# IMAGINATIONS

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## LOCATION AND DISLOCATION

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**Guest Editors - Alix Johnson and Mél Hogan**
**Issue Managing Editor - Brent Ryan Bellamy**

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Front Cover Image - Servers in Pionen, photo: Åke E:son Lindman

# INTRODUCING LOCATION AND DISLOCATION: GLOBAL GEOGRAPHIES OF DIGITAL DATA

ALIX JOHNSON & MÉL HOGAN



The contributions to this issue of *Imaginations* address the relationship between digital data and physical place. How is the economy of data storage organized in and across communities, regions, nations, and states? How does the industry reprise old relationships and forge new ones? How are boundaries and borders inscribed and encountered by users and creators along the way? How is information technology (IT) infrastructure built into environments, shifting social and natural terrain? By foregrounding spatial relations and infrastructures, these essays draw connections between globalized geographies of media distribution and localized impacts of IT on the ground.

## Emplacing Data

The articles convened here join a growing conversation on the materiality of the internet. In recent years, scholars, artists, and activists have taken apart the once prevalent notion of an immediate and immaterial global network, challenging the ephemerality evoked by language such as "the cloud." By treating the internet as an infrastructure, they have demonstrated its construction costs and environmental impacts; its affordances and limitations as a political tool; and the ways that race, gender, and other modes of embodiment remain as salient as ever, even online. These interventions have shifted our understanding of digital networks from an evocative but undifferentiated "cyberspace" to an uneven "global assemblage of digital flow" (Graham 78). The authors in this issue push this conversation forward in their specific and sustained attention to *place*. In doing so, they illustrate the necessity and potential of exploring the sites where our data is produced, transmitted, stored, parsed, and put to use.

In Yi-Fu Tuan's classic formulation, place is space made meaningful (1977). Such meaning is inscribed through practices and products that concretize collective memory and organize spatial relations: statues, street names, and scientific classifications that codify territorial bounds. The contributions in this collection read IT infrastructures through such a framework, considering how objects such as data centres and fibre-optic cables and practices such as surveillance and location tagging create consequential senses of place. Since Tuan, however, scholars have critiqued the limited role that place has been assigned: defined by meaning inscribed upon it, place looks passive, static, bound. Instead, theorists have drawn another picture of places as relational configurations, always-already entwined in broader webs of power (Massey). Fundamentally social, place is also politically active. Far from opposites, the local and the global are intertwined (Brown). In this vein, the authors here also attend to the ways that place comes to shape data infrastructures. From local ideologies of connectivity to marketable images of nature, from specific conditions of wind and water to the inherited structures of past industries, the particularities of place are worked into IT—sometimes, as this issue illustrates, to unexpected and unruly effect.

## The Visible, the Visual

The question of visibility has long been part of the conversation about digital data, often imagined as either invisible (see Parks; Starosielski) or hypervisible (see Holt and Vonderau). The risk when data is invisible is of a failure of collective citizen engagement in decision-making regarding the conceptualization, meaning, emplacement, management, and maintenance of these infrastructures. Similarly, hypervisibility, such as the high-gloss curation and self-representation of data centres online (Google, Facebook, Apple, etc.) reinforces the imaginary of a clean, controlled, and secure data infrastructure; people need neither physical access nor deep understanding of their policies and impacts. The pieces in this volume question this binary by re-embedding the visual aspects of digital infrastructure in their social, political, and environmental context. In keeping with the concept of *Imaginations: Journal of Cross-Cultural Image Studies*, the following articles open up the question of visuality, in both their content and their form.

Asta Vonderau, in "Technologies of Imagination: Locating the Cloud in Sweden's North," offers an ethnographic exploration of Facebook's first European data center in Luleå. Her contribution shows how the Node Pole project picks up on longstanding tropes of Swedish character while promising specifically regional empowerment in the form of a "post-extractive modernity." Yet such developments, Vonderau argues, are enabled by the industry giant's infamous secrecy: strictly limited information about this effort heightens its imaginative potential while obscuring less welcome environmental effects.

Like Vonderau, Graham Pickren charts future-making efforts in "The Factories of the Past are Turning Into the Data Centres of the Future." Examining the conversion of Chicago's industrial-building stock into server farms, he traces the shape of material infrastructure as "a bridge that connects our digital present to our industrial past." In doing so, Pickren maps continuities and transformations in uneven urban capitalist development. While the decline of manufacturing in Chicago has created the conditions for data storage to take its place, this new industry offers quite different configurations of investment and community impact. If data centres are the so-called "factories of the 21st century," Pickren asks, "whither the working class?"

While Vonderau and Pickren demonstrate the political and analytic potential of "visibilizing" data infrastructure, Kristen Veel and Alexander Taylor's contributions complicate that imperative in their attention to data centre space. Veel's "Uncertain Architectures: Performing Shelter and Vulnerability" critically reads the design plans of two data centers: the underground bunker, *Pionen,* and the prominent modular skyscraper, *Data Tower*. Her visual analysis contrasts two modes of relating to data: "enclosure and containment" on the one hand and "flexibility, flow, and modulation" on the other. Ultimately, Veel shows that these designs are performative, more representative of what we imagine about data than what it is. Taylor, too, takes up data centre architecture in "The Technoaesthetics of Data Centre 'White Space'." Critiquing the politics of exposure that characterize many popular and academic accounts, Taylor uses the "white space" of the data centre as a heuristic to explore the unresolved interplay between transparency and opacity in industry design. Whiteness sometimes illuminates, sometimes projects, and sometimes reflects back in dynamics more complicated than mere concealment. Making visible, he argues, is not the same as making known.

Evan Light, Jutta Lauth Bacas, Jeff Deutch, Daphne Dragona, Katrin M. Kämpf, Marta Peirano Valentina Pellizzer, Christina Rogers, Florian Sprenger, Jaron Rowan, and Abiol Lual Deng push the question of seeing and knowing in their Story Map of data flows across borders in the route from central Africa to Northern Europe. "Infrastructures of Dis/Connection: Of Drones, Migration, and Digital Care" analyzes migration as a process of connection and disconnection, in which access to communication infrastructures also exposes migrants to the threat of state surveillance. The movement of data, then, both facilitates and impedes the movement of people (many of whom are displaced by drone warfare, itself linked to some of the same infrastructures).


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Michael Audette-Longo takes up another mode of mobility in "Hear the World's Sounds: Locality as Metadata in Two Music Platforms." Tracking the feature of location tagging across the applications Bandcamp and Soundcloud, Audette-Longo shows how regional meta-data works to create a "sense of place" for consumers in a new media economy. While tagging organizes a particular experience of connection, he argues that it is naturalized as the feature blends into each application's interface.

The final essay in this volume, "Drones Caught in the Net," offers an experimental exploration of information infrastructures from the perspective of the unmanned drone. Adam Fish, Bradley Garrett, and Oliver Case document their mapping of fibre-optic cables, landing stations, and data centres in the North Atlantic. They argue that the potential of drone imagery inheres not in some fresh perspective made possible by new technology, but in the "relative parallelism" at play between their aerial information infrastructures and those on land and underground. They conclude with a call to media theorists to "fold ourselves back into the stratigraphy of place."

As part of the Elicitations component of our issue, Rafico Ruiz remembers Alberto Behar, a robotics engineer and polar researcher who was instrumental in generating early evidence of climate change. Ruiz explores Behar's work posthumously through his archive of readings and images. Antonia Hernández offers another visual exploration of networks in the context of domestic space. Through a series of art experiments called *The Moldy Strategy*, Hernández invites the viewer to navigate mold, exposing microscopic entanglements of bodies and media.

As Shannon Mattern noted in her cogent essay, "Cloud and Field," it has recently become a popular pastime to map the new infrastructures of our digital age (2016). Field trips and field guides now chart the nodes and networks that make up "the cloud," often reproducing a colonial ethos of exploration and faith in the making of encyclopedic knowledge—faith that making visible is making clear. With this issue of *Imaginations*, we aim to do something different. By staging a conversation about place and data through a wide variety of engagements with both, we offer a range of experiments and explorations that tackle rather than take for granted the question of the visual; model the potential of local perspective on global networks; and emphasize points of encounter and engagement between the cloud and the ground.

We would like to thank the authors and practitioners who have contributed to this issue, whose works mark an important moment of interdisciplinary scholarly interests and interventions. Thank you also to the peer reviewers for their invaluable intellectual labour in this process. Finally, we would like to thank the staff at *Imaginations* for helping us put the issue together: Sheena Wilson (Editor-in-Chief), Brent Bellamy (Managing Editor), Tara Milbrandt (Elicitations Reviews Editor), Shama Rangwala (Copy Editor) and Ève Robidoux-Descary and Aurélie Lesueur (Translators).

We hope you enjoy the issue and look forward to your feedback.

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# TECHNOLOGIES OF IMAGINATION: LOCATING THE CLOUD IN SWEDEN'S NORTH

ASTA VONDERAU


## Abstract

*When a world-leading IT company expressed the intention to locate its infrastructure in the Swedish city of Luleå in 2011, the announcement immediately triggered future scenarios and visions of a new industrial era, economic prosperity, and changing urban life. Such anticipations were supported and shaped by municipal planning and business management activities soon materializing in the form of building sites, regional development strategies, and new markets. Since the actual name and operations of the IT company were kept entirely secret, the planning and implementation of "Project Gold"—as the data centre project was called locally—was as much driven by collective imaginaries as by hard facts or former experiences. This paper is based on an ethnographic study that followed the implementation of Facebook's first European data centre in Luleå. It analyzes different modes of data centre infrastructural (in)visibility and shows how imaginaries became influential both for implementing the cloud in Luleå and for shaping the anticipated time and space of "post-extractive modernity." More specifically, the paper focuses on the socio-technical preconditions as well as the concrete practices and styles—that is, technologies of imagination—that enable those imaginaries.*

## Résumé

*Lorsqu'une société informatique reconnue comme un leader mondial a exprimé l'intention de localiser ses infrastructures dans la ville suédoise de Luleå en 2011, l'annonce a immédiatement déclenché des scénarios et visions d'avenir d'une nouvelle ère industrielle, d'une prospérité économique et d'une vie urbaine en transformation. De telles anticipations ont été appuyées et façonnées par des activités de planification municipale et de gestion des entreprises qui se sont rapidement concrétisées sous forme de chantiers, de stratégies de développement régional et de nouveaux marchés. Puisque le véritable nom et les opérations de la société informatique ont été gardés entièrement secret, la planification et la mise en œuvre du « Project Gold », comme le projet du centre de données a été appelé localement, ont été autant motivées par les imaginaires collectifs que par des faits concrets ou des expériences antérieures. Cet article repose sur une étude ethnographique qui a suivi la mise en place du premier centre de données européen de Facebook à Luleå. Il analyse les différents modes de (in)visibilité de l'infrastructure du centre de données et montre comment les imaginaires ont exercé une influence à la fois pour la mise en œuvre du « cloud » à Luleå, et pour l'élaboration du temps et de l'espace anticipés de la « modernité post-extractive ». Plus précisément, le texte se concentre sur les conditions préalables sociotechniques ainsi que les pratiques et les styles concrets, c'est-à-dire les technologies de l'imagination qui permettent ces imaginaires.*




## Introduction: The Mayor's Dream

"You know, when Swedish mayors dream, they usually dream of IKEA opening a store in town. However, there are more than 30 IKEAs in this country but there is only one Facebook—here, in Luleå!" (Interview, April 2014). This is how Karl Petersen, municipal commissioner (or as he called himself, "a mayor") of Luleå, an industrial town located near the Arctic Circle in Sweden's North, introduced me to his municipality's most ambitious industrial development project ever, a Facebook data centre. Petersen admitted to having been ignorant of IT infrastructural needs before he was contacted by the Luleå Business Agency with the idea of selling the Nordic cold to the cloud industry. He was proud of having realized in good time that "the cloud has a big future because data centres are needed all over the world and they need to be cooled" (Interview, April 2014). This business idea, unconventional for a Swedish municipality, led to unexpected success when the world's largest social-networking service announced its decision to locate its first European data centre in Luleå.[1]

Facebook's announcement made Luleå known in Sweden and abroad as a place "where the cloud hits the ground," as my interlocutors would put it. It also brought overnight fame to the municipal commissioner and his colleagues. Among the countless interviews and news reports that resulted from a frenzy of nation-wide and even global media attention, a cross-promotional video entitled *Swedish Thinking: Journey to the Node Pole* featured Petersen himself speaking out for his town's and the region's ability to create benefits from a harsh Arctic climate and peripheral geographical location. Praising this ability of "getting more from less" as a national character trait, the commercial made it clear that the mayor's dream was directly linked to economic developments and collective visions going far beyond personal aspirations and the boundaries of Sweden's northernmost county, Norrbotten.

Petersen's Facebook project introduced a new industry to the region and also directed the attention of global IT infrastructure providers to Sweden as a key European location for cloud infrastructure. This development was in line with the Swedish government's plan, laid out in the *Digital Agenda for Sweden*, to turn the country into one of the strongest IT nations worldwide, and consequently triggered anticipation of a new industrial era grounded in the vision of an upcoming post-extractive future.

*Figure 1. Luleå's municipal commissioner Karl Petersen, featured in a video promotion for Volvo and the Node Pole (www.youtube.com/watch?v=YwqtBJMZJIU).*


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This essay investigates how the global cloud materializes in a particular socio-cultural context. Based on an ethnographic study of Facebook's data centre implementation in Luleå, the paper shows how this large-scale infrastructural project forms part of an "economy of anticipation" characteristic of the temporal politics of today's (digital) capitalism (Cross). It also demonstrates how in the course of locating the cloud, national territories are reconfigured, new subjectivities and bodily experiences are enabled, and local future scenarios are reshaped by means of anticipation and imagination. Focused on the everyday infrastructure-making processes, this study engages anthropologically with questions of location of power, agency, and practice in IT economies.

*Figure 2. Facebook thumb in the lunch room of Luleå Business Agency, photographed by author, April 2014.*

I have followed the planning and implementation of Facebook's data centre over a period of almost two years. Due to the complexity of large-scale infrastructural projects and because of the data centre's difficult accessibility, my fieldwork activities did not aim for long-term research stays at single sites. Instead, it consisted of various "polymorphous engagements" (Gusterson)—that is, of multi-sited interactions around Facebook's Data Center project in different institutional and industrial contexts, engaging with diverse expert cultures, discourses, humans, and technologies. This included, for instance, interviews with regional and national decision makers, municipal employees, data centre engineers and managers, and representatives of industrial organizations such as Data Center Dynamics; observations at data centre building sites, at IT-related industrial and public events, and participation at conferences; and analysis of local and international media and political documents such as maps, regional development programs, and national IT strategies.[2]

Situated within the interdisciplinary field of infrastructure studies, this paper investigates Facebook's data centre as an aspect of cloud infrastructure. As such, a data centre is more than just a piece in a functional technological system, it is a contested and fundamentally relational techno-social configuration (see Hu; Larkin; Dourish and Bell; Parks; Starosielski; Bowker et al.). The concrete strategies and practices of localizing the cloud are here understood as a form of *infrastructuring* (Niewöhner)—a continuous bringing together, relating, and coordinating of technologies, communities of actors, organizational structures, and moral values. A perspective on infrastructuring emphasizes the complexity of work inherent in infrastructure-making processes. The infrastructuring of the cloud will mostly be described from the perspective of local authorities and experts, including politicians, business developers, consultants, municipal city planners, architects, and environmental and IT experts. Acknowledging the differing tasks and concerns of these actors regarding data centre implementation processes, and contrasting such concerns with Facebook's own corporate interests when it comes to infrastructural secrecy and controlling (in)visibility, I analyze some of the cloud's local social effects.

According to Jamie Cross, large-scale infrastructural projects form part of a global economy of anticipation characteristic of contemporary capitalism. These economies are underpinned with an abundance of dreamed-of futures in relation to which the present is constantly renegotiated (Cross 8). Infrastructural projects represent arenas of fantasy and desire; they are affective spaces "in which the lived sensation of future prospects can seize bodies, persons and selves" (Cross 9). Accordingly, I understand the Swedish Facebook data centre and infrastructure in general as such an object of fantasy and desire that provokes a "sensing of modernity" (Mrazek)—that is, aspirations and expectations of a new time, "a process by which the body as much as the mind apprehend what it is to be modern, mutable and progressive" (Larkin 337). The reconfiguration of territories and subjectivities that results from cloud infrastructuring thus includes not only material and bodily but also imaginative entities (Harvey 17).

Imagination—understood as a practice of synthetic knowledge production, "the bringing together of diverse forms of appearance and the ability to relate them" (Sneath et al. 11)—is thus inherent to processes of infrastructuring and the social transformations such processes enable. In what follows, the focus is on different actors' attempts to realize imagined futures and on the frictions resulting from the collision between differing visions of what such futures might entail. Hence, an ethnography of cloud infrastructuring allows to identify what Sneath, Holbraad, and Pedersen call "technologies of imagination" or the "specific material and spatial means by which particular imaginings are generated" (6). In the case of Facebook's Swedish data centre, such technologies of imagination were instrumental for connecting industrial materialities and corporate images of the cloud to locally situated ontologies, experiences, and historical horizons of meaning, and for shaping the glocal geographies of the cloud as a space of anticipated post-extractive modernity.

## Technologies of Imagination

### *Corporate (In)Visibility*

Cloud technologies are objects of popular imagination and corporate marketing. In order to understand how particular technologies of imagination become instrumental for local processes of cloud infrastructuring, it is therefore necessary to inquire how the cloud is being branded by IT companies and represented in popular media. Furthermore, how do these popular images of the cloud relate to the actual technological operation of data storage and processing?

Cloud computing is a currently dominating computation and data-processing model on which most social networks and online services are based. Data centres represent the core of cloud infrastructure and one of the fastest-growing industries worldwide. Their energy consumption represents over three percent of global electricity usage and is growing at a rate of fourteen percent annually. This energy-consuming heavy industry, however, is still not in the public eye. Media reports and IT companies represent the cloud, and the Internet more generally, as being natural, immaterial, and fluid—think of the language regularly used for describing such technologies and the metaphors of the "cloud," "data streams," or "IT ecologies" (see Blum; Hogan). Such images are supported and instrumentalized by IT companies in marketing campaigns that often present the cloud and data centres as sustainable by contrasting them with "older" and "dirtier" industries.

Dematerialized perceptions of the cloud are grounded in a specific relation between the cloud as a (virtual) network of data processing and data centres as the cloud's single infrastructural site. While data centres are located in concrete geographic places within national territories, their technological operations can range far beyond those territories and legislative boundaries. The cloud and its data centres thus entertain a relationship of "intimacy at a distance" by forming part of each other while being differently situated in spatial terms at the same time (see Rossiter). The cloud's materialities, its social effects, and the environmental impact of the data centre industry are unevenly distributed across spatial dimensions. This arrangement supports dematerialized perceptions of the cloud. Users of cloud services, for instance, located far away from the actual storages of their data, may remain unaware of the cloud's material existence and its resource needs.

Moving beyond the cloud's technological logics, in *The Prehistory of the Cloud* Tung-Hui Hu explains that such dematerialized metaphoric representations are not only instrumental for popular descriptions but actually form a major part of the cloud itself, which "has never really been about computing because computing is just one part of a larger cultural fantasy" (145). According to Hu, the business model of the cloud is based on popular visions of the Internet as a virtual, borderless, and open space, and on imaginaries of an all-embracing connectivity envisioned to be inevitable for our society's future development. As has been noted by various scholars, such dematerialized images of the cloud obscure its infrastructural and industrial materialities as well as its problematic social and environmental consequences, including the enormous electricity and water needs of data centres, the increasing pollution through waste heat, or the low number of job opportunities the cloud industry offers to local communities (see Hogan; Cubitt et. al.; Gregg; Dourish and Bell). They also incentivize permanent connectivity and data production, necessary for generating Big Data, and hence integral to prevailing IT revenue models. This is one key reason why larger IT companies aim to control the (in) visibility of cloud infrastructure.

In a similar vein, Facebook presents itself to its users mostly through visualizations of its global virtual connections. Representations of data centres are limited to cleaned-up, science-fiction-style images that are meant to suggest transparency and to evoke fascination for technology without disclosing the actual workings or complications of communication infrastructure (Holt and Vonderau). Similar strategies of dematerialization and delocalization can be observed with regard to Luleå's data centre. Storing the data of more than 800 million global Facebook users, the Luleå data centre does not operate under Facebook's name but as a subsidiary named Pinnacle Sweden. Given that Facebook's European headquarters are located in Ireland and that the social network is therefore amenable to Irish legislation, it is questionable from a legal standpoint whether Facebook is even present in Sweden or Luleå at all. Questions of corporate invisibility extend beyond legal issues and also include, among others, the data centre's outside appearance. The Luleå building resembles a large white box; no sounds or sights give an indication of the industry-scale data-storage processes going on inside. No Facebook logos or street signs are to be found, apart from a few small flags within the fenced territory itself or the Facebook bikes used by employees and construction workers for travelling the enormous area at Luleå's Datavägen (Data Street) [Fig. 4]. Despite the data centre's extraordinary scale and technological complexity, its representatives are reluctant to acknowledge the importance of this infrastructural site. The data centre's manager Joel Kjellgren, for instance, regularly stresses in public talks that even a complete data centre outage would not impede Facebook's functionality and would remain unnoticed by its users. While it is doubtful if such a major incident would stay unnoticed—it certainly would cause huge financial losses and have a devastating impact on the company's image—such statements clearly contribute to Facebook's strategy of channeling public attention from the local industrial to the global and virtual dimensions of the social network.[3] Facebook thus seems to have little interest in being perceived as industrial or local, apart from its persistent promotion of the Luleå data centre as an environmentally friendly and technologically advanced cloud following Facebook's turn towards sustainable energy consumption.

Contrasting the cloud's omnipresence and growing importance for today's society with its infrastructural secrecy and inaccessibility, as well as the data centres' "ignorant relation to architecture" and the difficulty of "decoding" them in social and cultural terms, architecture theorist Kazys Varnelis has identified data centres' architectural form as one embodying the cultural conditions of digital capitalism and what Deleuze terms the control society. The case of Luleå's data centre indeed illustrates IT companies' power in controlling their infastructural visibility. While ethnographically tracing the everyday processes of infrastructuring, however, the white box of the cloud appears much less solid and not just simply imposed from above. As I show below, the gap that corporate secrecy creates between the global virtual cloud and its local infrastructural sites opens up a relational space within which the cloud is decoded, negotiated, and contested in locally specific ways. Within this space the cloud is reshaped in relation to human and non-human relations and concerns by means of technologies of imagination.

*Grasping the Cloud*

In our conversations, Luleå's politicians, city planners, architects, ecologists, and other municipal experts emphasized

*Figure 3. Facebook's first data centre building in Luleå, photgaphed by author, April 2014.*


*Figure 4. Entrance area of Facebook's second data centre building, Datavägen 15 (Data Street 15), photographed by author, September 2015.*

the secrecy that marked the planning process for Facebook's data centre. During initial meetings, Facebook's representatives did not mention the name of their company and no business cards were exchanged. Communal experts responsible for the project planning were neither entitled to know their client's name nor its actual intentions (at least in the early planning phase).[4] The information needed for the planning could only be acquired indirectly, through a group of contact persons, making the planning process even more complicated. Only the project's working title—"Project Gold"—and the high priority it was given by local and national decision makers indicated that large investments were at stake.

