cloud firms tend to locate themselves on top the ghosts of the manufacturing economy as it is outsourced out of developed countries. However, the locative projects of the cloud are less revitalization projects—as much as these projects are often touted as kick-starters for economic regeneration—and more opportunistic decisions based on the historical built-up infrastructural capacities as well as the political willingness of the local governments. The situation creates a power relationship tipped heavily in favor of cloud firms. Desperate states and local governments competing to lure datacenter investments offer cloud companies enticing incentive packages designed specifically for them.[13] The resultant geography is one in which the cloud is grounded in the economically-weathered small communities that are willing to play with its rules. Otherwise, the cloud can as easily pack up and leave, taking with it the hundreds of millions of dollars of investment capital that it pours into every datacenter project.

Google's locative strategies reflect these power relations closely. Although the company lags behind

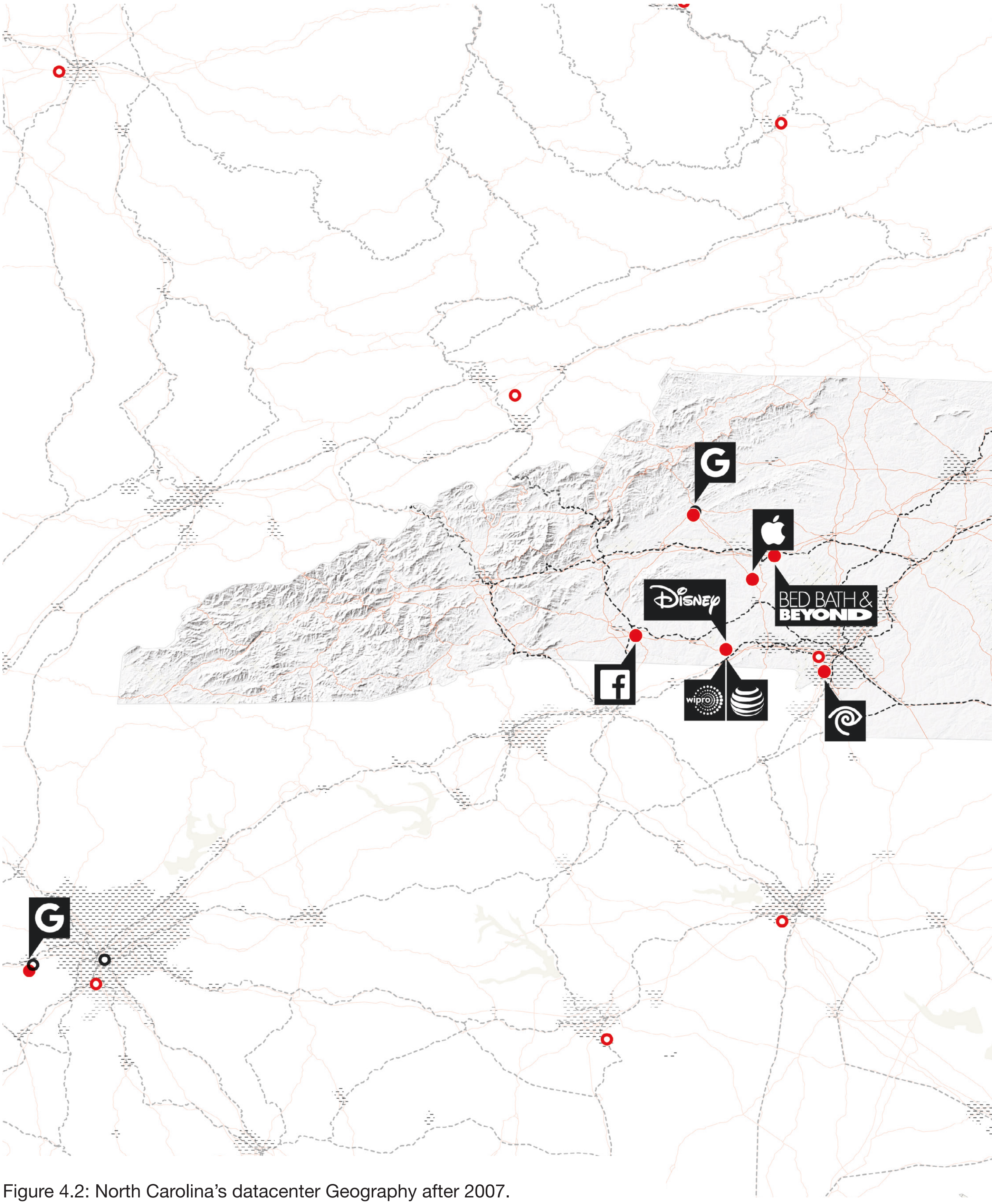
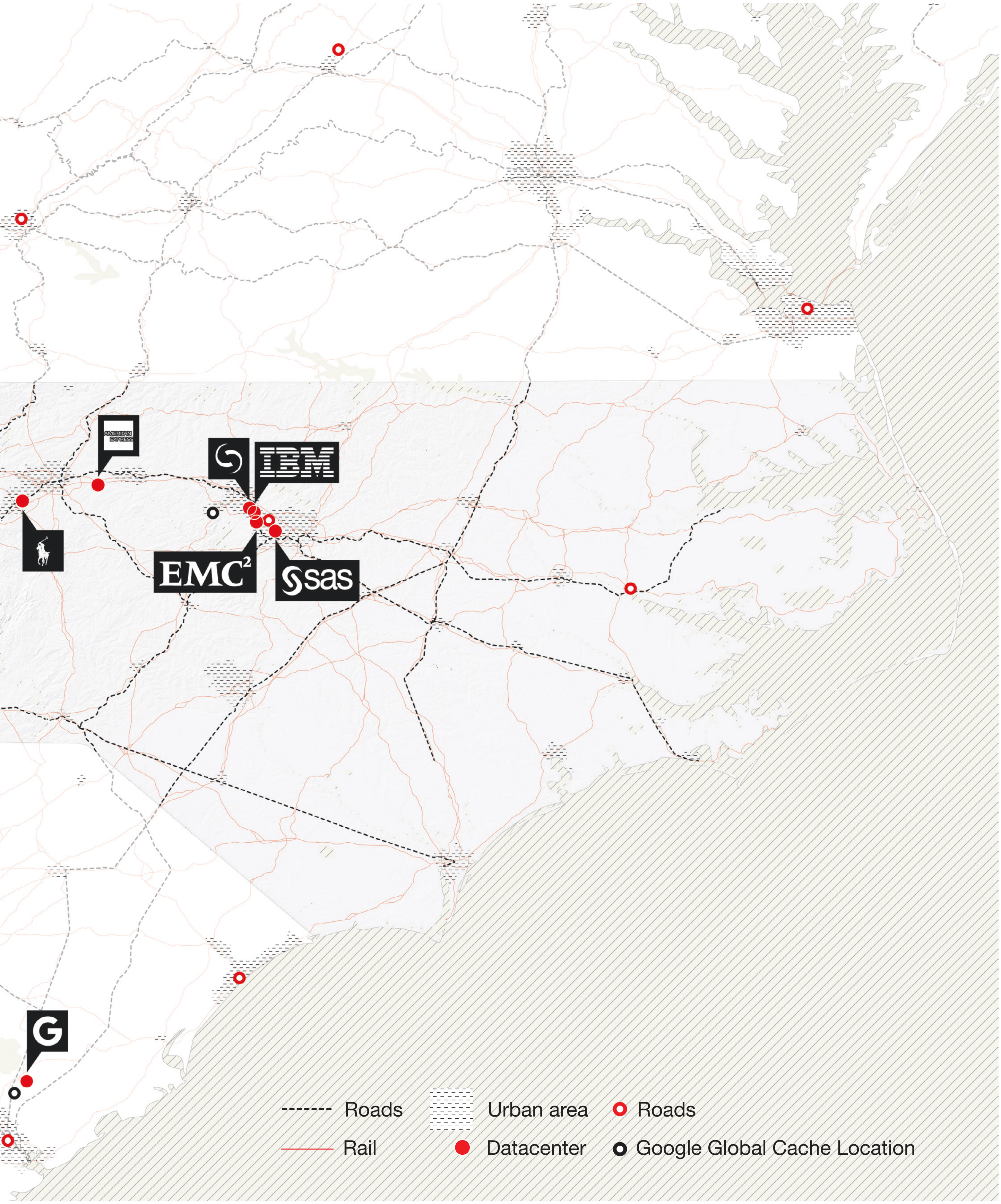


Figure 4.2: North Carolina's datacenter Geography after 2007.


IBM
EMC²
sas
G
Roads
Urban area
Roads
Rail
Datacenter
Google Global Cache Location

the likes of Amazon and Microsoft in its enterprise cloud platform, it has made a huge effort in recent years to expand on its global infrastructure. In addition to its current fleet of datacenters the company is planning to bring more projects online in Montreal, Sao Paulo, Finland, Frankfurt, London, Mumbai, Singapore, and Sydney.[14] This infrastructural expansion is part of Google's attempt at competing with other public cloud providers. But it is also heavily geographic and territorial in nature. The speed and pace of this expansion can easily overshadow its geopolitical basis. Google's addition of cloud regions through building out datacenter infrastructure is party due to an increasing demand for data sovereignty, which puts regulatory limits on the geographic location of cloud data. Cloud providers and boosters see these regulations as annoyances which hinder the global domination of the cloud.[15] To them, "[t]he beauty of the cloud is the promise of simplification and standardization — without regard to physical or geographic boundaries."[16] For states, data sovereignty laws demand that a country's citizens' data be stored within the geographic bounds of the state, and in turn be subject to the laws and legal jurisdiction of the country in which it is stored. Once Google, or any other cloud provider, decides to erect a datacenter, it enters into a process of negotiation with local governments in order to extract as much benefit as it can from its target location. In most cases Google's locational choices have the power to reorganize and restructure the communities in which it plants its infrastructure. The process is equal parts geographic, political, and economic. Its aim is the territorial expansion of the company's data empire.

Furnishing the Cloud: Google Lenoir

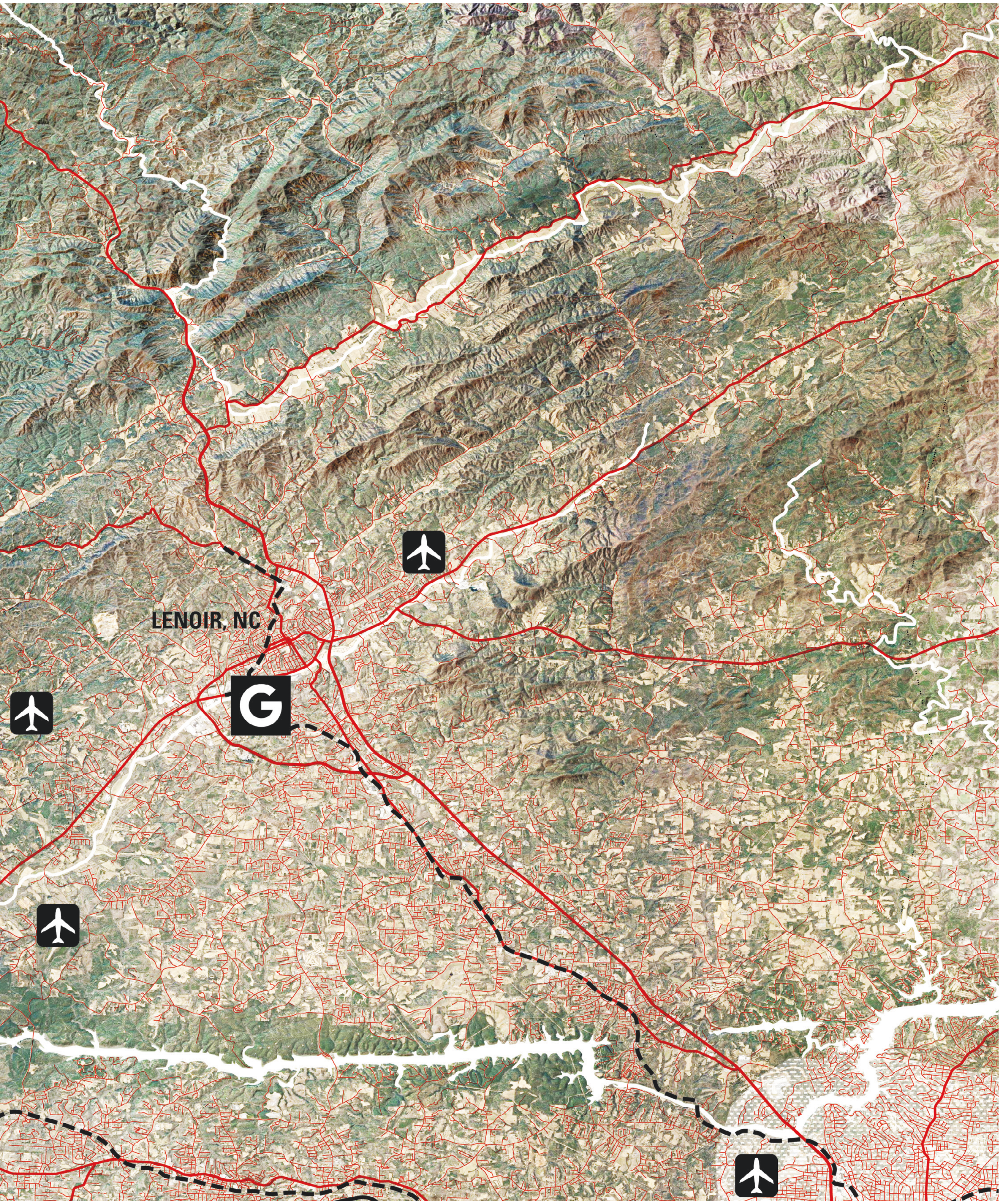
Lenoir is a small city of around 18,000 edging the Blue Ridge Mountains, and the county seat of Caldwell county in Western North Carolina. Lenoir's economic history has followed the ebbs and flows of the manufacturing sector in the U.S. The state as a whole has had a close relationship with furniture manufacturing and still accounts for a significant share of the sector's employment in the country. However, employment in furniture manufacturing has declined steadily. Lenoir was once home to one of the largest furniture manufacturers in the United States, Broyhill Furniture. Even today the city is dotted with furniture factories. By early 2000s however, these plants were facing massive competition from their Asian counterparts. Many factories were forced to downsize or close down their operations altogether. Between 1992 and 2012 furniture manufacturing in North Carolina declined 56% with most jobs migrating to Asia.[17] Lenoir was hard hit. Between 2004 and

2007 the city saw the closure of seven furniture factories and the loss of 2,100 jobs.[18]

While a declining manufacturing town hardly screams high-tech infrastructure, Lenoir's hard times presented a field of potentials for Google which was at the time in search of locations for a major expansion of its datacenter footprint. The closing of factories meant excess power capacity which had been built for manufacturing over the past 50 years. And the local electricity utility, Duke Energy, was willing to offer this excess capacity at low rates, of about 4-5 cents per KWh for industrial use.[19] There was also plenty of water capacity (for the cooling of the servers) and lots of inexpensive land. By late 2005 when google came calling, Lenoir's city officials led by the Caldwell County Economic Development Commission and supported by the state of North Carolina were ready to offer Google a massive incentive package to locate its datacenter in the city. Nanette Byrnes, writing for *BusinessWeek* in 2007, valued the incentives offered by the city, the county, and the state at $211.7 million for Google's initial $600 million facility.[20] As part of the incentive package the state legislature enacted a "Google-driven" bill that allowed for datacenter-specific sales and use tax exemptions. The state legislature's efforts were pushed along by Google's location czar Rhett L. Weiss (now with Amazon), who threatened Google would back out of Lenoir if the bill was not enacted quickly.[21] The legislation was passed a month later. The bill effectively exempts Google of paying sales taxes for the massive amounts of the electricity that its datacenters use. Servers, software, and other equipment (that would include "HVAC and mechanical systems, including chillers, cooling towers, air handlers, pumps and other capital equipment used for these purposes") would also be exempt.[22] For its part, the city of Lenoir offered a 100% discount on local property taxes and 80% off real estate taxes for 30 years. An offer which would prove to be substantial given Google's initial purchase of 216 acres of land.

By exercising its considerable power in Lenoir, Google has effectively altered the economic and spatial character of the entire region. After Google, others followed. In 2009 Apple chose Maiden in Catawba county, to the Southeast of Caldwell county, for its massive 500,000 square feet datacenter. In 2010 Facebook announced plans to plant a $450 million facility in Forest City, in Rutherford county.[23] American Express, Disney, Wipro, AT&T, IBM, and Ralph Lauren have all built new datacenters or have expanded on their existing facilities in North Carolina since 2007.[24] What we see in North Carolina is the emergence of a datacenter geography that is beginning to show its power to spatially and politically restructure the state and its major players. While this geography has emerged

Figure 4.3: Regional map of Google's datacenter in Lenoir, North Carolina.


LENOIR, NC
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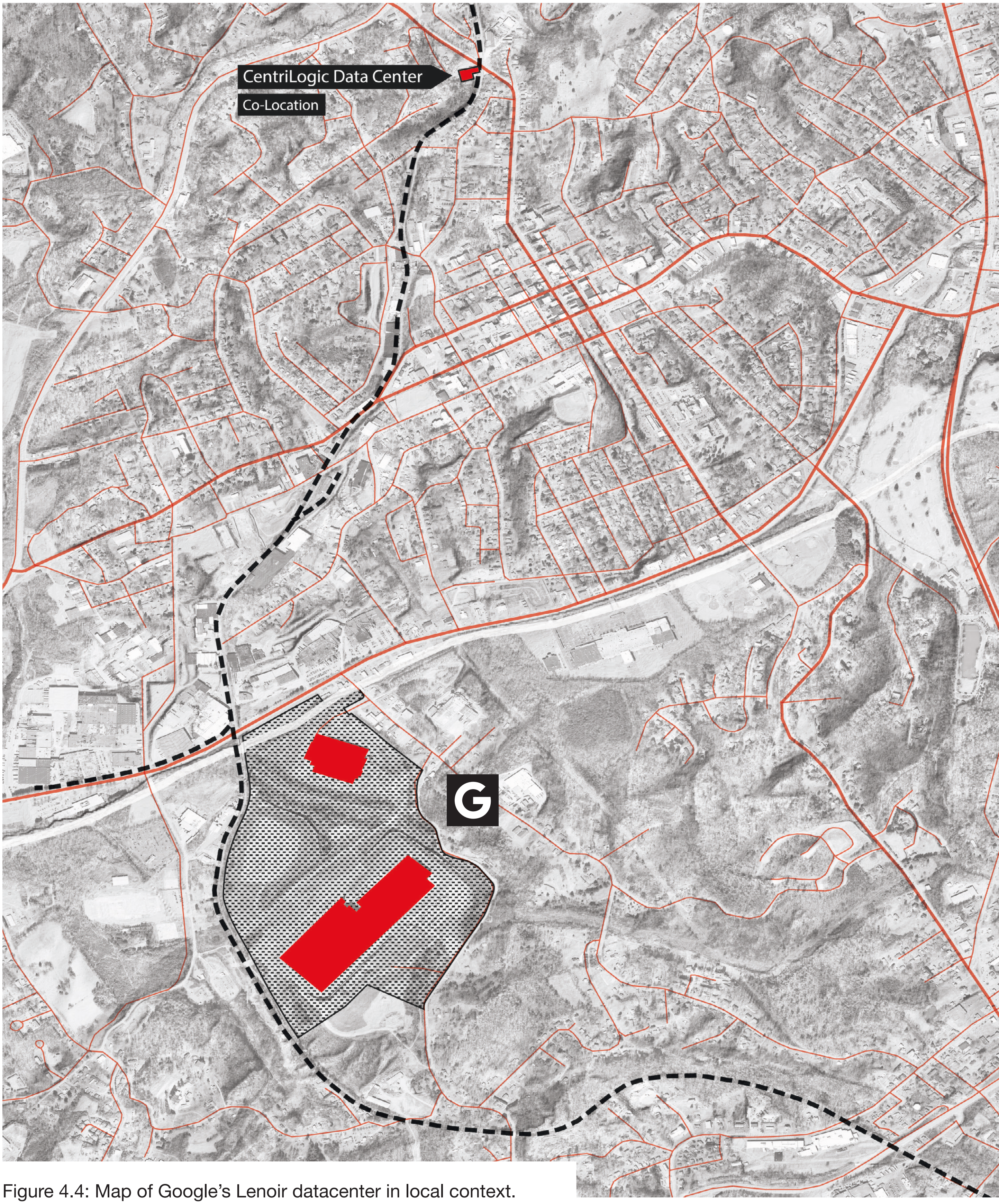

Figure 4.4: Map of Google's Lenoir datacenter in local context.

as a political force able to impose spatial and regulatory transformations, however, there may be limitations to this transformative power.

It is no secret that datacenters consume copious amounts of electricity. A 2013 study has estimated that the tech sector will command 10% of global electricity consumption by 2017. Although this percentage also includes energy used by manufacturing, devices, and networks, datacenters are projected to command 20-25% of all ICT energy consumption.[25] Greenpeace has highlighted the still heavy toll that all this increased energy consumption takes on the environment. In Greenpeace's 2015 report, of the major tech companies that it analyzed, only two companies source more than 50% of their electricity needs from clean energy sources. Additionally, coal energy is still responsible for a considerable chunk of the energy used by datacenters and cloud companies.[26] An exception to this is Apple, who provides 100% of its energy from clean and renewable energy sources. The company has installed three 100-acre solar arrays in Catawba county in North Carolina, close to its Maiden datacenter complex.[27] Following Greenpeace's report and mounting questions about the environmental toll of the electricity used in datacenters, tech giants are beginning to demand cleaner energy from local utility companies. Relying on their huge purchasing power in North Carolina, Google and Apple have successfully encouraged Duke Energy to start a renewable energy program and to invest heavily in solar energy production in the region.[28] This is not a small shift for the United State's largest electricity utility. In 2015 only 2% of the energy provided by Duke Energy was from renewable sources, while coal accounted for 32%.[29] And even though the new investment presents a positive shift towards renewable energy production, it only accounts for a meager 0.006% (278 megawatts of 50,000 megawatts) of the capacity produced nationally by the company.[30] As one of the catalytic forces that brought Google and Apple to the state, Duke Energy is by North Carolina law the sole provider of power to customers. And the energy used in datacenters is as clean or dirty as the local power grid that supplies it. One may question then whether the new push by Google for Duke to adopt renewable energy actually holds any merit, or is it solely cosmetic. In either case, the extractive logic of the cloud makes sure that the decision ultimately comes down to economics. "The price of renewable-power sources are far less volatile than power derived from commodities like coal, which is useful for things like long-term budgeting and cost-cutting."[31] The decision is as much a business tactic as it may be a marketing one.