In addition, Facebook's water and energy needs were much higher than for other industrial projects. Certain standards, such as regulations for noise exposure (caused by the data centre's 14 diesel generators), did not even exist in Sweden and had to be modelled on regulations in Germany and other countries. Despite all these complications, a detailed city plan—the main document for construction projects in Sweden—had to be completed within only three months instead of the usual one to two years. Facing the extraordinary scale and pace of "Project Gold" and its secrecy, city planners and architects had to be creative, trying to envision the secretive construction object and to imagine it in context of its future local surroundings. In interviews they related, for instance, stories of walking around in the city in an attempt to imagine the planned building, comparing it with other industrial

buildings and wondering about its magnitude (Interview, October 2014).[5]

In the early phase of its infrastructuring, the cloud (and the data centre as its specific local form) thus could neither be determined by local experts as an objectively existing material entity nor be easily grasped subjectively. Instead, the cloud was experienced and became visible in the sense proposed by Tim Ingold: as an assemblage of "active materials" that constantly emerge and transform through practices of planning, calculation, and imagination (429). Facebook's corporate strategies, aiming to establish a certain regime or order of infrastructural visibility for the social network, simultaneously created disorder when it came to city planning and perceptions of Luleå's built environments. The usual planning routines and existing expertise could not be easily applied to this new project and new approaches had to be invented. In this particular situation, technologies of imagination—such as comparisons of the new industry to existing industrial sites and imagining its buildings in relation to local environments—became instrumental for the project's successful implementation. Such technologies also opened up new ways for envisioning and shaping the future of the region.

*Figure 5. Facebook's Swedish cloud, seen from above. Buildings to the right include student dormitories and Luleå's Science Park. (Source: Genomförandebeskrivning/The Description of Implementation, Luleå Municipality 2011).*

*Figure 6. This drawing shows how Facebook's data centre (the thin line above the trees) was expected to be visible after completion, thus illustrating the cloud's peculiar infrastructural (in) visibility. (Source: Miljökonsekvensbeskrivning/Description of Environmental Consequences, Luleå Municipality 2011).*

*Fixing the Future*

The secrecy surrounding "Project Gold" and the abstractness of its scale and scope provoked euphoric visions among Norrbotten's experts and authorities: a new industrial era of economic prosperity, new urban cultures, and urban subjectivities. As my interlocutors related, such expectations allowed for unique solidarity among all authorities involved, transforming an extraordinary complex planning process into a "simple calculation," as difficulties and hardships such as long overtime hours or internal conflicts could be weighed against the project's expected gains for the city of Luleå and the Norrbotten region. This collective anticipation and belief in the positive impact of a new industry was especially fostered by local decision makers and business developers, as it helped acceptance of the client's pace of demands and redirected public attention away from the project's enormous energy and water needs, as well as from its possibly negative impact on a nearby nature reserve.

Expectations of a new industrial and urban era, however, also related to personal aspirations among many of the involved actors to change the burdened image of Luleå as a peripheral "steel city" in order to enable cultural diversity and social change. My male interlocutors, for instance, specifically stressed suffering from the traditional dominance of steel, mining, forest, and other extractive industries in this region. These industries not only represented the only opportunities for male workers for decades, but also contributed to the establishment of a specific type of unskilled masculinity, epitomized by the stereotypical image of a dirty, muscular steel worker. These interlocutors expected industrial change to bring about both different job opportunities and cultural and bodily diversity. Other respondents also emphasized being tired of Luleå's burdened image as Sweden's steel city. They even found it unfair that this image of the past kept dominating how the city was perceived by national authorities and the country's Southern regions, even after the steel industry ceased to be the biggest employer. Accordingly, they hoped that industrial development and its promise of a new era would free the city from its past and introduce a future-oriented temporality.

As Anna Tsing notes, however, future scenarios and visions represent fragile social orders that are always "almost-but-not-quite-there" (336). Establishing and maintaining such orders is therefore never trouble free. As my interlocutors reported, before Facebook's plans finally became official, local authorities were in constant fear that "Project Gold" could still be stopped, since their secretive client was known to negotiate simultaneously with other regions in the country and reacted sensitively to even the smallest restrictions of its interests. A technical project coordinator, for instance, recounted waiting months before a first signature was given, documenting that the project would actually be realized and that the client eventually would order to start cutting trees at the planned construction site.

The fear of losing an unprecedented investment and expected future benefits led Luleå's authorities to various compromises. Local city planners told me of accepting the unfavourably stretched data centre building shape even though it resembled a wall separating the city from a nearby natural reserve. The city even signed an "unusual agreement," as a representative of Luleå's administration acknowledged, that promised Facebook huge amounts of drinking water, exceeding the common official norm and only to be harmonized with Swedish law by help of legal trickery (Interview, September 2015). This extraordinary effort to serve a powerful client and its technologies did not end with the data centre's actual implementation. During my visits to Luleå in 2014–2015, municipal representatives were still eager to remain in a "constant mode of selling," as my interlocutors called it, to secure investments and an anticipated future. Indeed, infrastructures are simultaneously embedded within local social structures while serving as structural mechanisms in themselves (Dourish and Bell 28). In the course of the cloud's infrastructural implementation, the work modes and visions of Luleå's municipality regarding urban and regional futures were restructured. While the cloud was shaped and experienced through locally specific infrastructuring processes and relations, its local manifestations also were perceived as marking the beginning of a new urban and regional development. Such local perceptions also related to historical horizons of meaning and to experiences of Norrbotten as an exploited region.

### *Reconfiguring the Region*

The long-awaited opening of Facebook's data centre in the summer of 2013 triggered new visions and expectations among locals. A Luleå Business Agency representative explains: "If five or six years ago I would have gone down the street and told people that five years from now we would have billions in investments and a giant storehouse for everyone's holiday pictures, nobody would have believed me. They probably would have thought I was crazy, would have locked me into a basement and thrown the key away" (Interview, October 2014). In this interviewee's opinion, the opening of the Facebook data centre also made regular citizens come to believe that a change was imminent, that Luleå would be transformed from a key site of national steel production into a global node of IT competence. Such expectations were quickly integrated into regional and business development programs, such as *The Strategy for the Development of Norrbotten into a Leading Region for Climate Smart Data Centers* (Granberg), which described the region as a "paperless society," freed from the materialities identified with traditional extractive industries.

Regardless of how realistic such strategies were, they expressed the attempt to rebrand the city, the region, and Sweden as a cool and therefore ideal infrastructural site, a commando post of the global cloud. The Node Pole, a newly established semipublic company, was a key actor that managed this re-branding process and served as facilitator between private businesses and the state, lobbying for the data centre industry's interests, promoting this industry in local and national media, and presenting Northern Sweden at international industrial fairs or conferences. The Node Pole included business developers as well as IT and energy experts who took the role of liaison between city planners and the client during the secretive data centre planning phase. Parallel to their engagement with the Facebook project, these experts gathered a pool of expertise provided by regional and international companies that were interested in selling their construction, consultancy, technology recycling, and other services to the data centre industry. In collaboration with Luleå and other nearby cities, it started offering to sell land for potential data centre sites, promoting scenarios of new industrial regional futures in local media and public presentations. Facilitating successful and fast technological solutions, the Node Pole also provided the regional development discourse with ideas of "remote intimacies"—new spatial frames for regional development that were related to the potentially global territoriality of data processing. This encouraged regional decision makers to think about the region and the city not only as a part of a national state but as a part of the border-crossing geographies of the cloud.[6] The fact that the regional electricity grid had been connected to global cloud infrastructure because of Facebook's data centre was depicted in the media as an actual relocation of Norrbotten and Luleå from Sweden's periphery to the centre of the global cloud. The Node Pole consequently became a widely promoted brand name for an imagined space of post-extractive modernity: a glocal geography of IT competence and investment possibilities.

On the one hand, these promotional narratives merely perpetuated a hegemonic perception of the Northern periphery that over centuries legitimized Norrbotten's exploitation by Sweden's national centre. Such narratives presented the scarcely populated but resource-rich region as an empty space, free from local requirements or frictions—a cornucopia of natural resources, technological innovations, and security arrangements offering an abundance of cheap hydro power and limitless economic expansion far away from urban conflicts and the public eye (Sörlin, "Introduction: Polar Extentions"). A representative of Luleå's neighbouring town, Boden, described its potential as a data-storage site: "Boden is the most boring place in the world for people but it is great for servers" (Interview, April 2015). On the other hand, however, these narratives also empowered the region vis-à-vis the national centres by envisioning Norrbotten as an independent actor within a global data economy and by stating its proximity to major IT hubs such as Frankfurt or London, based on comparable regional fibre cable networks, high-speed internet traffic, or the availability of international flight connections. Calculations and graphs developed for branding purposes compared the average temperature in Luleå with temperatures in London, Frankfurt, or New York in order to underline the competitiveness of Norrbotten's cloud infrastructure. The idea of regional emancipation from the state was also supported by the expectation that server farms would be the first industry to make local use of natural resources such as the Arctic cold and hydro energy without having to export these resources to Sweden's South, as had been the case with the traditional heavy industries in this region.

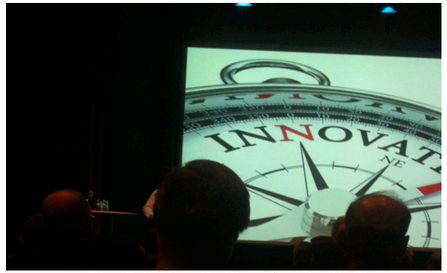


*Figure 7. An informational event for regional business representatives promoting participation in data centre development, organized by the Node Pole and the Luleå Business Agency, Luleå, October 2014. Photographed by author.*

In sum, "relocating" Norrbotten and Luleå to the cloud and reconfiguring these territories within the imagined geographies of the Node Pole transformed the usual understanding of centre and periphery and re-evaluated the region and the city in geopolitical terms as an IT hub. The new industrial development changed the local actors' understanding of the city's territoriality as flexible and determined by spatial and temporal regimes of data operation and not just by national borders (Rossiter). It was still to be determined, however, what the region and the city actually had to offer on the global IT market.

### *Packaging a "Unique Sales Proposition"*

While for regional politicians and individual citizens cloud implementation meant opening up new visions for Norrbotten's future, for local and national business developers the cloud became palpable first of all as a new market. In the context of the imaginary space of the Node Pole, the Arctic cold—a former symbol of Norrbotten's and Luleå's peripheral geographic position—now appeared as a natural resource. As Richardson and Weszkalnys note, being socially produced, natural resources come into being not only as a result of technical inventions and physical productions, but also through acts of epistemological and ontological creativity (129). To reshape the Arctic cold as a valuable resource and new commodity, technologies of imagination were needed in order to re-conceptualize the local cold in relation to global data flows.

In order to be commodified, the cold had to be packaged with other local benefits into a specific regional product. Packaging, according to representatives of Luleå's Business Agency, turned out to be particularly challenging as it demanded bringing things together that had previously been seen as unrelated. As they later would acknowledge, it was not clear yet what they were actually selling when first knocking at Facebook's and Google's doors during early visits to the United States in 2009: "We understood that we had a fair chance to sell cheap electricity and our cold climate, and we had plenty of space and also intellectual capacity, so we tried to pack those things together. Admittedly, we were packing something which we didn't own. We did not own the land, we did not own the climate, and we neither owned electricity. But we still tried to come up with a workable USP—a unique sales proposition" (Interview, November 2014).

Eventually, business developers came to package the Arctic cold with Norrbotten's cheap electricity prices and Luleå's exceptionally stable infrastructural grid, framing these and other local advantages with the help of a promotional narrative that pictured Sweden's North as a place of technological modernity (Sörlin, "Rituals and Resources of Natural History"). The abundance of "empty space"—a symbol for Luleå's and Norrbotten's peripheral position and demographic

problems—was reinterpreted as a guarantee for unlimited and undisturbed industrial growth. Using the Arctic cold for cooling global data in this context not only meant creating a technological innovation but also a specific local service for "getting more from less." The revaluation of the Arctic cold thus enabled business developers to realize their economic plans in attracting IT industry investments and confirmed Luleå's citizens' anticipation of Norrbotten entering a post-extractive era. The Node Pole's promotional narratives depicted this process of resource-making and product-shaping as an affective bodily experience. The above mentioned video *Journey to the Node Pole,* for instance, shows Luleå's citizens enjoying leisure activities on the snow, stating that while snow was formerly associated with freezing, snow and cold now are a good thing as they can be used for cooling the world's data.

Positive perceptions of the new industry not only rested upon an enthusiasm for technological innovation but also on Luleå's particular history. Over more than a century, Luleå and Norrbotten were exploited through resource extraction and regularly struggled with demographic problems caused by the vagaries of the national steel and mining industries. Since the beginning of the 20th century, when dams for hydro energy production and the electricity supply of mines and steel mills were built at Lule river with many locals being forced to move from their homes, national industrial projects had a major impact on the region's economic and demographic development. One prominent example of this impact is the currently ongoing relocation of the 18,000 inhabitants of Norrbotten's city of Kiruna due to the fact that the entire town is slowly plummeting into a sinkhole caused by a former iron ore mine.

In this historical context, it is little surprise that the transformation of the Arctic cold into a new natural resource—not meant for export, but for attracting investment—was greeted with enthusiasm by both local entrepreneurs and citizens. The cloud industry's enormous electricity and water needs[7] and waste heat pollution were barely discussed and seemed harmless compared to the environmental damage caused by traditional extractive industries: as a local journalist explains, "this city is accustomed to pollution and environmental damages through the SSAB steel mill. Note that Luleå's most popular living area is located just in front of the mill. And in the case of the data centre, there is not even a chimney on top of it, and it's just about electricity consumption" (Interview, November 2014). The making of new resources is a relational process involving different actors as stakeholders. As Richardson and Weszakalnys observe, new resources can generate financial profits or losses, strengthen or weaken nation states, cause environmental damage and change local modes of living (10). Shaping the Arctic cold as a new resource of the digital era and packaging that resource into a unique local product empowered the Norrbotten region as an independent economic actor by relating the Arctic cold to global data streams. At the same time, however, it obscured the environmental effects of the cloud and the difficulty of actually proving that the cloud had positive future effects—a claim that could be easily contested given the lack of new jobs for locals, for instance. The economy of anticipation was, however, certainly beneficial for Facebook, since it mobilized the local community around the promise of change and an imagined post-extractive future, making the most efficient, fast, and frictionless implementation of the cloud possible.

## Conclusion

This article has analyzed the implementation of the cloud in Sweden's North as a form of "infrastructuring"—a process of relating, anticipating, networking, and negotiating among technologies, actors, institutions, and stocks of knowledge through different geographical locations and social contexts. The article has traced the diverse ways that cloud infrastructural forms disconnect from their technical functionality and link to multiply located actors and their concerns enabling social change (see Larkin). The making of cloud infrastructure was described against the backdrop of a global economy of anticipation in relation to which the past and present of the involved communities were negotiated and formed. Infrastructuring here is not a linear top-down movement, but a historically and culturally situated and friction-laden process, facilitated by means of imagination and anticipation. Technologies of imagination—understood as knowledge production practices of bringing together seemingly unrelated things—were identified as an inherent part of infrastructuring. This ethnographic perspective allows the seemingly virtual global data flows to be reconnected with their material and political channels, and renders their multiple local entanglements visible. It shows how the cloud's material forms and modes of visibility are contested in culturally specific ways with social and environmental effects (see Tsing).

In contrast to Facebook's corporate strategies of obscuring its infrastructural materialities, it was clearly never in the interest of the Swedish state, the city, or the region of Norrbotten to hide the social network's Luleå infrastructure. Rather, local actors were interested in publicly claiming Facebook's local presence and interpreting it as a meaningful and lasting form of belonging. By connecting Facebook's infrastructure to the national energy grid and by relating the data centre project to the regional interests and aspirations of a post-extractive future, the cloud was integrated into national territories and local narratives. Cloud technologies provided Luleå not only with technological connections to a border-crossing IT economy, but also with new narratives and spatial frames that allowed a reimagining of the future of the city and the region beyond the Swedish state in relation to the glocal geographies of data processing. As a result, the city of Luleå and the region of Norrbotten were reframed as a hub of IT competence within the imaginary space of the Node Pole. Such future scenarios were, however, not simply determined by corporate visions of the cloud or by regional actors' technological dreams, but rooted in particular local experiences and aspirations that had developed historically with regard to Luleå as a geographically peripheral industry town and Norrbotten as a traditionally exploited region.

Following local processes of infrastructuring sheds light on the relation between the urban centres of digital capitalism and its infrastructural peripheries, between virtual data flows and their political and material channels, and between transnational IT companies and local communities. The relation that I have described here as "intimacy at a distance" demonstrates the mutual dependencies between the virtual and material and the local and global dimensions of the cloud, as well as between the different stakeholders involved in processes of infrastructuring. This perspective also demonstrates the uneven distribution of visibility, agency, and power within these glocal geographies of the cloud. Although the introduction of the data centre industry and cloud infrastructure in Luleå empowers this peripheral city vis-à-vis Sweden's national centres, by turning Luleå into an independent actor within a global data economy the costs of this empowerment are high and its future uncertain.

Local authorities, experts, and even regular citizens in Luleå unite in their efforts to imagine a post-extractive future. However, technologies of imagination that reconfigure local territories, redefine identities, and shape new subjectivities also obscure the cloud's actual extractive character and its problematic social and environmental effects, including the data centre's enormous energy needs, waste heat, or its disappointing effects on the local labour market. Imaginings and anticipations of a post-extractive future are mainly based on infrastructural promises that are "almost-but-not-quite-there." Therefore, it is still questionable if locating the cloud is actually advancing Luleå and Norrbotten from the national periphery to the centre of the glocal cloud or if it is just turning them into peripheries of the digital economy: places to which friction-laden materialities and problematic social and natural impacts are being outsourced.

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## Image Notes

Figure 1: Luleå's municipal commissioner Karl Petersen, featured in a video promotion for Volvo and the Node Pole www.youtube.com/watch?v=YwqtBJMZJIU. Accessed 20 February 2017.

Figure 2: Facebook thumb in the lunch room of Luleå Business Agency, photographed by author, April 2014.

Figure 3: Facebook's first data centre building in Luleå, photographed by author, April 2014.

Figure 4: Entrance area of Facebook's second data centre building, Datavägen 15 (Data Street 15), photographed by author, September 2015.

Figure 5: Facebook's Swedish cloud, seen from above. Buildings to the right include student dormitories and Luleå's Science Park. Source: Genomförandebeskrivning/The Description of Implementation, Luleå Municipality 2011.

Figure 6: This drawing shows how Facebook's data centre (the thin line above the trees) was expected to be visible after completion, thus illustrating the cloud's peculiar infrastructural (in)visibility.

Source: Miljökonsekvensbeskrivning/Description of Environmental Consequences, Luleå Municipality 2011.

Figure 7: An informational event for regional business representatives promoting participation in data centre development, organized by the Node Pole and Luleå Business Agency, Luleå, October 2014. Photographed by author.

## Notes

1 Luleå is located about 100 kilometres south of the Arctic circle. The city has 45,000 inhabitants and is the capital of Norrbotten, the most northern Swedish province. Norrbotten is the infrastructurally strongest region in the country, traditionally dominated by steel and forest industries and mining. Over the last five to ten years, Luleå experienced strong economic and demographic growth. However, seen from a historical perspective, the city and the region regularly struggled with demographic problems that arose due to its peripheral geographic position and harsh climate as well as the ups and downs of the heavy industries. Facebook's decision to locate its data centre in Luleå was announced in 2011 and in 2013 the first data centre started operating. As of late 2016, a second data centre building is still under construction and a third building is in the planning phase.

2 Facebook has rejected my inquiries for meetings and did not allow the subcontracted companies to give interviews about their involvement in the Luleå Data Center project. My meetings with Facebook representatives at public events were, accordingly, not informative since they did not provide any other information than that which was covered in the media. However, my interest was focused on regional actors and their experiences.

3 It is questionable if this indeed would be the case. Facebook's infrastructure is of course redundant, but technical problems of such an extent would cause huge costs and might harm the company's image.

4 This early project phase covers the time period of 2009 to 2011. Municipal activities during this period included the selling of land and the infrastructural preparation of the construction area; issuing environmental and building permissions; preparing a detailed city plan; and presenting the project to the public. While Facebook's plans were kept entirely secret in the beginning of that period, municipal experts later learned that the client did not want to reveal the firm's name even after completion. However, local media spread the news that the client was actually Facebook, confirmed in 2011 when Facebook officially announced its decision to build the data centre in Luleå.

5 After completion, this data centre will contain three server halls, 28,000 square metres each, requiring 120 MW of power. The data centre implementation costs amount to 800 million Swedish Krona (SEK).

6 Established in the course of the Facebook data centre project by Luleå's municipality and private business, the Node Pole represented first of all a regional brand. In 2016, the company was bought by the Swedish state-owned energy company Vattenfall and the Northern Swedish energy company Skellefteå Kraft, which advanced the Node Pole to a national brand.

7 Facebook's data centre in Luleå needs one terrawatt of electricity per year, which is comparable to the energy consumption of Sweden's sixth largest municipality of 146,000 inhabitants.

# THE FACTORIES OF THE PAST ARE TURNING INTO THE DATA CENTRES OF THE FUTURE

GRAHAM PICKREN




## Abstract

*This essay traces the history and geography of data's materiality by examining the transformation of industrial building stock in Chicago to serve the needs of the data industry. Using contemporary and archival photographs as entry points, the paper unpacks the rise of an information-based economy in relation to the decline of an industrial economy. Buildings where workers once processed checks, baked bread, and printed Sears catalogues now route packets of information and host servers engaged in financial trading. Thus, contained within the physical transformation of some of Chicago's buildings is a larger historical and geographical narrative about the uneven development of capitalism. This historical view reminds us that infrastructure is, and always has been, political.*

## Résumé

*Cet essai retrace l'histoire et la géographie de la matérialité des données en examinant la transformation des bâtiments industriels à Chicago pour répondre aux besoins de l'industrie des données. En utilisant des photographies contemporaines et d'archives comme point de départ, le texte explore la montée d'une économie axée sur l'information par rapport au déclin d'une économie industrielle. Les bâtiments où les travailleurs ont autrefois traité des chèques, cuit du pain, et imprimé les catalogues Sears, transmettent maintenant des paquets d'information et hébergent des serveurs impliqués dans les échanges financiers. Ainsi, à travers la transformation physique de certains bâtiments de Chicago, il existe un vaste récit historique et géographique à propos du développement inégal du capitalisme. Ce point de vue historique nous rappelle que l'infrastructure est, et a toujours été politique.*


We live in a data driven world: from social media applications, to "smart" cities (Batty; Shelton, Zook, and Wiig), to the Internet of Things (Wasik), the generation of huge volumes of information about nearly every detail of life has revolutionized fields such as business, government, and even the pursuit of romance. While we tend to focus our attention on the applications of these new technologies, it is crucial to remember that, like other industries, the growth of computing entails physical changes in the landscape. The networks of data centres, fibre-optic cables, and cell towers that power the transmission of digital data and make the internet, mobile devices, and big data applications work are hidden in plain sight in our cities, suburbs, and rural communities. Like the factories, railroads, and highways that formed the backbone of the U.S.'s industrial economy, the infrastructure of computing is now central to modern capitalism.