Since its initial 2007 project in Lenoir, Google has expanded its facilities and has doubled its investment to $1.2 billion.[32] In 2008 the company purchased an additional 60 acres, brining its total to 276 acres of land.[33] This also means that the value of the incentive package offered by the city and the state has in turn increased well beyond the initial $211.7 million. Over the years of development in Lenoir, Google's imprint has also entailed major infrastructural upgrades including: closing and rerouting of a railroad; upgrading the city's water facilities to accommodate the needs of the thirsty datacenter complex; and widening of roads and access routes. All of these changes translate to costs for the city and local governments, who are happy to shoulder the burden as long as Google stays in the city.

So while data farms entail massive allocation of resources that require regulatory maneuvering and spatial transformations by local governments, it is unclear whether their locative strategies translate to positive local restructuring and economic gains. Google has released economic impact reports annually, since 2009, that announce the company's economic impact in every state. In 2016, the most recent report, Google claims to have provided $2.38 billion of economic activity for North Carolina businesses, website publishers, and non-profits.[34] However, this measurement is solely based on the business generated through the company's advertising activities and does not account for its datacenter impact in the state. So what is the actual value of having a datacenter in your backyard? Initially the Lenoir project was touted for its economic regenerative potential for the city. Following years of decline, there was a need for the city to embrace a "new economy," to be part of the 21st century. As Byrnes wrote in 2007, the arrival of Google in Lenoir was welcomed with open arms and seen as "a vital morale booster, if not a full replacement for the lost furniture factories."[35] The subsequent landing of Apple in 2009 sparked even more enthusiasm as the North Carolina Department of Commerce projected in a press release that "a data center investment of $1 billion would create more than 3,000 jobs in the regional economy, including hundreds of jobs related to construction and others created as a result of economic growth."[36] And here lies another fuzzy math of the cloud: Although the construction of the datacenters would mean more construction jobs initially, these are temporary employment opportunities. Datacenters are known for their lean workforce. Google currently employs 250 employees in Lenoir, of which 150 are "white-collar technical staff" who attend to the 50,000 servers of the facility. The remaining 100 employees are

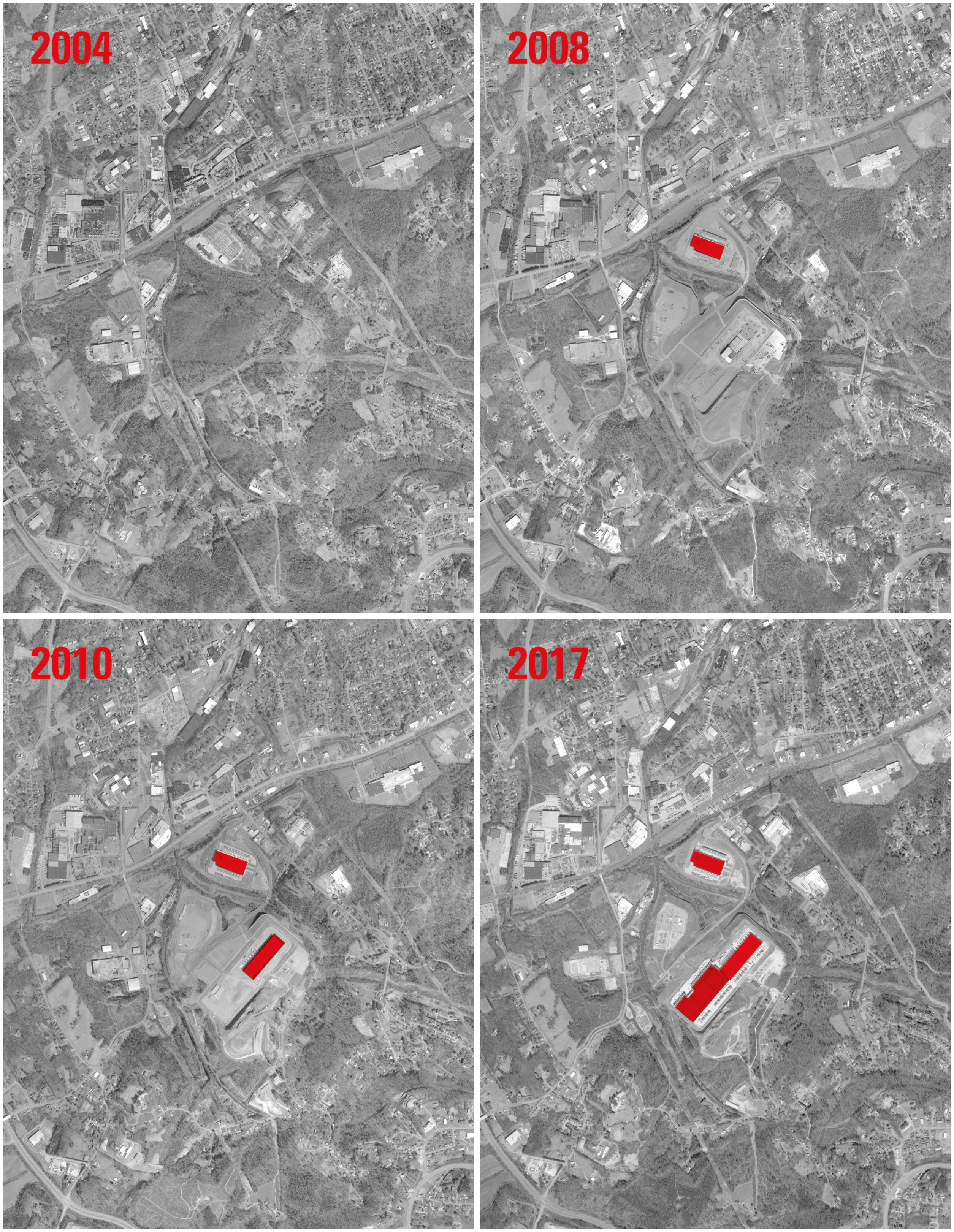

Figure 4.5: Photographic timeline of the construction and operationalization of Google's Lenoir datacenter. 2004-2017.

mostly security guards and HVAC technicians. Only about two thirds of the employees actually live in Caldwell county.[37] That number can hardly replace the more than 3000 jobs that have been lost in Caldwell county since Google came to town.[38] Datacenters are many things, but they are not local economic engines. Their allegiance is to the network.

There has been some recent criticism of the now established practice of offering tech companies massive incentive packages in hopes of economic development spurred by datacenters.[39] However, the aggressive extractive/locative strategies of the cloud and the growing desperation of small communities gutted by job-loss have ensured the continuity of these practices. Every new Google datacenter project is treated enthusiastically, citing past "successful" projects.[40] Although the power of the cloud extends well beyond the bounds of its datacenters and is able to remake geographies, rewrite regulations, and alter the geopolitical landscape of entire regions, this territorial remaking is to serve the cloud as opposed to local needs. The process is inherently geographic, linking the materiality of the cloud to the larger environmental systems and socio-political relationships that govern processes of energy generation, land use planning, water management, and capital production. But the cloud operates within the capitalist logic of extraction. Its locative strategy aims to extract as much as it can from where it hits ground, for as little as possible. Meanwhile its data empire spreads, claiming territories, and expanding globally in the name of progress.

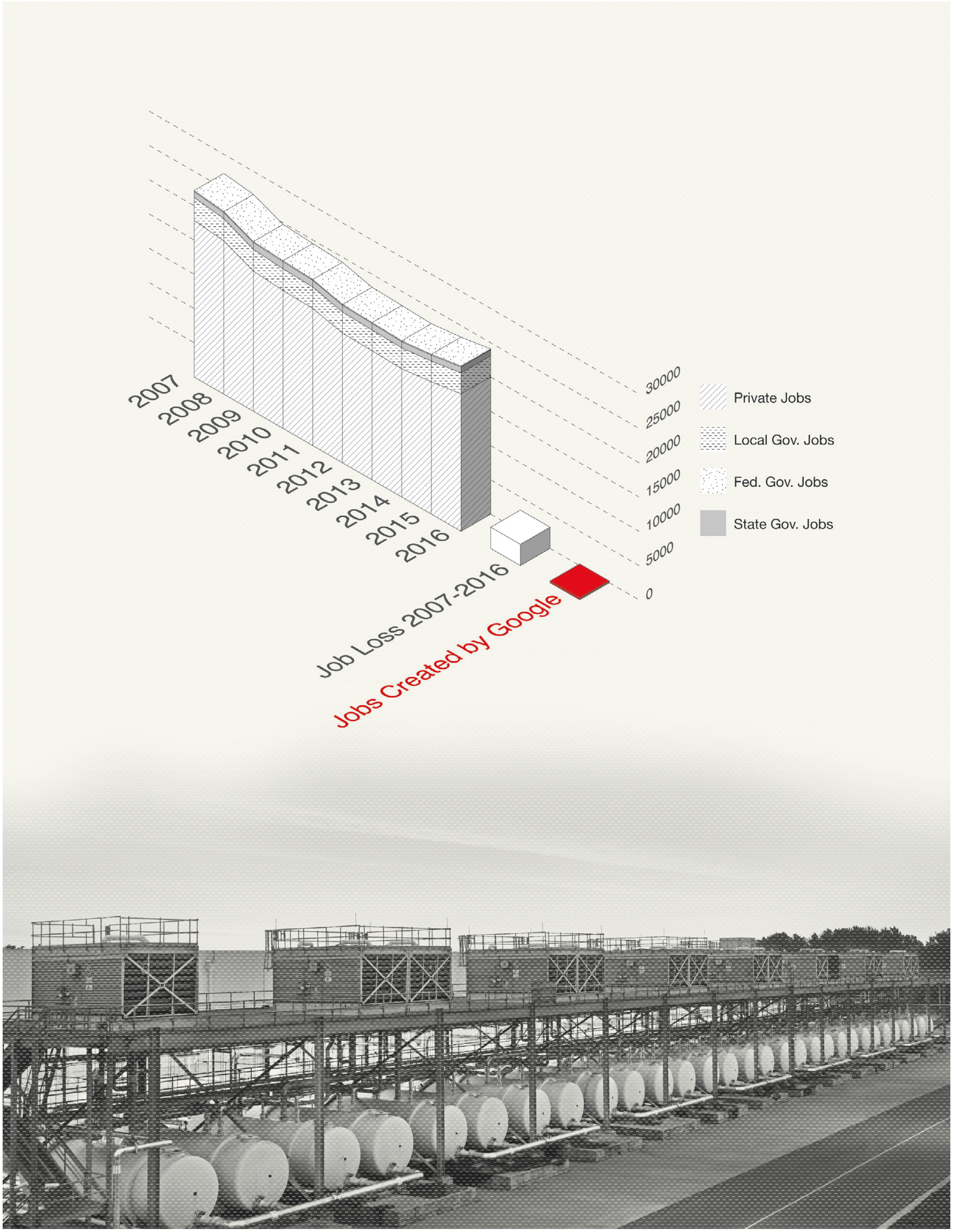

Figure 4.6: Job loss in Caldwell county NC 2007-2016
Vs. Jobs created by Google in the county since 2007.

Notes

1 The document is also thought to be one of the earliest uses of the term cloud computing and the cloud to denote this shift towards the computing power of networks. See: Antonio Regalado, "Who Coined 'Cloud Computing'?," *MIT Technology Review, Business Impact* (October 2011).

2 Cisco Public, *Cisco Global Cloud Index: Forecast and Methodology, 2015–2020* (2016), http://www.cisco.com/c/dam/en/us/solutions/collateral/service-provider/global-cloud-index-gci/white-paper-c11-738085.pdf.

3 Katie Fehrenbacher, "The Ultimate Geek Road Trip: North Carolina's Mega Data Center Cluster," *Gigaom*, July 8, 2012, https://gigaom.com/2012/07/08/a-geeks-road-trip-north-carolinas-data-center-cluster/.

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5 See, David Harvey, "Globalization and the 'Spatial Fix,'" *Geographische Revue* 3, no. 2 (2001): 23–30.

6 David Harvey, *Justice, Nature and the Geography of Difference* (Oxford: Blackwell, 1996), 241.

7 Harvey, "Globalization and the 'Spatial Fix,'" 24.

8 Eric Schmidt, the Chairman of Alphabet, mentioned the $30 Billion investment in Google's infrastructural expansion at Google Cloud's Next conference in San Francisco on March 8, 2017. See, "Google Cloud Next '17 - Day 1 Keynote," YouTube video, 2:04:35, posted by "Google Cloud," March 8, 2017, https://youtu.be/j_K1YoMHpbk; See also: João Marques Lima, "Google's Cloud CAPEX Hits $30bn With More To Come As Giant Plans 10 New Data Centres," *Data Economy*, March 13, 2017, https://data-economy.com/googles-cloud-capex-hits-30bn-come-giant-plans-10-new-data-centres/.

9 "Azure Datacenters," *Microsoft Azure*, https://azure.microsoft.com/en-ca/overview/datacenters/; See also: Lima, "Google's Cloud CAPEX Hits $30bn".

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PIPES

Among the most enduring myths that have surrounded digital communication systems the immateriality of data flows and infrastructures of communication remain as prominent as ever. While globalization of capitalism has demanded evermore territorial expansion, the need to coordinate, control, and command this ever-expanding footprint has manifested in the emergence of global communication as an essential service. And this service is increasingly materialized in the cables and physical infrastructures of connectivity that quite literally wire the globe. The allure of satellites as immaterial transmitters of data is perhaps the most common trope in dematerializing ideologies of communication networks. However, satellites account for an insignificant share of the global communication load. Around 99% of all intercontinental telecommunication traffic, which includes voice and data, is transmitted through submarine cables.[1] These cables are the not-so-visible threads sewing the cloud into the ground. And as such they cannot be simply represented as vectors.[2] Instead a more territorial and historically grounded reading of these networks would construct a much larger extended landscape of data and forms an important aspect of understanding the territorial logic of the cloud.

If the datacenter is the quintessential building typology of the cloud, cables are its logistical network. The dependency and the relationship between datacenters and cables closely resembles the relationship between the railway and the factory. As the railway was a necessary ingredient in the growth and spread of industrialization, so is the global fiber network of data an essential aspect of the information age. Yet most discussions about cloud computing tend to overlook the network that enables its delivery. Far from operating outside of its logic, this global network is an essential layer of the cloud. Through their material history, the geopolitics of the right-of-way underlying their spatial logic, and the share of resources and energy their expansion requires, cables have become the grounded tentacles of the data empires vying for cloud supremacy.

A recent wave of literature has attempted to articulate the historically grounded territories and dynamics of global cable networks. While the prevalent understanding of these networks as apolitical tubes or indifferent pipes still persists, the contextual dynamics of their rollout and the historically conditioned trajectory of their deployment has slowly begun to penetrate the critical sociopolitical imagination.[3] The dominant myth of immateriality has been disproved overwhelmingly. The closely-related deterritorialization of communication systems has also been questioned. Unlike the common assumption about the ability of digital communication to transverse territorial limitations or its immunity to territorial politics, the global network of cables that mediate digital communications is very much shaped by the social, political, and cultural forces emanating from the territories through which they are strung. Early telegraph lines were mapped over colonial lines of domination and control, while telephone networks that followed similar paths were owned and controlled by governments or state-affiliated monopolies.[4] The fiber optic lines of internet's backbone were similarly threaded along the very same "historical and political lines, tending to reinforce existing global inequalities," and for the most part have contributed to the continuity of historical power relations.[5]

A Short History

The precise ebbs and flows of the historical narrative of the deployment of communication cables has been extensively covered elsewhere and falls beyond the aims of this research. However, the most recent round of cable investment and the changing landscape of players involved in the provision of global communication networks demands more scrutiny. The growing bandwidth demand of cloud providers and the intense competition between them has entailed a shifting of the balance towards the internalization of data flows within private networks as opposed to their transmission over typical internet backbones provided by telecoms. This emerging centrality of private network bandwidth provision will provide a useful entry into the operational logic of networks of communication and their contribution to the cloud's territorial expansion.

An early catalyst for this global transformation was the emergence and popularization of the internet in the 1990s which generated a massive speculative expansion of the global networks of communication. The 1990s rush to lay fiber optic cables in the United States came in the wake of widespread technological optimism that accompanied digital information and communication technologies. This optimism, and the infrastructural necessity of laying advanced fiber optic networks as harbingers of the emerging information economy, were clearly encapsulated in the metaphor of the "information superhighway" that rose to prominence in 1992.[6] The presidential campaign of Bill Clinton and Al Gore relied heavily on the metaphor to signal a major expansion of the country's fiber optic network that would make U.Ss competitive in the "new economy". The election of Clinton and Gore would further raise media interest and inflame the speculative market of fiber optics. A 1993 *Newsweek* cover story lucidly captures the growing competition over the strands of fiber optic cables. Bill Powell and Anne Underwood wrote at the time:

> "A century ago the wars were fought for land… Today's wars are fought over tiny strands of high-strength glass, called fiber-optic cable, and the pulses of light that they transport. Whoever controls these information pipelines and whoever figures out how to use them to deliver something valuable to a society that consumes information voraciously will get very, very rich."[7]

The competition was so fierce that telecoms and other cable providers began to lay fiber optics merely in anticipation of an explosion in the broadband market, not necessarily in its wake. The internet, introduced publicly in 1994, only fanned these flames. Soon it was not just telecoms that were investing in fiber optics. The speculative market of cables was to peak in 2001, coinciding with the bursting of the "dot-com" bubble. However, the massive interest in fiber optics at the time was still premature. By 2001 the internet industry was faced with a massive glut in capacity. Only five percent of the nearly 40 million miles of fiber optic cables laid under the streets or strung along the railroads and pipelines was actually "lit". The rest were "dark" fibers that were installed in the anticipation of a market growth that was yet to materialize.[8] A noteworthy example of the hot fiber speculation market was the ambitious plan of Enron to create a national bandwidth trading market. The same thing it had done for the energy market. Beginning in 2000, the company set out to either buy bandwidth or install cables. The plan, which was essentially propped up by the company's "creative" accounting techniques, would ultimately fail and would prove to be one of the indicators of the company's dubious profit claims.[9]

The Right of Way

Within this rush to expand, the right-of-way already coded into other infrastructural networks plays an important role for the paths and the territorial politics along which communication networks expand. The right-of-way (ROW) of railroads, roads, and even pipelines and electricity lines are extremely valuable in the competitive market of communication infrastructure networks. A recent study of the long-haul fiber network of the United States suggests that "a significant fraction of all the physical links are co-located with roadway infrastructure." The study also suggests that "it is more common for fiber conduits to run alongside roadways than railways, and an even higher percentage are co-located with some combination of roadways and railway infrastructure."[10] A significant proportion of those fiber lines not "co-located" with transportation networks followed other infrastructural right-of-ways, like those of pipelines.[11]

As far back as telegraph lines, railroads and other transport infrastructure have hosted communication infrastructures. Telegraph lines were particularly necessary for the synchronization and control of the internal operations of railways. Most railroad companies hence had communications divisions. Realizing the advantage of their command over sometimes nationwide right-of-way networks, railroad companies began to lease their communication lines and their right-of-ways to telecommunication companies. MCI, for example, has installed much of its expansive fiber optic network along Amtrak railway lines and the right-of-way it inherited from the former Western Union Telegraph Company. Sprint, on the other hand, was spun off of the communications division of the Southern Pacific Railway.[12] These lines now form the basis of contemporary communication networks. In the United

States this was especially highlighted in the case of the massive wave of fiber network construction that followed the 1996 telecommunications act, which incentivized railroad companies with large ROWs to jump directly into the bandwidth capacity provision market.[13]

The continuity of operations that accompanies the infrastructural coupling of communications on previous networks is not solely limited to the physicality of their lines. These networks also tend to inherit the socio-political messiness and the techno-ideological determinism of the host networks. As Ingrid Burrington writes about fiber optic networks, "networks tend to follow networks, and telecommunications and transportation networks tend to end up piled on top of each other." She continues that while the historical trajectory of the fiber networks is not always easily recognizable, "it's there, forming a kind of infrastructural palimpsest, with new technologies to annihilate space and time inheriting the idealized promise and the political messiness of their predecessors."[14] It is on this "infrastructural palimpsest" that the most recent transformation of the global networks of data is unfolding.