A robust literature now exists that has sought to unpack the relations between the "virtual" technologies of computing and the material relations that underpin them (see Easterling; Hogan; Parks and Starosielski; Velkova). In this essay I add to this conversation by showing how the material infrastructures of computing connect our digital present to our industrial past. Infrastructures that served one historically and geographically specific regime of accumulation (U.S. industrial capitalism) have been reworked to serve the needs of a digital economy. In this reworking, we are reminded that capitalism is a set of continually evolving social relations that constantly turnover what has come before while never quite abandoning the past.

In Chicago, where I teach and research, I have been studying the transformation of the city's industrial buildings to serve the needs of the data industry. Buildings where workers once processed checks (Baeb), baked bread (1547 Realty), and printed Sears catalogues (Miller) now stream Netflix and host servers engaged in financial trading. The buildings themselves are a kind of witness to how the U.S. economy has changed, but, more than that, they are what Mattern has described as the "bleed points" where the physical and the virtual meet (2014). By exploring these changes in the landscape and these bleed points, not only do we get a better sense of how data exists in the physical realm, but we are also struck with new questions about what the rise of an information-based economy means for labour and the politics of growth in contemporary cities. I argue that debates about the emergent smart city and the knowledge economy should be grounded in the historical and geographical context of capitalism's uneven development in order to foreground new urban technological formations as political rather than merely inevitable. I use photographs and archival images to help illustrate this context while also bringing the bleed points of the digital age into clearer focus.

In what follows, I provide a brief overview of the role of data centres in Chicago's urban development. I then describe the adaptive reuse of industrial buildings for data purposes as an "analog to digital" shift. The final section considers the political implications of this shift in terms of employment and urban economic development policy.

### From Analog to Digital

Data centres have been described as the factories of the 21st century (Cook). A data centre is a facility that contains servers that store and process digital information. When we hear about data stored "in the cloud," that data is materially stored in a data centre. Contrary to the ephemeral-sounding term "cloud," data centres are highly energy- and capital-intensive infrastructure. Servers use tremendous amounts of electricity, which generates large amounts of heat, which in turn requires extensive investments in cooling systems in order to keep servers operating. These facilities also need to be connected to fibre-optic cables, which deliver information via beams of light and constitute the "highway" part of the "information superhighway." In most places, fibre-optic cables are buried along the rights of way provided by existing road and railroad networks, meaning the pathways of the Internet are shaped by previous rounds of development (Burrington).

What is important to keep in mind here is that an economy based on information, just like one based on manufacturing, still requires a built environment through which inputs and outputs circulate. In other words, place always matters. For the data industry, taking advantage of the places that have the power capacity, the building stock, the fibre-optic connectivity, and the proximity to both customers and other data centres is often central to their real estate strategy.

As this real-estate strategy plays out, what is particularly fascinating is the way in which infrastructure constructed to meet the needs of a different era is now being repurposed for the data sector. In Chicago's South Loop, the former R.R. Donnelley & Sons printing factory, at one time one of the largest printers in the U.S. producing everything from Bibles to Sears catalogs, is now the Lakeside Technology Center, one of the largest data centres in the world and the second largest consumer of electricity in the state of Illinois (Miller). The eight-story Gothic-style building contains vertical shafts formerly used to haul heavy stacks of printed material between floors, and these columns are now used to run fibre-optic cabling through the building (which comes in from the railroad spur outside). Heavy floors built to withstand the weight of printing presses are now used to support rack upon rack of server equipment. What was once the pinnacle of the "analog" world of the printed word is now a central node in global financial networks.


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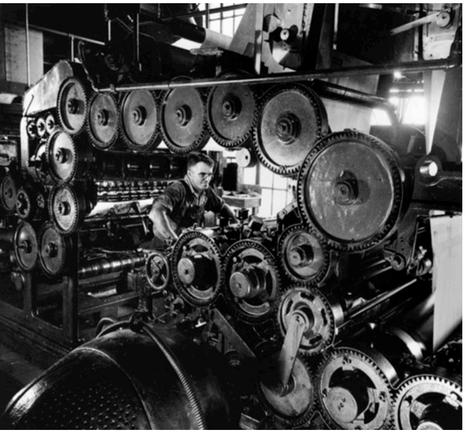


*Photograph of printing press #D2, 1949. R.R. Donnelley & Sons Company. R.R. Donnelley & Sons Company. Archive, Special Collections Research Center, University of Chicago Library*

Just a few miles south of Lakeside Technology Center is the former home of Schulze Baking Company in the South Side neighborhood of Washington Park. Once famous for its butternut bread, the five-story terra-cotta bakery is currently being renovated into the Midway Technology Center. Like the project in the South Loop, the Schulze bakery contains features useful to the data industry. The building also has heavy-load-bearing floors as well as louvered windows designed to dissipate the heat from bread ovens (or in this case, servers). The neighborhood as a whole also makes the Schulze desirable. I interviewed a developer working on the Schulze redevelopment project and he told me that because the surrounding area had been deindustrialized, and because a large public housing project, the Robert Taylor Homes, had closed down in recent decades, the nearby power substations actually had plenty of idle capacity to meet the data centre's needs.


*Schulze Baking Company advertisement. University of Illinois Chicago Digital Collections*

Examples of this "adaptive reuse" of industrial building stock abound. The former *Chicago Sun-Times* printing facility recently became a 320,000 square foot data centre (Harley); a Motorola office building and former television factory in the suburbs has been bought by one of the large data centre companies (Sverdlik); and the once mighty retailer Sears, which has one of the largest real-estate portfolios in the country, has even created a real-estate division tasked with spinning off some of its stores into data centre properties (Ryan). Beyond Chicago, Amazon is in the process of turning an old biscuit factory into a data centre, and in New York some of the world's most significant data centre properties are housed in the former homes of Western Union and the Port Authority, two giants of 20th-century modernity.

To be sure, not every data centre project involves reusing existing buildings. Many of the large tech companies, such as Facebook and Google, focus on building standalone state-of-the-art facilities custom-built to their needs. Yet even in these examples, place still matters. For instance, Facebook, Google, and Microsoft have all built large data centres in the Pacific Northwest in regions that have cheap electric power and high-voltage power lines that formerly served the timber and mining industries. The common thread is that across urban adaptive reuse projects and rural developments, there is no blank slate upon which the world of data simply emerges. What we see here in these stories is the seesaw of capitalist development and how decline can actually create conditions for growth. As certain industries and regions decline, some of the infrastructure retains its value, thus providing incentives for savvy investors down the road to seize upon an opportunity. More broadly, we see that understanding where the infrastructure of computing is and why requires grappling with previous rounds of uneven capitalist development spanning back a century or more to the development of the railroads, the telegraph, and the industrial and political needs of the 19th and 20th centuries. Cycles of boom and bust, tensions between capital's fixity and mobility, and the shifting prominence of a "cognitive cultural capitalism" (Scott) vis-à-vis manufacturing all therefore provide much-needed context in understanding big data and computing today.


*The Schulze Baking Company operated on Chicago's South Side from 1914–2004. The historic building is being turned into a data centre. Photo: Graham Pickren*

While this essay does not attempt to review the vast literature on critical political economy in order to pinpoint the macroeconomic drivers of an industrial to post-industrial shift, of which computing's rise is a part, (see Harvey; Arrighi; Brenner), what this literature offers is a relational approach to understanding how built environment, capital, and social relations intersect. Rather than neatly periodizing different phases of capitalist urbanization and situating data as novel, what I focus on instead are the continuities between an (always temporary) industrial period and the (similarly temporary) ascendancy of digital capitalism. Across these different moments, we see material relations—the mixing of labour, non-human objects, and value—unfolding in ways that produce winners and losers. Both printing factories and data centres are political sites as well as sites that transform resources and materials. In what follows, I briefly consider both the labour politics and the urban growth politics that flow from this analog to digital shift.

## Data, Labour, and Urban Politics

How computing continues to animate changes in the physical landscape is of course linked to changes in the social landscape. Many studies of technology focus on one or the other, but in this section I link them together. First, there is the issue of labour and employment. Data centres gen-

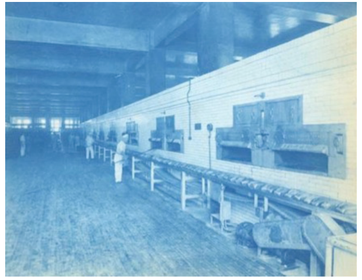
erate tax revenues but do not employ many people, so their relocation to places such as Washington Park is unlikely to change the economic fortunes of local residents (even so, the developer on the Schulze project hopes to have an IT-training component of the facility available to local residents). If the data centre is the "factory of the 21st century," whither the working class?

Data centres are in many ways crucial to changes such as machine-learning, which threaten to automate large numbers of tasks across a range of both high- and low-skilled jobs that involve routine work. By one measure, as much as 47% of U.S. employment is at risk of being automated ("Automation and Anxiety"). Buried within the question of what the factory of the 21st century means for working people is the larger issue of the relationship between automation and the polarization of incomes. Both low- and high-skilled jobs that are non-routine (i.e. difficult to automate) are growing in the U.S. Some of these jobs will be supported by data centres, freeing up workers from certain tasks (say, medical image analysis) so that they can focus on other skills ("Automation and Anxiety").

On the flip side, the manufacturing sector, which has provided so many people with a ladder into the middle class, is in decline in terms of employment. The data centre also embodies and facilitates that polarization, as data management supports the logistics of offshoring and automation that displaces workers. To paraphrase Joseph Schumpeter, data centres seem likely to both create and destroy. The political problem is that where jobs are created, where they are destroyed, and who is affected are socially and geographically uneven. For neighborhoods such as Washington Park, capital is once again flowing and sparking surplus-value creation, but this swell of investment does not raise as many boats as it used to under previous regimes of accumulation. The neighborhood is prized for its infrastructure but not necessarily for its people. In fact, the developer of the Midway Technology Center told me that the low population of the neighborhood was an added bonus for building security.

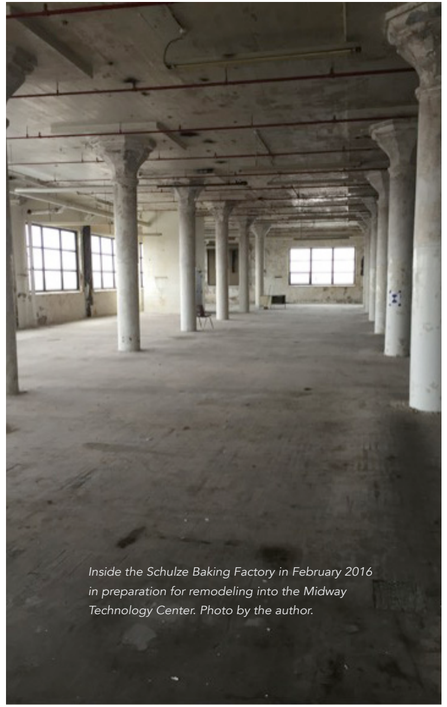
Second, the physical Internet today is expanding in ways that are path-dependent but also being shaped by the current neoliberal political economic context in which urban and regional entrepreneurialism and place-marketing figure prominently (Harvey). Public officials around the world are eager to grease the skids of data centre development; for example, Chicago has the Data Center Express, a public-private partnership whose purpose is to streamline the process of data centre development, and generous tax incentives are often part of the data centre development process in any location. As the Associated Press recently reported, state governments across the U.S. extended nearly $1.5 billion in tax incentives to hundreds of data centre projects nationwide during the past decade ("Competing for data centers"). For example, an Oregon law targeting data centres provides property-tax relief on facilities, equipment, and employment for up to five years in exchange for creating one job (Hammil).

It also appears that tax incentives have now become a bargaining chip for the data centre industry to use to create competition between regions and localities. In an editorial written in *The Detroit News* as tax breaks were being considered by the state legislature, one data-company CEO wrote "If Michigan doesn't pass the legislation, it means we can't come to Michigan because our clients won't and the reason is simple: More than 20 other states have passed the same set of data center tax policies being considered in Michigan" (Kramer). There is little new in this race-to-the-bottom discourse, but in previous eras cities and regions could potentially expect jobs to be created and that some of capital's return to an area could be invested in labour.



*Bakers working the conveyor belt at Schulze Baking Company, circa 1920. The new data centre will employ significantly fewer workers than the bakery. By Fred A. Behmer for the Jeffrey Manufacturing Company, via Wikimedia Commons*

More philosophically, as a geographer, I've been influenced by scholars such as David Harvey and Neil Smith, who have theorized capitalist development as *inherently* uneven across time and space; thus, boom and bust and growth and decline are two sides of the same coin. The implication here is that the landscapes we construct to serve the needs of today are always temporary. The smells of butternut bread defined part of everyday life in Washington Park for nearly a century. Today data is in the ascendancy, constructing landscapes suitable to its needs. Yet those landscapes will also be impermanent. What remains common over time, however, is that people struggle over the trajectories of that uneven development.



*Inside the Schulze Baking Factory in February 2016 in preparation for remodeling into the Midway Technology Center. Photo by the author.*

Studies of infrastructure remind us that telecommunications and transport technologies have always been political. Remembering that people struggled to exercise some modicum of democratic control over the changes wrought by railroad networks and telecoms offers important insights for struggles around contemporary networks of computing. For example, in Banks' brilliant essay on the continuities between railroads and the Internet, he notes that because railroads were once so central to everyday life, in the U.S. they became regulated as "common carriers," a legal designation that prohibited price gouging and discrimination but also allowed local publics to make demands on this private infrastructure (2015). Many of these demands simply provided that trains stop in particular towns so passengers could get off and buy goods and services ("Lines of Power"). The city of Lowell, Massachusets even required rail companies to run their tracks right to factory doors. Other groups, such as Native Americans, some southerners loyal to the Confederacy, and many elites tried to block the expansion of railroads altogether. In Chicago in 1897, an armed mob marched on City Hall and successfully prevented the extension of Charles Tysen Yerkes' monopoly contract on the city's urban rail network. In all of these cases, Banks reminds us that these groups were not attempting to return to some pre-railroad past, but to exert "control over the contours and contexts of connection" (Banks).

Likewise, today the web is an almost inescapable part of everyday life, even for those without access. Yet it was only in February of 2015 that the U.S. designated Internet service providers as "common carriers," thus preventing them, like previous publics did of the railroads, from operating a "tiered" Internet that blocks, throttles, or prioritizes specific content over others (Banks). Thus the democratization of network infrastructure continues to be fought, as the debate over "net neutrality" indicates, and various groups are contributing to alternative visions of what ubiquitous computing might look like. For example, instead of contracting with Internet service providers who operate a near monopoly in most cities, as Yerkes did with trains in Chicago, over 100 U.S. cities are currently seeking to build out municipally owned and operated Internet services that prioritize low-cost, speed, and access to underserved communities (Nguyen). Ethnographic work that gets up close to the ways in which people struggle to carve out control over technologies, combined with the kind of historical view that Banks provides, creates a powerful lens through which to capture the historical conditions from which phenomena such as the smart city emerge.

In sum, thinking about computing and big data as physical and historical phenomena helps to contextualize the rapid

social and technological change taking place within space and time, rather than viewing this shift as a movement towards a kind of inevitable end state. For media scholars and others, the goal of much recent work seems to be to open up digital technologies and networks and the black-boxes of new socio-technical formations in an effort to make these formations more bottom-up, responsive, and inclusive (Jeffrey and Levin; Mattern). The vignettes discussed here are intended to show the layers of history and politics embedded within our everyday technologies. Visually recognizing these layers by studying buildings serves, even in a small way, to make the smart city and the digital present less abstract and more grounded the everyday spaces of contemporary life.

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# UNCERTAIN ARCHITECTURES: PERFORMING SHELTER AND EXPOSURE

KRISTIN VEEL




## Abstract

*Originally housed in generic industrial buildings, data centres have become sites of architectural feats and playgrounds for starchitects in recent years. These buildings testify to a changed role of how we think of these repositories for data and their position in our society. Through a reading of the Bahnhof data centre Pionen in Stockholm from 2008 and the design schematic for a Data Tower in Iceland, this article examines how the data centre as an architectural and infrastructural edifice facilitates data storage and access, focusing on how security is articulated in the architectural vocabulary through negotiations of visibility. By intermingling images of these sites with textual vignette-like reflections, this article uses the architecture of the data centre to address how the design of dynamic data archives embodies cultural imaginaries of uncertainty through the tropes of shelter and exposure.[/column]*



## Résumé

*Initialement hébergés dans des bâtiments industriels génériques, les centres de données sont devenus récemment des merveilles d'architecture et des terrains de jeux pour les « starchitects ». Ces bâtiments témoignent d'un changement de rôle dans la façon dont nous pensons à ces entrepôts de données et à leur position dans notre société. Grâce à une lecture du centre de données Bahnhof Pionen à Stockholm à partir de 2008 et au schéma de conception d'une tour de données en Islande, cet article examine comment le centre de données, en tant qu'édifice architectural et infrastructure, facilite le stockage et l'accès aux données, en mettant l'accent sur la façon dont la sécurité est articulée dans le vocabulaire architectural à travers les négociations de visibilité. En entremêlant les images de ces sites avec des réflexions textuelles semblables à des vignettes, cet article utilise l'architecture du centre de données pour aborder comment l'élaboration de centre de données dynamiques incarne des imaginaires culturels d'incertitude à travers les tropes d'abris et d'exposition.[/column]*


## Storage and Access

Data centres are the buildings that house the servers that enable our online communication, thereby constituting the physical residences that allows for the ubiquitous integration of digital technology into our everyday lives. As anchoring points for the data deluge that envelops us, they can be regarded as the contemporary architectural form of the repository archives and libraries in which Western culture has stored information for centuries. In this sense, data centres may also be regarded as spatial containers for our current engagement with time, offering not only storages of the past, but gesturing towards the temporal regime of a broad present (see Gumbrecht; Ernst; Cox and Lund): in the data centre the past and the future intermingle in the dynamic accumulation of data, which can be operationalized for predictive and pre-emptive purposes in an even more tangible way than their physical antecedents. While predictive data analytics are marketed as tools for certainty and security, the temporal regime of simultaneity of which they are part also marks a move towards uncertainty as a fundamental condition that engages in a re-negotiation of what is considered visible and what is invisible.[1] The aim here is to unfold how this uncertainty takes architectural form through architectural and discursive analysis of blueprints, architectural renderings, and photographs of the Bahnhof data centre *Pionen* in Stockholm from 2008 and the design entry for a *Data Tower* in Iceland, which came in third in the magazine *eVolo*'s 2016 Skyscraper Competition.

*Figure 1*

As facilities for storage and access, data centres have different spatial affordances than traditional archives. As opposed to archives containing books, images, or objects, data centres store the servers that house the data, which can be extracted and rendered remotely in different formats and through a range of different interfaces. Admission to the storage facilities is therefore not necessarily granted in order to access material and the materialisation of data can be regarded as more fleeting and modular than the physical archive. Nonetheless, as this special issue on the geographies of global data makes clear, information infrastructures partake in natural, social, and political geographies in new and noteworthy ways. While they are containers for ephemeral data, they are also the epicentres of power and control, and their physical location has extensive implications for information ownership as well as environmental consequences (Hogan and Shepard; Hogan).

Looking at the diverse architecture of this new generation of data centres—which are increasingly custom-built and the result of prestigious design competitions—conveys important information about how contemporary culture imagines and projects the function of these data hubs. The architectural vocabulary and the narratives these sites exert about data storage and access provides us with insight into how security (understood as spectrum of issues ranging from equipment conditions to privacy)

*Figure 2*

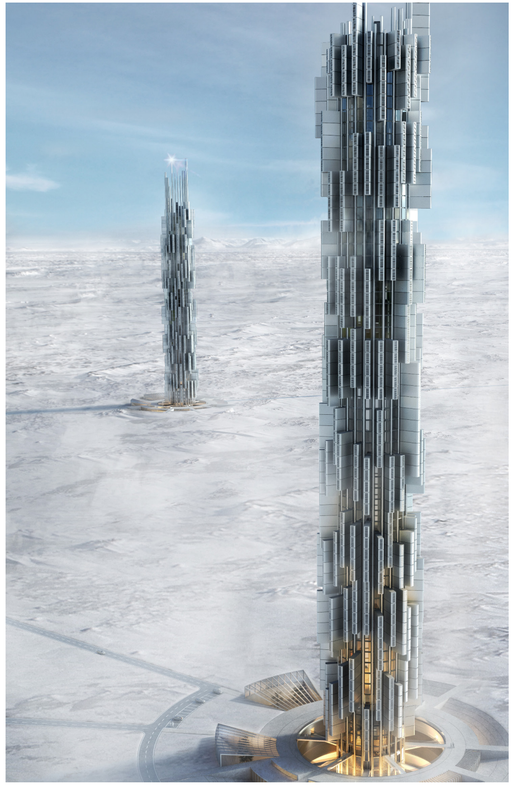


DOI : http://dx.doi.org/10.17742/IMAGE.LD.8.2.4

takes architectural form. In recent years, the architecture of data centres has gathered interest among a wider audience, evidenced by Douglas Alger's coffee-table book *The Art of the Datacenter* (2012), *Wired*-correspondent Andrew Blume's bestseller *Tubes: A Journey to the Centre of the Internet* (2012), and the documentary project *The People's Cloud* (2016). This article considers the materiality of infrastructure and how we may go about reading the cultural implications of these structures, following the work of scholars such as Mél Hogan, Jennifer Holt and Patrick Vonderau, Peter Jakobsson and Frederik Stiernstedt, Shannon Mattern, Lisa Parks, and Tung-Hui Hu.

The two architectural structures on which this article focuses appear at first sight to be opposites—one convex and one concave structure: *Pionen—White Mountain*, built in 2008, 30 metres below ground in an old nuclear bunker carved out of the mountain in Stockholm, houses the facilities for the Swedish internet service provider, Bahnhof.

The design for a *Data Tower* in Iceland, which came in third in the magazine *eVolo*'s 2016 Skyscraper competition, shoots out of the ground. Yet its height, designed to be adaptable to shifting storage needs, and its modular structure made out of server boxes that can



move in and out of the building, make for an appearance that is as flexible and in flux as the content it contains.

*Figure 3*

In what follows, I shall focus on these two data centres—one built and one imagined—as architectural, infrastructural imaginaries that, in different ways, encapsulate a reflection on the cultural imagination of data access and storage as linked to uncertainty in the 21st century. These reflections take their starting point in a series of illustrations from the design proposal of the *Data Tower* by the two architects, Valeria Mercuri and Marco Merletti, and Åke E:son Lindman's photos of *Pionen* for Albert France-Lanord Architects. Weaving between these images, my work also re-narrates the buildings, thus providing a representational architecture in and of itself that shares with these buildings an engagement with the future in which we live through imagining it.

## Security as Shelter and Exposure

The equipment housed in a data centre makes specific demands on its surroundings in terms of resilience with respect to natural disasters and equipment failure. In particular, data servers are required to be kept cool, which means it is more





energy efficient to place them in the northern regions of the world. Both examples in this article are intimately tied to a specific geographical location and climate conditions. This visual and textual exploration thus starts by looking closer at how these buildings take advantage of the environment in which they are situated in order to create the optimal conditions for the equipment they store.