Data, Expansion, and Attention Control

Once dominated by telecom companies, the global landscape of communication infrastructure now reflects the growing demands of the cloud, as the amalgamation of competing private data ecosystems. The bandwidth-use and the growing investment of "content providers"—otherwise known as cloud computing companies—in communication infrastructure speaks to the expansionist aims of the cloud. Of the 443 Tbps international bandwidth used in 2016, 170 Tbps, or 38%, was deployed by cloud providers like Google, Amazon, Facebook, and Microsoft. Even more telling, this share represents a 14-fold rise in the international capacity deployment of these companies within only four years, from 2012 to 2016.[15] Compared to the 3-fold rise of all other operators over the same period, this rapid rise is indicative of the growing domination of the cloud in global data traffic. The rapidly growing cloud capacity is mediated through private networks that tend to internalize the operations, and benefits, of the cloud—as opposed to externalizing them like public utilities. This is significant as the public internet's share of bandwidth, which is dominated by major Internet Service Providers (ISPs), has dropped from 80% in 2010 to slightly over half (54%) in 2016.[16] The general trend points towards a private network environment where the cloud mediates the majority of global

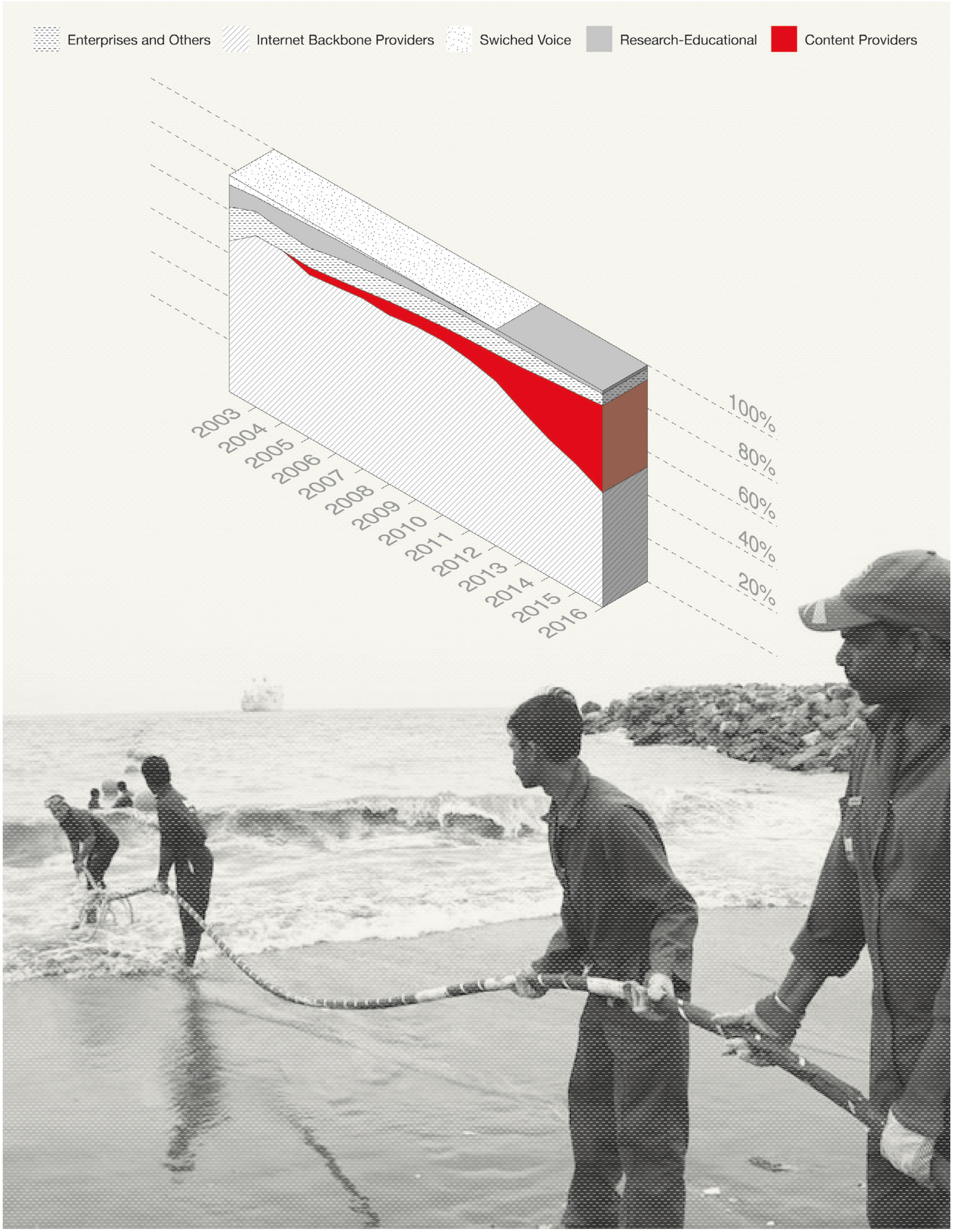


Figure 4.7: The massive growth of international bandwidth usage by content providers (i.e. cloud providers) like Google, Microsoft, Amazon, and Facebook.

data, making that data bound to its operational logic and its almost militarized shell.

To be clear this private network is built on both capacity initiated by cloud providers themselves—i.e. by investing in new fiber optic cables—as well as capacity bought from other cable operators. However, cloud providers have recently increased their investment in their own fiber optic networks. Google is now sole or part owner of eight submarine cable systems. In comparison, Microsoft, Facebook, and Amazon are either part owners or major capacity buyers of four, three, and one submarine cables respectively.[17] This trend is only on the rise, as companies compete to exert control on one of the remaining puzzle pieces of their data ecosystems.[18] Reminiscent of the fiber optic rush in the 1990s which was propagated by the hype surrounding "the information superhighway", the expansionist logic of the cloud has itself become a catalyst for development of more cable capacity, not necessarily dependent on other activities. This move is an important aspect of the cloud's domination over user data, which is now increasingly internalized within the blackbox of private networks established by cloud providers.

The emerging era of network development by cloud providers represents a larger territorial aim. These companies have built massive empires based upon keeping costumers within the expansive data ecosystems constructed from their own wants, activities, and habits. The missing piece of this ecosystemic puzzle seems to be the transmission and control of the data flows between devices, datacenters, and markets. The always-available, everywhere, efficient ideology of the cloud and the security needs of dealing with massive amounts of private data requires continuous synchronization and mirroring of applications and data on multiple servers in different geographies. Given the dynamic nature of this data, this entails an enormous coordination effort between every cloud company's datacenters, which are dispersed globally to be closer to users and customers. Hence, the cloud logic necessitates increasingly high volumes of global inter-datacenter traffic. As more data is continually produced about the activities of their users and their data, cloud providers experience an exponential rise in the amount of data they need to transmit, as evident in the recent rise of used international bandwidth by content providers.[19] This creates an operational necessity for globally expansive, privatized channels of constant data flow. And this expansionist logic is not solely ideologically and operationally driven. There is an inherent economic logic to this expansion which justifies the massive amounts of capital invested in communication infrastructure by cloud companies. Staking claim to cables makes sense for companies like Google who are faced with the inevitable exponential growth of data globally. And obviously with more data comes more bandwidth. And the ownership of cables “gives content providers two things: economies of scale and a future-proof network. Content providers can add new capacity when they need it at considerable cost savings.”[20]

While it is difficult to ascertain exactly how much a company like Google spends on expanding its network, the cost is considerable. The FASTER cable system, in which Google has an ownership stake, for example, came with a price tag of $300 million.[21] These are massive operations that come with a hefty cost. The ultimate aim is to build up data resources and exert control over means of data production in an attempt to construct the most holistic cloud ecosystem. Whether this ecosystem is geared towards the enterprise customer base or the public cloud, the point remains the same: to keep the customer, and more importantly their data, within the realm of the control of the cloud provider. While cables represent an important part of this closed data ecosystem, they are not the only components. The cloud’s system of delivery also includes cable landing stations, internet exchange points, cell towers, terrestrial fiber cables, routers, switches, and devices. The cloud’s dependency on these networks and devices manifests in a much larger and ever more expansive footprint for the cloud. Without them, there would be no cloud. And deploying and maintaining these networks is also extremely costly and energy consumptive.

When it comes to the energy use of the cloud, datacenters tend to take center stage. Studies like Greenpeace’s two reports, *How Clean is Your Cloud?* (2012) and *Clicking Clean* (2015), have demanded accountability from cloud providers for the energy use of their datacenters.[22] Yet once access networks and access technologies are included within the cloud ecosystem this perception changes dramatically. Recent studies have shown that access networks and wireless technologies consume much more energy that datacenters. In a 2013 white paper, The Center for Energy-Efficient Telecommunications (CEET), based at the University of Melbourne and supported by Bell labs, projected that by 2015 the wireless cloud ecosystem would consume up to 43 TWh of electricity, up 460% from 2012. Of this amount, datacenters accounted for only 9% of the total energy use.[23] Another report from 2013 places the datacenters’ projected share for 2017 at 21%. Devices and Networks account for 63% of total electricity use in the same projection.[24] Although the two reports

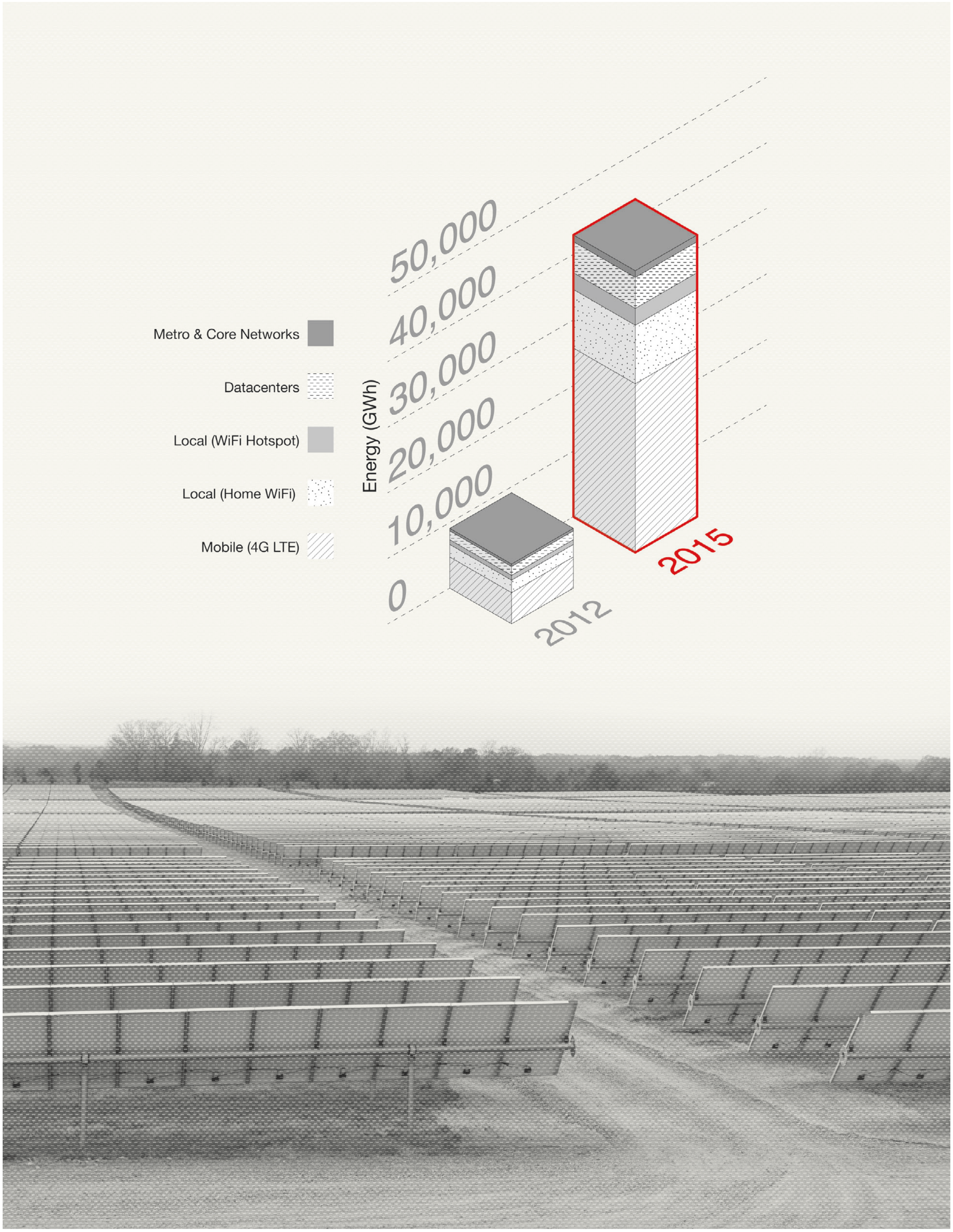


Figure 4.8: The growth of energy usage by the “wireless cloud,” 2012-2015.

project different shares for wireless access networks, they do hint at the need to go beyond solely datacenters to understand the full energy impact and the environmental footprint of the cloud. The CEET's report, encouragingly, determines the energy consumption of the cloud as contained within four key components: end-user's devices (ex. Smartphones and tablets), broadband access technology (ex. wifi modems), metro and core telecommunication network (ex. In-ground fiber optic cables), and lastly, datacenters.[25] Together these components underpin the cloud's data ecosystem and form its physical layer.

Wiring the Globe: Google's Pipes

Google is among cloud companies that have invested heavily in expanding their data ecosystems through infrastructural investments and intensifying their network footprint. The company's many operations globally speak of the dominant expansionist ideology of the cloud. One in which territorial expansion through wiring the globe is an inherent part of cultivating the cloud. Google's wires represent yet another dimension of the material and territorial groundedness of the cloud and the global expansionist logic by which it operates.

Starting as early as 2008, Google has been ramping up its investment in submarine cable systems. The company was the first cloud provider to invest directly in submarine systems. Over the past decade the company has expanded its global submarine cables to complement its growing terrestrial network of data centers, Points of Presence (PoPs), and fiber. Currently, Google is the sole or part owner of eight publicly announced submarine cable systems, the length of which totals approximately 64,966 kilometers.[26]

The Unity cable system, announced in 2008, represented a first for a tech company like Google and marked the company's foray into submarine cable investment. At a cost of $300 million, the cable spans 9,620 kilometers and connects Chikura, located near Tokyo, to Los Angeles. At either end, the cable connects to other terrestrial networks. Unity would become an important connection for Google, since at the time the company did not have a physical footing in Japan. The cable system connected the massive Asian market to the company's points of presence on the West coast of the United States. It was reported that with a bandwidth of up to 7.68 Tbps the cable would increase Trans-Pacific capacity by about 20 percent.[27] At the time of Unity's announcement Google's Manager of Network Acquisitions, Francois Sterin (later to become Director of Global Infrastructure) wrote on the company's official blog that they were not going into the submarine cable business. He wanted to make certain that they were not in competition with telecom providers, and that their move to invest in the undersea cable was necessitated by the growing amount of data the company handles, the shear force of which had "exceeded the ability *traditional players* can offer."[28] This is significant because until then Google bought cable bandwidth from other providers like major telecom companies who have historically been the providers of fiber optic cables. This move would not only add needed bandwidth to the company's network, but it would also set Google apart from other content providers (i.e. cloud providers) as a non-"traditional" stakeholder within the cable capacity market and a player in the data infrastructure game.

Unity came online in 2010. Within the next seven years the company announced major investments in seven more submarine cable systems, aggressively expanding its global fiber footprint far beyond its competitors. In October of 2016 Google announced the Pacific Light Cable Network (PLCN), a 12,871 kilometers-long submarine cable system connecting El Segundo, California to Deep Water Bay in Hong Kong. On its way to Hong Kong the cable will also land in Philippines and Taiwan.[29] Google who had just launched another trans-Pacific cable in June of the same year (the FASTER cable system), announced that the new cable would double the capacity of FASTER at 120 Tbps, making it the highest-capacity trans-Pacific route.[30] The PLCN cable, which will come online in 2018, will be an essential aspect of Google's global cloud network, connecting its new datacenters in Japan and Taiwan to its network in the U.S. This new investment represents a growing appetite for Asian data market among cloud companies. And Google is well-positioned infrastructurally to take advantage of this emerging market for cloud computing. The company's most recent cable project follows suit in expanding its footing in Asia-Pacific. Announced in April 2017, Indigo will run from Singapore to Sydney, landing on its way in Jakarta and Perth.[31] The 9,000 kilometers cable is in line with the expansion of Google's cloud regions mediated through new datacenter investments in Singapore and Sydney.[32]

Of Google's eight submarine cable projects, five have been in the Asia-Pacific region. Unity, FASTER, and PLCN connect Google's Asian cloud region to its North American network, while SJC and Indigo extend the company's Asian network into South Asia and Australia. The remaining three cables

(Monet, Junior, and Tannat) form an extended network connecting North America to yet another emerging global market, South America. The three cables essentially form a chain extending from Boca Raton in Florida to Maldonado in Uruguay, while making three strategic landings in Brazil, in Fortaleza, Rio de Janeiro, and Santos (around 70 kilometers from São Paulo). The 12,946 kilometers cable chain is slated for completion by the end of 2017, and will be an important link between the company's North American operations and its new South American cloud region in São Paulo, Brazil.[33]

Complementing Google's submarine cables is an extensive network of terrestrial fiber and private network nodes which together form a massive global net of presence. The company's investments in submarine cables in Asia-Pacific and South America are accompanied by unpublicized private fiber networks and massive amounts of bandwidth bought from more traditional cable providers like telecoms. Mediating the interconnection between these various networks is yet another layer of Google's global infrastructure. Google's private network connects to the public internet at specific locations called Edge Points of Presence (PoPs). The company maintains a presence at over 90 internet exchanges and over 100 interconnection facilities throughout the globe.[34] A global network of fiber optics then connects the PoPs to the company's datacenters. At the very edge of Google's network there are the Edge Nodes or Google Global Cache (GGC). The edge nodes represent Google-supplied servers that reside within the networks of Internet service providers (ISP) and network operators.[35] Them main aim of the GGCs is to create a temporary cache of the most popular Google content for the user base of an area served by the local ISP at the very edge of the network, hence reducing load times and latency in accessing Google content to a minimum. The data that is continuously collected from the physical and digital behavior of users is used to evaluate what content types are cached locally. Other cloud providers have similar systems in place. While these nodes are beneficial to the end-user—and that is certainly how they are marketed—they nonetheless perform an essential operation for Google: allocating content access points within metropolitan areas, sometimes thousands of miles from the company's datacenters, reduces the load on the company's long-haul fiber networks. PoPs and GGCs temporarily localize the cloud.

Google's efforts in building up its private cloud network is matched by efforts in improving access to the company's services through last mile projects that extend out even further than the PoPs or the

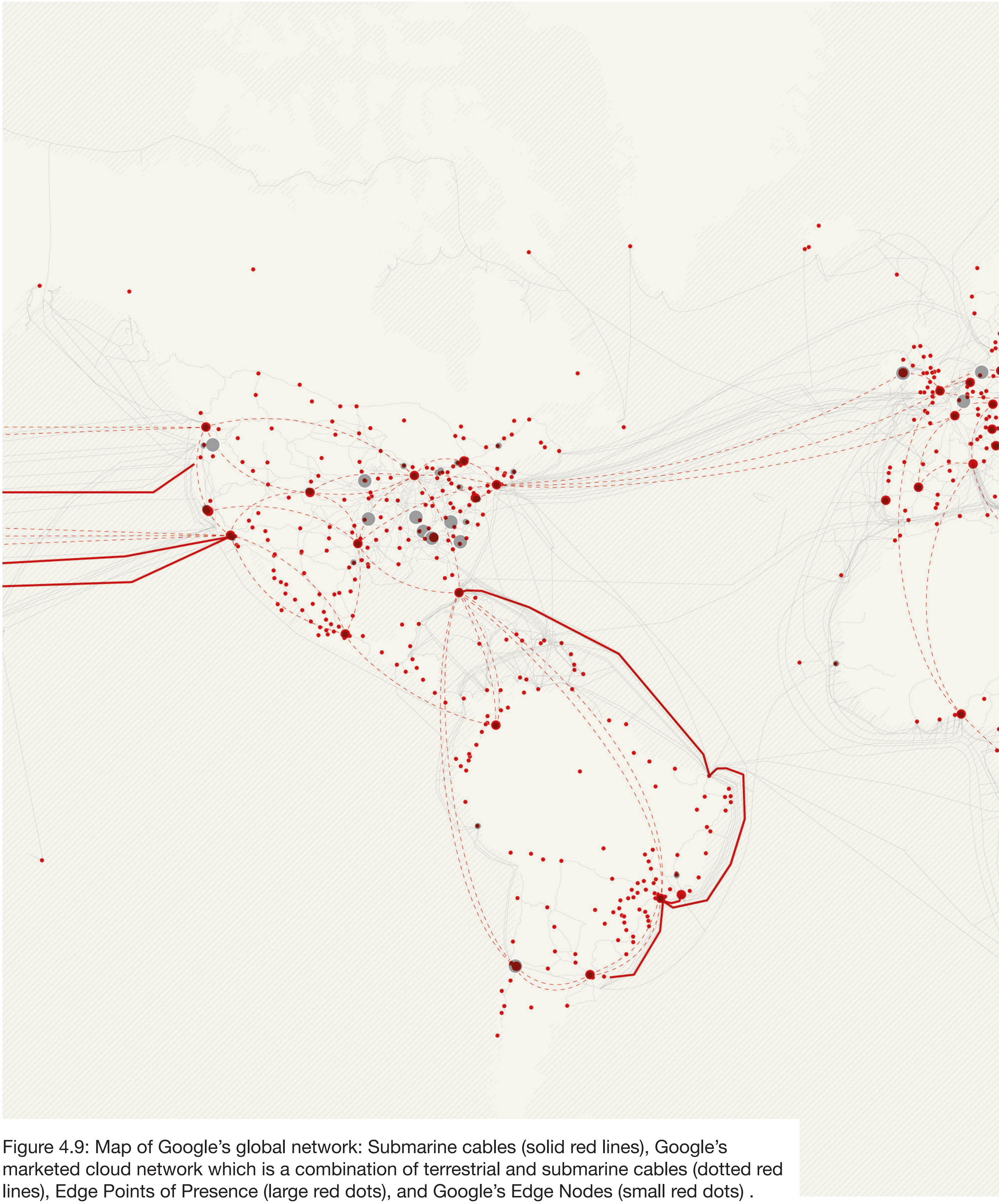
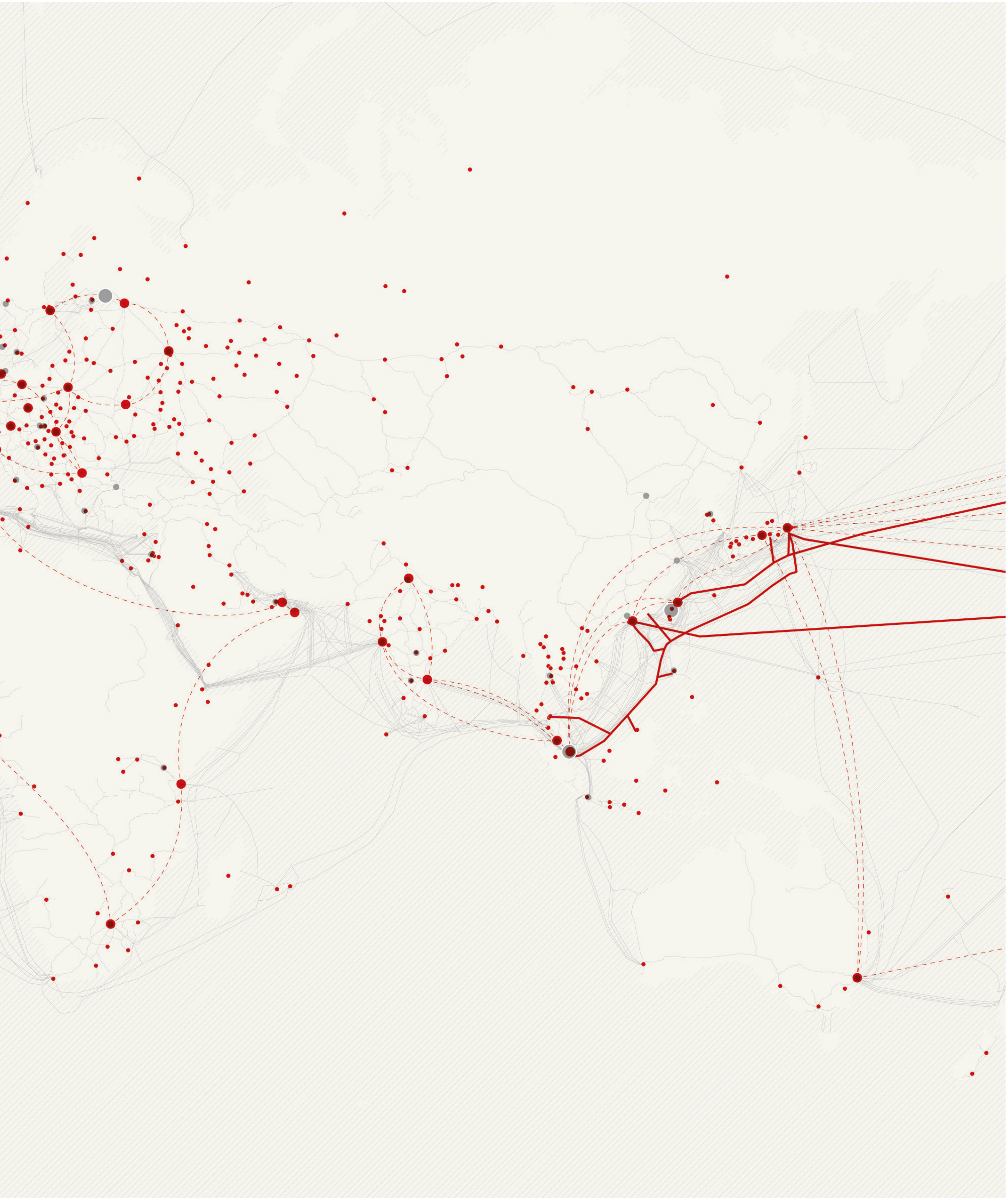


Figure 4.9: Map of Google's global network: Submarine cables (solid red lines), Google's marketed cloud network which is a combination of terrestrial and submarine cables (dotted red lines), Edge Points of Presence (large red dots), and Google's Edge Nodes (small red dots) .



GGC nodes. In addition to submarine communication cables, Google also operates Google Fiber. Established in 2010, Google Fiber launched its first project in Kansas City. Although the company's activities have been limited to 10 cities, there are 2 more cities in the works and the company has identified 8 more cities as having potential for the future expansion of the network.[36] While the project has been viewed as less of an entry into the costly market of telecoms and more as an attempt to motivate existing internet providers to introduce faster connections, it still represents a dramatic shift for Google towards public internet service provision.[37] And while fiber expands Google's hold on established markets, with efforts like the company's now abandoned project Titan, and the still ongoing project Loon, the company is attempting to beam down the last mile to remote regions of internet connectivity.[38]

Google's massive efforts to expand its private network are extremely significant given recent calls by the Trump administration to repeal central pieces of the FCC's 2015 ruling in favor of net neutrality, which essentially reclassified broadband access as a telecommunications service and thus applies the common carrier status of the Communications Act of 1934 to internet service providers.[39] These projects, from new cables to internet balloons over Sub-Saharan Africa, expand the logic and footprint of the cloud ecosystem in search of new domains, new opportunities, and new users, to be territorialized by the cloud. What unites these efforts is a fundamental belief in the supremacy of data in contemporary global economy and a mandate for the infrastructural expansion of the cloud as its organizational model. The cloud would not exist without its logistical network of delivery. However, as much as they may be swept under the rug, the material form and territorial operations of communication networks weigh the cloud down to the ground—or the bottom of oceans—as they trace the territorial footprint of its global domination.

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MINES

An ecosystemic analysis of the cloud must surely include the devices that form the interface layer between computing resources stockpiled in the cloud and its users. Contrary to the distributed dream, the growth of mobile computing, especially the integration of mobile communication with mobile computing devices in smartphones and tablets over the past 10 years, has only exacerbated the rise of centralized organizational forms of global computing. The growth of the cloud and the evermore dominance of computing by a handful of cloud service providers could not have been possible without the immense popularization of slimmer, more mobile, computing devices and the integration of computing into appliances, and infrastructures. In other words, the physical limitations of these devices transfers the burden of actual computing (the costliest but also the most universal aspect of data economy) to the cloud. Through deployment of "a weave of networked perception" that seeps through spaces and places, and that wraps things and bodies, the purveyors of the internet of things (IoT) are pushing for a future in which everything is connected to everything and everyone.

This "colonization of everyday life by information processing," as Adam Greenfield has called it, is mediated through a network of devices and perceptors that harvest data about environments, cities, places, bodies, and the various flows that take place within and around them.[1] The immensely important questions about the control of the data and the unbalanced power relations that this relationship entails remain unanswered, if not ignored. The truth is that while the networked device of IoT possess incredible observational and sensing capacities, very little computing actually happens locally in them. They are essentially there to syphon data. It is once this data is aggregated within databases and correlated with other databases that patterns emerge, upon which decisions are made. So the mediators of the IoT are inherently dependent on communication networks and centralized computing resources for the actualization of their power and the monetization of the data. They need the cloud.

An increasing number of these perceptors are embedded within public spaces hiding in lamp posts, underneath streets, on buoys out on water, or integrated into billboards. They track public transportation, regulated traffic, collect utility meter data, or detect weather patterns. They are designed to be out of sight and are very much integrated within the daily life and infrastructural flows of any urban area. Complementing this hidden, but critical, networks of perception is a more mobile network of personal devices that have become so centrally tuned to our daily lives that we cannot go a day without them. In a recent survey by Bank of America 91% of respondents found their smartphones to be as important as their cars or deodorant. For the generation that has grown up in the digital age (aged 18-24) smartphones are more important that even personal hygiene products like deodorant or toothbrush.[2] Mobile devices, like smartphones and tablets, have become so fetishized as consumer products and integrated into our lives that we tend to willingly surrender to them our most personal information. So much of the most creative, critical, passionate, sexual, representational, and clandestine aspects of our lives are mediated—directly or indirectly—through four to ten inch multitouch Gorilla Glass-faced screens that they have essentially become observational hubs for our bodies, homes, and cities.

The rise of mobile computing

While the personal computing revolution of the 1990s helped to establish the primacy of the internet and other computer networks for both individual and business applications, the rise of mobile computing (accessing data through smart phones and tablets for example) is signaling a more mobile future for computing. This is a significant transformation as mobile devices have begun to surpass desktop computers as the dominant means of accessing the internet.[3] Mobile computing is central to the realization of the ubiquitous epoch of computing put forward by Mark Weiser, the head of the Computer Science Laboratory at the Xerox Palo Alto Research Center, in 1991.[4] Weiser's formulation of "the Computer for the 21st Century," relied not only on networked communication but also on lightweight, personal, and mobile devices that ubiquitously integrated into the daily operations of users across a local network. Weiser strongly believed that "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."[5] The disappearing act of information technology through embedded and ubiquitous computing, which Weiser articulated as "a fundamental consequence not of technology but of human psychology," is perhaps one of the most essential contributors to the growth of cloud computing over the past decade, once the mobility of computing was able to match the mobility of life. In fact, the everywhere anytime promise of the cloud is partly driven by this increased need for mobility.

It was the integrative potential of mobile communication devices that gave way to the creation of the first multi-touch smartphone 16 years after Weiser's prophecy about ubiquitous computing. Apple's iPhone was unveiled in 2007 and quickly commanded the top spot in global smartphone market. Although the iPhone has lost some ground in recent years to competitors, it still remains the model, sort of a gold standard, for smartphones.[6] An important part of the model is how well it integrates itself into daily tasks thanks to the design of its familiar user experience and gestural user interface. Over time various other essential pieces of the iPhone have become standardized components of the contemporary smartphone. Aspects like touchscreen user interface mediated through scratch and shatter resistant Gorilla Glass; GPS, Gyroscopes and other locative spatial technologies that can quickly and accurately locate the phone in the globe; expandability of operations through third-party apps that make the device indispensable to the professional, recreational, and entertainment activities of its users; and extendibility of storage and processing through cloud services which mitigate the limited storage and increasingly complex processing functions now demanded of handheld mobile devices.

A Mobile Cloud

The relationship of mobile computing and smart devices to the cloud is quite complex and far from linear. However, within the spatial and expansionist discussion of the cloud certain dependencies in this relationship require highlighting. On one hand the increased mobility demanded of computing and the physical and operational limitations of mobile devices have justified the increasing dependence on centralized computing resources. As mentioned previously mobile devices such as smart phones and tablets have inherently limited capacity and capability. The growing dependence on data and the massively complex storage, analytic, and processing functions being demanded of these devices cannot be locally satisfied. (i.e. on the device itself) So in response new computing models have emerged that prioritize the cloud as the off-site processing and storage engine of mobile devices. Augmentation of mobile devices through the cloud would address some of the inherent limitations of mobile devices such as relatively slow processing and limited RAM, the need for an external power source and the rapid depletion of batteries in cases of high processing demand, limited storage especially given the growing size of the increasingly complex media formats, and the stability and security of data as well as concerns for privacy.[7] By centralizing these functions within the cloud and the growing capacity of broadband networks to interconnect devices and datacenters, mobile devices can instead focus their limited energy and processing capacities on improving user experience which has traditionally been a big selling point of contemporary smartphones and tablets.

On the other hand, the locative capacities and spatial-behavioral identifiers embedded within mobile devices continually produce data that is of great value for cloud providers who have in turn produced a secondary market for this data. Additionally, cloud providers can use the data collection capabilities of mobile devices to fine-tune their own services towards more spatially and behaviorally relative provisions, which may include advertising and other ways of monetizing data. Locative and temporal data regarding the activities and behavior of users can be folded into other data mining operations of the cloud companies to form a truly universal and spatial platform.

The focus on the user interface and the near-instantaneous interactions of the user with the cloud, mediated through broadband networks, tend to infuse devices such as smartphones with "seemingly cosmic omnipotence," that occult their dependence on the centralized resources of the cloud. "[A]s if the computation and all the data it is based on were happening in the palm of [the user's] hand."[8] In the background, the extended geography of the cloud starts to generate an interwoven and uneven planetary-scale network of materials, processes, and practices that are imbued with power dynamics and control mechanisms that feed back into the sociotechnical construction of the cloud. Mobile devices play an important part in this extended geography.

Extended Footprint of Mobile Computing

Consider an Apple device, like its flagship iPhone. The phone is designed in California by large teams of engineers, product designers, interface designers, and user experience specialists. However, the supply chain that extends beyond the campus is expansive. The phones are assembled in Foxconn plants in Zhengzhou, Northern China, where Foxconn's labor practices have been under heavy scrutiny since the growth of cases of death and suicide due to high workload caused by pressure to meet global demands for electronics.[9] The parts that find their way into Foxconn plants to be assembled are sourced from United States, Asia, and Europe. The assembled phones themselves are sent to intermediate warehouses at UPS or Fedex for online customers, or to Apple's Elk Grove, California facilities for retail stores and other distributors.[10] The extended footprint of mobile devices goes well beyond the glass curtain walls of the Apple store, however. Once we consider the variegated landscapes of extraction, labor, energy, and waste that is produced within the production and supply chain of mobile devices the scope becomes undeniably global.

At even a more basic level, the minerals and the elements that go into each component of mobile devices come from all over the world, sometimes from the most troubled regions. About half of the global supply of cobalt, which is a key component in lithium-ion rechargeable batteries used widely in smartphones and tablets, comes from the Democratic Republic of the Congo (DRC). A 2016 report by Amnesty International found that of the total cobalt exported from DRC, 20% come from artisanal mines with massive human rights issues which include the use of child labor.[11] Many of the smartphone manufacturers named in the report have stated that their vendors do not buy cobalt from these artisanal mines. However, the report has found that given the complexity of the global cobalt supply chain it is highly likely that the cobalt mined illegally in DRC artisanal mines does find its way to China where it is smelted. In fact, a further inquiry by The Washington Post in 2016, a year later,

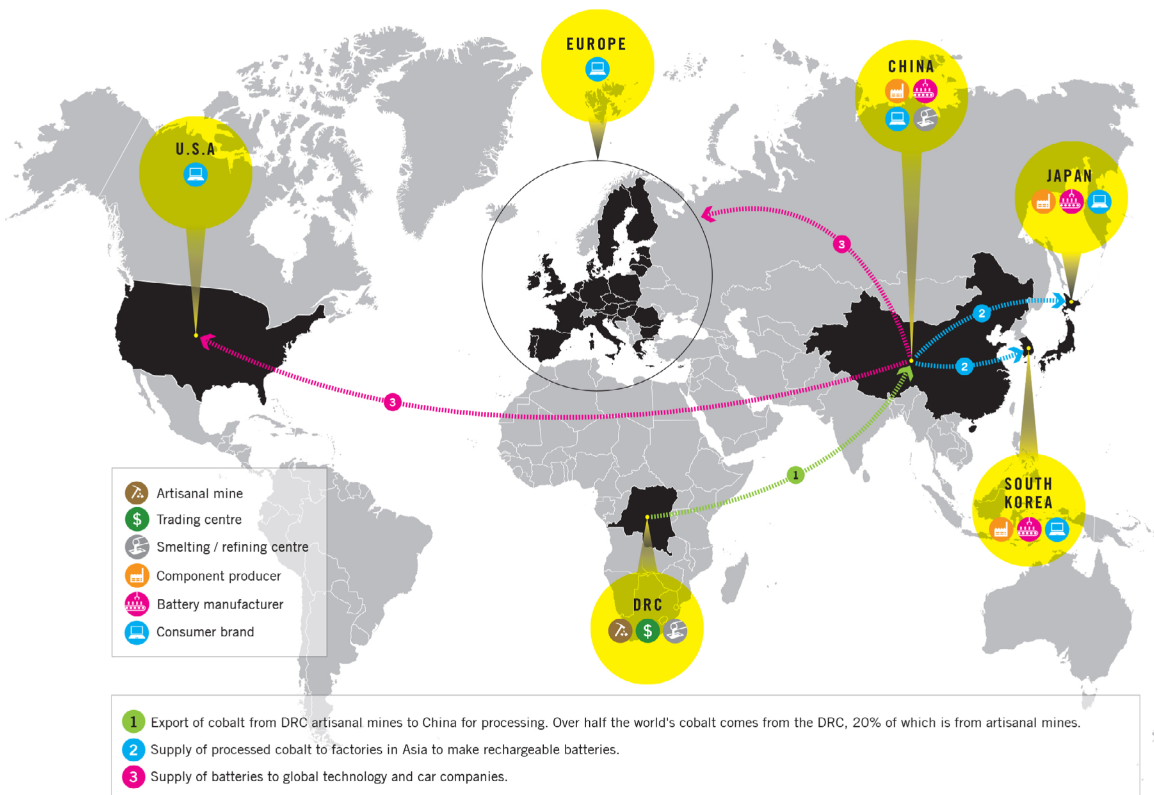

Figure 4.10: Map depicting the movement of Cobalt from DRC to global consumption markets.

confirmed the prevalence of cobalt from artisanal mines that use child labor within the global supply chain of cobalt.[12]

The processed cobalt is then sold to battery component manufacturers in China and South Korea and eventually finds its way into lithium-ion rechargeable batteries which form a critical part of contemporary smartphones and other mobile electronics.[13] A single Apple iPhone 6, for example, uses 6.59 grams of cobalt, which accounts for more than 5% of the total weight of the device. There are only six raw elements that are used more than cobalt in the iPhone: Aluminum (24.14%), Carbon (15.39%), Oxygen (14.5%), Iron (14.44%), Silicon (6.31%), and Copper (6.08%).[14] With the global shipment of smartphones growing to 1,470,600,000 units in 2016, one can reasonably calculate the massive amount of cobalt used in these units.[15] And this is only for smartphones, leaving out tablets, laptop computers, and other portable electronic devices that also depend on lithium-ion batteries and the cobalt used in them.

Once we consider the thirty or so other elements that make up the iPhone, the reach of the productive landscape of mobile computing touches almost every corner of the globe.[16] And with as much raw material entering this system even more waste is outputted. Whether it is massive lakes of toxic sludge in Inner Mongolia, or the tons of electronic waste shipped annually from North America to India, Ghana, or China, both ends of the lifecycle of computing devices heavily contribute to environmental degradation and global socio-political inequalities.[17] In a recent report, Greenpeace has outlined four major areas of mobile computing that are in need of immediate critical engagement: Environmentally degradative and socio-politically devastating extractive practices in countries like the DRC; Abusive and destructive working conditions within the manufacturing and extraction industries that produce the components of devices; Energy requirements of contemporary smartphones and tablets which in turn leads to increased demand for coal and other dirty sources of energy; And the deficiencies within the manufacturing process of mobile devices which encourage replacement rather than maintenance and contribute to a rapidly growing e-waste stream globally.[18]

These extractive and waste landscapes cannot be imagined as existing outside of the purview of the cloud. Instead, these territories form a critical operational geography that lays at the base of the grounded and expansive logic of the cloud. The around-the-world journey of Apple's iPhone problematizes the limited understanding of the cloud's spatial footprint that has come to dominate most discussions. By going beyond the devices that mediate our access to the cloud, this journey maps an extended geography of the cloud that tends to remain hidden behind the screen and the slick user interfaces of mobile devices.

Google's Mines

While Google has been viewed as primarily a software company, it is beginning to position itself within the highly competitive and crowded hardware industry. The company's recent move into hardware is an attempt to control "the end-to-end user experience," according to Rick Osterloh, the head of hardware at Google who was previously the President of Motorola.[19] It could be that Google is trying to do with hardware what it has been doing with software. Or at least complement its extractive software strategies with hardware that would complete its data ecosystem. Google has for a long time made an extremely lucrative business of gathering and operationalizing what is known as "data exhaust," or "digital exhaust." This is basically data generated as a byproduct of user interactions online. The company uses this data to help advertisers reach the right customer at the right time by tracing the activities of its users, as well as the effectiveness of the ads themselves and relaying this information back to its customers. It is important to note here that Google's customers are not necessarily the users of its services, but rather the advertisers. It has been an immensely successful business model. In 2016 Google had a $79.38 Billion revenue from advertising which accounted for close to 89% of its total revenue.[20] At every stage of this process (collection, storage, aggregation, analysis, sale, etc.) new data is generated which is then fed back into the system to improve its services or roll out new products. According to the Economist, "creating new economic value from unthinkably large amounts of information is [Google's] lifeblood."[21]

This thirst for user data, which began with the company's eponymous search engine, soon spun off many other extractive practices that grew rapidly through other free services and products like Gmail, Google Docs, and Google Maps, all of which collect data generated from the activities of their users. This data exhaust is then fed back into the system to not only improve the services but also to be aggregated and analyzed for marketing and advertising purposes. The raw material of unstructured user data is collected, stored, aggregated and analyzed. Through this process the data, now in

Figure 4.11: Google's "end to end" cloud ecosystem. The company's hardware push recently saw the launch of a complete line of consumer hardware which includes two Pixel phones, three Google Home smart speakers, a small mountable/wearable camera, a set of VR goggles, a new premium line of laptops, and a set of smart headphones.

structured sets, is bestowed new economic value and is then sold to advertisers. In a snowballing loop, data generated of this whole process is fed back into the system.

Google is essentially in the data mining business. It basically operates as an ad-supported data mining practice fronted by extremely well-crafted services that are designed to be effortlessly integrated into the daily life of millions of people. This is how Google is able to keep offering a slew of free services and products. Google's Android operating system, for example, is currently the world's most popular operating system, whether on a mobile device or a desktop computer.[22] Although the company offers Android as an open source software, recent court documents have revealed that Google has generated more than $30 Billion in revenue from the operating system.[23] It is likely that a major bulk of the revenue is generated from mobile advertising fine-tuned through the granular and highly personal data Google is able to extract from Android's native Google apps and its various location services.[24] However, considering that each user has to sign into Android with a unique account and the strong possibility that each user actively uses the same account on other devices (maybe on another mobile device, on Google's Chrome browser installed on a personal computer, or through a smart speaker like Google Home) then the true value of this data rapidly scales up much beyond the reported $30 Billion. This is what Osterloh is referring to with "end-to-end user experience." It is essentially a data ecosystem constructed of the data generated from user activities, the what, where, how, and why of such activity, whether on a mobile device, on a PC, or at their home. This ecosystem is extremely valuable to companies like Google whose entire business model depends on value-added data that can be aggregated and sold to advertisers who potentially use the very same medium used for the collection of data (Google apps, web advertising, etc.) to reach their consumers, in turn generating more data exhaust.