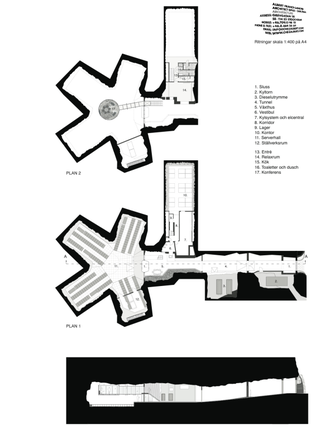



*Figure 4*

First, we go into the ground:

On September 11, 2008, Bahnhof opened their new computer centre inside the former civil defence centre *Pionen* in Stockholm's Vita Bergen, a very stable geological area that consists of two-billion-year-old granite. The defence centre

*Figure 5*

was built in the 1970s to protect government functions from nuclear attacks. Thirty metres below ground and sheltered behind a 40-cm-thick metal door, it has 1200 square metres of space for its server halls and offices. Dynamite blew out 4000 cubic metres of extra space, and it took them around two and a half years to turn the atomic shelter into a data centre. The shelter uses outside air cooling rather than geothermal cooling (drilling into the mountain and using the coolness of the ground) to avoid heating the mountain that surrounds it. Backup power generators repurposed from second-hand diesel engines from German submarines secure the stability of this site. In the event of a system failure, a submarine sound horn alerts the surroundings (see *Albert France-Lanord (A)rchitects*; *Bahnhof*; "Pionen"; McMillan).

In this way the atmosphere resonates with Cold War connotations, and the design of the data centre itself, by the architects Albert France-Lanord, has been heavily inspired by James Bond and sci-fi film sets. The interior decoration evokes spaceships and notions of self-sufficiency—for instance, in the way fountains, greenhouses, and a fish tank have been installed in the depths of the cave to create a sense of the intermingling of nature, technology, and humans (see Fortin; Schrijver; Sanders).

As an internet service provider, Bahnhof works mainly with what is called "colocation"; they provide space for the servers and networking equipment of different companies, particularly desirable for companies with midsize IT needs for which it is not profitable to invest heavily in the technological logistics that support their work ("Colocation"). Bahnhof thus makes a living from providing a physical storage facility that offers security and stability in terms of power supplies as well as flexibility in terms of facilitating different types of customers and their equipment. Since this data centre is essentially an extension of a nuclear bomb shelter, the site was already constructed with security issues in mind, and the vocabulary of a self-contained world-within-a-world in its sci-fi interior decoration enhances this feeling.

On constructing the Bahnhof data centre *Pionen*, Albert France-Lanord Architects stated: "It has been very exciting to work with a space which at first didn't offer one square angle: the rock. The main room is not a traditional space limited by surfaces but defined by the emptiness inside a mass." ("Pionen") This notion of "emptiness inside a mass" is an evocative metaphor for thinking about digital storage space. The concept of data is often discussed in relation to the trope of the *black box*, the archetype of which is, of course, the flight recorder. Entering common language from engineering and cybernetics in the second half of the 20th century, the black box is a trope for something about which we can only know the input and the output. In Bruno Latour's words, it describes "an expression from the sociology of science that refers to the way scientific and technical work is made invisible by its own success" (304). In the case of *Pionen*, we may say that the whole data centre is, in a sense, black-boxed—to the many pedestrians making their way above ground past wooden houses and an old church, *Pionen* is emptiness inside a mass.

The logic of a site such as *Pionen* hinges on the particular configuration of access and storage that it provides. Storing the servers 30 metres underground evokes a Cold War logic of containment and of invisibility as connoting security, with which the interior inspired by the self-contained spaceship is in dialogue. Yet significantly, the architecture revolves not only around the fundamental needs of securing a stable environment for the servers but also making the resources housed here easily available for distribution and consumption. Unlike the original nuclear bunker—the submarine or the spaceship—the *raison d'être* of the data centre lies in the connectivity it provides to the surrounding world. This gives rise to a series of architectural paradoxes, as we shall see when we in the next section return to how visibility is negotiated in the interior of this building.

Figure 6

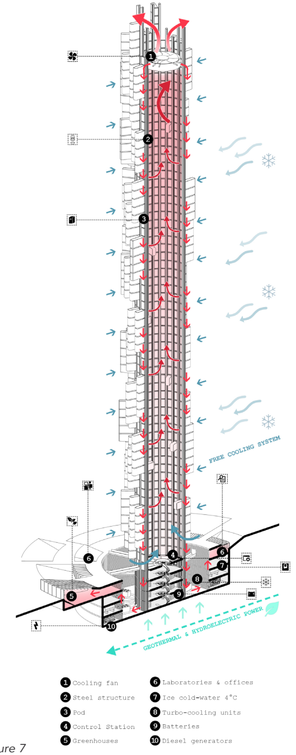



Figure 7

First, however, we shall turn to the projected 65-story *Data Tower*. Here the notion of emptiness inside a mass takes on another meaning. *Data Tower* is envisioned as a tall vertical structure that elevates the servers rather than burying them in the ground. The design is modelled on an enormous, 3D motherboard with a cylindrical shape, inspired by Volkswagen's Car Towers in Wolfsburg and the Apple Mac Pro Tower. All the hardware components are fastened on the external façade, while the inside is left as an empty void that has a double function: it is the main air duct of the cooling system and the space in which the pods can be moved to the ground floor for maintenance and upgrade. It is imagined to function as a giant chimney that heats the laboratories and greenhouses located in the basement as well as the surrounding neighbourhood.

The *Data Tower* demonstrates the same logic of self-sufficiency and attention to the heat the servers produce that we saw with Bahnhof's bunker. Yet while the bunker struc-

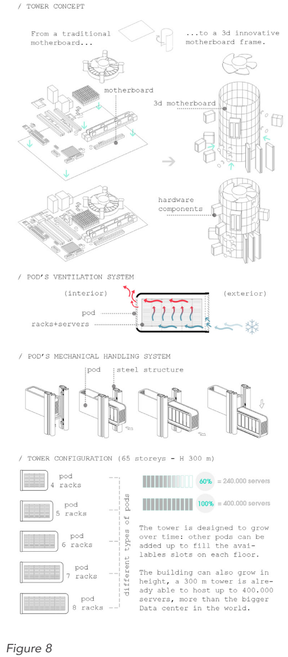



Figure 8

ture encapsulates the servers, they almost leap from the surface of the tower. Here, security takes a different form: rather than sheltering, it exposes its contents to the surroundings. Flexibility and connectivity are privileged over the sense of protection that comes from the hidden cave structure. The motherboard as an architectural model allows for modular thinking, which makes the façade adaptable to the needs at a given time. Thus, the height of the tower is not fixed but adaptable. In this way, the building allows for much more plasticity than is possible in Bahnhof's bunker, which is much more difficult to expand at a later stage.

Thus, in different ways, the two buildings give form to data storage in a way that emphasizes that this content should be *simultaneously* secure and also remain flexible in terms of access. The bunker foregrounds the security aspects as an issue of protection and shelter while the tower makes for a much more exposed edifice that exhibits extreme flexibility and vulnerability. Turning now to look closer at the notion of *visibility*—a concept that has saturated most public institutions and private corporations in the 21st century—allows us to explore this constellation of shelter and exposure more and examine the relation between security and flexibility that we see at work in these buildings.

## Visibility

Transparent glass facades have dominated much contemporary high – to mid-rise urban architecture since the 1990s, reflecting the architectural articulation of ongoing negotiations of visibility and invisibility in a contemporary culture dominated by increasing surveillance (Steiner and Veel). Architecture historian Anthony Vidler, among others, has argued that glass (as a material which is only transparent under very specific light conditions) is often used as a political or ideological statement to *signify* transparency rather than necessarily embody it. Transparency can therefore be considered an ideological condition (Vidler 217-18). So, I argue, is security, and data centres are a particular type of building in which we can observe visibility perform a negotiation of security issues in built form.

On a first reading, *Pionen* and the *Data Tower* may seem to embody a transition in thinking about institutions and visibility—an architectural equivalent of the Gilles Deleuze's distinction between disciplinary societies and societies of control ("Postscript on the Societies of Control"). Here Deleuze uses the imagery of the serpent and the mole as a way of articulating a shift from Michel Foucault's disciplinary societies, which involved an individual passing through one contained environment after another (the family, the school, the factory, the hospital, the prison). These institutions are embodied in distinct physical and architecturally recognisable settings in which the panoptic principle of a centralised gaze can easily be implemented and stand in opposition to control: "Enclosures are *molds*, distinct castings, but controls are a *modulation*, like a self-deforming cast that will continuously change from one moment to the other, or like a sieve whose mesh will transmute from point to point" (Deleuze 4). Applying this perspective, the two data centres can be read as representing these two different (albeit connected) regimes, with *Pionen* representing a notion of enclosure and containment while the projected *Data Tower* embodies flexibility, flow, and modulation.

In the *Data Tower*, the server-filled pods are outside the tower. They are lifted up to their spots automatically and taken down when needed. The inside void is a chimney that exhausts hot air or recycles it for heating. *Data Tower* thus exposes what it stores on its façade—in that sense, performing complete visibility where everything is there for us to see, server after server, gigabyte after gigabyte. There is nothing at the centre to expose but hot air. Whereas *Pionen*, as we have seen, embodies storage as shelter, the modular flexibility in the *Data Tower*, exposed to the Icelandic climate, makes a statement about flow, distribution, and connectivity that is linked to its use of visibility. The façade has been turned into an adaptable surface that can adjust the density and height of the tower according to what is needed at any given time. By design, it asserts a distributed and modular sense of the data it stores. Although there is a control station at the bottom of the building that can check the status of each server and, via a mechanical handling system, bring any pod to the ground, it is embedded seamlessly in the surroundings. It is not an elevated, panoptic control tower that provides a bird's-eye overview. Thus, it is not a building that promises protection, security, and centralised control the way we are used to thinking about them in panoptic terms. Rather, it is a building that seems attuned to a conception of security that is equally modular and operates with modes of uncertainty as an unavoidable condition.

However, if we return to *Pionen* and look at its interior, visibility is here also articulated rather ambiguously, and its en-

*Figure 9*

gagement with disciplinary modes of visuality is in fact often tongue-in-cheek. While the site at first glance maintains an aura of security and containment as an underground location that distinguishes itself markedly from the wooden houses above ground, thus marketing itself by its impenetrability and obfuscation, it also engages with visibility as a negotiable stance dependent on point of view. For instance, in its central meeting room it emulates the control tower of a traditional industrial infrastructure: the airport, the ship, the panopticon prison. Overview and visibility here connote safety and control.

Yet the allusions to sci-fi films throughout the interior of the building bring attention to the choreographed performativity of these security structures. This emphasis on the performativity of the site makes it all the more apparent that all there is to survey and control from this platform is the impenetrable white server boxes. The glass encapsulation thus comes to appear more as a theatrical instalment that may bestow a sense of power upon the people on the bridge but in turn makes them part of the décor on the same level as the 2600-litre saltwater fish tank we saw earlier. The people likely to sit in this room know only too well that monitoring takes place elsewhere and, for the most part, is not even conducted by humans. A cyberattack or a systemic error would not be visible by looking at the white boxes. Most likely, it would not even be visible from observing the people working in this environment. Significantly, the server boxes are white, not black, which may be read as a comment on the fact that, while full visibility is granted from this platform, there is nothing to see.[2] Visibility does not always render the inner workings more transparent.

## Uncertain Architectures

The playful engagement with 20th-century security connotations in *Pionen* can thus be regarded as pointing to the possibility of a subversive space emerging out of the cultural imaginaries of the Cold War. The founder and CEO of Bahnhof, Jon Karlung, is an active voice in Swedish public discourse on cybersecurity. He is famous for housing Wikileaks in 2010 as well for taping and releasing conversations with the Swedish intelligence services when they tried to persuade Bahnhof to release information on their customers' emails and phone calls in 2013 ("Bahnhof"). In a similar manner to the building's take on visibility, also security can be seen as a question of point of view: from whose gaze should the stored data be protected? The prying eyes of competitors or government agencies? It can be argued that the ambiguous engagement with visibility in the architecture of *Pionen* gestures towards what is called "bulletproof hosting"—i.e., web-hosting firms that do not meddle too much with what their customers upload and distribute and can provide offshore sanctuaries, for instance, from US jurisdiction.[3] Most service providers have terms of service that enable them to suspend a hosting account if complaints are made, either for ethical reasons or for the practical reason of reducing the risk of anti-spam filters blocking their IP subnet. However, a "bulletproof" host allows a content provider to bypass the laws regulating internet content and service in its own country of operation, which was the case with the Wikileaks servers. In this way, *Pionen* embodies an "aesthetics of the secret" that, according to cultural theorist Clare Birchall, may provide a way for coping with the surveillance regimes that current data-tracking possibilities may facilitate:

*Figure 10*

> *Instead of acts of publicity such as legal marches or online petitions, the "datatariat" might need to meet the pervasive protocols of inequitable dataveillance employed by the securitised state with opacity. A right to opacity in this context would mean the demand not to be reduced to and understood as data as defined by the state. Though we have to acknowledge the attendant risks of non-progressive and criminal activity made possible by the "dark" web, it is nevertheless here that the right to opacity might be asserted. (45)*

Another approach would be that of complete openness—embracing the exposure and vulnerability that comes with the tracking of movement and predictive analytics that is enabled with big data analysis. As early as 2001, surveillance studies scholar David Lyon described how data move freely between different sectors of society, resulting in information from discrete realms spilling into other contexts. Private life, work life, and shopping should be understood as what he calls "leaky containers" (Lyon 37-48). More recently, media theorist Wendy Chun has made the point that leakiness should not be regarded as a fault. Rather, computer devices are leaky and promiscuous by default, "Networks work—they allow us to communicate—by exposing users, by making users vulnerable, so to that there can be a 'we,' however inoperable, to begin with" (379). However, according to Chun this may in fact be employed as a mode of resistance:

*Figure 11*

> *Thus, rather than fighting for a privacy that is no privacy, what if we rather embraced our role as collective characters in public? What if, rather than accepting the reduction of trust to corporate security, we embraced Nissenbaum's argument that trust entails the ability to take risks? (375)*

These two different strategies provide a more nuanced framework for understanding the way in which *Pionen* and the *Data Tower* embody security as architectures that respond to conditions of uncertainty by way of a negotiation of visibility. *Pionen* maintains an aura of security and containment while it exposes visibility as a negotiable stance and a performative gesture that may obfuscate as much as reveal. The *Data Tower*, on the other hand, is essentially a leaking and exposed architecture, its visual impression that of flux and movement. The façade appears porous and membrane-like with pods containing servers flowing up and down the 65 stories, either sucked into the building for maintenance or protruding into the cold Icelandic air. The pods will not all be inside or outside the tower at the same time; some will always be exposed to the weather. As Chun points out, just as there will always be leaks with networked media, there will always be a part of our private data that is exposed. As soon as we interact with the machines that store our data, we make ourselves vulnerable. This is the nature of these archival machines, and it is the narrative that a building such as the *Data Tower* projects.

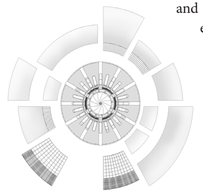


*Figure 12*

## The Architecture of Data

Through architectural and discursive analysis of blueprints, architectural renderings, and photographs, this text has aimed to illuminate how uncertainty takes architectural form as a negotiation of visibility that reveals different ways of giving built form to contemporary notions of security and privacy. When juxtaposed *Pionen* and the *Data Tower* gesture towards a temporal regime of a broad present in which past, present, and future intermingle in data structures used in equal measure to preserve our past and predict our future. *Pionen* playfully integrates the retro appeal of Cold War rhetoric in a way that subverts the sincerity with which it employs the bunker as an imaginary for security as shelter and containment. *Pionen* thus plays with imaginaries of the future that date back to action and sci-fi films of the 1970s and 1980s and uses this imagery as smokescreens to securitize through obfuscation. While *Pionen* is bound not only by its physical encapsulation inside a mountain but also by the fact that it is an actual, physical building, the *Data Tower* is still an imaginary construct. The *Data Tower* remains in the fictional realm until it is built and can, as such, be read as our own time's projection of the future. It faces uncertainty through an act of exposure and an embrace of vulnerability that, at the same time, also gestures toward an "aesthetics of the secret" in Birchall's terms. The server pods are no more revealing of their insides than the white boxes in *Pionen*, and the exposure the tower exhibits may be regarded as equally performative as *Pionen*'s shelter. It is a tower without a centre; it carries its content on its surface, making the world aware of what it contains while at the same time displaying in material terms the invisibility of that content. It is emptiness inside a mass of connectivity, and herein lies its imaginative force.

## Image Notes

Figure 1: Inside the *Data Tower*, architectural rendering, Valeria Mercuri and Marco Merletti

Figure 2: Servers in *Pionen*, photo: Åke E:son Lindman

Figure 3: Viewed from the outside, *Data Tower*, architectural rendering, Valeria Mercuri and Marco Merletti

Figure 4: *Pionen*, drawing, Albert France-Lanord Architects

Figure 5: Generators, *Pionen*, photo: Åke E:son Lindman

Figure 6: Fishtank, *Pionen*, photo: Åke E:son Lindman

Figure 7: Cross-sectional view, *Data Tower*, drawing, Valeria Mercuri and Marco Merletti

Figure 8: The tower explained, *Data Tower*, drawing, Valeria Mercuri and Marco Merletti

Figure 9: Meeting room, *Pionen*, photo: Åke E:son Lindman

Figure 10: View over the servers, *Pionen*, photo: Åke E:son Lindman

Figure 11: Landscape view, *Data Tower*, architectural rendering, Valeria Mercuri and Marco Merletti

Figure 12: *Data Tower*, drawing, Valeria Mercuri and Marco Merletti

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## Notes

1 This article comes out of work on the research project *Uncertain Archives* (www.uncertainarchives.dk).

2 In contrast to the black box's focus on input and output rather than the inner workings, the white box (also called glass box or transparent box in software development) is a system where the inner logic is transparent and accessible.

3 Yet another way in which geography is important to the positioning of the data centre while also obfuscating transparency.

# THE TECHNOAESTHETICS OF DATA CENTRE "WHITE SPACE"

A.R.E. TAYLOR

*And "white" appears. Absolute white. White beyond all whiteness. White of the coming of white. White without compromise, through exclusion, through total eradication of non-white. Insane, enraged white, screaming with whiteness.*
*—Henri Michaux (198)*

*What then is the essential nature of cloudiness?*
*—Ludwig Wittgenstein (15)*

IMAGINATIONS DOI : http://dx.doi.org/10.17742/IMAGE.LD.8.2.5




## Abstract

*Why are the walls, floors, and ceilings of data centres always painted white? Photographs of data centre interiors tend to focus on the advanced technologies contained within them, while the surrounding white surfaces disappear into the background. Bringing this overlooked design feature to the foreground, this essay explores the technical functions, temporalities, and transparencies of white space within data centres.*

## Résumé

*Pourquoi les murs, les planchers et les plafonds des centres de données sont-ils toujours peints en blanc? Les photographies de l'intérieur des centres de données ont tendance à se concentrer sur les technologies de pointe qu'elles contiennent, tandis que les surfaces blanches environnantes disparaissent en arrière-plan. En mettant en lumière cet élément de conception souvent négligé, cette étude explore les fonctions techniques, les temporalités et les transparences de l'espace blanc dans les centres de données.*


### Chromopolitics

"White space" is a term used in the data centre industry to describe the space allocated for IT equipment. It is the space occupied by server cabinets, storage, network gear, racks, air-conditioning units, and power-distribution systems. The phrase also refers to the empty, usable square footage that is available for the deployment of future IT equipment. Optimising white space is a key part of data centre design and management. Generally speaking, the more white space the better, as the ability to expand computing capacity is essential to ensuring long-term business growth. White space management (WSM) is an increasingly valuable skill for data centre managers who should be able to maximise usage of white space by strategically deploying IT equipment to increase facility efficiency and save space.

Weaved around three photographs of the interior whitescape of a data centre managed by Secura Data Centres[1] in the north-east of England, this experimental essay blends insider (emic) and outsider (etic) voices together to explore the technical and aesthetic - "technoaesthetic" - operations of white space. The term "technoaesthetics" aims to capture the fusion "of appearance and utility" (Masco 368) that white space encompasses by addressing the ways in which the whitewashed surfaces of the data centre have a technical function but also an aesthetic (and therefore social, political, and historical) dimension.

A variety of commentators have recently begun to grapple with cloud computing as both a metaphor and a material infrastructure. It is typically argued that the metaphorical conceit of "the cloud" evokes images of ethereality and immateriality that actively erases the physicality of Internet infrastructure and rhetorically conceals the political realities of its practices and processes. Critically and creatively exploring the gap between the metaphor of the cloud and its material components, this nascent body of work has attempted to draw attention to the fibre-optic cables, pipes, wires, and satellites that are seemingly removed by the misleading cloud metaphor (Parks; Blum; Starosielski). Across these diverse projects, perhaps the most persistently examined object of cloud infrastructure has been the data centre (Arnall; Bridle; Graham; Holt and Vonderau; Hu; Jones; Levin and Jeffery). Yet, while data centres and the technical equipment contained within them have been subject to growing critical reflection, the white floors, ceilings, walls, and surfaces have been left largely ignored, appearing only as a passive backdrop for the action of other sociotechnical arrangements.

Histories of architecture have long-recognised the structural role of architectural features that may at first appear "superficial", such as the white wall (Wigley; el-Khoury). Space, too, is never a neutral backdrop but a product of people's interactions with the material world (Lefebvre). Building on insights from the history of modern architecture and bring-

ing the white space of data centres into relation with other white spaces from popular culture, this essay will explore what this overlooked design feature may tell us about the cloud and its supporting infrastructure.

## Public Images

The last decade has seen a slow but steady increase in images of data centres circulated within the global mediasphere, with visual technologies facilitating the aestheticisation of the white data centrescape. The fictional action of a growing number of films and TV shows has occurred within the white space of data centres (Smolaks), while photographs of these "architectural curiosities" (Stasch 77) frequently garnish articles, exposés, and essays in the popular press. Chanel even adopted a data centre theme for their SS17 event for Paris Fashion week, with the catwalk transformed into a white floor flanked by white server racks (Moss). It is the aesthetically-pleasing white spaces of the data centre that are most often photographed or filmed in advertising campaigns and other media products. Rarely do we see what some practitioners refer to as the "grey space": the unphotogenic backstage areas of the data centre where back-end equipment like switch gear, uninterruptible power supplies, transformers, chillers, and generators are located. White space plays an important role in mediating and transforming popular imaginaries of the cloud. We might say, then, that data centres are steadily coming out from behind the screens of the digital world and are increasingly infiltrating the popular imagination through a number of visual channels and media forms.

The data centre industry's increasing visibility is heavily entangled with several major political developments. Perhaps the most significant of these was the leaking of top secret documents by ex-NSA contractor Edward Snowden in 2013, which revealed extensive partnerships between government mass surveillance projects and tech companies like Microsoft, Google, Facebook, and Apple, who granted organisations permission to access data stored in their data centres as part of various surveillance programs (such as the NSA's PRISM and GCHQ's Tempest programs). Tech companies have released extensive visual footage of their data centres as part of a larger effort to restore public trust in the post-Snowden environment. The regular and highly publicised hacking of global corporations such as Sony, TalkTalk, and Yahoo! has further drawn attention to the ethics and (in) security of practices and processes of data storage. Increasingly stringent international regulations on data sovereignty, in which data is subject to the laws of the country in which it is stored, has radically reinforced the significance of geographic space within cloud culture and resulted in a widely-publicised boom in data centre construction in "information friendly" countries like Luxembourg (Dawn-Hiscox) and Iceland (Johnson). Heavy criticism from environmental policy makers over the industry's excessive (fossil fuel) energy consumption to power and cool IT equipment has also played a central role in many companies relocating their data centres in Nordic countries, where they can take advantage of the naturally cool climate. These sociopolitical and geopolitical developments have steadily brought data centres into the media spotlight, mobilising popular opinion as well as academic reflection. Indeed, a gradual cultural awakening to the political realities of data storage has occurred: data in "the cloud" is increasingly figured less as some ethereal evaporation in a kind of Internet water cycle but is increasingly imagined to be stored – held hostage, even - on corporate hard drives hidden in sinister server farms.

Public debates and discussions about data centres and cloud computing within the popular press and academia thus tend to revolve around questions of privacy, trust, and transparency. It is largely in response to accusations of non-transparency that tech companies like Facebook, Amazon, Apple, Microsoft, and Google have engaged in rigorous publicity campaigns visualising their data centres (or "fulfilment centres" in Amazon's case) in an attempt to improve their public image.

As data centres begin to reposition themselves more visibly within a variety of media landscapes, a flood of data centre imagery has been unleashed showcasing the physical insides of the Internet. Google has released photo galleries, panoramic tours and video footage of their data centres, featuring the friendly (and ethnically and gender diverse) faces of the staff who work in these buildings. Amazon has employed a similar strategy, releasing high-definition footage of their machine-warehouses interspersed with brief talking-head interviews of their warehouse packers (or "fulfilment centre associates" in Amazon parlance). Extensive photo and news coverage accompanied the 2013 opening of Facebook's "green" data centre in Luleå, Sweden (Jones; Vonderau). Facebook also made the blueprints public for their recently constructed facility in Prineville, Oregon (Quirk). Microsoft has similarly jumped on the bandwagon, making free QuickTime video tours of their data centres available

*Figure 1: A world of white space*

for download from their corporate website.[2] In fact, today, the majority of data centres - from the corporate behemoths to the independent colos - have some form of image gallery or 3D virtual tour on their websites where you can scroll through various photographs or view video footage of the facility.

Data centre interiors tend to be represented as specialised technological environments full of colourful cables, complex wiring and futuristic-looking IT equipment. Yet, while the specific machinery pictured in these publicity shots always varies, the white ceilings, walls, and floors that form the background against which the equipment is displayed, rarely, if ever, changes [Figure 1].

## Virtual Spaces

Journeying through data centres – whether in person, by browsing online images, or through a 3D virtual tour of a facility – is perhaps the closest a human can get to being sucked into the Internet. On the server hard drives locked behind the

perforated doors of the white metal cabinets, data is stored and accessed by Internet users from all over the world. The whirring machinery and the giant cables and wires are the organs and intestines of the Internet. Seemingly endless air-conditioned corridors of identical server cabinets surround you as you venture through this strange data space. But this is not the 8-bit "electronic world" of "cyberspace" as imaged and imagined in the vintage visions of the film *Tron* (1982), William Gibson's *Neuromancer* (1984), or any other "human-sucked-into-a-computer" narrative from cyberculture films and literature - the visual strategies of which were predominantly informed by the aesthetics of early graphics programs and the computer-generated neon-grid geographies of early arcade video games like *Pong*.[3] Instead of black backdrops vectorised by space-time neon gridlines we have a vast expanse of whiteness. The only neon here comes from the flickering server-lights and their reflections in the fluorescent white of the floor-space when the lights are turned off.

This is not to say that the visual strategies of data centre advertising campaigns do not play with the semiotic remnants of these retro cyber-visions. "Data centres often turn their lights off for photo shoots so you can properly see the neon," Stuart Hartley, the Chief Technology Officer at Secura explained to me, "simply because it makes them look more virtualistic" (Hartley). The image of the server-cabineted corridor [Figure 2], typically bathed in blue neon, has become the canonical icon of the data centre. Produced and reproduced by and through "patterns of imaginal repetition" (Frankland 103) and mass media circulation, it is the shot of a neon-soaked aisle flanked by racks of encaged servers that is no doubt the most frequently encountered representation of data centres today (returned by any basic Google search for "data centre"). In advertising images, the symmetrical geometries of the cabinets are typically combined with a low-angle shot, cinematically transforming the server cabinets into sublime, giant monoliths reminiscent of the extra-terrestrial machine-monoliths in Stanley Kubrick's *2001: A Space Odyssey* (1968).

In keeping with William Gibson's (60) various descriptions of cyberspace as "distanceless" and "extending to infinity", the whitewashed interior makes this data centre appear sublimely vast. Painting surfaces white is a technique commonly deployed by interior designers to make spaces appear larger than they are. The hyper-illuminated, uniform whiteness of this data centre obscures the points where the walls, ceiling, and flooring join together, creating the illusion of an almost dimensionless space that appears "seamless, continuous, empty, uninterrupted" (Batchelor, *Chromophobia* 9). In this respect, the white innards of the data centre perhaps have more in common with the contemporary visualisations of virtual spaces that we find in multi-dimensional modelling software programs, virtual world editors (sometimes referred to as "sandboxes") and the famous virtualistic white spaces that featured in *The Matrix* franchise (1999-2003).

Yet data centre white space not only emits signs of virtuality through its association with the imaginal renderings of "infinite datascapes" (Gibson 288) from popular culture, but is also the direct product of virtualisation technologies. In data centre parlance, virtualisation describes an approach to pooling and sharing technology resources between clients and has been widely adopted throughout the industry in recent years.[4] Ian Cardy, the Head of Disaster Recovery at Secura explained the logic behind virtualisation to me as follows:

> *Before the recent surge in virtualisation, data centres were rapidly running out of white space. Servers and storage devices were only running at 10% or less of total capacity, meaning floor-space was filling up with hardware. Virtualisation basically enables us to unlock the unused 90% of a device's capacity… Think of a server or hard drive as a tower block without any floors in it; you can't access all the unused space above your head, which just goes to waste. Virtualisation software divides that space into multiple floors and rooms and puts in stairways and doors to access them. This means multiple clients can then experience fast and seamless server or storage access without realising they are all living next door to each other in the same device or distributed across multiple devices. In a virtualised environment, multiple physical machines can be consolidated into fewer machines, meaning less physical hardware is needed, which greatly increases the availability of white space in the facility. (Cardy)*

Virtualisation enables data centres to maximise the utilisation of their hardware and "has allowed for thousands if not millions of users to share a data centre in the cloud" (Hu 61).[5] By pooling IT resources together in this way, facility operators are able to reduce the number of physical devices in the data centre and reclaim vital square footage. "Virtualisation", Cardy summarised, "means less hardware [and] more white space".

While the term "virtualisation" conjures imaginaries of dematerialisation or non-physicality, there is always an underlying physical machine doing the work. At the same time, however, virtualisation can be seen as a dematerialising process to the extent that its implementation enables data centres to eliminate excess physicality in the form of surplus hardware and free-up white space. For data centre practitioners, then, the white, dimensionless spaces of the data centre not only look like the computer-generated spaces that feature in popular imaginaries of "the virtual", but are the product of virtualisation itself, symbolic of the moment when the virtual has become infrastructured.

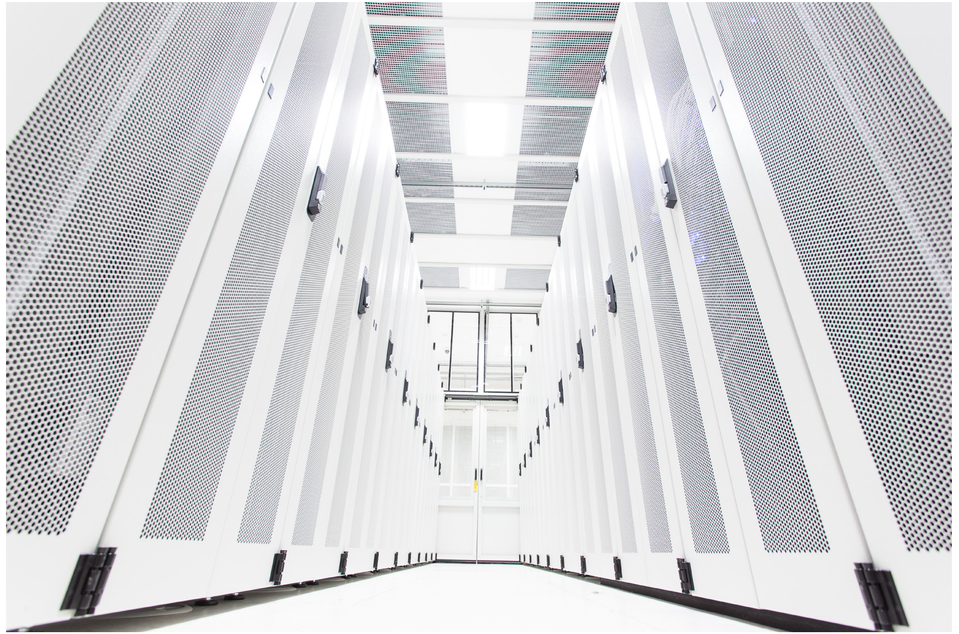

*Figure 2: The iconic image of the server-cabineted corridor.*

## Future-Proof Spaces

Whiteness has long-featured in cultural images and imaginations of the future. The white wall was the icon of the modernist architectural movement pioneered by Le Corbusier – and later associated with minimalism.[6] It reached the height of its popularity during the interwar period and was central to the modernist project's desire to whitewash the past and build a new future after the First World War (Wigley; Ballard). White space has also been a recurring motif in science fiction films, from George Lucas' *THX 1138* (1971) to the Wachowski's *The Matrix* (1999). White surfaces are a central design feature of Hollywood spaceship interiors – from the Space Age cinema of the 1960s and 70s to present-day blockbusters and video games. When combined with the advanced computer technology and the hermetically-sealed metallic surfaces,[7] the white ceilings, floors and walls, give data centres an unmistakably spaceship-like appearance.[8] "White surfaces just have that futuristic feel about them", Hartley explained to me. "It's important for a data centre to look futuristic; you don't want them to look old or dated, as this doesn't inspire confidence in the client… white can make a facility look like it's going to last well into the future" (Hartley).

Yet, while the white spaces of science fiction and modernist architecture imaged and imagined new possible futures, the white spaces of the data centre do not attain their futurity by virtue of their active role in bringing new futures into being but rather seem to achieve their futuristic effect by virtue of their association with these future-making projects of the past. In this way, the whitewashed technoaesthetics of data centre interiors creates more a "retroactive sense of futurity" (Jakobsson and Stiernstedt 2012:112). They do not so much participate in the production of new possible futures but rather, participate in the visuo-nostalgic reproduction of futures past.

The technical function of white space as part of a broader anticipatory practice known as "future-proofing" further complicates the data centre industry's relation to the future. "Future-proofing" is an emic term that describes an approach or design philosophy to data centre resources that aims to save infrastructure and IT from rapid obsolescence. In the fast-changing world of the data centre, where new (and extremely expensive) equipment is constantly being developed and deployed, it is important that this equipment will last well into the distant future and not be "outdated before it's even installed", as Cardy put it. Maximising the availability and production of white space (through techniques like virtualisation as well as strategically organising the arrangement of IT equipment) is a future-proofing measure that aims to ensure the continued growth and future of the data centre.

The practice of maximising the availability and production of white space so that data centres do not get too full too quickly is guided by logics of preparedness, contingency, redundancy, and resilience rather than ideals of renewal or regeneration. While the presence of white space represents the possibility of future expansion and growth, the future, as embodied in the concept of future-proofing, appears not so much as something to be embraced but something to protect the data centre from, to stop the future from *getting in* and outdating the technology. White space not only regurgitates the *mise-en-scène* of futures past, but, as a future-proofing technique becomes a barricade against *future* futures, blocking them out. The aesthetic strategy of whitewashing, which produces the illusion of seamlessness, further reinforces this hermetic imaginary. While discourse on Big Data is dominated by optimistic hypes and hopes for a better future, the anticipative white spaces of the buildings in which this proleptic data is stored reflect an inability to imagine that future as anything other than threatening.

## Sterile Spaces

The startling whiteness of their architectural surfaces presents data centres as sterile spaces. Data centres are highly controlled environments. A variety of contaminants can cause lasting damage to the expensive equipment housed within these infrastructures. Organic and inorganic particulate matter (PM), such as dust, plant pollens, human hair, liquid droplets and smoke from cigarettes and nearby traffic can interfere with the drive mechanisms of magnetic media (such as the read/write actuator arms in hard disk drives), causing corrosion, oxide flake-off, wasted energy, and permanent equipment failure. The white surfaces and well-lit rooms serve to make visible any foreign matter that may have entered the facility. Here the data centre whitescape joins "the doctors white coat, the white tiles of the bathroom [and] the white walls of the hospital" (Wigley 5). Furthermore, for security reasons, most data centre construction standards prohibit windows that provide "visual access" to the data centre, particularly the computer rooms, data floors, and other secured areas. The reflective properties of the white surfaces therefore enable facility operators to get more mileage out of their artificial lighting, reducing electricity costs. For this reason, often the IT equipment itself is painted white [Figure 2].

The brightness of white surfaces, where light is reflected, is a frequently deployed trope in the domain of public health, where the white wall has long-played a prominent role not only in the exercise and display of cleanliness, but also "in the construction of the concept of cleanliness" (el-Khoury 8; Berthold). In an analysis of urban sanitisation projects in late-18th-century France, Rodolphe el-Khoury suggests that the rhetorical power of the white surface stemmed primarily from its visual properties, or, more precisely, from its capacity to translate the condition of cleanliness into an image. El-Khoury argues "The norms of cleanliness were moral rather than functional" and "had more to do with 'propriety' than with health" (8). In this way, from the 1780s whiteness came to function as an evident index of cleanliness in the domain of public health and hygiene – a symbolic code that continues to be deployed in diverse arenas today - from sanitation photography to data centre security.

This "evidentiary" relationality of whiteness and cleanliness, is, of course, social and historical and tightly tied to long-standing racial associations that emerged from the classificatory projects of the Enlightenment era. During this period, whiteness was brought into relation with concepts of cleanliness, purity, and civilisation, while blackness was aligned with dirt, impurity, and backwardness (Garner 175; Cretton; Dyer). Whiteness-as-cleanliness is thus a social cleanliness. Jonathan Shore, the Data Hall Manager at Secura, suggested that "white looks virtuous, innocent". He elaborated by explaining that, in the hyper-luminous data halls, "there are no dark corners for dirt to accumulate or secrets to hide" (Shore 2016b). Here whiteness eliminates darkness, transforming data centres into clean and moral spaces in the process. In our conversations, data centre professionals would often align the internal whiteness of the data centre with a social or moral cleanliness, reflective of the data centre's responsibility, security, and, perhaps somewhat paradoxically, transparency.

## Transparent Spaces

While the opacity of the white surface might at first appear diametrically opposed to established conceptions of transparency (Wittgenstein 24), for Shore it actually makes Secura's data centres more transparent: "A white wall obviously isn't see-through like a glass wall," he highlighted, "but we're not trying to hide that we're hiding something" (Shore 2016b). For Shore, transparency was a suspect term, the invocation of which was always an act of concealment: "It's the suspiciously over-transparent buildings that we should be cautious of," he argued, "the see-through office workspaces and BBC newsrooms... that pass under the radar because they look like they're hiding nothing."[9]

The white interiors of data centres stand in stark opposition to other architectures of the so-called "Information Age", in which transparency of information has arguably led to transparent interiors and exteriors (Shoked 101). Contemporary architectures are typically defined by see-through surfaces, open spaces, and spherical shapes that eliminate angles and corners. Such architectures reflect non-hierarchical, holacratic management forms and aspire to ideals of openness and transparency. Walls are not white but glass, while ceilings and floors are stripped back to expose the bare pipes, concrete, or metal foundations as if there is nothing to hide.

In contrast, within the rectangular geometries of data centres, corners proliferate and transparent materials like glass, Perspex, and translucent polycarbonate are actively avoided. The ubiquitous white surfaces in data centres are overtly opaque yet provide Shore with a claim to transparency by virtue of that very opacity. Indeed, the extreme opacity of Secura's white spaces highlights – rather than hides - the act of concealment that is usually elided within images of buildings or spaces claiming to be transparent. Shore suggests "The opacity of the white basically draws your attention to what you can't see" (Shore 2016b). Here, white space does not just symbolise cleanliness but cleanses itself from the ideology – or 'tyranny' - of transparency (Strathern).

As white walls gradually became a staple of modern architecture, whiteness as a signifier of cleanliness also came to signify absence – not only of dirt, but also of visual stimuli (el-Khoury). The colour white became a neutral or blank background that was supposedly colourless in the same way white people were "raceless" (Cretton; Dyer). As such, white walls did not need to be see-through to be transparent, because they "are just what they are" with "no possibility of lying" (Batchelor, *Chromophobia* 10). Yet with the vast whited rooms of the Secura data centre, a different logic is

at work. While Le Corbusier's white wall supposedly rendered architecture transparent by liberating the walls from visual decoration, Secura's white wall problematizes the relation between transparency and visibility (Lefebvre 76; Kuchinskaya). In Secura's data centre facilities, it is not so much about what can be seen, but whether what *can't be seen is shown*. By showing what can't be seen (e.g. photographing the white cages of the servers but not the servers themselves) the luminous whitescapes of this data centre make visible the limits of transparency-as-visibility.

At the same time, we must not forget the "grey spaces" that exist in the often unseen background of the data centre (though the ceilings, floors and walls of these spaces are still often painted white). Indeed, as David Batchelor reminds us, "the luminous is almost always accompanied by the grey" (60). While the emic division between "white" and "grey" space may at first appear to correspond to "visible areas" and "invisible areas" respectively, rather, these represent two different regimes of in/visibility. As we have seen, the aesthetically-pleasing white areas, though frequently-visualised, are composed of registers of visibility and invisibility and the same goes for grey space. At the same time, Shore's assertion that whiteness eliminates *dark* corners suggests that, though the white spaces of the Secura data centre may aspire to operate beyond transparency, they are still entangled within Enlightenment associations of light, whiteness, truth, and morality that underpin contemporary regimes of transparency (Mehrpouya and Djelic). Images of white space, then, may be seen more as a kind of performative playing with the signs of transparency, allowing data centres to hover somewhere between revelation and concealment.

Another white space that hovers between revelation and concealment is the famous virtual environment from *The Matrix* (1999) known as the Construct. This cinematic white space is a productive tool for thinking through some of the ways in which white space may operate in data centre imagery. *The Matrix* is set in a dystopian future where intelligent machines keep humans in a state of suspended animation, harvesting their energy to power their machine world. Humans do not experience this machinic reality. Rather, they are plugged into a neural-interactive virtual reality known as the Matrix. The protagonist is the computer hacker Neo, who learns the truth about the nature of reality from a mysterious figure named Morpheus. The film follows Neo as he goes through the process of discovering the true conditions of his existence, waking up from the ideology of the simulated Matrix and fighting in the war against the sentient machines. In perhaps one of the most memorable scenes, a data probe is inserted into the headjack at the base of Neo's skull which plugs him into the Construct. He is immediately transported into a completely white and dimensionless space. Morpheus is standing in the seemingly endless whitescape, along with two leather armchairs, a 1950's television set, and a small circular table. Morpheus explains that this is the Construct, a "loading program" that provides users with a virtualised space in which training simulations are run.

It is in the Construct that Neo begins what we might call – following the psychotropic writings of Henri Michaux (xiii) and Timothy Leary - the process of "deconditioning". For these figures, psychedelic drugs had a demystifying effect on human consciousness, enabling users to free themselves from the ideological shackles of their social conditioning and thus "awaken from a long ontological sleep" (Leary 76). Whiteness, in particular, played an important part in Michaux's entheogenic experience of mescaline. Similarly, the white space in *The Matrix* does not just serve as a background against which Neo's ontological transformation takes place, but is itself a constituent part of this transformation, an active mechanism of deconditioning: it is *in* and *through* this space that Neo awakens to a newly-deconditioned plane of existence.

Could we see the images of data centres released by technology companies under the guise of "transparency" as similarly operationalising white space? Within tech companies' representational strategies, the hyper-illuminated white interiors of data centres are analogously positioned as the material, machinic "reality" behind the illusory ideology of the cloud in a way almost identical to the revelation narrative that structures *The Matrix*. In this way, the use of photographic and video imaging technologies to reveal the physical foundations of the cloud may be seen not simply as practices of visualisation and visibilisation, but also as belonging to rituals of illumination and revelation associated more with the mystic tradition.

A crucial similarity between the whitescapes of the data centre and *The Matrix* is the way in which they reverse the revelation narrative of the mystic tradition (most commonly associated with occultism of secret societies like the Illuminati and Freemasons, but also tied to the psychedelic mysticism of the 1960s). Mysticism is typically underpinned by a dualistic ontology, that is, the postulation of a spiritual and a material realm (Surette 13). In the classic mystical revela-

*Figure 3: The abstract art of cloud infrastructure.*

tion narrative, a transcendental revelation occurs whereby the material or hylic world gives way to the substanceless, immaterial or spiritual plane of noumenal reality (Yates; Surette 13). In *The Matrix* and the cloud revelation narrative, however, rather than achieving some sort of transcendental access to an immaterial or ethereal realm beyond the cloaked world of matter, we experience the violent return of materiality: Neo is a slave in a machine world; the cloud is concrete. Data centre visual revelations enact a mythic reversal (in Lévi-Straussian terms) of the traditional narrative of mystical illumination. Like the deconditioning process that occurs in the Construct, the aim of the cloud revelation narrative is not so much to open viewers' eyes and minds to the spiritual, psychical, or divine world hidden behind the material world, but rather to reveal the material reality behind the illusory myth of the cloud.

We must, however, not overlook the slight but significant way in which the cloud revelation narrative departs from that of *The Matrix*. Whereas in *The Matrix* the white Construct space operates outside of both the virtualised world of the Matrix and the ruins of the present-day world, in the case of the cloud revelation narrative, the white space and "reality" collapse into each other: white space is represented as *the* reality of the cloud. It is in this functioning, that we find the ideological operation of the data centre imagery released by tech companies and it is precisely here, in this sl(e)ight difference that a number of critics of the data centre industry have positioned their analyses.

While these revelatory images of white space were released by tech companies predominantly to promote transparency and improve the public profiles of data centres, critics of the industry have noted that these images offer very little in terms of providing any meaningful insights into the political realities of data storage practices. Glossy close-ups of wires, pipes, and servers "drag" this equipment out of its context (Rojek), concealing the "real" facts about how these buildings operate (Strathern 314). Holt and Vonderau (75) have noted how these images transform cloud infrastructure into a kind of abstract art [Figure 3], obliterating the trace of any relationship between the imaged equipment and larger environmental, political and social processes in which they participate.[10] Indeed, non-specialists will have little clue

as to what is being pictured. Critical commentators have thus argued that media economies provide the data centre industry with a circuity in which to mediate its own visibility, "dictating the terms of its own representation" (Levin and Jeffery 8). These coded representational strategies have the inverse effect of rendering these buildings and their social relations more invisible and opaque. Through carefully exposed, angled, and framed photographic and filmic image-products data centres are transformed into beautiful, aestheticised whitescapes, the sociopolitical structures of knowledge and the vested interests that configure the conditions of data centre visibility are effectively whitewashed. Something of a stalemate has thus ensued. While the data centre industry continues to pump out "behind-the-screens" footage of cloud infrastructure, that footage is always suspect, insufficient and concealing something else.