Currently Google holds the largest market share for search engines (Google at almost 92%, compared to its closest competition Bing at 2.6%)[25], internet browsers (Chrome at almost 56%, second is Safari with 14%)[26], and operating systems (Android with 39.8% has just surpassed Windows which is at 36.3%).[27] In addition to Google's investment in urban hardware technology, from self-driving cars to WiFi access/advertising kiosks, the company is investing heavily in consumer hardware. While the company's data mining strategies have been quite successful they are still at the merci of hardware producers like Apple, who has its own ecosystem through iOS, or Samsung which uses a highly customized version of Google's Android OS. Hence, it would make logical and financial sense for Google to double down on its hardware investment given the massive capital and engineering power that it has at its disposal. While the sales of Google Pixel phones shy in comparison to Apple's or Samsung's, and they may not ever reach those levels, the potential benefit in capturing even a small fraction of the smartphone market would be massive for Google.[28] Again, unlike Apple or Samsung, Google's main business is not consumer products, it is data, its extraction, and its resale. The importance of consumer hardware for Google is justified through their potential as sources of data extraction, from which economic value may be generated through targeted advertising. The same is true with regards to Google Home. While Amazon entered the market earlier with its Echo line, Google's expertise in search and AI will be critical for the growth and wider appeal of such "smart home" devices, not to mention the massive Android market the company can potentially tap into for Google Assistant, the artificial brain of Google Home.[29]

Through investments in both consumer products and urban technology Google will squarely place itself at the intersection of three interconnected scales of the Internet of Things: the individual, the home, and the city.[30] While it is likely that each of these strategies will have its own economic return, it is the data generative potential of the synthesis of these devices and scales that hold the largest potential for Google, both economically and politically. By controlling the various scales of the "end-to-end user experience" Google is able to continuously gather data about its users' bodies, their behavioral patterns in homes and cities, how they move around, and what they are thinking about. This data will have immense economic and political value and is an important aspect of the company's territorial expansion into new markets and new contexts.

Virtual assistants and the watches, phones, tablets, and laptops that host them interface between the cloud and the user's bodies and the spaces of everyday life. They essentially extend the reach of the cloud into the most personal aspects of contemporary living. At the same time these devices make possible the extraction of personal behavioral and spatial data and its integration and aggregation in the cloud. They are data mines which mediate the transformation of everyday patterns into information. The power relations enacted through this system remain largely tilted towards the corporation. While the user may receive nominal benefits, largely in the form of temporary convenience from their submission to the system, the "provider gets *everything*, all the data and all the value latent in it."[31] The increasing supremacy of data within contemporary information economy means that the extractive practices of Google and similar companies will continue to grow, seeping into all aspects of life and operating at various scales, from the individual and the home, to the city and beyond.

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31 Greenfield, *Radical Technologies*, 42.

ENCLAVES

The territoriality of the cloud is not always hidden away in devices, pipes, or server farms. Sometimes the cloud's centralizing logic finds expression within architecture, urban design, and the brick and mortar of physical spaces. Increasingly, the cloud gods are searching for ways of grounding their strategies and ideologies within physical spaces, especially within that ultimate spatial artifact: the city. The cloud's brand of urbanism is one built up of equal parts neoliberal spatial strategies and techno-utopian ideologies, which attempt to bridge the gap left by weakening government oversight and the deteriorating agency of public urban planning institutions in cities worldwide. Cash-strapped cities wanting to compete with other global cities for jobs and development dollars give away billions in incentives just for the chance of having a tech giant land in their town. And as discussed in the "farms" section of this chapter, tech companies actively pit cities against one another to get the best incentives package for their projects. However, building a data center in the middle of the American Corn Belt is one thing and attempting to construct "smart" cities from scratch is another. For the most part, the urban projects of the cloud—the "smart" cities, towns, neighborhoods instigated by tech companies that treat data as a resource to be extracted—take the form of enclaves, campuses, or neighborhoods, that are contextually closed-off, controllable, and technologically decked-out.

In a lot of ways, the urban projects of cloud providers are the culmination of all the other groundings discussed in this chapter. (Farms, Pipes, and Mines) The concentration of resources and infrastructures, selective regulatory suspension and lucrative incentive packages, and the uninterrupted access to user data as well as control of key infrastructures, all coalesce into detached enclaves that operate in a vacuum that is deemed necessary for "innovation" and technological "experimentation." The idea of the camp, as an urban morphology, is invoked here both as the internalization of control over seemingly finite and defined conditions, as well as a defensive mechanism against external forces, which are manifested as either governmental/regulatory, environmental, or both at different times.

Over the past few months, three of the top cloud providers—Amazon, Google, and Microsoft—have initiated urban projects. While all three projects share the common traits of tech driven urban enclaves, they have gone about it in very different ways. Two will be discussed in detail here. Microsoft's recent attempt is in its very early stages and will be omitted from this discussion. But given the trajectory of development of other initiatives, it is likely that Microsoft will follow along the same path.

A New Urban Crisis

Amazon has approached the process as a pageant. In September 2017 the company put out a request for proposals (RFP) for cities to bid to host its new North American headquarters, Amazon HQ2.[1] The RFP attracted 238 proposals from cities and regions across 54 North American states, provinces, and territories.[2] In a unified show of urban desperation, the 238 proposals have clamored for the $5 billion investment by giving up almost as much in tax breaks and other incentives, with all the gimmicky charm of wooing a rich suitor. Tucson sent a 21-foot $2,000 cactus as a symbolic gesture that "Amazon can grow in Arizona."[3] Many of New York's landmarks were lit "Amazon Orange" in support of its bid.[4] And the Atlanta suburb of Stonecrest has set aside 345 acres of industrial land to be used to create a new city called "Amazon" with Jeff Bezos as its mayor for life.[5] However, the unabashed gestures of gushing over Amazon only mask the massive monetary incentives offered by cities and local governments. Chicago, supported by the state of Illinois, has offered $2.25 billion in subsidies and tax incentives.[6] This from a city administration that has consistently cut public services while raising taxes.[7] Perhaps the most aggressive incentive package came from New Jersey, where Governor Chris Christie offered Amazon a $7 Billion incentives package for the company to locate its new headquarters in Newark.[8]

This model of wooing businesses, called "corporate welfare," is not new. Nor is it unique to technology companies. Based on a recent study by the *New York Times*, more than $80 billion of incentives are awarded to businesses by local governments every year.[9] This is in addition to the $100 billion a year in the federal budget that goes towards corporate welfare.[10] However, the Amazon sweepstakes are perhaps the most public and unabashed contemporary example of the dominance of neoliberal urbanism. While neoliberal urbanism is a complex and variegated landscape of strategies, sites, and models, as Neil Brenner has articulated,

> "the common denominator of neoliberal urbanisms is the market-fundamentalist project of activating local public institutions and empowering private actors and organizations to extend commodification across the urban social fabric, to coordinate a city's collective life through market relations, and to promote the enclosure of non-commodified, self-managed urban spaces."[11]

In this vein the lobbying effort of city managers for Amazon HQ2 is perhaps the ultimate commodification of urban life, in which each one of the 50,000 jobs Amazon has promised comes with a price tag that would be financed by public funds. Furthermore, the Amazon pageant follows decades of weakening city administrations and deterioration of public planning institutions in the wake of neoliberal policies adopted after the urban crisis of 1970s in North America. The Amazon sweepstakes for some represents the ultimate bankruptcy of the notion of "urbanism" inherited from the aftermath of the urban crisis, as a loosely adopted and fetishized Jacobsian "ballet of street life."[12] A kind of urban idealism that ignores the neoliberal economic characteristics of contemporary city which is now increasingly subject to the whims of corporate strategies and their profit-driven locative logics. Michael Storper, writing about the importance of the location of businesses in the economic health of cities like New York, London, and Paris writes that the "vast majority of their people come to these cities in order to work. The world urban system—from its richest to poorest cities—is not a set of playgrounds or amenity parks but instead a vast system of interlinked workshops."[13]

And here lies the neoliberal basis of contemporary tech-urbanism. By dangling 50,000 "well-paying jobs," Amazon is able to underwrite its $5 billion capital investment over 15-17 years through massive incentives from eager city administrations.[14] The jobs however are not guaranteed and the race to grab the private capital offered by Amazon will ultimately result in a massive devaluation of fiscal policy to appease the needs of the corporation. Amazon's strategy, which is only indicative of the much more common—and increasingly—neoliberal policies of local governments, seems to encourage unnecessary and ultimately destructive competition among municipalities.[15] "Driving down taxes (and public spending) not only makes investment less costly, it creates space for the private sector to take over what had been public."[16] Hence, this strategy will likely result in further social strife between those that can afford access to the rapidly privatizing urban realm and those that will be displaced as a result.[17]

As observed in countless corporate campuses across the world the project will also likely result in a physical separation of Amazon resources, talent, and any infrastructural bounty that may come with them, from the larger context of the city in which it lands. This separationist ideal is coded into the physical and urban DNA of tech corporations. In advancing their neoliberal agendas the cities that the cloud builds will seamlessly combine utopian imaginaries, frontier ideologies, and extrastatecraft strategies to generate enclaves of privilege, which are separated from the larger urban realm. In doing so, each aspect carries with it the escapist and the separationist ideals coded into the camp morphology.

From Campus to Tech Utopia

The core spatial strategies of the cloud first take form in the spatial experimentations of the campuses and headquarters of tech companies. As discussed in the previous sections the various materialities of the cloud (from data centers and cables, to mobile phones and tech campuses) are heavily dependent on the so-called "grounded" infrastructures of energy, water, and transportation, and rely on tax incentives and inexpensive land for their siting. They also have to be shielded from natural disasters and sociopolitical fluxes. In other words, they have to be environmentally, socially, politically, and contextually protected. In parallel, we are now seeing the rise of the headquarter campuses of large tech companies as they try to enhance their cultural identity and corporate image. Designed by "starchitects" like Norman Foster (Apple), Frank Gehry (Facebook), or Bjarke Ingels and Thomas Heatherwick (Google), these corporate campuses have become the horizontal monuments of the contemporary information economy. Coupled with the culturally integrated products they produce, and the libertarian ideologies they advance, contemporary technology companies have transformed from corporations to pseudo-cultural institutions. Yet, the smoothing of space that happens within the bounds of tech campuses rarely finds its way outside the walls where social and political tensions are the highest they have been in decades.

Formed within the relative vacuum of enclaves, the "best practice" models and foundational ideologies of tech campuses are subsequently exported globally and seep into the general psyche, masquerading as innovative and novel spatial forms that produce equally innovative results. (software, hardware, etc.) Often packaged as developmentalist strategies, the continual paraphrasing of the most pronounced urban morphologies of the Silicon Valley (the campus, the techno-industrial park, etc.) in the contested geographies of Southeast Asia, Sub-Saharan Africa and the Middle East, have produced emerging forms of territorial expansion. Chief among these spatial arrangements is the rapid process of enclave urbanization that emerges as a result of the infrastructural and socio-political dependencies of high-tech industries.[18]

As direct descendants of "the zone"—the diverse variety of incentivized urban forms and specialized economic zones that have propagated economic growth in developing countries through foreign investment—these informational enclaves, fitted with walls, security fences, armed guards, and defensive urban design, are designed as hyper-connected info-bubbles that attempt to systematically bypass the barriers and constraints of the local geography, while aligning themselves with global flows of information and economy.[19] The "splintering" of the urban fabric in this manner creates highly specialized and repeatable cellular clusters similar in character to gated communities, a condition Carlo Ezechieli calls "global citadels," and which Saskia Sassen refers to as "sited maternities with global reach."[20] Originally emerging from a technological leapfrogging ideology, and in hopes of becoming catalysts for a more general societal development in emerging economies, these enclaves still represent a large portion of infrastructural urban development in the majority of these contexts. As far back as 1980, United Nations Industrial Development Organization (UNIDO) cautioned about Export Processing Zones (EPZ), one of the predecessors of the contemporary informational enclave. “The disadvantages of the EPZ would appear to lie in the continuation of its enclavistic nature,” the 1980 report warned. “Perpetuation of the enclave will retain the problems, the social and economic costs, without the obvious off-set of further benefits.”[21]

Even without any quantifiable advantage for the contexts they are located in, these enclave forms of urbanization represent a stubborn hope for leapfrogging capabilities of concentrated infrastructures of information and communication. In a 1997 report Yunkap Kwankam and Ntomambang Ningo maintained that African countries can leapfrog several stages in the use of ICTs by incorporating the latest technology available and learning from the experience of the more advanced countries.[22] However more recent studies have found that for the latest technologies to be widely diffused, they are reliant on the availability of “intermediate technology.” The prevalent leapfrogging ideology tends to ignore that the spread of access to 21st century’s technology is bolstered by infrastructural developments of two centuries ago. “Computers and broadband links are not much use without a reliable electrical supply, for example, and the latest medical gear is not terribly helpful in a country that lacks basic sanitation and health-care facilities.”[23] The deep rooting of such ideologies, coupled with the surficial economic success of special economic zones—or other variants of the zone model—as models of development in South-East Asia, have paved the way for a wide acceptance of these enclave developments as catalysts for social growth in much of the developing world.

In their contribution to global urbanism these enclaves take on an infrastructural character as they form the basis of the type of spatial construction that underlies much of new economic development globally. As Keller Easterling has maintained, if “diverse spatial types demonstrate the ways in which architecture has become repeatable and infrastructural, then it is the zone that demonstrates the ways in which urbanism has become infrastructural.”[24] It is in fact this infrastructural condition of urbanism that has helped the enclave, or the zone, to mutate into a diversity of urban forms, from the traditional office park to entire cities. They have become forms of “incentivized urbanism”, offering varying levels of freedom—political, economic, and social—to the businesses and companies that reside in them, the sort of freedom that do not leak beyond the bounds of the bubbles they have created.[25] From office parks and factory towns to call centers and tech campuses, variations on the concept of the zone “easily migrate around the world” and “thrive in legal lacunae and political

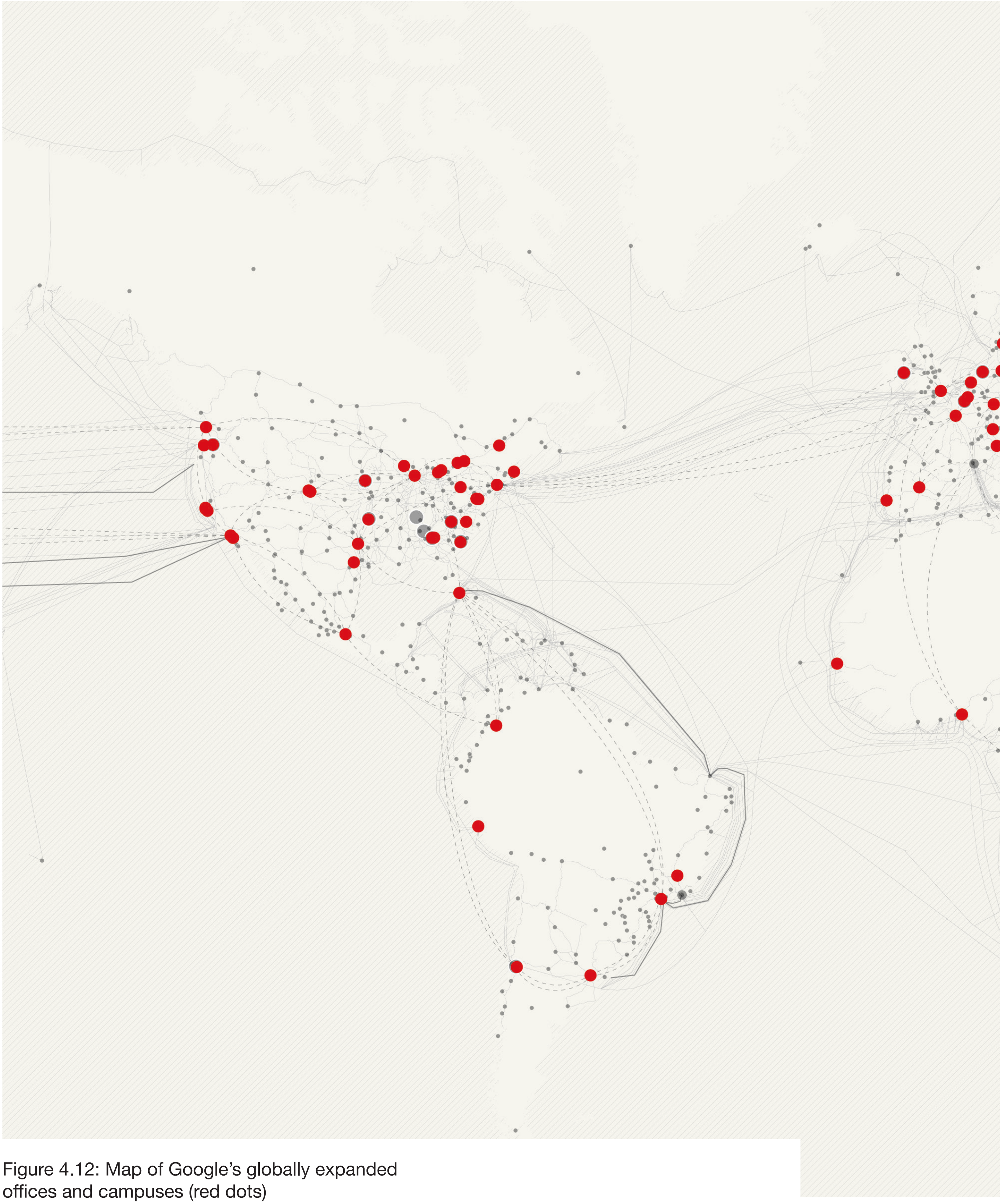
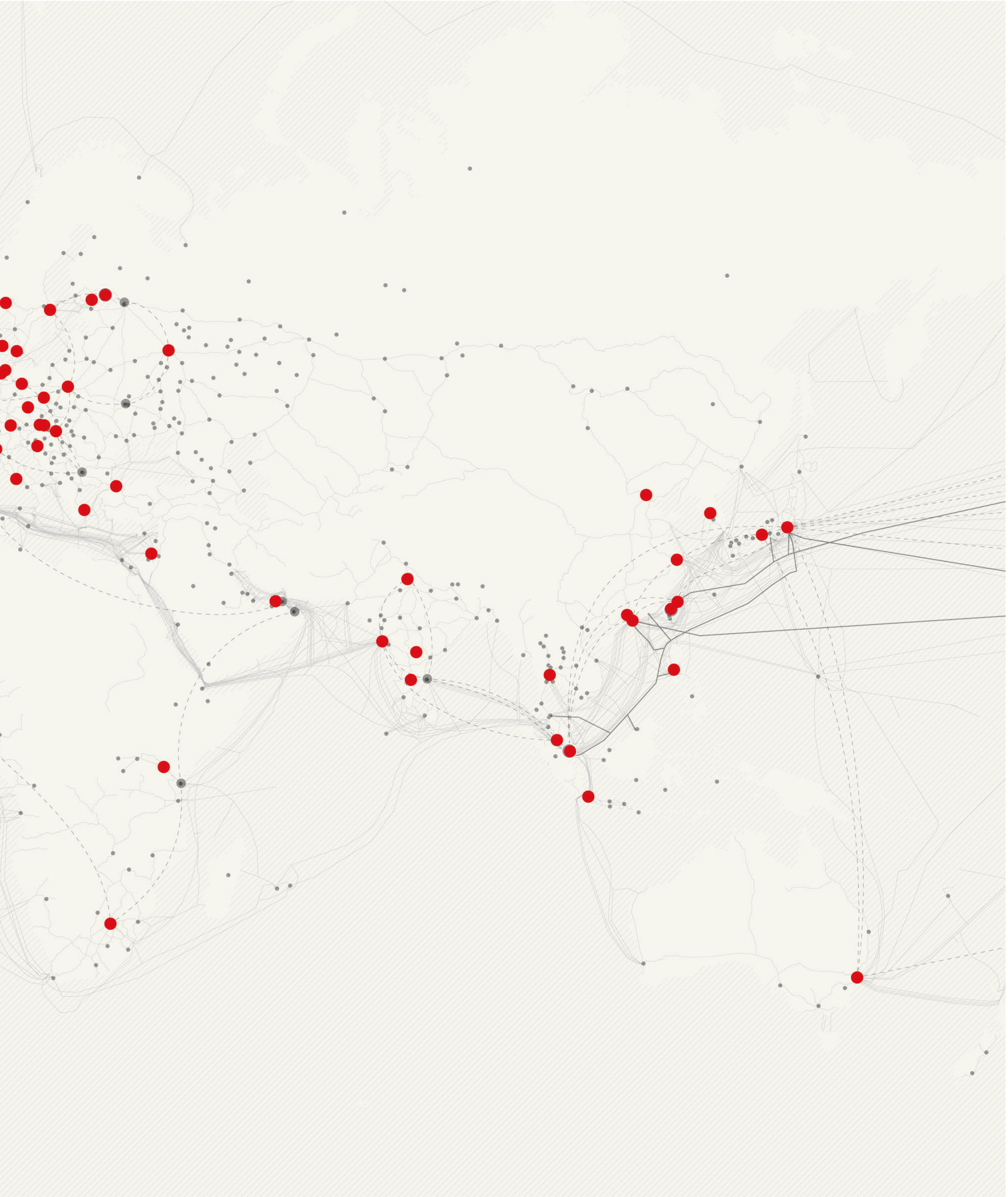


Figure 4.12: Map of Google’s globally expanded offices and campuses (red dots)



quarantine, enjoying the insulation and lubrication of zone exemptions."[26] In this new urban role, the enclave becomes a new way of attracting direct foreign investment, and acts as an important component of post-oil, or post-manufacturing economic plans of host regions.

Beyond the developing world, the highly repeatable nature of this enclave urbanism—mostly devoid of contextual relationships—and their deployment in multiple contexts with variegated cultural, social, and environmental dynamics, in effect generate a capsular geography of information. Similar to the Disneyfication of suburban environments and the emergence of gated communities in the second half of the 20th century, the capsular urban logic of the informational enclave can be representative of the type of development we can expect over the next few decades at the intersection of information and communication technologies and urban processes. A condition which places the majority of emphasis on the network—the global networks of information and communication as well as capital and commerce which are increasingly interwoven—on one hand, and the capsule—enclaves of high infrastructural and technological accessibility and exclusionary zones of leisure, business, and living—on the other hand, leading to a "smoothing" or "pacification" of whatever lies in-between.[27] In this framework, enclaves become less a space of exceptions, and more the norm.

Tech Secession

There is yet another side to the propagation of tech enclaves, and that is the immense visibility they bring to some of the libertarian ideals that lie at the core of their foundation. While architecture and urbanism have become infrastructural they are also part of a processes of materialization of the ideals of software and its engineers. According to Easterling, "Architecture and urbanism are accoutrements in the masquerade. While the logistics park is the materialization of software on the network side of the screen, the IT park materializes the media and marketing side of the screen."[28] Urbanism is increasingly used as a tool of grounding the techno-utopianism of the frontiersmen and the technologically empowered settlers of the techno-utopias of the future.

In a recent speech at the Y Combinator's Startup School, Balaji Srinivasan, passionately argued for Silicon Valley to "exit" the limiting regulations and political shackles of the United States.[29] Comparing "Silicon Valley's Ultimate Exit" to emigration, Srinivasan based his arguments on Albert Hirschman's 1970 book, *Exit, Voice, and Loyalty*. In the book Hirschman conceptualizes two responses in relationship to an organization's decline, whether the organization is a state, a company, or any other form of human grouping: voice and exit.[30] Voice amounts to more of a political action which is essentially about voicing displeasure through protest or submitting a complaint through corporate channels. Exit on the other hand represents a less confrontational less political action through which the members of the organization exercise their freedom to sever ties with the organization and leave. Emigration is an example of exit, so is quitting a job or leaving a business for a higher quality competitor. In his talk Srinivasan speaks about the ascendance of Silicon Valley—in terms of the power it is able to wield—above what he calls the "Paper Belt," the older, less agile institutions of governance, education, publishing, finance, and entertainment, as represented by the four cities of Washington D.C. (the seat of the national government), Boston (the representative nucleus of higher education), New York (the center of publishing, and the seat of Wall Street), and Los Angeles (the hub of entertainment, film, and music industry). Srinivasan is not alone in this. A growing chorus of tech elites have recently voiced their belief in Silicon Valley's growing power over the other traditional institutions of society.[31] In fact, what Srinivasan and others argue is that these traditional seats of power are holding back the innovative push of Silicon Valley through unnecessary regulations while blaming tech companies for the myriad of sociopolitical problems, including soaring housing costs, and the deterioration of public institutions. Srinivasan's counter argument is exit: "we want to show what a society run by Silicon Valley would look like without actually affecting anyone who still really believes the Paper Belt is actually good. And that's where exit comes in." For him Silicon Valley's ultimate exit means to "built an opt-in society, ultimately outside the U.S., run by technology." Srinivasan believes this is the path Silicon Valley is currently on and will get there—to the ultimate exit—over the next ten years.

About a month after his talk at the Y Combinator, Srinivasan followed up with an opinion piece in *Wired* magazine. In the article he examines how tech innovations developed in the Silicon Valley are reorganizing the world. While, as Srinivasan mentions, every square foot of space on earth is spoken for by at least one nation-state, the lack of remaining physical frontier is leading people to exit to the cloud, at least mentally. He goes on to articulate the emerging dominance of the cloud in relation to the American ideal: "while our ancestors had America as their ultimate destination, it is not immediately obvious where those seeking opportunity might head today… With our bodies hemmed in, our minds have only the cloud—and it is the cloud that has become the destination for an extraordinary mental exodus."[32] According to Srinivasan "states of mind"—as opposed to nation states—formed in the cloud are increasingly staking ground in the physical realm. Within this logic, hacker houses, co-living spaces, and gatherings like Occupy Wall Street and Tahrir Square are all manifestations of cloud formations in physical space. And the divergence between social relations formed in the cloud and those formed based on geographic proximity is starting to nullify, as "these cloud formations of mind are beginning to take physical shape, driving the reorganization of bodies."[33] And it is the technological basis of the cloud that is enabling this reorganization of the world because the latest wave of technologies born in the cloud is "not just connecting us intellectually and emotionally with remote peers: it is also making us ever more mobile, ever more able to meet our peers in person."[34]Underlying Srinivasan's arguments for exit is a deeply rooted ideological mix of frontier-seeking, individual freedom, the unquestionable techno-utopian belief in the transformative power of technology, and the ultimate irrelevance of location and spatial friction mediated through technologies of the cloud. But it is also about an inherent set of exclusionary mechanisms that concentrate power and wealth while allowing the spaces and people that lie outside of specific communities to perish: "The best part is this," Srinivasan declares in his talk, "the people who think this is weird, the people who sneer at the frontier, who hate technology, they won't follow you out there."[35]

This separatist notion of exit tends to ignore foundational questions about who can actually opt into these communities? What are the cost and barriers to access? What kind of relationship do these communities—or countries—need to establish with those outside of their bounds?[36] The tech secessionist ideology also completely ignores the inherent dependencies of Silicon Valley on the "paper belt" and those who actively live in, contribute to, and construct it. In response to Srinivasan's speech, Farhad Manjoo, technology journalist and author, warns of these hard-to-ignore links and the arrogance-induced ignorance of the Silicon Valley elite. Highlighting the fact that Silicon Valley's new found power is historically enabled by the rest of the country and its institutions, Manjoo writes:

> "Silicon Valley's money, its customers, and its legal and technological foundations are all made possible by institutions that belong to the paper belt. The government funded the early technologies that led to the Internet, venture capitalists are financed by nontechies' retirement funds, and laws passed in Washington can determine the tech industry's legal

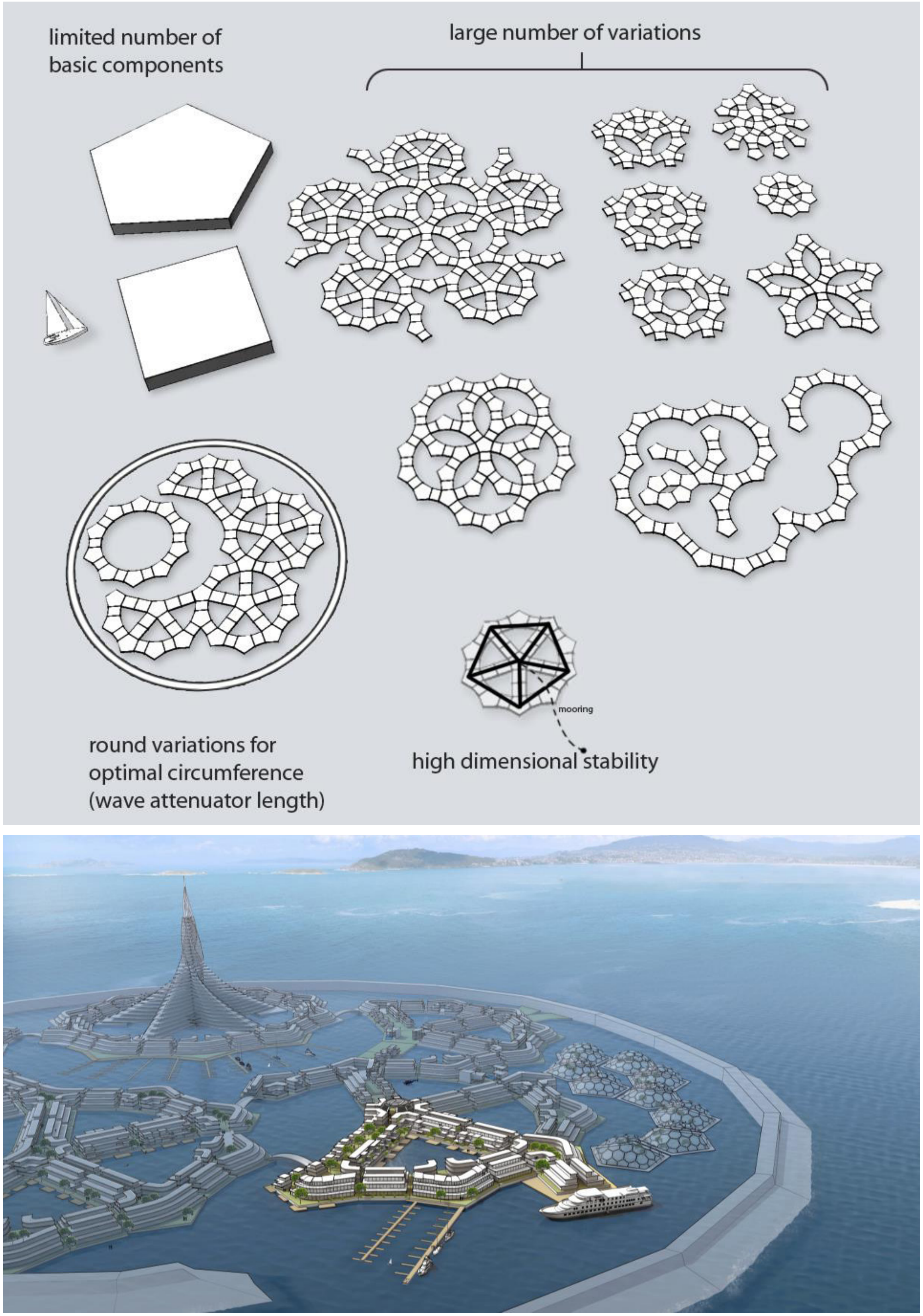


Figure 4.13: System of urban configuration and design for a long-term Seasteading community.

> future. Companies launched in the Valley depend on the quick, widespread acceptance of their products by everyone who lives outside their shiny bubble. What would it mean for an entrepreneur to start a company from a tech utopia favored by Messrs. Srinivasan, Page and Thiel?"[37]

In invoking a separationist attitude towards the mainstream, the neo secessionist faction of the Silicon Valley falls within a long history of the Californian counterculture who claimed freedom and individualism as their ideals.[38] For Douglas Spencer—the architectural theorist and historian who has worked for a number of years on the architecture of neoliberalism—the entrepreneurial account of liberty that is shared in both the history of the Californian counterculture and the contemporary Silicon Valley stems from their parallel development and effective alignment with the rise of neoliberalism in their conceptions of freedom and the individual. Within neoliberalism,

> "freedom is to be expressed through choices made within the economic market, but not through any choice or determination over the norms structuring this condition. Neoliberalism is not, however, simply a return to older market-based notions of freedom but a concerted intellectual mobilization against all forms of planning, welfare, reform and socialism, particularly as these gained ground in the aftermath of WWII."[39]

In this regard, neoliberalism tends to understate and subvert the political through an inherent assumption that all planning leads to authoritarian governance. And Silicon Valley is implicated in this as its "tools of personal liberation" heavily contribute to the depoliticizing project of neoliberalism, "both in the conditions of temporality they impose, and in their tendency to atomize the social into an aggregate of hyper-connected individuals constituted, as such, by their investments in capital and its technological apparatus."[40]

However, while generally the spatial dreams of the tech sector have been represented as colonies out on the ocean or in outer space, hence outside the bounds of governments, these dreams are continually being manifested in cities around the world. Much tamer in language and with promises of improved access, openness, and "high-paying jobs" the contemporary cloud cities are advantageously positioning themselves within the gap left by the desperation and insecurity of local governments and are increasingly offering their capital and their extractive practices as high-value services to cities. In other words, urbanism has now effectively become a tool for the grounding of the techno-utopian dreams brewed up in the clouds of the Silicon Valley's elite. The amazon sweepstakes

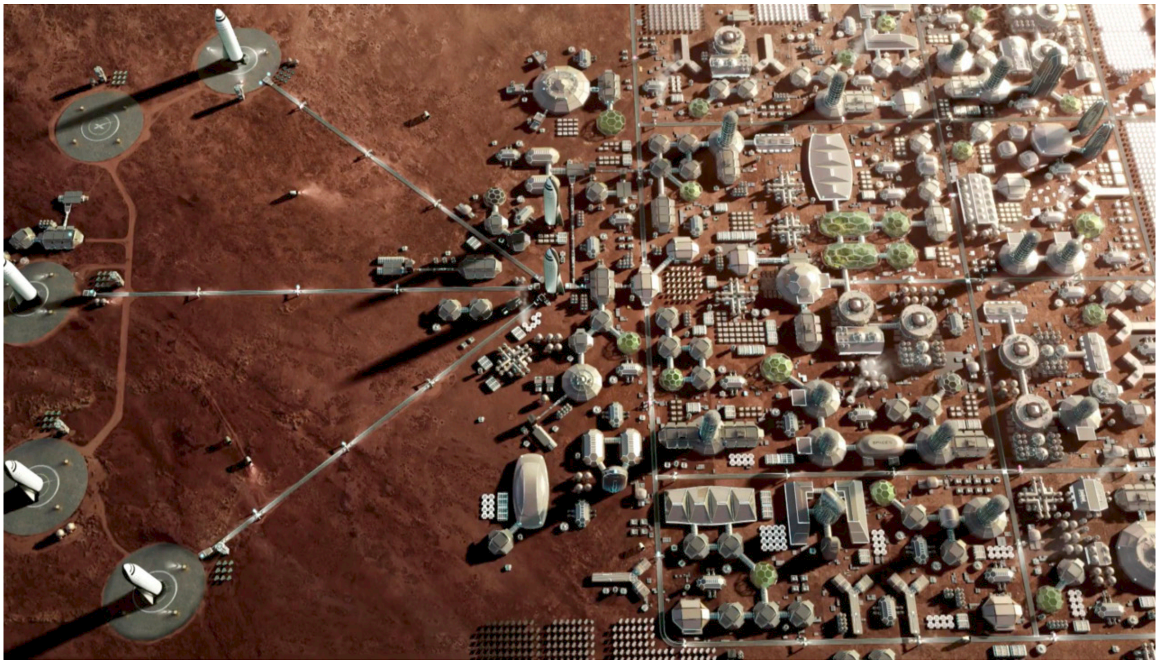


Figure 4.14: SpaceX's proposed space colony on Mars.

is one example of this ultimate grounding of the utopian ideology and territorial logic of the cloud. But the sentiment is growing and forming new strategies and responses.

Page's Dream

On May 15, 2013, as part of Google's annual developer conference, Google I/O, Larry Page, the cofounder and CEO of Google at the time, held a rare and informal Q&A session. While the questions oscillated between technical concerns of developers to socially oriented aims of the company, an intriguing exchange towards the end of the session is worth expanding upon. In response to a question about reducing the negativity and focusing on the positivity of technological developments and their transformative power to change the world, Page voiced his frustration that the older institutions of society—"like the law and so on"—have not been able to keep pace with the rapid changes caused by technological development. While acknowledging the need for some regulation, so the world does not "change too fast," Page objected that we, as a society, have not been able to build mechanisms that allow for experimentation:

> "There's many, many exciting and important things you could do that you just can't do because they're illegal or they're not allowed by regulation… But maybe we should set

> aside a small part of the world. You know, I like going to Burning Man, for example… That's an environment where people can try out different things. But not everybody has to go… I think as technologists we should have some safe places where we can try out some new things and figure out what is the effect on society, what's the effect on people, without having to deploy it kind of into the normal world. And people who like those kinds of things can go there and experience that."[41]

In this short response Page is invoking a number of the most critical aspects of tech secessionism. First, the general dissatisfaction with the slow institutional and regulatory response to technological change. Second, a utopian belief in the transformative power of technology to change the world. Third, the sacredness of the Californian/neoliberal ideals of individualism liberty and freedom, exemplified through events like Burning Man. Four, the importance of "safe" enclaves of experimentation and innovation, separated from the larger societal and contextual frictions. And fifth, the opt-in exclusionary nature of these enclaves. Page's comments have since become emblematic of the Silicon Valley's "ultimate exit" for agitators like Srinivasan, who cite Page, Peter Thiel, and Elon Musk's ventures into cities, oceans, and outer space as indicators of the general direction of technological development towards an immanent exit from the rest of the society. However, far from fantasies, the tech elite is organizing their massive resources behind these ventures and are steadily moving them towards reality.[42]

Following retaking control of Google as CEO in 2011, Page has been adamant in unifying the company, its image, and its culture. One of the lofty goals of the company, which among other things include "moonshot" projects under the banner of "Google X" and investments in biotechnology through Calico, has been to improve cities and urbanization. As early as 2013 Page had floated the idea of creating a second research lab along with Google X which would focus on "building a model airport and city."[43] Initially named "Google Y," Page's urban disruption arm would ultimately materialize in Sidewalk Labs, an urban innovation company that was formed in 2015 in the wake of the creation of Alphabet as holding company for Google and other subsidiaries like Calico, and Waymo, the company's self-driving car company. By positioning itself in "the huge space between civic hackers and traditional big technology companies," Sidewalk Labs aims to apply Google's cloud technology and its massive data apparatus to urban issues such as transportation, health, and housing.[44] The company identifies itself as a platform for other initiatives and start-up spinoffs.

According to Daniel Doctoroff, the company's founder and CEO, besides partnering with city agencies and organizations to develop urban technologies, the company will incubate "labs" led by "entrepreneurs-in-residence." Enabled by Google's infrastructure and funding, Sidewalk Lab's mission is to "accelerate the process of urban innovation."[45] And the company has begun to get some traction. As part of a consortium, the company was instrumental in the establishment of hundreds of free Wi-Fi kiosks in New York City.[46] Besides providing free internet access and mobile device charging to the public, the kiosks also integrate advertising, provide maps and information about the city and its services, and are rumored to be part of Google's eventual self-driving car network. Sidewalk Labs is also offering its cloud-based traffic and transportation optimization software Flow to cities like Columbus, Ohio, which was the winner of the $50 million Smart City Challenge organized by the US Department of Transportation in partnership with Sidewalk Labs, Amazon Web Services, and other cloud companies.[47]

Perhaps the most ambitious goal of Sidewalk Labs remains the actualization of Larry Page's dream of securing a portion of the world for a technologically oriented urban district aimed at testing and experimenting with emerging urban technologies and innovations. To reimagine cities "from the internet up," as Doctoroff would have it.[48] The reports about the possibility of this idea emerged in April 2016, as the Sidewalk Labs team was preparing to present their idea to the now Alphabet CEO, Larry Page. If the proposal was green lighted the company would begin to solicit bids from counties and states by the end of 2016, in a process likely similar to Amazon's HQ2 call for proposals.[49] That line of inquiry was to be rerouted in 2017 as a new opportunity would arise, up North.

Google-on-the-Lake

In March 2017, Waterfront Toronto—an organization formed as a partnership of three levels of government, City of Toronto, Province of Ontario, and the Government of Canada, charged with the administration of the redevelopment and revitalization of Toronto's post industrial waterfront—announced a Request for Proposals (RFP) for an "innovation and funding partner" for the development of Quayside, a 12-acre site situated on the Eastern waterfront at the Western tip of the Toronto Port Lands.[50] In the RFP, besides the typical calls for sustainable, high quality design, and sound financial planning, Waterfront Toronto asks for the proposal to "reflect broader urban innovation, including technology-enabled, inclusive, connected communities," and to "leverage the strength of existing world-class digital infrastructure within the waterfront to realize fully the benefits of emerging technologies—including but not limited to the Industrial Internet of Things ("IIoT"), analytics, and artificial intelligence ("AI")—to support data-informed decision-making for residents, visitors, investors, employers, and service providers."[51] Waterfront Toronto also called for the establishment of an "urban innovation cluster," that would include "demonstration spaces, project testbeds, and industry-academic partnerships" to "accelerate" the growth of the cluster. The keywords used here are eerily similar to the mission statement of Sidewalk Labs and the marketed capabilities of its parent companies Google and Alphabet. So for the Quayside RFP to emerge when it did, as Sidewalk Labs was about to embark on a search for a site of experimentation, is either a huge coincidence or it was an opportunistic initiative of Waterfront who were possibly aware of Sidewalk's pending search.

However, without too much speculation about the origins and timing of the call, the partnership seemed like a perfect match and was enthusiastically announced on October 17, 2017.[52] The Canadian Prime Minister, Ontario's Premier, and the Mayor of Toronto joined the Alphabet Chairman Eric Schmitt and Dan Doctoroff to the launch the new partnership between Sidewalk Labs and Waterfront Toronto, to be called "Sidewalk Toronto." As part of the partnership agreement Sidewalk has allocated $50 million towards a year-long consultation and planning process and Google will move its Canadian headquarters to the Toronto waterfront to serve as the plan's initial anchor tenant.[53] The result of the year-long planning and consultation will be a "Master Innovation and Development Plan (MIDP)" which will not only set the course for the development of the Quayside parcel but will also serve as the innovation testbed for the rest of the Eastern waterfront and even the rest of the city of Toronto.

Beyond a four-page summary of the "Framework Agreement" the specifics of the terms agreed to by either party is unknown.[54] For example, important questions regarding the collection practices, ownership, and marketing of data from urban services, environment, and people remains unanswered. Similarly, the extent of the easing of regulation by the three levels of government to accommodate the experimental and testing of urban technologies, and the extent by which these technologies would be applied to the rest of the Waterfront and the city remain unclear. However, early indications point towards a massive deployment of Google branded data extractive apparatus much beyond the Quayside site and their integration within the rest of the city. Waze, a crowd-sourced Google-owned traffic mapping company, has just agreed to trade traffic data with the City of Toronto.[55] Also Doctoroff has publicly referred to a "new transportation flow modelling concept" that would possibly find its way to Toronto, beyond Quayside, sooner than expected.[56] So it is clear that the relationship will most likely not be limited to the confines of the 12-acre site, which Doctoroff himself has said is "not sufficient" for its aims of testing and experimenting with emerging urban technologies.[57] However, given the lack of clarity of the process that is to unfold over the next year and the scope of the partnership, Sidewalk's proposal, what they call the "project vision," provide initial clues to the extent and nature of the type of urbanism one can expect.