## Conclusion: Cloudy Spaces

Despite the heavy criticism of "the cloud" as a misleading metaphor, in an accidental way, the idea of cloudiness accurately captures the obscurities, opacities, and contradictions of data centres and openly points to the obfuscatory operations of "clouding" or concealing that occur in these spaces. In his *Remarks on Colour*, Ludwig Wittgenstein focuses his attention on the seemingly trivial fact of white's opacity and its relation to transparency and cloudiness. "Is cloudy that which conceals forms, and conceals forms because it obliterates light and shadow?" (15). He follows this question with another: "Isn't white that which does away with darkness?" (Ibid). Whiteness lightens, so the puzzle proposition goes, but clouds, though white, obscure light. The white spaces of cloud infrastructure operate in similarly contradictory ways. While data centres are essential to storing and managing the information that plays such an important part in public imaginaries of the "transparent" information society, their architectures do not readily reflect the logic of transparency associated with the data they store (Shoked). Their hyper-illuminated interiors are completely opaque, but, in a "post-truth" (or, to perhaps be more accurate, "post-transparent") kind of way, they are arguably *more* transparent than the suspiciously "over-transparent" architectures of the Information Age. Transparency and opacity cease to be perceived as contradictory. As a future-proofing measure the white spaces of cloud infrastructure are at once orientated toward the future, but also serve to block the threatening future out, steeped in mediatised memories of futures past. Spanning the real and the fictive, these cinematic spaces engage with cultural manifestations of futurity in film, cyberpunk, and interior design, and play with the signs of transparency and visibility to such an extent that physicality, fantasy, and technical function are inseparably entangled.

These fantastic buildings, epic in volume, sit at the centre of the ongoing industrialisation of computing, and whiteness thus plays an important part in their functioning, staging, and imag(in)ing (Larkin). Reversing the revelation narratives of mystical experience, the white spaces of data centres perhaps reveal less about "the cloud" and more about cultural fetishisations of the physical sites of production and the inability of analytical dualisms like transparency/opacity, materiality/immateriality and visibility/invisibility to adequately capture and conceptualise the contradictions of digital-industrial infrastructures. Data centre technoaesthetics performatively play with and collapse distinctions between these categories. Questions, accusations, and analytics that fall along these lines appear hopelessly ill-adapted to the post-transparent logics of these architectures and the terrain they traverse.

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## Notes

1 All names and identifying details have been changed to protect the privacy of individuals. The material presented in this article is drawn from fieldwork and interviews with data centre practitioners over a 15-month period.

2 See Holdt and Vonderau for a more comprehensive overview of the "technopolitics" of data centre "hypervisibility".

3 The Simpsons' "Homer³" episode from *Treehouse of Horror VI* (1995) and *Marvel's Ghost Rider 2099* comic book series (1994-1996) are also clear examples of this grid aesthetic.

4 Jean-François Blanchette has provided a detailed historical contextualisation of virtualisation (7).

5 For a nuanced analysis of virtualisation as a political ideology productive of neoliberal subjectivities, see Tung-Hui Hu (2015).

6 Le Corbusier introduced his theory of the white wall in his book, The Decorative Art of Today (1925).

7 While the focus of this essay is colour, the politics of texture play an important role in the production (and selling) of data centre space. A significant function of the hard surfaces of the data centre is their role as security shields against electromagnetic radiation. These surfaces are usually made from specially reinforced metallic panels designed to block the various frequencies, fields, signals, waves and rays from threatening sources of electromagnetic radiation such as lightning, electromagnetic pulses, space weather, and radio frequency interception devices.

8 The influence of the cinescape of the spaceship in data centre design is perhaps best illustrated by the space station-themed data centre developed in 2013 by Bahnhof, a Swedish Internet service provider (Miller). Influenced by sci-fi TV shows like Star Trek (1966-1969) and Space 1999 (1975-1977), the outer shell of the data centre is an inflatable dome reminiscent of Buckminster Fuller's geodesic domes and was built by Lindstrand Technologies, who previously built the parachute that deposited the Beagle 2 space probe on the surface of Mars. In a promotional video, Jon Karlung, the CEO and visionary behind the science fictional data centre describes how the automated pneumatic entry doors make a Star Trek-style whooshing noise as they open and close (Miller). Jakobsson and Stiernstedt have an insightful analysis of Pionen, an older data centre owned by Bahnhof that is equally science fictional.

9 As Marilyn Strathern asks, "what does visibility conceal?" (310).

10 By presenting data centres as a stand-in for the "globally dispersed forces that actually drive the production process", corporate images of data centres enact what Appadurai has called "production fetishism" (41). Building upon Marx's theory of commodity fetishism, Appadurai's concept of the production fetish addresses the way in which locality – the local factory or other site of production (in this case the data centre) - "becomes a fetish" to the extent that they conceal geopolitical and transnational relations that are vital to the production of the cloud.

# INFRASTRUCTURES OF DIS/CONNECTION: OF DRONES, MIGRATION, AND DIGITAL CARE

EVAN LIGHT ET AL

EVAN LIGHT | YORK UNIVERSITY

JUTTA LAUTH BACAS | UNIVERSITY OF MALTA

DAPHNE DRAGONA | BERLIN

KATRIN M. KÄMPF | HUMBOLT UNIVERSITY

MARTA PEIRANO | WRITER, JOURNALIST, ACTIVIST

VALENTINA PELIZZER | ONEWORLD PLATFORM

CHRISTINA ROGERS | TECHNICAL UNIVERSITY OF DRESDEN

FLORIAN SPRENGER | GOETHE UNIVERSITY FRANKFURT

JARON ROWAN | BAU, CENTRO UNIVERSITARIO DE DISEÑO DE BARCELONA

ABIOL LUAL DENG | WASHINGTON, D.C.


## Abstract

*Migration from sub-Saharan Africa to Northern Europe is imagined and visualized as the movement of human bodies along different territories, eventually traversing the geographically locatable line of the EU border. What this conceptualization of migration, mobility, and the border leaves unacknowledged is that all three are material-virtual phenomena. This paper addresses the infrastructures of mobility that can be traced and analyzed within a migrant route from Niger to Germany. We highlight the need to connect and/or disconnect as strategies of migration and envisage ways to support freedom of movement by bringing aspects of digital care work into the analysis.*

## Résumé

*La migration de l'Afrique subsaharienne vers l'Europe du Nord est imaginée et visualisée comme le mouvement des corps sur différents territoires, traversant éventuellement la ligne géographiquement localisable de la frontière de l'UE. Ce que cette conceptualisation de la migration, de la mobilité et de la frontière ne reconnaît pas, c'est que les trois sont des phénomènes matériels et virtuels. Cet article aborde les infrastructures de mobilité qui peuvent remontées et être analysées au sein d'une route migrante allant du Niger à l'Allemagne. Nous soulignons la nécessité de se connecter et/ou de se déconnecter en tant que stratégies de migration et envisageons des moyens d'appuyer la liberté de circulation en intégrant des aspects du travail en soins numériques dans l'analyse.*

Please read this article alongside the StoryMap available here:

StoryMap: https://uploads.knightlab.com/storymapjs/04e9d-49ce98b0db02d668a4186813a79/drone-war-care-culture-and-the-infrastructure-of-mobility/draft.html



## Migration and Infrastructures of Mobility

In the current migration regime, the digital versions of migrants—their data shadows—can travel at high speed with complete disregard for national borders, often through the same undersea cables that carry intelligence and commands for drone operations in Sub-Saharan Africa. At the same time, the bodily versions of migrants may be stuck in refugee camps on the Greek Islands, in trafficking hotspots in Niger, or in detention centers in Libya. A complex net of infrastructures, consisting of undersea cables, databases, communication channels, physical borders, camps, and hotspots forms the backbone of this paradoxical assemblage of data flows and human (im)mobility.

Migration is an act of movement across borders that depends upon these infrastructures. The following introductory remarks give a basic outline of the theoretical framework that informed our work on the StoryMap. Technical infrastructures can be defined by their ability to transform something—objects, people, data—on different levels of scale (Larkin). In this sense, they foster movements between separate systems, highlighted throughout the map. By using infrastructures to travel, we are always crossing the visible and invisible borders that exist between these infrastructures. Migratory movements, as shown by the map, are characterized by the fact that they constantly need to cross borders and thus travel between different systems and their respective components. Due to their transformative impact on material forms and their distribution in time and space, as well as their literal state as passages of intersection, borders serve as media of exchange. Borders are places where objects are classified and categorized. They are, in other words, the unexchangable basis of exchange. By taking the agency of national borders into account, the infrastructural challenges of migration become evident and can be visualized while simultaneously highlighting the challenges of analyzing migration in the context of infrastructure studies. Two concepts helped us structure the patterns of migratory movement via infrastructures: connection/disconnection and digital care work.

### *Connecting and Disconnecting*

In acts of migration, borders are the locations where infrastructural connections come into contact with active attempts to disconnect, while enforced disconnection—the need for migrants to stay beyond the registration apparatus—is confronted by the necessity of connection, such as staying in contact with other migrants and families and friends back home or at the destination. Connection implies the use of GPS, social media, or messaging applications and thus a reentry into a system where one is identified and observed. Crossing borders, a migrant regularly switches between these two modes—disconnection and connection—that quickly become tangible states of being once a border is encountered (Barney). Borders consist not only of walls and fences, officers and vehicles, weapons and visions, roads and traffic control but also of devices for digital registration, identification, tracking, and tracing—all relying upon data-centres, protocols and micro-decisions (on the status of borders, see Rumford; Johnson et al., and on the term micro-decisions, see Sprenger). The border is a place constructed around notions of standards, norms, and protocols and the gatekeepers who enforce these. At a border, individuals are identified and sorted, passing through a variety of systems that determine one's worth, one's politics, and one's validity (Walters). Data are obtained, baggage secured, vehicles scanned. Those who arrive at borders, in this sense, are forced to lay bare the clouds under which they travel. Border control is an intervention magnifying the scale of all that passes before it, mastering points of entry and exit, arrival and departure, or interminable stasis. As the StoryMap shows in selective detail, every person or object being disseminated into a new territory must have special properties or attributes depending on the infrastructures of distribution. As political-economic domains, such assemblages, in other words, connect and disconnect individuals, both willingly and unwillingly. Crossing a border illegally circumvents this apparatus of sorting and measurement, successfully appropriating infrastructures of mobility and employing the tactics of connection and disconnection.

Connection and disconnection may be necessary preconditions of today's migratory movements. The infrastructural challenges of migration are, indeed, challenges of connecting and disconnecting at the right time and at the right place. In this sense, migration is deeply embedded in the technical infrastructures that determine and enable movements from one place to another, across borders and over vast distances; this study focuses on the case of migrations from Niger to Northern Europe. The infrastructures that are employed by migrants following this path are not neutral, rather they are inscribed with a biopolitics – they provide for the distribution of people and things in space (Walters; Bigo; Heinemann and Weiß).


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*Digital Care Work*

Movement, in the context of the StoryMap, is not restricted to human transportation, but necessarily includes the movement of information and objects as well as their obfuscation. Every migrant moves with data and objects that migrants try to maintain as invisible and thus untraceable, rendering themselves untraceable as well. Cross-border mobility therefore necessarily implies digital care work in the facilitation of dis/connection strategies. Care work is defined most often as intrinsically motivated and involves connecting to other people and helping people to meet their needs (Folbre). Taking into account the importance of digital technologies can expand the concept of care work more broadly. As data shadows becomes increasingly important to our lives (Leonelli et al.), work involving the care for these data shadows can be defined as digital care work. It enables connection as well as disconnection and education about the infrastructures of dis/connection.

Examples of digital care work include the provision of free Wifi hotspots in transit countries to and through Europe, strategic connections with other people while en route or with smugglers via smartphones and social-media channels, publicizing GPS coordinates while at sea, or supplying translation devices and respective applications to allow communication among migrants. Each care tactic requires a connection to human-technological infrastructures; a concern for one's own data shadow (Lyon; Haggerty and Ericson) compels strategies of disconnection, such as remaining outside the bounds of the EURODAC[1] database as long as possible on the way to a country of destination in Europe or beyond the reach of information gathered and used by Frontex, the European Border and Coast Guard Agency (Kasparek)[2]. These examples show a care for the digital self and the material-virtual interdependencies that make up cross-border mobility today. To make the infrastructure of digital care work visible, the StoryMap shows the different registers of care work along the voyage from Niger to Northern Europe.

## Migrants, Cables, and Free Wifi Hotspots: Mapping Contexts

Legal conceptualizations of migration, mobility, and the border have largely ignored their material-virtual dimensions. Information systems and border-control technologies have externalized the European Union (EU) border far into Sub-Saharan Africa, internally into the Schengen Area,[3] and have even inscribed the border into the migrant body via biometrics (Amoore; Van der Ploeg; Broeders; Hess and Kasparek; Forschungsgruppe). Borders are no longer mere territorial markers, but instead have become gateways into different levels of measurement and sorting. Migration as such is often related to or even triggered by the "power of the virtual," that is, preemptive warfare and the use of drones in conflict areas or algorithmic risk-modeling that equates third-country nationals to potential terrorists, thus producing the visa restrictions that force people to walk to Europe (Guild). The constant negotiation between connection and disconnection during the process of migration can also be seen through the specific routes people take to avoid being captured in the EURODAC (European Dactyloscopy) system or detected by surveillance drones.

Our StoryMap explores how migration from sub-Saharan Africa to Northern Europe is imagined and often visualized as the movement of human bodies along different territories and finally across the geographically locatable line of the EU external border.[4] We examine these interrelations by focusing on the framework of mobility that can be traced and analyzed within a migrant route from Niger to Germany. By examining the respective local infrastructure—drone bases in Niger, the war in Libya, free Wifi options in Europe, fibre optic networks, "refugee hot spots," detention centers, and surveillance and information systems on the way to Germany—we demonstrate how delocalized networks and invisible data flows can have very specific (localizable and visible) effects on migration, mobility, and border practices and vice versa.

Through highlighting the infrastructures of a possible migrant route from Niger to Germany, it becomes apparent that political issues, conflict, or economic factors are not the only elements at play in the emergence of migrant escape routes. Increasingly, drone wars (Chamayou) and their effects on civilian populations play a significant role in creating the original impetus for migration to Europe. The materialized presence of implicated international actors can be seen in the installation of drone bases, drone activity, and drone strikes in many countries, such as Niger and Libya [see Drone Base et al. in map]. The proceedings of the drone war in many African countries are also inevitably linked to the development of drone programs in Europe, which, among other factors, are considered vital measures to restrict migrant movement at its southern borders or to detect and aid people in distress at the Mediterranean Sea [see Mediterranean Drone Projects in map]. This situation creates a loop between drone operations that generates migration from Sub-Saharan Africa to the EU, which counters with drone programs aimed at repelling cross-border mobility from the south.

The presence of drones in these areas creates respective infrastructures and networks of data exchange. Delocalized networks and invisible data flows facilitate the externalization of Europe's borders into Africa while enabling a deterritorialization of the virtual aspects of war into Europe. Drone-targeting operations in Africa or signals intelligence used in drone targeting is directed, processed, and analyzed within European countries. The command and control centers of the drone war and other AFRICOM[5] operations in countries such as Libya are physically located on military bases in Germany and may use intelligence gained from tapped undersea cables (Angwin et al.), from migrants interrogated by intelligence agencies or from drone surveillance flights through central and North Africa, including Libya or Mali.

One of the central infrastructures of these deterritorializations are submarine cables [see Submarine Cables in map]. Today, submarine cables transport most international phone calls and internet traffic and have been of interest to intelligence agencies for years (Starosielski). They are a central infrastructure of everyday communication but also play a role in the drone war. Some of them are being tapped by the National Security Agency (NSA) or the Government Communication Headquarters (GCHQ) for surveillance,[6] while others are used in drone operations, may be key tools for the inter-agency data exchange in anti-trafficking and border-control operations, or may be the route EURODAC input takes from Libya to Europe.[7]

EURODAC, the Visa Information System (VIS),[8] and the Schengen Information System I+II (SIS)[9] are information systems of the EU and associated Schengen States that support police cooperation and enforce migration policies, such as the Dublin Regulation or visa restrictions [see e.g. Border Control in Europe in map]. These databases demonstrate how borders are visible for some and invisible for others (Balibar). Visa requirements, for example, create divisions between "trusted travelers" and "risky people," whereby the latter category is generated in reference to the country of the visa applicant (M'charek et al.). The traditional sites of transit, like airports and harbors, thus become highly monitored spaces restricting mobility (Andreas and Snyder). For citizens of Niger, for instance, visa restrictions may lead to the creation of alternate routes to Europe by foot, bus, boat, or rubber dinghies.

These information systems are also the backbone infrastructure for the control and assertion of policy regulations concerning migration within the Schengen Area. They provide the databases and deliver the sorting systems for verification and identification (Adey), thereby preventing visa or passport fraud and "shopping" for asylum, and facilitate the detection of illegalized migrants, such as "visa-overstayers" and people breaking residency laws. Headquartered in Tallinn, Estonia, the European Agency for the operational management of large-scale IT Systems in the area of freedom, security, and justice (eu-Lisa)[10] is responsible for the operational management of all of these systems.

The geographic sites captured in various databases or through surveillance activities are often the same spaces where police and border security roam, but also where food, assistance, and shelter may be provided. Refugee camps, detention centers, hot spots, as well as International Organization for Migration (IOM)[11] transit centers (see IOM Niger; Tagging Refugees at Camps and Detention Centers in map) are among the infrastructures that restrict, regulate, and aid migration flows. International organizations and refugee agencies play a vital part in assisting migration, but can also become a form of "remote control" (Guiraudon and Lahav), as they become hubs where information is exchanged that again feeds the cycles of risk analysis by authorities such as the European Border and Coast Guard Agency (Frontex).

From the time they leave their home community, migrants constantly negotiate complicated relationships with communication technology and infrastructure. While some may be forced to abandon their mobile phones before crossing waters, others go to great lengths to document their journeys.[12,13] As explored in the StoryMap, refugees often have their biometric data processed in central Africa long before they arrive on Europe's shores. Likewise, mobile phones are commonly tied to the identity of their users, enabling the tracking of individuals while they communicate.

## Care Culture

Understanding the irony that data shadows of migrants will travel faster than they do, possibly through the same infrastructure used in the drone wars, we believe it is important

to document the preexisting infrastructure that can facilitate online communication. Europe has a long tradition of hacker spaces and maker spaces, physical and social locations where individuals come together to embrace the freedom to create and experiment with technology and to provide communication tools to their local communities. Our map identifies a number of these spaces, providing a theoretical guide from coastal cities of Italy that often serve as migrant transit points, moving through Italy to common staging points for crossing the borders further north. We then trace a route through Austria and Germany, eventually arriving in Berlin.

Technology is involved in the structuring and policing of the borders of this journey, as well as providing important tools for crossing them and enabling the act of migration. Smartphones with GPS connectivity, digital maps, or communication tools to exchange information regarding open corridors and border policing are key features of transnational mobility today. In addition to highly important local infrastructures that provide food, housing, economic support, part-time employment, or transportation, other facilities such as electrical outlets, free WiFi hotspots, SIM cards, and translation applications offer vital components to people on the move. Digital care work can include the maintenance of free anonymous access to digital communication tools: multilingual websites, free WiFi hotspots that do not require login via social-media accounts, options for charging devices, or housing opportunities without registering online with one's legal status (see e.g. FreeForRefugee Wifi in map). This form of care is self-evident for migrants as well as activists and people in the trafficking industry and has created respective solidarity and economic networks. Furthermore, migrants are very much aware of their own data shadows. For instance, information on where fingerprint scans are fed into EURODAC in different parts of Europe is widely shared, allowing migrants to alter their routes to avoid documentation (Tsianos 121; Tsianos and Kuster 183). Care for the digital self is a significant part of migrant struggles and supporting networks should pay attention to its maintenance.

## A Final Note on Terminology

A general concern with infrastructures cannot marginalize the terms and legal categories that regulate migration and greatly affect people crossing borders. Due to legal categorizations and respective terms, corresponding technical facilities are installed to produce divisions between forms of migration that create the material effects of the terms introduced on paper (see Eurodac in map), which, in turn, influences language use. Language must be considered as infrastructure too. "Legal migration," "illegal migration," and "refugeeism" are three main differentiations within the field of human mobility, particularly in relation to the ordering principle of so-called migration management (Ratfisch). In much scholarly work, it is therefore common to speak of "refugees and migrants" to acknowledge different statuses. This distinction, however, leads to an iteration of terms introduced top-down, delivering a template for discriminatory representations in which migrants appear as "villains" and refugees as "victims." Further, this terminology denies refugeeism from being a matter of choice and migrants the right to escape/flee, and affects self-perceptions and the practical realities of cross-border mobility. For instance, economic migrants may become refugees within a country along their migration route. A way to mirror these difficulties in terminology is to use the term "refugee migrant" (Hess et al.), as it shows the connection between these categorizations while leaving space for ambivalence. The Oxford English Dictionary defines a migrant as "a person who moves from one place to another in order to find work or better living conditions"; in the accompanying map, all categorizations have been subsumed under the term migration in order to highlight any migrant path from one place to another and to strengthen migration as a term of struggle. Many of the infrastructures described so far are deeply embedded in migration management through a structure of legal categorizations. Our goal here has been to provide an analysis of processes of migration as well as to replicate the migrant strategies of dis/connection with relation to existing terms that regulate migration. Infrastructures, as seen above, have the capacity to modulate. A care for the digital self and the digital other means acknowledging the ways technical infrastructures are linked to further frameworks that create and traverse the boundaries and borders that affect mobile subjects. The StoryMap renders visible the connections and exchanges in infrastructures of mobility while also taking the interstices into account in which cross-border mobility might not be readily legible or from which migrants strategically withdrawal or disconnect to make mobility happen.

*This article and map are the products of a workshop entitled "Drone War, Care Culture and Mass Mobility" which was organized in October 2016 in Berlin, as part of the Berliner Gazette annual conference Tacit Futures.[14] Workshop participants were drawn from a broad array of backgrounds and included journalists, activists, curators, international NGO workers, and academic researchers. Working together over the course of two days, we built a StoryMap[15] tracing the journey of migrants from central Africa to Europe via the Mediterranean route, paying close attention to the flows of data and the use of communication infrastructure along the way.*

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## Notes

1 EURODAC has existed since 2003. The fingerprints of every asylum seeker in the European Union are transmitted to EURODAC. https://ec.europa.eu/home-affairs/what-we-do/policies/asylum/identification-of-applicants_en. For a detailed analysis of Eurodac until 2014, see http://www.statewatch.org/analyses/no-235-eurodac.pdf. The research leading to these results has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013) / ERC grant agreement n° 312454.

2 Frontex. http://frontex.europa.eu/

3 The border-free Schengen Area denotes the external borders of the European Border and permits for free and unrestricted movement between member states. https://ec.europa.eu/home-affairs/what-we-do/policies/borders-and-visas/schengen_en

4 On different concepts of the border see Newman; Parker and Vaughan-Williams; Brambilla. Concerning the relationship between movement of bodies and data see Amoore; Van der Ploeg.

5 AFRICOM. United States Africa Command. http://www.africom.mil/

6 Snowden Digital Surveillance Archive. https://snowdenarchive.cjfe.org/greenstone/cgi-bin/library.cgi?e=q-00100-00—off-0snowden1–00-2—-0-10-0—0—0direct-10—-4——-0-1l–10-en-50—50-about—01-3-1-00-00–4–0–0-0-01-10-0utfZz-8-00&a=q&r=1&hs=1&k=0&s=0&fqa-=0&fqv=undersea+cables,,,&fqf=TE,TT,DE,SU&fqk=&fqs=&fqc=and,and,and&fqaf=

7 More research and greater government transparency is needed in these areas.

8 http://ec.europa.eu/home-affairs/what-we-do/policies/borders-and-visas/visa-information-system_en

9 http://ec.europa.eu/home-affairs/what-we-do/policies/borders-and-visas/schengen-information-system_en

10 Eu-Lisa. http://www.eulisa.europa.eu/Pages/default.aspx

11 International Organization for Migration. http://www.iom.int/

12 Traces of Movement. Tacit Futures, Berlin. 27-29 October 2016. Hamed's Journey. http://berlinergazette.de/traces-of-movement/?page_id=2

13 Van Houtryve, Tomas. "Europe's Migrant Trail, Through The Instagrams of Refugees. Following the 'digital breadcrumbs' left by refugees on social media'. *The New Yorker*. 27 Jan. 2017, 2017.http://www.newyorker.com/culture/portfolio/following-europes-migrant-trail-through-the-instagrams-of-refugees

14 http://berlinergazette.de/tacit-futures/

15 http://storymap.knightlab.com/

# "HEAR THE WORLD'S SOUNDS": LOCALITY AS METADATA IN TWO MUSIC PLATFORMS

MICHAEL AUDETTE-LONGO


## Abstract

*Music-streaming services have disrupted the music industry's established commodity formats and place-bound consumer experiences, producing seemingly limitless and algorithmically driven modes of listening. These music services target a global audience, as evident in Soundcloud's promise to enable audiences to "hear the world's sound." This article maps out the deployment of local regions as tags and metadata in music-streaming services, arguing that there is a reconfiguration of locality evident, what I dub the indexi-local. This portmanteau---coordinating the terms index and local---grasps at the effort to design a participatory platform experience vis-à-vis local regions. This article undertakes a close reading of the interfaces of two music-streaming services: Bandcamp and Soundcloud. First, metadata is shown to play a significant role in the design and operations of digital music platforms, not only organizing the circulation of data but also generating listening recommendations. Second, the circulation of local regions as metadata within these two services' interfaces is then highlighted in the tagging activities of platform users. While the circulation of local regions as metadata imbricates with broader efforts to create a more participatory and place-bound streaming experience, it also flattens local differences into a gray media aesthetic of hashtags and geotagged text.*

## Résumé

*Les services de diffusion de musique ont perturbé les formats de produits établis par l'industrie de la musique et les expériences de consommation liées aux lieux, produisant des modes d'écoute apparemment illimités et basés sur des algorithmes. Ces services de musique ciblent un public mondial, comme le prouve la promesse de Soundcloud de permettre au public « d'écouter les sons du monde ». Cet article décrit le déploiement des régions en tant qu'étiquettes et métadonnées dans les services de diffusion de musique, en faisant valoir qu'il y a une reconfiguration de localité évidente, que je surnomme l'indexi-local. Cette expression, qui combine les termes index et local, capte l'effort de concevoir une expérience de plate-forme participative vis-à-vis des régions. Cet article effectue une lecture approfondie des interfaces de deux services de diffusion de musique : Bandcamp et Soundcloud. Tout d'abord, les métadonnées sont présentées comme jouant un rôle important dans la conception et l'exploitation des plates-formes de musique numériques, non seulement en organisant la circulation des données, mais aussi en générant des recommandations d'écoute. Deuxièmement, la circulation des régions comme métadonnées dans les interfaces de ces deux services est alors mise en évidence dans les activités de marquage des utilisateurs de plateformes. Alors que la circulation des régions en tant que métadonnées se superpose avec des efforts plus larges pour créer une expérience de diffusion plus participative et liée au lieu, elle réduit également les différences locales à une esthétique morne de médias de hashtags et de balises géographiques.*




In summer 2015, the music-streaming service Spotify released a "musical map" of the world featuring playlists generated for cities around the world. As described on Spotify's *Insights* blog:

> *This is music that people in each city listen to quite a bit, which people in other cities also do not listen to very much. So it is, exactly, the music that makes them different from people everywhere else...Because this music represents music that over-indexes in these cities, it's a great way to pluck local favorites from around the world and add the ones you like to Your Music in Spotify. (Van Buskirk, "Musical Map")*

With the map, Spotify makes two promises to the listener. First, to facilitate a sort of musical tourism through the world via the music-streaming service; such an inclination is evident in the opening of the blog post:

> *In our connected world, people everywhere tend to enjoy the same top hits . . . but when most travelers visit another place, they don't seek out the same food they eat at home, even if they can find it. We travel to experience what makes a place different, and special, by sampling local specialties. Let's try the same approach with music, on a big map of the world. You can click any of nearly a thousand cities to hear a playlist of the music that is most distinctively enjoyed there. (Van Buskirk, "Musical Map" my emphasis)*

Second, and tied to this touristic application, Spotify also uses the data collected from its listening base to generate recommendations for other users of its streaming platform. Spotify's musical maps invite listeners to engage with this music-streaming service by stepping outside their genre interests and trying to listen, instead, with geographic locations guiding the way.

I begin with this example because it gestures to the central concern of this article: the circulation of local geographic regions as user-generated metadata within two digital music platforms, Bandcamp and Soundcloud. On the one hand, I pinpoint how the region-oriented tags produced by users facilitates the organization and retrieval of musical data uploaded to these music platforms; on the other, I suggest that a "local feel"---defined, following J. Berland, as the narrative production of local regions within commercial media sites (190-191)---emerges in both platforms through the articulation of local regions to such metadata-specific functionalities as generating recommendations and facilitating frictionless platform navigation. To capture the articulation of locality to metadata I deploy the term indexi-local: a *portmanteau* that collapses the terms index and local to describe the tendency in these two platforms to design a participatory platform experience based in users' tagging of local regions. To establish the indexi-local, I examine the tagging of local regions through a closer reading of Bandcamp and Soundcloud's interfaces.[1]

J.W. Morris and D. Powers define an interface as "all that greets a user when she/he starts up a service, including design, features, content organization, navigational options, etc., as well as the affective pull this combined assemblage has on users" (110). The interface is a key part of digital platforms that, moreover, works to "shape how users see, hear, feel, and experience the functions of any given piece of software and the cultural content that passes through it" (Morris, *Selling Digital Music* 18). Interface design both guides and enframes everyday interactions with different software, platforms, and websites. To illustrate data's region-oriented emplacement, I include several screengrabs of these tagging practices. This work follows previous interface-oriented studies of digital media (see Bolter and Grusin; Manovich; Galloway). Drawing on M. Fuller and A. Goffey's work on "gray media" -- which examines the functionality produced in such administrative sites of digital mediation as spreadsheets and databases -- this article considers the indexi-local as a more functional articulation of local regions, stylized as hashtags and lists of geotagged text circulating through these two music platforms. I conclude by suggesting that the indexi-local signals the place and value of local music-making regions within the broader reconfigurations of commodity forms and audience experiences connected to the current "new music economy" that hinges on social media platforms, user-generated content, and increasing participation from consumers in valorizing, promoting, and distributing music (see Galuzska; Morris, "Artists as Entrepreneurs"; Morris and Powers).

### Introducing Bandcamp and Soundcloud

Bandcamp is a private, venture-capital funded music retail and streaming service created by Ethan Diamond and


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Shawn Grunberger in 2008 to provide unsigned and independent musicians and record labels a platform with which to sell albums (both digital and physical) and merchandise (Tozzi and Leiber; McIntyre). In an interview with *Billboard*, co-founder Diamond explained his interest in starting Bandcamp as emerging from both his own fandom for independent music as well as dissatisfaction with the design and usability of then-popular services such as MySpace:

> *In the earliest days, it started because there was a band I really liked. This was 2008, when you have MySpace, Imeem, those sites. Very little choice if you wanted to go on your own. What you ended up with was somebody else's logo, advertisements --- someone else's identity. If you wanted to do it on your own you had to hire a designer, an engineer. It seemed nuts. (qtd. in Flanagan)*

The e-retailer went online in 2008 and offered musicians a customizable artist page free of in-page advertisements. Artist account-holders are responsible for a diverse range of activities, including uploading songs; providing and editing information relating to sound recording, artist biographies, etc.; preparing and uploading artist and album artwork; setting prices; processing, shipping, and receiving orders of physical albums and merchandise; and generating tags that categorize both albums and artist.

Alex Ljung and Eric Wahlforss created Soundcloud in 2007 with the aim of facilitating musical collaboration by music producers within digital settings. As co-founder Ljung explained in a 2009 interview with *Wired*:

> *We both came from backgrounds connected to music . . . and it was just really, really annoying for us to collaborate with people on music---I mean simple collaboration, just sending tracks to other people in a private setting, getting some feedback from them, and having a conversation about that piece of music. In the same way that we'd be using Flickr for our photos, and Vimeo for our videos, we didn't have that kind of platform for our music. (qtd. in Van Buskirk)*

Soundcloud ascribes distinct URLs to the audio files circulating within the platform, which can then be embedded in a variety of websites. This enables the easy sharing of tracks. Meanwhile, comments can be posted within the service's audio player, which is stylized as a visualization of the song's waveform (a visual facsimile of a song's volume and sound dynamics). Interested listeners provide feedback by clicking on a part of the song's waveform and posting their comments there. The visualization of waveform typical in Soundcloud's audio player can be seen in the below screengrab of the track "Pools of Iris" associated with the account of the Ottawa-based independent electro-pop musician Pippa (https://soundcloud.com/pippalouu).

Both Bandcamp and Soundcloud are audio platforms that, like social-media services Facebook and Twitter, emphasize social connectivity and operate through the user-generated content. Both services promise, moreover, social connectivity for users; Bandcamp promises both listeners and musicians a platform with which to "discover amazing new music and directly support the artists who make it" (www.bandcamp.com). Soundcloud, meanwhile, promises its subscribers a platform that will "help you connect with fans and grow your audience" (www.soundcloud.com). Morris and Powers argue that streaming services advance, through discourse, interface design, and marketing, "branded musical experiences that target certain styles of musical discovery and use as they vie for consumers" (109-110). The next section highlights how the promises of discovery, support, and connection advanced by both Bandcamp and Soundcloud intertwine with the region-oriented tagging practices of users.

*Image 1 (https://soundcloud.com/pippalouu)*


## Locality and Metadata: Music Scenes, Collective Intelligence, and Extra Work

The tagging practices circulating through and evident in both Bandcamp and Soundcloud work as user-generated metadata. A.G. Taylor and D.N. Joudrey define metadata as the "data about data" that "describes the attributes of information resources for the purposes of identification, discovery, selection, use, access, and management" (89). Examples of musical metadata include song names, album titles, artist names, and genre. In these instances, metadata is the information that enables its search and retrieval within different digital platforms (Morris, "Making Music Behave" 851-853). Metadata is particularly useful in digital settings it works to organize and categorize the data constantly (over-)accumulating (Boehm; Manovich 221-225). L. Gitelman observes, moreover, that metadata is embedded at both visible and invisible layers within digital media objects. Writing about DVD discs, she explains: "All of the information on a DVD menu that users watch are data; the information they do not watch are metadata. Some metadata become visible in menus and titles, but a lot more remain unseen" (142). Tags operate as visible and user-generated metadata within these two platforms.

Considering the tagging activity in Bandcamp, genre and local region are the most typical tags deployed. There is no pre-set template for genre tags, so they range from more standard descriptors as "indie," "punk," and "folk," to more idiosyncratic ones, such as "Ouija rock," which is utilized by the Ottawa-based punk rock band The Yips (https://yips613.bandcamp.com/). The other popular tag is for geographic region, largely based in the cities or towns with which artists self-identify. For example, the Ottawa-based indie rock group The Yips deploy two tags for Ottawa: Ottawa with a lower-case O and upper-case O. (Image 2). There are also bands that tag for multiple cities, as with the punk group Best Fiends, which tags the cities Toronto, Montreal, and Ottawa in its profile and album page (https://bruisedtongue.bandcamp.com/album/best-fiends).

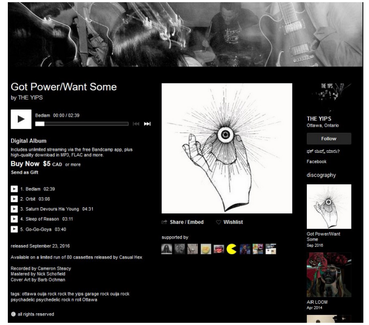


*Image 2 (https://yips613.bandcamp.com/)*

The tagging of geographic regions circulates throughout the artist pages of Bandcamp account holders, ranging from smaller-scaled groups with regional popularity like The Yips, to more internationally renowned groups like Fugazi, who also embed a tag for the city "Washington DC" (https://fugazi.bandcamp.com/) within their artist and album pages on Bandcamp. While these groups are aligned to the punk rock genre, a wide range of independent and unsigned musicians working in different genres utilize the platform and tag for geographic region as well, including the London-based electronic/dubstep musician Burial (https://burial.bandcamp.com/); New York-based hip-hop artist KRS-One (https://krsone.bandcamp.com/album/the-world-is-mind); and Durham, NC-based indie rock group The Mountain Goats (https://themountaingoats.bandcamp.com/album/goths-deluxe-version).

Soundcloud also features an option for tagging. The platform provides users with the option to embed one hashtag in the audio player. Not only do musicians and record labels use the platform, but radio stations and podcast producers also embed sound files for playback and streaming within Soundcloud. The screengrab below of the Ottawa-based fuzz-pop band Baberaham Lincoln shows a hashtag for Ottawa:


*Image 3 (https://soundcloud.com/bruisedtongue/baberaham-lincoln-stir)*

The repeating reference to local regions in both platforms signals the historical and contemporary value of local music scenes in the formation and circulation of many of the music genres represented within both services, including electronic dance music (Reynolds); punk rock (O'Connor); hip hop (Harrison); and indie rock (Shank; Kruse). Studies of music scenes tend to examine the local media sites, social and professional networks, and musical players that shape the emergence and circulation of certain music genres (Cohen; Shank; Crossley). A focus on music scenes can reveal the important role that such sites as live music venues, rehearsal spaces, recording studios, music stores, and local media (such as zines and campus radio) play in providing the "soft infrastructure" on which social relations, musical practices, and economic activity rests (O'Connor). Working with Brian Eno's concept of "scenius," S. Reynolds surmises that a focus on music scenes reveals the important role that social milieu plays in shaping the formation and circulation of music, which challenges myths of music creation based in autonomous genius (527). Whether banal infrastructure or revealing the musical influence of social relations, music scenes underpin the production of much of the music represented in both platforms.

Kruse has shown in her work on music scenes and indie rock that the value and meaning of indie rock is actively produced by scene participants through both their discursive articulations of and affective investments in music at the level of the local music scene. More precisely, she finds a recurring tendency for scene participants to construct both their personal biographies of music fandom and indie music's history through their own investment and involvement in their local music scene (*Site and Sound* 12-13). Research into the adoption of social media and e-retail platforms by musicians has highlighted their fit within the existent cultural, economic, and social activities of music scenes ( Kruse, "Local Identity"; Sargent). Following Kruse's insight into the centrality of identifying and creating music via local regions in indie music scenes, in Bandcamp the tagging of local regions locates and identifies musical data uploaded by musicians and labels to this platform, indicating the social and geographic regions in which these users are situated. Moreover, the tendency for these local tags to cut across different genres not specific to indie rock suggests that locality---that is, relating to a specific region vis-à-vis music and media (Bennett 63; Kruse, *Site and Sound*)---continues to be significant in the production, distribution, promotion, and organization of music uploaded to these platforms.

Upon introducing tagging into Bandcamp, co-founder Diamond explained that tagging was a valuable addition to the operations of this platform because:

> *We think it [tagging] has the potential to build a community in the best possible sense of the word, where every individual contributes to its strength. It won't, of course, be built overnight. At the time of this writing, there are exactly zero tags in the system, but with your help . . . it shouldn't be long before the solitary goal of these new features is realized: make every artist on Bandcamp more successful, by making it easier for fans to find you. (Diamond)*

Diamond's suggestion that community will emerge in Bandcamp through tagging enacted by different account holders resonates with H. Jenkins' research into the production of "collective intelligence" within online settings. Following the lead of French philosopher of cyberspace Pierre Lévy, Jenkins distills collective intelligence into the following slogan: "None of us can know everything; each of us knows something; and we can put the pieces together if we pool our resources and combine our skills" (4). Jenkins identifies collective intelligence in the online sites and spaces in which media users and fans collaborate and produce culture, whether looking to "spoiler groups" that agglomerated around the reality television series *Survivor* or the collaboratively produced online encyclopedia *Wikipedia*. Diamond sees community emerging in the contributions made by users of the platform to categorize and describe the music they upload to the platform. However, while the music uploaded to the service fits within the broader reliance on the decentralized circulation of user-generated content evident in social media platforms, with tags we also see a more precise form of "collective intelligence" emerging, whereby the terms mobilized to describe music not only work to categorize and describe the individual musical products uploaded by musicians and record labels but also the broader aggregate of music uploaded to the platform by different users.

Indeed, the tags generated by users of this platform become conventional terms to mobilize, thereby indicating a collectively produced form of information management by platform users. While Bandcamp's reliance on users to tag signals the collective intelligence of platform users contributing, it also places the burden of data management away from the platform's engineers and towards the individuals uploading data to this service. This does not exactly count as "free labour" performed by users of this platform to make it work better (see Terranova; Srnicek), because the musicians and labels selling and promoting music with Bandcamp are not exactly unreimbursed; rather, it is a sort of informational work performed by platform users that makes the platform work better. We can see tagging as extra informational work performed by platform users that facilitates platform navigation, which is entangled with the already-existing creative labour performed by musicians and record labels to create, sell, and promote music (Stahl).

This section has highlighted a repeating tendency for local regions to emerge in the tags circulating through both Bandcamp and Soundcloud. These tags reflect the "collective intelligence" of both platforms' user bases; emerge as extra informational labour performed by platform users; and gesture to the fit of these platforms within the scene-bound musical and entrepreneurial activities of record labels and musicians.

## Gray Locality, or, Engineering Connections

Fuller and A.. Goffey develop the term "gray media" to describe seemingly mundane and task-oriented media forms such as databases, spreadsheets, and writing/editing software. These media technologies are gray because their seemingly seamless operations contribute to the myth of "frictionless" communication that is prioritized in digital milieus:

> *The transparency of the facilitation of activity that is produced when devices, practices, protocols and procedures, gadgets and applications, mesh and synchronize simultaneously creates vast black-boxed or obscurely grayed-out zones. . . that permit the abstract social relations characteristic of "frictionless" communication to take root. (4)*

However, these media are also gray because they closely intertwine with the various administrative practices to which they are deployed, thus becoming invisible. Or, as Fuller and Goffey explain, "Grayness is a quality that is easily overlooked, and that is what gives it its great attraction, an unremarkableness that can be of inestimable value in background operations" (11). Gray media are, in short, administrative and function-oriented media forms that are largely used as means to achieve specific ends. One may not necessarily think of them as distinct media forms unto themselves until they stop working (as for instance, when a Word Document crashes). Their work on gray media is suggestive in its accounting for the ubiquity of administrative media forms within the everyday lives of media users. Keeping in mind this special issue's focus on the visualization and emplacement of data, I argue that the indexi-local is a gray and platform-specific "local feel," to use Berland's term.

As seen in the screengrabs, there is a degree of aesthetic "unremarkableness" evident in these tags, which circulate in Bandcamp as hyperlinked text listed within the album and artist pages of account holders and hashtags. While the artist and album pages are customizable in both Bandcamp and Soundcloud---with musical acts able to upload album art, select font colours, page colours, etc.---both tags appear as simple text embedded in different regions of the webpage. In Bandcamp, tags are listed at the bottom of album pages; in Soundcloud, it is a hashtag embedded in the audio player. Moreover, Soundcloud users also have the option to identify geographic regions in the biographical information posted to the profile pages of Soundcloud users. Consider the stylization of local regions as profile information in the screengrab posted below of the Ottawa-based indie electro-folk group The Acorn (Image 4). In The Acorn's profile, the listing of location in profile information appears as simple text, stylized and formatted in the same colour and font as the musical act and members. Again, there is aesthetic unremarkableness, or indeed, a quality of grayness in subsuming local regions to biographical information listed in a profile.

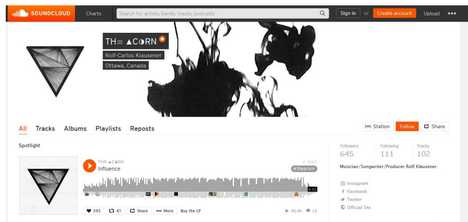


*Image 4 (https://soundcloud.com/theacorn)*

When one clicks through the region-oriented tags circulating within Bandcamp, two types of search results appear: other items that have been tagged with that tag by that musician, and other music that has been categorized with that tag. In the frictionless navigation of pages, local regions are articulated as metadata generating further listings of music to stream and purchase. For example, clicking through the "Ottawa" tag within The Yips' Bandcamp page produces results for albums released by the group that have also been tagged with that tag; other albums and artists that have used that tag; and a list of "related tags" with which listeners can further explore the service (Image 5). These results emerge across all instances of region-based tagging.

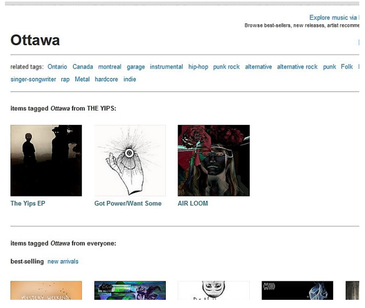


*Image 5 (https://bandcamp.com/tag/ottawa?artist=1462450860)*

Similarly, clicking through the hashtag embedded in Soundcloud's audio player produces a list of audio files featuring that tag, broken down in terms of popularity for individual audio files and playlists (Image 6).

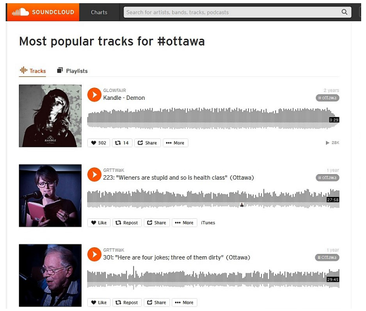


*Image 6 (https://soundcloud.com/tags/ottawa)*

In both instances, tags create lists of further listening recommendations. J.D. Peters has argued that lists are both a symptom of and strategy to deal with "information abundance" in digital milieus (9); similarly, the list of results opened by this tag reflects the quantity of data uploaded to these platforms and provides platform users a means with which to navigate through the data contained in these platforms. In *Media Ecologies* (2005), M. Fuller performs a formal analysis of lists, suggesting that lists accrue significance through the connections generated in-between any given item placed on a list. More precisely, he argues that lists possess a sort of "compositional" logic, whereby each element in a list produces a broader "communicative dynamic" (15). The "communicative dynamic" emerging in these instances of tagging involves engineering data interconnections to generate recommendations.

Indeed, hashtags are an everyday part of social media websites such as Instagram and Twitter and they provide users with a means to render their social-media posts searchable, groupable, and part of larger social-media trends. In relation to social-media activism, hashtags articulate networked connections between posts, producing larger aggregates of protest messages as social-media postings (Scott). The use of hashtags fit, moreover, within the increasing tendency for users to perform "interpersonal search" in social-media platforms. M. Zappavigna explains: "This cultural shift to interpersonal search has resulted in the emergence of searchable talk, that is, online discourse where the primary function appears to be affiliation via 'findability.' This kind of talk . . . incorporate[s] metadata into language so that online talk can be found" (789). As the screengrab listing the results for the tracks and playlists categorized as #Ottawa (Image 6) depicts, there are a range of individuals using Soundcloud who hashtag local regions to align their tracks, podcasts, and/or playlists with others. This facilitates the findability of these tracks via the tagging of local regions.