Sidewalk's proposal is sprinkled with mentions of "flexibility," "dynamism," "openness," and "integration." And at least physically the project seems to be driven by urban innovation. The vision document asks, "what could today's cities look like if they were built from scratch in the internet age?"[58] However, the urban and architectural responses to that question do not feel particularly as new or revolutionary as the language of the proposal would have you believe. In fact, from the urbanistic and architectural perspective the project is far from innovative. Facets of its proposed urban vision seem to be remnants of previous rounds of rethinking cities and urbanization that stretch as far back as a century ago. The proposal heavily references many of Jane Jacobs' ideas, for example, opportunistically building on the time she spent in Toronto from the early 1970s until her death. However, the ideas mentioned are not innovative and have become part of the doctrine of urban planning since at least the 1980s; Especially with regards to the creation of a lively and diverse public realm, and prioritizing people over cars within planning of neighborhoods. These are concepts which were initially articulated almost a century ago in response to the modernizing and slum clearance efforts of Robert Moses in New York City.

Similarly, architects and urbanists have long grappled with ideas of spatial interactivity and flexibility in response to market or social dynamics. Cedric Price's projects the *Fun Palace* (1964) and *Potteries Thinkbelt* (1964-66) were emblematic of this dynamic and flexible spatial logic manifested architecturally and regionally. The adaptability of urban environments, mediated through information and communication technologies, have also been explored within architecture and planning since at least the Second World War. In fact, many of Sidewalk's sustainable proposals, from district heating to the use of mass public transit and bicycles, are hardly revolutionary and are based on technologies developed in the 19th century.[59] Architecturally, the most noticeable building type proposed by Sidewalk is the "Loft," which as the name suggests is a recycling of the idea of retrofitting old or abandoned industrial spaces for residential or commercial use; a practice very common in city cores around the world.[60] This time around however, Sidewalk's lofts of "the future city" are essentially shell buildings that can be adapted towards various uses over time. In invoking yet another central aspect of neoliberal urbanism, Sidewalk's loft "will remain flexible over the course of its lifecycle, accommodating a radical mix of uses (such as residential, retail, making, office, hospitality and parking) that can respond quickly to market demand."[61]

So if the urban forms and sustainable technologies proposed are basically a selective rehashing of previous attempts at addressing physical dynamism and spatial flexibility in cities, then perhaps it is the project's structures of management and planning that prove to be innovative. Hence, the question may be rearticulated as "how could today's cities be managed and governed if they were built from scratch in the internet age?" In various online literature and marketing material, and indeed within the Quayside proposal, Sidewalk Labs presents the bridging of "the divide between urbanists and technologists" as one of its key mandates within its innovative brand of urban management in the information age.[62] Here also, a selective line of thinking seems to conveniently bypass the various moments in history in which such a merger was operationalized between the ideals of technologists and urbanists. In fact, the disciplinary agency of urban planning is initially formed and then

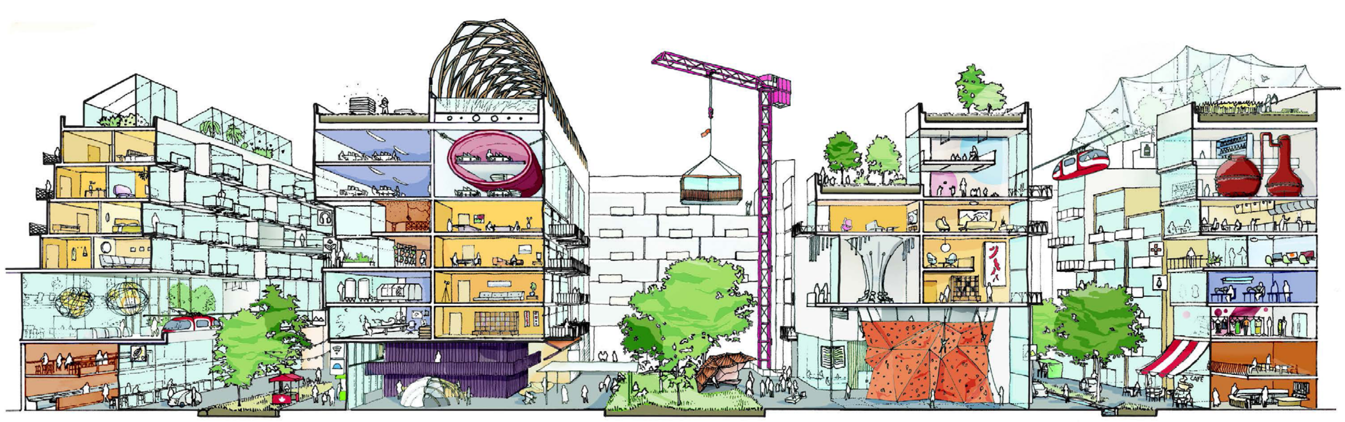


Figure 4.15: Sidewalk Toronto's proposed "Loft" building typology.

opportunistically sustained through a similar convergence of interest between technologists and urban thinkers. Often packaged as reformist calls to arms aimed at alleviating the ills of the city and the problems of urbanization, these convergences have effectively left their mark on cities and the practices of urban planning and management.

One prominent point of convergence between technological and urban ideals took place at the beginning of the 20th century, when a range of interconnected ideological, technological, and managerial ideals began to transform the nature of urbanization in Western societies. Faced with a "problematic" urban condition at the turn of the new century, a modernist regime informed by rational and scientific planning principles and enabled by new technological advances in transportation, sanitation and communication, took on the task of urban reform. As Simon Marvin and Stephen Graham have articulated, notions of societal progress, ubiquity of access, and emancipation through technological development were to legitimize the growth of "single, integrated, and standardized" infrastructures of circulation (roads, water, waste, energy, and communication) between about 1850 to 1960.[63] In parallel, planning and civil engineering emerged as drivers of the rational and scientific expansion of the ideals of progress towards "unitary, coherent, emancipatory cities" through rational and comprehensive planning of infrastructural systems. The rise of planning and engineering—with their philosophical belief in science, technology, and standardized infrastructure—coupled with the growth of a consumption society mediated through grids of power, water, transportation, and communication, eventually would lead to the development of what Graham and Marvin have called "the modern infrastructural ideal."[64] I would argue that this progressive ideal still informs planning and urban decision-making which tends to equate societal progress with infrastructural accessibility.

Another key merging point worth expanding upon here coincides with the rise of cybernetics and the study of communication and control systems in nature and machines following WWII. The influence of electronic communication technologies and their networks of dissemination would begin to permeate the spatial field as major conceptual drivers for imagining alternative forms of urbanization. These alternatives were for the most part driven by an emerging understanding of cities as communication systems and the process of urbanization as the creative management of not only flows of people, resources, and goods, but also increasingly flows of information.[65] If the organicist conception of the city in 19th century "emerged out of a functional analogy, originating within the medical sciences, wherein spatial differentiation corresponded with a distinctive arrangement of human organs," in relationship with "an emerging circulatory emphasis within the nascent science of political economy," by around the 1960s the predominant image of the city and urbanism revolved around technological coordination and control of biological and technical urban networks through machinic ensembles of computer systems.[66] However, the shift was not only evident in the language of spatial thinkers of the time, as noted above, but also within the operational structure of urban practices themselves. By that time, the physical top-down planning of urban renewal had proven to be immensely unpopular.[67] In the context of the failure of planning to effectively respond to the urban needs of 1950s and the resultant urban crisis of 1960s, an authoritative vacuum was created which was to be filled by military expertise and technology. Understanding cities as communication systems opened the door for the urban application of information theories and communication technologies that were incubated in defense and military research and development programs. Cities—and their planning and management—presented obvious sites of opportunity for military executives and engineers who were, in the chaotic aftermath of urban renewal programs of 1950s, actively seeking new markets for the transference of their innovations and technologies beyond military use.[68] The domestic threat of urban crisis and unrest would replace the previous decade's fear of external threats—i.e. atomic warfare—as the trigger for the application of urban defensive strategies. Tools, techniques, and expertise initially developed for the military could now be applied to cities. Cybernetic systems of communication and control were actively marketed to urban administrative and planning agencies and cybernetic principles and expertise were seamlessly weaved into the education of the next generation of planners.[69]

As a precursor to the contemporary "smart cities," during the 1960s, computer modeling and analysis accompanied by electronic communication systems and emerging models of urban analysis (initially aerial photographs and then satellite imagery) would form the basis of a comprehensive and "scientific" regime of top-down technologically mediated planning. By the mid-1970s, however, the limits of cybernetic urbanism as adopted by American cities were showing.[70] Mathematical models and computer systems of analysis of the time were not able to fully capture the massive complexity and dynamic relationships of urban environments. As a result, decisions made on this analysis were more often than not partial, incomplete, and devoid of clear objectives that could never reflect the urban complexities beyond narrowly defined urban goals. While the influence of cybernetics was beginning to wane towards the middle of 1970s, the relationship between cybernetics, military institutions, and urban agencies would create a set of expertise and practices that would dominate city panning for decades. And this is the context within which Sidewalk Labs is situated but which it also selectively ignores. Interestingly, Sidewalk's approach, especially its reliance on a "digital layer" that, together with the "standards" layer, commands and controls the physical layer of the proposed project, bears a striking resemblance to the cybernetic urbanism of the past century.[71]

So what about this proposal is actually innovative? A question that becomes even more critical when one looks beyond the flashy exquisite corpse of urbanism that Sidewalk has presented and into the business model driving this project. It would appear that through notions of flexibility, spatial dynamism, and adaptability, mediated through a "digital layer" of sensors, and enabled by inexpensive prefabricated materials, Sidewalk is essentially promoting a democratization of space. However, the kind of spatial democratization proposed here is more likely to mean freedom from regulatory burdens of zoning and oversight, and not necessarily democratization of ownership and control. Here, Sidewalk's strategies tend to follow typically neoliberal trends in privatizing urban spaces and the public realm. Even though no land may actually change hands between Waterfront Toronto and Sidewalk Labs, the data extractive apparatus (manifested in the combination of the "Sense", "Map", and "Model" components) and the mechanisms of control (enabled by the "Account" component) embedded within the the "digital layer" of the project will ensure a high level of exclusivity and surveillance for the real-estate investments that will ultimately fund the neighborhood's technological experimentations in applied behavioral modeling and management.[72] Even Doctoroff has said on multiple occasions that their Toronto venture is "primarily a real-estate play."[73] As Evgeny Morozov has observed, "the main 'input' into Alphabet's algorithmic democracy is 'market demand' rather than communal decision-making." He continues that, as in cities around the world, one-dimensional responses to "market demand" have increasingly catalyzed the privatization of public space,

> "decisions are no longer taken in the political realm but are delegated to asset managers, private equity groups, and investment banks that flock to real estate and infrastructure searching for stable and decent returns. Google Urbanism would not reverse this trend, it would accelerate it."[74]

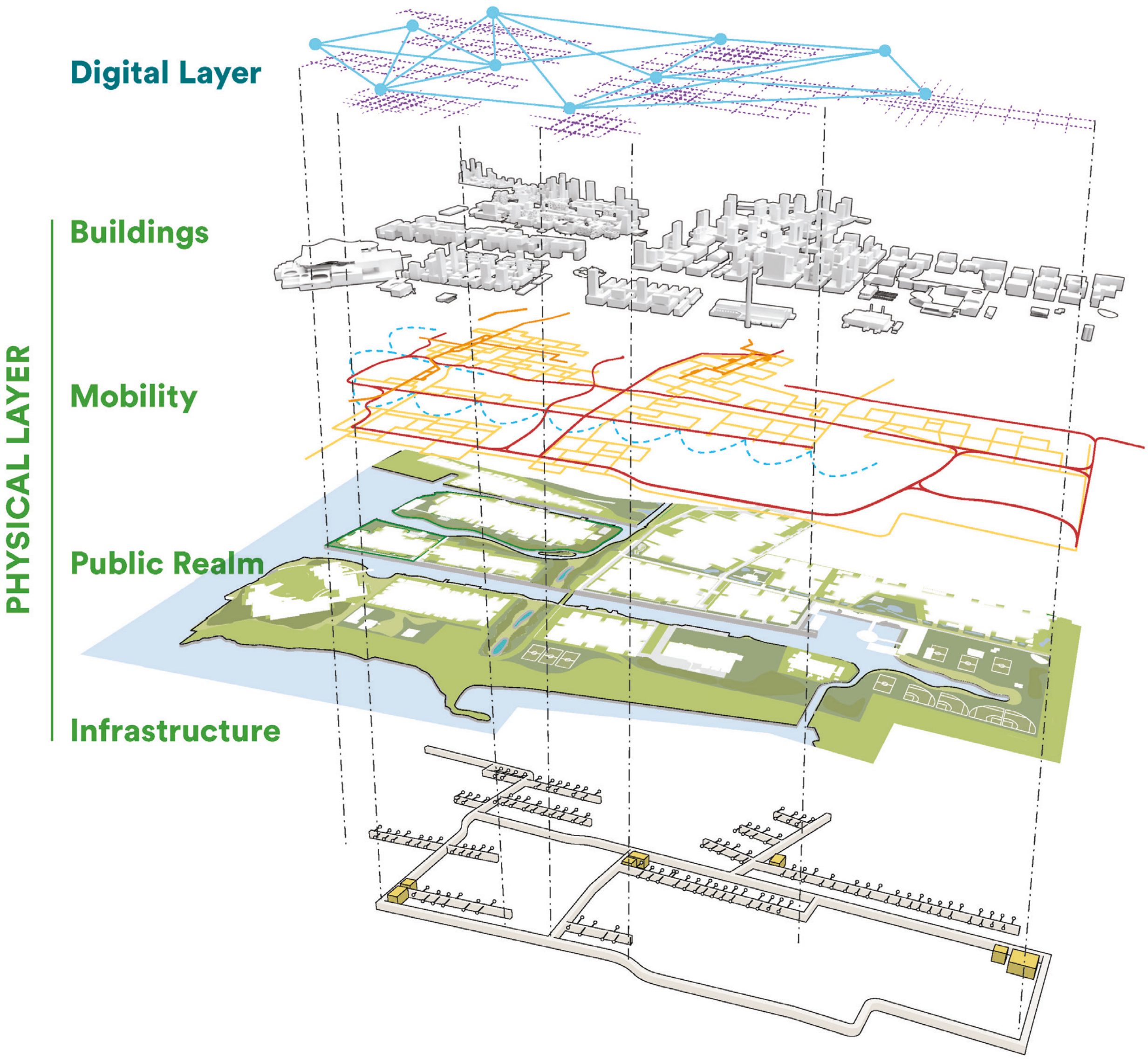


Figure 4.16: Sidewalk Toronto's proposed layers for the Port Lands.

And hence, it would appear that even the underlying business model of Sidewalk's proposal is essentially based on tried and true strategies of neoliberal urbanism, manifested in extraction of resources (in this case urban and personal data) and grounding of the dynamism of capital within exclusionary zones of real-estate investment. In a sort of cybernetic feedback loop one ensures and catalyzes the other, securitized by a set of extractive-surveillance technologies masquerading as urban services. Perhaps an exchange at Sidewalk Toronto's first public town hall meeting best exemplifies the anxious enthusiasm that surrounds the cloud's urban turn. Inquiring about the centralizing logic of platforms, Hamoon Ekhtiari, a local entrepreneur, addressed a question to both Dan Doctoroff and William Fleissig, Waterfront Toronto's CEO:

> "One of the things that's been shown over the last few years with platform ventures is that while they distribute a lot of benefits and services, they concentrate wealth and power quite significantly. So, I'm just really curious, when there is so many innovations that this venture is going to push, on the urban side and the technology side, is there an opportunity, do the two of you see an opportunity, to also rethink and fundamentally reimagine the power and wealth concentration that happens with platform ventures and platform plays? Is there a way for residents and early adopters in Toronto to be shareholders in one way or another in a venture like this?"[75]

In response Doctoroff, acknowledging the importance of the question, remarked:

> "Until we have the model of what we're actually going to do it's a hard question to answer. But I will tell you that amongst ourselves we've talked about different models of governance and ownership. I just don't think we know the answers to those at all."

Doctoroff's response is a non-answer, but it points to a worrying weak point within the cloud's push in urbanism. Alternative models of governance and ownership remain unknown. However, based on its trajectory, it would be safe to assume that cloud urbanists will be more than happy operating under conditions of centralized corporate ownership and lack of governance, as they are some of their founding principles.

Urban Techno-Colonization

Amazon and Google's new urban moves represent a simultaneous evolution of neo-cybernetic urbanism and devolution of public city planning, management, and discourse.[76] Instead of acting as technologists, or consultants, the agency of the new breed of cloud urbanists becomes manifested in the ultimate privatization, control, and management of cities bit by bit. Softer at first but increasingly forceful, the organizational logic of the cloud will inflict communities, neighborhoods, cities, and regions, and will reorganize them through its own controlled, exclusionary, and extractive logic. If the "smart city" represents the discursive translation of the tech dream of commanding friction-less urban environments, cloud urbanism represents its ultimate aim. Cloud urbanism, extending on the neoliberal logics of platform capitalism, internalizes notions of enclosure, centralization, and monopolization. Evolving beyond the initial aims of smart cities, through cloud urbanism the city—or urbanism in general—is bounded, standardized, packaged, controlled, branded, marketed, and entirely commoditized.[77]

In parallel, the separatist turn in Silicon Valley represents a new wave of ideologically aligned techno-colonizers in search of new frontiers, away from government scrutiny and democratic oversight. From outer space to oceans the tech elite have formed a renewed interest in the libertarian potential of new colonies outside the reach of the limiting bounds of terrestrial regulatory mechanisms. While

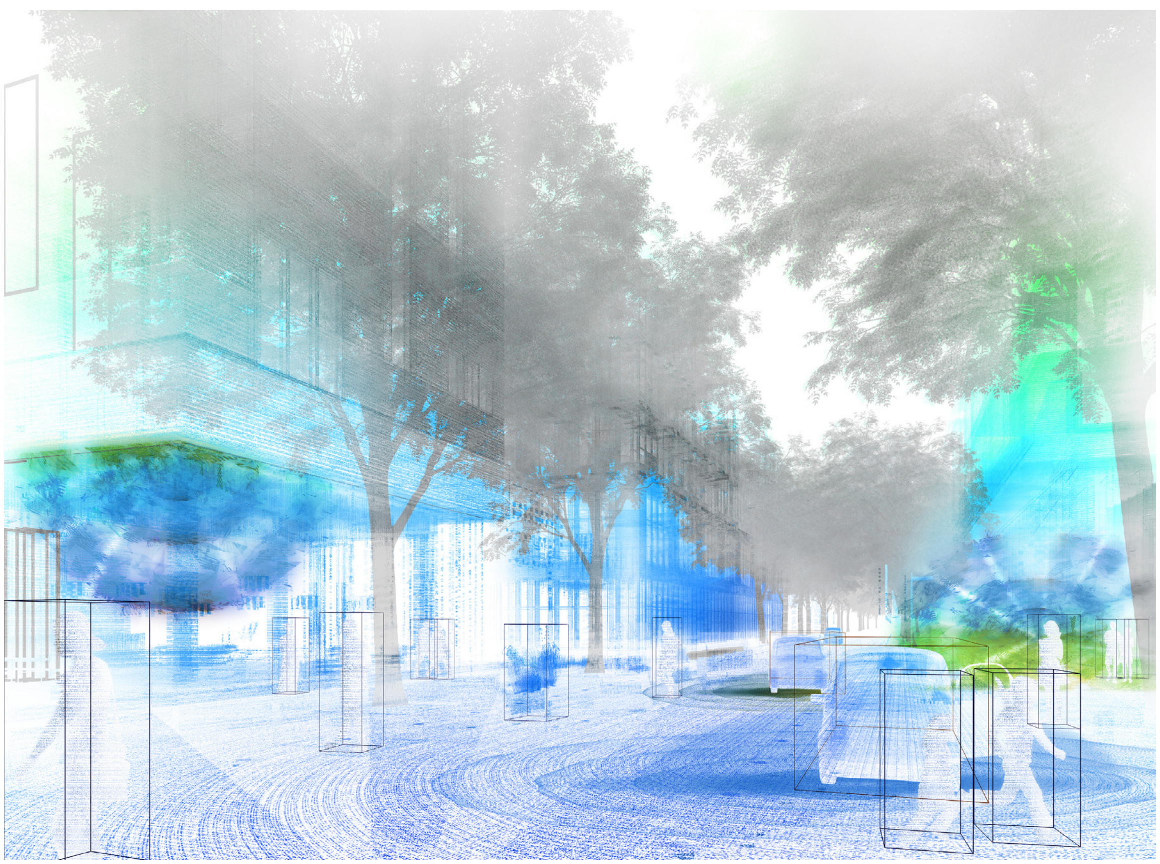


Figure 4.17: Sidewalk Toronto's ultimate codification of urban space.

the frontier status of outer space and the largely inhabited oceans is perhaps more clear, cities and urbanization, now faced with a renewed sense of crisis, are beginning to emerge as frontiers for technological colonization once again.

It is likely that the marriage between the secessionist turn in Silicon Valley and the incentivized urbanism of the zone will in the short term result in more exclusive enclaves of innovation, further separation from the context they are so dependent upon, and partial freedom from regulatory mechanisms of oversight, taxation, and democratic governance. However, given the repeatability of the model and the ease by which it proliferates and regenerates, these zones will grow to overtake entire metropolitan regions, as they have already done in China or UAE, or even entire countries, like Singapore or the many offshore islands.[78] In the long term the neoliberal basis of these cloud cities, propped up by ideals of individual freedom and liberty, will increasingly call for friction-less urban environments mediated through "tools of personal liberation." This will ultimately lead to the depoliticizing of social and environmental resistance which, together with the personal behavioral activities of inhabitants, are now quantified, aggregated, and monetized as external forces to be dealt with through market-driven technological innovation and unregulated experimentation. Once contextually and politically detached from the very real frictions of urbanization—which is now primarily made up of like-minded, demographically consistent population-users—the externalities will be perceived to be eliminated. The hegemonic tech elite—now the planners of these cloud nations—rule by data and surveillance, and through technological platforms that regulate their population-users socially and behaviorally to maintain the smoothness of their territories.

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63 Stephen Graham and Simon Marvin, *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (London; New York: Routledge, 2001), 41.

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65 For example As Kenzo Tange—an influential architect and the patron of the Japanese Metabolist movement in architecture—reflected in 1966, “in modern civilized society, space is a communication field, and it is becoming more and more organic with the development of the communication system... Creating an architecture and a city may be called a process of making the communication network visible in space.” in Kenzo Tange, “Function, Structure and Symbol,” in *Kenzo Tange, 1946-1969: Architecture and Urban Design*, ed. Udo Kultermann (New York: Praeger, 1970), 240-45.

66 Matthew Gandy, “Cyborg Urbanization: Complexity and Monstrosity in the Contemporary City,” *International Journal of Urban and Regional Research* 29.1 (March 2005): 29. See also: Mark Wigley, “Network Fever,” *Grey Room* 04 (Summer 2001): 82-122.

67 Racial segregation, displacement, inequality of access to infrastructure, and the razing of vibrant neighborhoods in the name of modernization, slum clearance, and urban development seeded intense resistance and unrest in cities across United States. The federal program’s heavy focus on the removal of physical blight from city cores while downplaying the need for social programming in the same areas, its emphasis on individual redevelopment projects as opposed to comprehensive city planning, and the lack of evidence and quantifiable feedback in its operations were amongst the major criticisms aimed at urban renewal programs. See: Jennifer S. Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore; London: The Johns Hopkins University Press, 2003), 55-91.

68 Facing an uncertain economic environment due to a decline in federal defense spending, by late 1950s executives and engineers from military and defense institutions such as RAND and SDC were looking for new markets for their technologies and expertise. See: Light, *From Warfare to Welfare*, 46.

69 As a sourcebook from a course in the University of Southern California’s School of Public Administration attests: “Cybernetics, the science of communications, feedback, and control, if utilized properly and adequately supported by modern electronic data processing equipment, will permit the city planner of the future to view the municipal urban environment as an integrated system rather than, as does today’s city planner, to relate primarily to the objectives of the separate parts.” Glenn Johnson, of the LA Department of City Planning, and Leland Swanson, of USC, quoted in Light, *From Warfare to Welfare*, 76.

70 Jennifer Light has observed several factors that contributed to the lack of success of the new tools and techniques: First, while the new technologies and techniques were touted to be superior to the old practices of planning because of their “scientific” methodologies, the lack of social data and quantifiable dynamics arrested the use of these decision-making tools that were heavily reliant on quantified data. Second, the ineffectiveness of the new tools was

partly due to the lack of deep understanding of administrators about the tools themselves. They were often used blindly without setting goals and objectives. For the most part assumptions about the tools drove the analysis of decisions to be made. Third, while the new computing and analysis tools were to reassert the role of the planning profession after the very public failure of urban renewal, soon after their adoption a new class of urban experts emerged—technocratic and defence analysts and intellectuals—that began to undermine the professional authority of planning. And finally, there were fundamental differences in the organizational logic of military—hierarchical, centralized command—and that of urban management and planning—dispersed and distributed authority. Adoption of military techniques and technologies came with operational logics which were contradictory or disruptive within the existing framework of city management and planning. See: Light, *From Warfare to Welfare*, 85-89.

71 “Project Vision, Response to Waterfront Toronto RFP No. 2017-13,” *Sidewalk Labs*, October 17, 2017, https://sidewalktoronto.ca/wp-content/uploads/2017/10/Sidewalk-Labs-Vision-Sections-of-RFP-Submission.pdf, 38.

72 “Project Vision, Response to Waterfront Toronto RFP No. 2017-13,” *Sidewalk Labs*, October 17, 2017, https://sidewalktoronto.ca/wp-content/uploads/2017/10/Sidewalk-Labs-Vision-Sections-of-RFP-Submission.pdf, 85-98.

73 Alex Bozikovic, “Google’s Sidewalk Labs Signs Deal for ‘Smart City’ Makeover of Toronto’s Waterfront,” *The Globe and Mail*, October 17, 2017, https://www.theglobeandmail.com/news/toronto/google-sidewalk-toronto-waterfront/article36612387/..he Smart City Projectssterling, Extrastatecraft;tner X venture which among its aims is planning for the colonization of Mars.

74 Evgeny Morozov, “Google’s Plan to Revolutionise Cities is a Takeover in All But Name,” *The Guardian*, October 22, 2017, https://www.theguardian.com/technology/2017/oct/21/google-urban-cities-planning-data.

75 “Sidewalk Toronto Community Town Hall (11/1),” YouTube video, 1:10:10, posted by “Sidewalk Toronto,” November 2, 2017, https://youtu.be/ycZDGwXVKJ8?t=1h10m10s.

76 Danny Westneat, “This City Hall, Brought to you by Amazon,” *The Seattle Times*, November 24, 2017, https://www.seattletimes.com/business/amazon/this-city-hall-brought-to-you-by-amazon/.

77 Ezechieli, “Shifting Boundaries;” Graham & Marvin, *Splintering Urbanism*; Easterling, *Enduring Innocence*; Easterling, *Extrastatecraft*; and, Adam Greenfield, *Against the Smart City* (New York: Do Projects, 2013).

78 Easterling, *Extrastatecraft*, 25-70.

CON-CLUSION

The data mediative operations of the cloud are essential aspects of production within the contemporary information society, in which data is treated as raw material. The extraction, processing, storage, distribution, and commodification of this data is mediated through the global apparatus of the cloud. By doing so, the cloud also controls and mediates social relationships and power dynamics that are constructed and enacted through its technical apparatus. In this regard, the cloud becomes more than a technical system. By projecting the cloud beyond solely technical descriptions this dissertation has articulated it as an organizational model for the centralization and allocation of computing resources that mediate and govern the relationship of contemporary society to the data it produces. The model of the cloud organizes space and territories based on an expansionist logic of domination which produces polarities and competing platforms in its wake. Hence, this dissertation has mapped the spatial footprints and has highlighted the territorialities of the cloud as a global organizational model. Through a process of grounding, the spatiality and territoriality of the cloud has been demonstrated by a deep mapping of Google's expansive global cloud platform as well as its corporate structure. Far from merely another tech company, the company's operational logics, its spatial footprints, and the complexities and frictions of its global expansion have been important vignettes for articulating the general outlines of the cloud as a whole. By adopting a telescopic analytic lens, this dissertation has traced the various scales of Google's operations and the contextual dynamics of their territorialization.

As the operations of the cloud have increasingly become interested in urban environments, another important facet of investigation for this dissertation has been the move of the cloud, as an organizational model, into cities and its influence on emerging urban practices. The emergent condition of *cloud urbanism* has appeared at the nexus of three developments: the growing primacy of data in society, the centralization of computing resources through the cloud, and the growing ideology of smart, data-driven urbanism. The smart city discourse and the significance of big data have effectively paved the ground for the emergence of new markets for cloud companies. As capitalist platform-driven endeavors, cloud companies are in a state of continual expansion. The cloud's search for new markets for the application of its data-extractive operations have ultimately landed in cities and urban areas. As cities and urbanization have dominated the global social imaginary, it is natural that the cloud would want to establish foundational ties to urban processes. The cloud needs to urbanize, as it moves beyond solely a technological platform to become the organizational model of urban life.

The cloud's move into urbanism is multifaceted and is composed of a set of parallel dimensions. First, and at the very basic level, the cloud is beginning to establish structural and political ties to the provision and management of increasingly complex urban environments. This condition represents a transference of authority and has emerged in the context of the growing stagnation of the fields traditionally associated with urbanism. In the aftermath of the 1970s and with the growth of neoliberalism, a growing majority of architecture and urban design projects no longer express the values of the public and have been reoriented towards the market-driven tendencies of neoliberal economics. Planning has increasingly become a legislative and legal discipline and has been largely paralyzed in response to the enormous pressures put on the discipline from the explosive speed of urban expansion, its infrastructural needs, and environmental risks. Cities are increasingly articulated

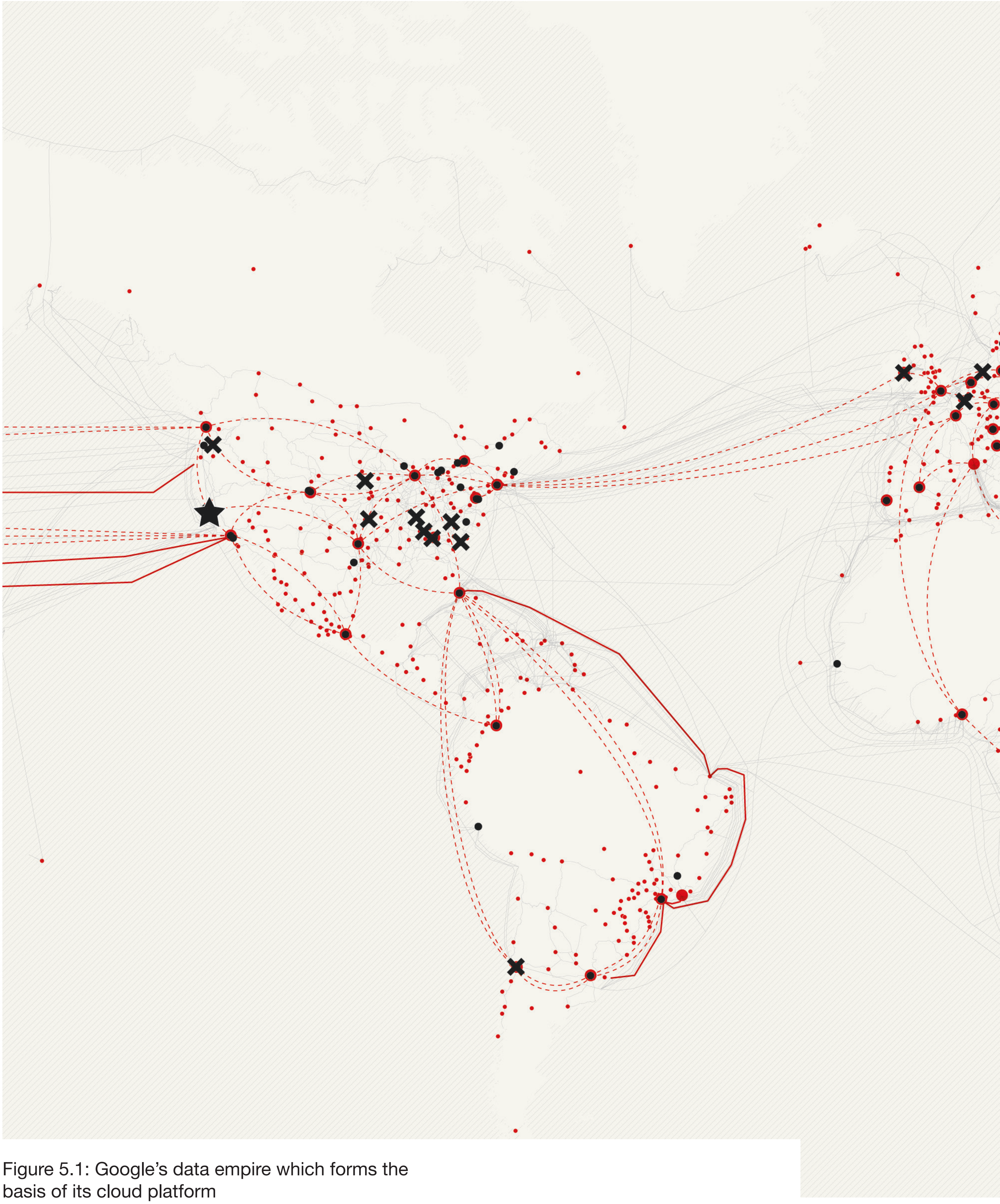
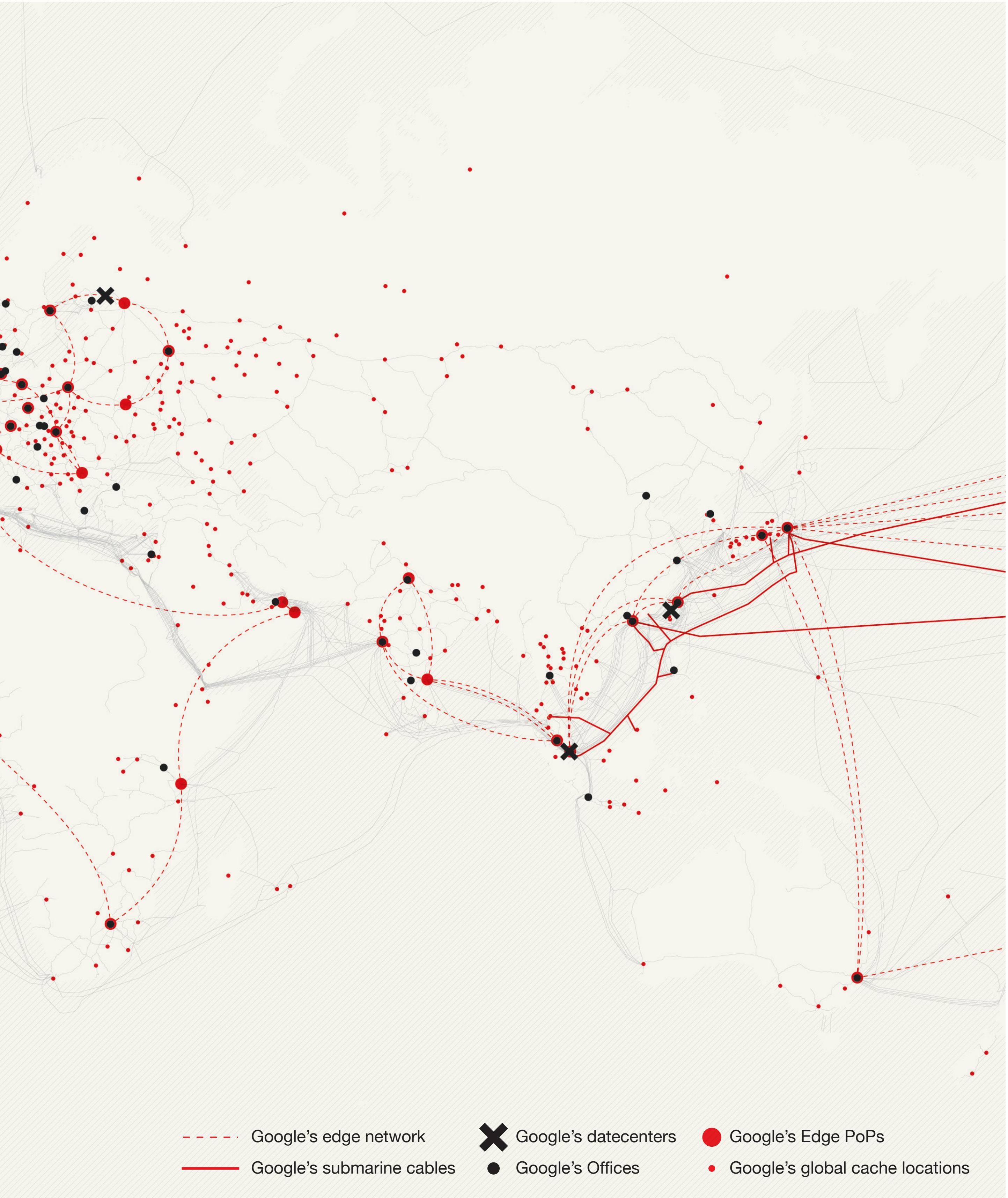


Figure 5.1: Google's data empire which forms the basis of its cloud platform


Google's edge network
Google's submarine cables
Google's datecenters
Google's Offices
Google's Edge PoPs
Google's global cache locations

through the logic of neoliberalism. Today, "both urban 'problems' and urban strategies are framed in neoliberal terms," and over the past three decades "cities have become increasingly central to the reproduction, transmutation, and continual reconstitution of neoliberalism… Under these conditions, cities have become the incubators for, and generative nodes within, the reproduction of neoliberalism as a living institutional regime."[1]

The growing importance of data is important here as it reflects the dynamism and complexity of neoliberal urbanization. Planning and other spatial disciplines lack the technical expertise, the funding, and the speed to effectively operate in the increasingly data-driven landscape of contemporary urbanization. In its capacity to work with data the cloud has begun to position itself as an indispensable platform for city management within the dynamic logic of neoliberal urbanization. In this context, tech companies have situated themselves as urban disrupters and harbingers of urban innovation for cities where traditional planning and design have failed. Using "acceleration," "optimization," "innovation," and "disruption" as keywords, companies like Google and IBM have taken advantage of the disciplinary vacuum of cities to position themselves within their operative structure as the dynamic alternative.

Second, the cloud's move into urbanim represents the dissemination of an ideology that socially and culturally solidifies the dependency of urban environments on the cloud. As articulated in other parts of this dissertation, an important aspect of the sociotechnical construction of the cloud are representations, images, and imaginations that communicate and distribute its foundational ideologies. In parallel to the growing structural positioning of cloud companies in urban practices, these representations and narratives have increasingly taken on a more urban tone as well. So while ideas of effortlessness, sustainability, stability, and comfort are still very much at the core of these representations, increasingly they are being complemented by notions of dependence, social agency, and urban innovation. Advertisements are a massive part of this project of dissemination. So are conferences, trade shows, and new partnerships with city management. Together these representations of the cloud's urban potential are expanding upon its technological platform to make the cloud a socio-cultural phenomenon.

And finally, a third dimension of the urbanization of the cloud concerns the provision of platforms that technologically mediate the relationship of designers, architects, and planners to urban environments. While the precise parameters of this dimension fall outside of the bounds of this dissertation, it nonetheless forms an important facet of the cloud's move into urbanism. Even though the digital tools that architects, engineers, and planners use to plan and design urban environments do not directly mediate in the processes of urbanization, they have nevertheless become the framework through which urban actors observe and analyze urban dynamics and, as importantly, plan and compose their actions. And even though these platforms are not necessarily considered part of the cloud, they have for the most part embraced the logic of the cloud. Through standardization, consolidation, and monopolization—processes which lie at the core of the operational logic of cloud platforms—they impose specific ways of seeing and acting upon urban space. In a general move towards service subscription models of use these companies, which include ESRI, Adobe, Autodesk, and others, are increasingly offering codependent productive environments as opposed to standalone products. Software as product is giving way to software as service in the same way that through the cloud personal computing is transforming into infrastructure as service. By learning from the cloud these design platforms have essentially incorporated its organizational logic. In this way these companies exert a huge amount of influence on the way urbanists see and act upon urban processes and environments.

In light of these emerging conditions, this dissertation has critically engaged the urban turn in technological innovation, in which cities and urban artifacts of many scales have (re)emerged as new markets for the commodification of data extractive practices. The underlying logic of these practices, from the so called smart city discourse to the enclave urbanism of tech corporations, presents an evolution of neoliberal strategies that have bankrolled the resilience of advanced capitalism through crises and crashes. The cloud—an important facet of this urban turn—simultaneously presents a massive distribution of risk and liability, as well as the ultimate centralization of resources and agencies within the dominant information economy. Contrary to the ethos of flexibility, collectivity, emancipation, and liberty that the cloud perpetuates, the platforms on which the economic base of the cloud are constructed maintain monopolistic centralization of resources (fine grain data, computing resources, and expertise) within lax regulatory environments. Furthermore, the secessionist turn in the tech sector, with its looming threat of Silicon Valley's "ultimate exit" and its invocation of the frontier ideology and the enclave typology, create a context for the techno-colonial strategies of the tech elite. The result is further centralization—both ideologically and spatially—of wealth and power within the information society.

While the aims of this dissertation have been expansive, a number of questions still remain and will guide future work on the spatial agency of cloud platforms. Given the emerging status of many of the facets of this discourse, one can expect further evolution and grounding of the cloud within everyday life in the years to come. The entry of cloud companies such as Google into the hardware sector is still in its infancy. The reception of their various personal gadgets and their incorporation into everyday life still remains unclear. Similarly, the urban projects of the cloud, especially those of Amazon (HQ2) and Google (Sidewalk Toronto) remain as initial proposals and will take years to materialize. However, once they do, they will likely act as best practice models for other spatial projects of the cloud, further engraining the centralizing logic of the cloud within the management and governance of urban environments. Hence, this dissertation has attempted to remain proactive—as opposed to retroactive—in its response to evolving and developing trajectory of these projects.

While the exact contours of the development of the projects of the cloud may evolve and change, by critically engaging with them early on, this preemptive work attempts to position the agency of critical spatial research within future discussions of the spatial role of the cloud, and its actors, within society. A society whose forms and processes are increasingly mediated through data. The cloud, as the computing apparatus of this data, is far from accidental. The cloud is a result of intentional actions and strategies that have opportunistically built on the historical trajectory of the past to construct, socially and technically, a global model for the organization of resources, people, and spaces within the information society. Therefore, an active engagement with the evolving practices of urbanism that precondition their agency on data and the computing apparatus of the cloud will be immensely important in the future development of this work.

Notes

1 Nick Theodore, Jamie Peck, and Neil Brenner, "Neoliberal Urbanism: Cities and the Rule of Market," in *The New Blackwell Companion to the City*, ed. Gary Bridge and Sophie Watson (Chichester, West Sussex: Blackwell Publishing, 2011), 91.