Writing about localness in Canadian commercial radio broadcasts, Berland unpacks and identifies how a "local feel" is produced in Canadian commercial radio to "appeal to" both advertisers and listeners (189). Localness is not intrinsic to Canadian commercial radio; instead, the feel of locality is produced, more precisely, through such narrative means as: DJ banter identifying local events, locally focused news updates, and broadcasting commercials for local businesses (189-191). These elements re-code commercial radio as a local media production (though localness can also be established in the signal limits of terrestrial radio stations). Similarly, I would like to suggest that there is a "local feel" being produced in these platforms through the deployment of region-specific tags.

Specifically, in Bandcamp and Soundcloud, these instances of user-generated metadata both describe musical data uploaded to these platforms and generate connections between musical data identified with that regional tag. This fits with Morris' argument that "metadata plug users into a vast repository of commodities on the internet, where the act of listening to a song triggers advice to purchase music by similar-sounding bands, related merchandise, or other linked media properties" ("Making Music Behave" 860). The indexi-local articulates and visualizes these connections between musical data circulating within this platform as lists and tagged text. The functionality of these instances of region-oriented metadata is reflected in the very aesthetics of tagging: a gray and platform-specific "local feel" oriented towards enabling, on the one hand, the frictionless navigation and retrieval of musical data uploaded to these platforms, and on the other, recommendations for further listening, streaming, and purchasing options.

## Conclusion

Scholars have identified a "new music economy" that has disrupted music's established commodity forms and producer/consumer relationships (see Galuzska; Morris, "Artists as Entrepreneurs"; Morris and Powers). This new music economy privileges "features like social connections and contributions (between fans and artists, fan-generated reviews and playlists, etc.) in lieu of sales of discrete objects" (Morris and Powers 109). While Bandcamp still sells "discrete objects," this article has emphasized how forms of user-generated contributions, social connection, and participation emerges in the collective and regionally oriented tagging practices circulating through both music platforms. The indexi-local, moreover, signals the place and value of local regions within these two music platforms to organize data, generate recommendations, and facilitate frictionless navigation. While further research is needed to identify the social, emotional, and professional needs that these practices of region-oriented tagging meet for users, it is evident that both local regions and these music platforms operate as mutually beneficial "way-finding aids" (Straw413). Indeed, the tagging of local regions enables users not only to sift through the density of musical activity transpiring in a local music-making region with that platform but also locate music within that platform via local regions. This focus on metadata reveals a platform-specific "local feel," produced by re-articulating local music-making regions to metadata-specific functionalities of categorization, connection, and retrieval. While one can potentially, as Soundcloud promises users, "hear the world's sound" (www.soundcloud.com) in and through these music platforms, this world of musical data is navigated, organized, and emplaced through the aggregation of user-generated and region-oriented tags generated by users of these two music platforms.[2]

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## Notes

1 In an earlier study, the indexi-local was identified in the online radio station CBC Radio 3 and argued to operate as a "virtual image" of local music scenes (Audette-Longo). In doing so, it looked to the "experiential potentiality" of participating in a local music scene vis-à-vis this online radio station (516). This article further builds on this initial study of how styles of participating in independent music overlap local music scenes and a single digital music platform by considering the tagging practices of platform users. Moreover, because this article branches off from a broader study of independent music within Ottawa, Ontario's indie rock scene (Audette-Longo, "Shine a Light") the examples of tagging included below deal with Bandcamp and Soundcloud accounts based in Ottawa.

2 "Hear the world's sounds" was a slogan circulating on the homepage of Soundcloud until early 2017, when it changed to "Discover, stream, and share a constantly expanding mix of music from emerging and major artists around the world."

# DRONES CAUGHT IN THE NET: PILOTING ABOVE INFORMATION INFRASTRUCTURE

ADAM FISH | LANCASTER UNIVERSITY

BRADLEY GARRETT | UNIVERSITY OF SYDNEY

OLIVER CASE | LANCASTER UNIVERSITY

## Abstract

*This short experimental essay reflects upon our video Points of Presence. In producing the video we used unmanned aerial drones to visually and vertically examine undersea fibre-optic cables of the North Atlantic. We reflect upon how the drone's flying technologies allow pilots to creatively engage with the atmospheric element. We argue that the drone's optical and object-avoidance technologies share similarities with the mammalian senses. In concluding, we examine how drones and information infrastructures reflect each other as complex and imperfect systems designed to extend the human body and senses across geographies.*

## Résumé

*Ce court essai expérimental se penche sur notre vidéo Points of Presence. En produisant la vidéo, nous avons utilisé des véhicules aériens sans pilote pour examiner visuellement et verticalement les câbles de fibres optiques sous-marins de l'Atlantique Nord. Nous réfléchissons à la façon dont les technologies de navigation du drone permettent aux pilotes d'interagir de manière créative avec l'aspect atmosphérique. Nous soutenons que les technologies optiques et d'évitement des objets du drone partagent des similitudes avec les sens des mammifères. En conclusion, nous examinons comment les drones et les infrastructures d'information se reflètent comme des systèmes complexes et imparfaits conçus pour prolonger le corps humain et les sens à l'échelle de la planète.*

This short experimental essay reflects upon our video *Points of Presence*. The core production strategy was to employ unmanned aerial vehicles – drones – to examine undersea fibre optic cables of the North Atlantic. We reflect upon how the drone's aerial capacities allow pilots to engage creatively with the atmosphere. We encounter surprising similarities between the drone's optical and object-avoidance technologies and other non-human sensibilities. This experiential orientation challenges more utilitarian drone methods and proposes a more intimate relationship between humans, drones, and the environment. In what follows, we examine how drones and information infrastructures parallel each other. They are both complex communication systems situated in elemental forces and designed to extend the human body and senses across geographies.

## I. CANTAT-3 Tjørnuvík, Faroe Island

> *"What is commonly called environmental consciousness could be described as subterranean consciousness – the awareness that we are in a very real sense not living on the earth but inside of it."*
> *—Rosalind Williams (213)*

The video above is an experiment in apprehending information infrastructures from a unique perspective using camera-equipped unmanned aerial vehicles or drones. This view from the air is novel not only because the drone's motility renders previously un-sensed atmospheric volumes but also because we are able to move through them with extreme flexibility. We chose to inhabit this particular volume in order to trace a system of communication between landing stations and data centres in the North Atlantic, stretching from Iceland to the United Kingdom and following the undersea cables CANTAT-3, DANICE, and FARICE-1. Though these cables extend in myriad directions, we are interested in the cables that connect Iceland and the Faroe, Shetland, and Orkney islands, because of their unique geographical locations as communication archipelago and the interconnected geopolitical connotations that arise from their terrestrial "landing sites"—also known as "points of presence" (PoPs) in the telecommunications industry. Yet the landing sites, like the cables, reveal little about their function as they provide no beginnings nor endings but instead act as mediating nodes in a net of evolving technologies. They transmit the hopes, dreams, and fears of millions of people and do so impartially alongside a child's homework or a president's tweet. As drone pilots exploring these cables and the beaches that harbor them, we encounter local histories embedded in the environment, a cache of stories mediated by geographic proximity to this infrastructure. Surrounded by data, stories, and narratives travelling at light-speed under the Earth and beneath the sea, we linger in the atmosphere on quadcopter props—navigating a different information infrastructure—and scrutinize the (often imagined) materiality of the media assemblage. Framing one infrastructure within another, we pull back and pass over the volume containing the cables in an attempt to render it, tracing and etching the information infrastructure with movement. In the process, we encounter parallel sense regimes in animals, drones, and cables.

A clutch of interventions have sought to describe the materiality of global communication infrastructures. For instance, as Stephen Graham outlines in the introduction to *Disrupted Cities: When Infrastructures Fail*, infrastructures have been framed as "complex assemblages that bring together all manner of human, non-human and natural agents into a multitude of continuous liaisons" (11). Through the lens of political ecology, Matthew Gandy argues that these networks blend the social, the technical, and the natural through processes of cyborgization. The politicization of infrastructure—thinking about questions of access and supply as well as frailty and security—have challenged tendencies to relegate "infrastructures to an apolitical context or backdrop, as not noteworthy of attention, too hidden from view" (McFarlane and Rutherford 364). Anthropologists have worked towards an ontology of infrastructure, suggesting that infrastructures are "matter that enable the movement of other matter; they are both things and the relation between things" (Larkin 329). This is where the revelation of infrastructure shocks, when their mute operations take shape. Mundane yet alluring, data packets moving through a fibre-optic cable, for instance, play this mysterious double game of twinning the banal and the awe-inspiring.

Interest in infrastructures is by no means monopolized by researchers. As Shannon Mattern writes, in the desire to develop infrastructural taxonomies, "a new wave of Cloud explorers are pushing the limits of the field and the work they do in it—from drone spotting to algorithm forensics to global infrastructure expeditions" (Mattern np). Seeking to elucidate the spatial arrangement of communication nodes with reference to their oft-overlooked geography, fragility, and temporality, these investigations can be renewed and reworked through the use of atmospheric platforms such as drones. By ascending into the atmosphere and allowing us to sense celestial space remotely, drones offer vantage points that are not only novel for the purposes of tracing and recording but also challenge our understanding of how phenomenological boundaries are complicated by emerging assemblages of bodies, technologies, and spaces. The drone, a data-collecting and transmitting device, relies on its own infrastructure to operate. Drone piloting is therefore a methodology for understanding cable network ontologies in a parallel circuitry. It is from this standpoint, or rather hover-point, that we begin our journey into a newly reconfigured Earth-computer.

Although the drone as an object has a lineage aligned with visual and physical violence, articulated by scholars such as Derek Gregory, Ian Shaw, and Lucy Suchman, the new technology also enables us to see and imagine differently. Drones have the capacity to bring antipodal, alien, underrepresented, incongruous, and inscrutable spaces into a dialogue with an audience. Flying drones around the PoPs further accentuates the parallels between the two objects, as information systems in the air and information systems under the sea. This parallelity refers both to the movement of the objects and to a transferability of a speculative geographic consciousness where the scalability of theory and experiment is confronted by different assemblages. Economist Vernon Smith explains parallelity by discussing how laboratory experiments with gases gave scientists purchase on understanding the atmospheric constitution of celestial bodies (Smith 936). The mirroring of bodies by other bodies


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does not "reveal" those bodies as much as it mediates our awareness of them through a repeated coupling and uncoupling of the assemblage that forms the parallelism.

Ours is a *relative parallelism*, following recent work that uses the term to theorize experimental methodologies. Drone piloting over North Atlantic information infrastructures enables us, through our machines, to see and sense in ways that traditional, terrestrial approaches unavoidably omit. In developing this process, we found ourselves, our tools, and our techniques transforming in tandem with the objects and environments we sought to interrogate. Drone mobility, visibility, and fallibility allowed us, however humbly, to move and see in parallel alongside the animals, landscapes, and infrastructures encountered on our journey. A reflection takes place, both on the subjective and the intersubjective level, but we do not envision a mirrored relationship between the drone and the networked object under investigation, nor between the videos and the environs depicted (Barad). Rather, parallelity for us refers to how drone methodologies situate us and our drones in an indexical relationship with our subjects and environments. The "reflective" surfaces transmitted by the drone are not replications or accurate representations but rather distorted in-situ performances of the function of the observed object.

Our experiments with piloting above information infrastructures suggests a sensorial parallelity with a range of phenomena including, strangely enough, local Indigenous hunting techniques as well as the undersea fibre-optic cables. By entering the elements, particularly air and water, and tracing the communication infrastructures that run alongside and through these places, it is apparent that the elemental *is* an infrastructure—the matter facilitating matter alluded to above—and that there are more porous boundaries between the cable and the sea as well as the drones' senses and our human senses (McCormack). Emphasizing the elemental and historical continuities that link the material and immaterial, atmospheric and terrestrial, and the technological and biological, thus mitigates perceived dualities.

As we cruise the PoPs, strafing them with the cyclops' camera-eye, the drone asserts its presence, which also affects us as researchers, since we sense through the machine. The volumetric sensibility enabled by the drone situates the viewer at an atmospheric stratigraphy between satellite views and the human field of vision. We can imagine "the cloud" from here as a relatively clear stratigraphic domain of global connectivity trenched into the geological and archaeological matrix; the two ideas dovetail, though neither is strictly revealed. Piloting challenges vision. Often the drone flies at such a distance that it can no longer be seen by the ground-level human eye. Instead of looking at the hovering craft, referred to as "line of sight" flight, the pilot scrutinizes video on a tablet sutured to a radio controller or through first-person-view goggles, thus sensing via the drone's "payloads" of sonar, 4K, and infrared video, GPS, and altimeter. The drone, levitating in the atmosphere, may in fact be relaying sensorial data from hundreds of metres away. This would be an existentially disconcerting experience were it not for the immersive capacities of the aircraft, remote controller, transmitting WiFi, and tablet interface. The interaction with the drone, via these tools working in concert, begins to condition not just how the human body acts with the drone but also how the body imagines one can act. In her ethnographic work with the NASA Jet Propulsion Laboratory Mars Rover team, Janet Vertesi writes that the "body work involved in simulation, and the embodied imagination that practitioners must gain about their objects of study as part of their training" (Vertesi 398) also retrains the body of the human (we might also look here to the post-phenomenology of Don Idhe or James Ash who refers to human-technology interfaces as "envelopes"). This concept clearly demonstrated than in the now all-too-ubiquitous swiping gesture of the touchscreen that children attempt to use on glossy "dumb" surfaces they encounter (Mowlabocus).

Moving past the novelty of drone piloting to see whether it harbors potential for thinking differently is key. What does the aerial perspective and its intrinsic mobility really show us? Does it have the potential to reveal the Janus-faced nature of the technology (Chamayou), to ground the "cloud" (Starosielski), to imaginatively dive under the waves of the sea as we move with the cable (Wright)? Or does it simply skim across the maritime and terrestrial surfaces, revealing little more than the cartographic representation we used to locate the site? (Figure 1).

Among other sites, the video above examines the undersea internet cable CANTAT-3, which connects the PoPs of Vestmannaeyjar, Iceland and Tjørnuvík, Faroe Islands. The edit, which includes some limited archival layering—the place-based speech, sound, history, and labour that revolve around the object—is spatially ordered but temporally motley, much like the information is depicts. The video thus operates at a range of registers, reworking geographical and cultural

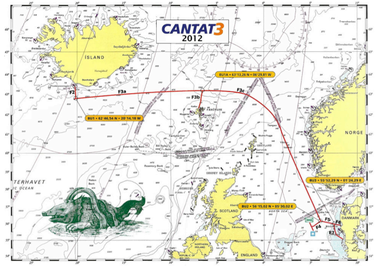


*Figure 1. Cartographic depiction of CANTAT-3, Faroe Islands in the center of map*

imaginations. The volumetric sensibility of the drone as a remote-sensing infrastructure, from which lenses and sensors focus, exposes the ecological situatedness of the information infrastructures stretching between the geographical isolation of Vestmannaeyjar in Iceland to the environmental expansiveness of Tjørnuvík in the Faroe Islands. Tjørnuvík has a permanent population of only 64 human habitants, yet it has cultural saliency as more than just a landing site for an international communication cable. The *Færøsk Anthologi* (Hammershaimb) describes how, once upon a time, the giants in Iceland decided that they wanted to obtain the Faroe Islands. A giant and a witch were sent there to retrieve the fragmented landmass. The witch tied a rope to Eiðiskollur Mountain and gave it to the giant to pull towards Iceland. As he did so, the resistant landform split. In their labours, the giant and the witch failed to notice the sun rising and they were both turned into stone at the mouth of the fjord, where they still stand as a warning to those who would threaten the sovereignty of the Faroes.

In the shade of a Faroese fishing hut, we stared at the tablet, directing the path of the drone with a delicate nudging of the joystick along the trajectory of the cable stretching out to sea. The novelty of this method was quickly subsumed by the locativeness of the act of flight. This prompted archival research and rumination in an effort to depict the convergence of human, mammalian, and technological senses at play on the beach at Tjørnuvík. The stories we heard here about the laying of the cable were a knotty cultural stratigraphy of place paralleling the complications we encountered through flight. Even those images (captured in 4k resolution no less) were archival, for as Rebecca Solnit writes in *River of Shadows*, photography may be history's most paradoxical invention since each image produced is already the past (Solnit). This is especially relevant in the case of the consumer drone, a technology that from its inception has been subjected to profitable planned obsolescence. The temporarily extended perception enabled by the drone, while opening out new perspectives, also furthers the displacement of space and memory that is triggered by photography. In contrast to recorded intimacies at ground level, in the air our memory and experiences of the Earth becomes detached and differently tangible. This may lead us into unknown places with a new sense of shared familiarity.

The black basaltic sand in Tjørnuvík is a site for the annual grindadráp, where pods of pilot whales (grind) are stampeded to land and killed for food. The beach is ideal for herding pods because of its proximity to the open sea where the grind ambulate and because of its sandy shore, which absorbs the sonar of the whales instead of bouncing it back and informing the whales of the shore's location. The result is that they do not sense the shore and thus swim into villagers, where lances are stuffed into blowholes, lacerating spines and providing ample cetacean meat for the dark winter months. Like the whales, our drone has sonar, which feeds back information about its proximity to the shore, telling it to rise autonomously from surfaces to avoid fatal collision. The sonar kicks in several times during the videoing at Tjørnuvík and does indeed prevent us from crashing—unlike the previous

*Figure 2. The laying of the CANTAT-3 in front of the witch and the giant*

three drones which lacked this payload and all met their end slamming into trees, mud embankments, and lava outcrops. Drone and whale sonar is an imperfect adaptation.

Watching archival video after our departure, we see that had we staged a modest excavation below the black beach we would have indeed "found" the cloud. Under the sand another form of sensing and communicating, light pulsating in data packets, coursed through the fibre-optic cable. These pencil-lead-thin cables are prone to failure; they break because of errant anchors, shark bites, and ill-plotted digging. When breakage occurs, electrons are absorbed into the salt water, never arriving to their sender, like a 19th-century postal letter on a sunken steamer. Yet the elements here act as bridges as much as barriers. Information travels by using the elements as conductors and insulation (Starosielski 19). The boundary between the infrastructural and elemental cannot be clearly cleaved along human/nonhuman lines.

Piloting a drone in this location—a site of great aesthetic beauty that many also consider a locus of brutality—slots us and the drone into a historical stratigraphy of place, sand, sea, and sonar. The drone becomes a "boundary object" (Star) where sensorial resonances meld the communication systems of machine and mammal. The data being relayed to us on our sutured touch-screen transfers more-than-representational information (Lorimer). It relays important signals and bridges the gap between animal and technological ontologies at the locus of ethnographic and phenomenological experience. Traditionally, in surveillance activities, technology (whether architectures or predator drone flights) allows those in power to watch those without the means to avoid surveillance. More recently, the popularization of drone technology allows for new forms of sousveillance, where the watched watch the watchers. This was evident, for instance, at the 2016 Standing Rock protests in South Dakota, USA, where protesters used drones to track police movements. Yet one more step removed here, the drone, experienced through the tablet, allows us to inhabit two positions at once, watching ourselves as the watchers, thus prompting two parallel phenomenologies of place, one displaced through the drone by sensorial extension and one displaced through the tablet because of virtual simulation.

In other words, the drone offers a methodology which both parses and multiplies vertical stratigraphies. The result of "seeing" (or more accurately sensing) from here may be that stratigraphy becoming more complicated. Every lift-off is an "opening" or a renewal of the attempt to differentiate temporal layers from and within the aerial atmosphere. As we saw, the efficacy of drone and whale sonar is disrupted by the sonar absorbent sand. We are right to be nervous, given that the technology is based on animal mimicry. These machines bring with them their own sets of vulnerabilities reproduced from the biological for the technological. Yet at some point the machines exceed the limits of the biological organism and a speculative evolution kicks in, where the machines sense in ways bodies cannot and thus offer an indication of what bodies might one day do. In this sense, flying the drone is clearly a kind of extra-sensorial experience in which we are assisted in sensing by technologies. This harkens back to the intertextual roots of cinema, as when Dziga Vertov buried cameras in railroad tracks to capture trains driving over them, or filmed the process of making a film only to replay that footage in a theatre where the audience was also being filmed. Likewise, we are obsessed not by what the technology does, but in how it might change the way we think, if we allow it to. This is the nature of this meta-methodological experiment.

Ultimately, positioning the drone into the sensorial assemblage—where the technological apparatus enables us to inhabit parts of space otherwise inaccessible—partially melds us into the stratigraphy of place where we are attuned to the PoPs but also more conscious of how the cable creates a space of mobility and flow as the drone does. As we fly people talk to us, sometimes initially out of wonder or outrage; tracing the connections across moments triggers conversations, as people offer up unsolicited memories and archives. In the process, the cable itself gets dredged up through a refrain when the novelty of the flight reinvigorates an interest in places, myth, story, and memory—and how these things flow across space.

Rather than a mere methodological novelty, the new technology causes us to return to the old technology, conforming to Marshall McLuhan's theory of the tetrad of media effects, an archaeological cycle of enhancement, death, and resurrection that occurs with the development of each new technology (McLuhan and McLuhan). The spatial and temporal mobility invoked by piloting uncovers a stratigraphy in the context of the volumetric which runs in parallel or, as Gilles Deleuze and Felix Guattari put it, along horizontal lines (Deleuze and Guattari). The inclusion of the atmospheric gaze into future ethnographies, we argue, may also serve to identify undiscovered balance-points between social, geographic, and technical circuits—a climate's view of the Earth's anthropocentric arrhythmia.

When we began this project, we were inspired by those scholars and artists who encouraged us to improve our infrastructural literacy through visiting, seeing, and visually documenting the terrain-based systems of communication around us. In so doing, it is hoped, citizens will become empowered to understand how infrastructure works (Graham and Marvin), to assume responsibility for governance of these systems (Mattern), or, at the least, to take more interest in how individuals, governments, and corporations build and maintain these systems (Garrett). This shift in attention raises important social, cultural, economic, and even geopolitical questions. An important question not examined in this brief essay is the relationship between seeing or sensing the actual information infrastructure and the virtual and potentially malicious forces that use these systems, such as big-data crunchers, high-frequency traders, personalization programmers, drone commanders, and mobile-mast-enabled pilot-whale fishermen. Can parallelity bridge the actual and the virtual, the pragmatically wicked and the symbolically circumstantial? In this video and essay we have reflected upon how socio-technical and mammalian systems of communication run parallel to each other. This tenuous theory is based on experiments with drones, information infrastructures, and human and non-human senses and sensing. This realm of trial and error is a call to return to the field, to fold ourselves back in the variegated volumes of place.

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# THE MOLDY STRATEGY

ANTONIA HERNÁNDEZ

*The Moldy Strategy* is part of a series of art experiments that interrogate what we do when we live with a digital network. In this video, mold, a common inhabitant of the house, performs under a microscope and becomes a vehicle for thinking through the network. It is an exploration of the ecology of the home that renders as an opportunity to speculate on complex interactions and companionships among all sort of components, including software and non-human bodies, data and space.

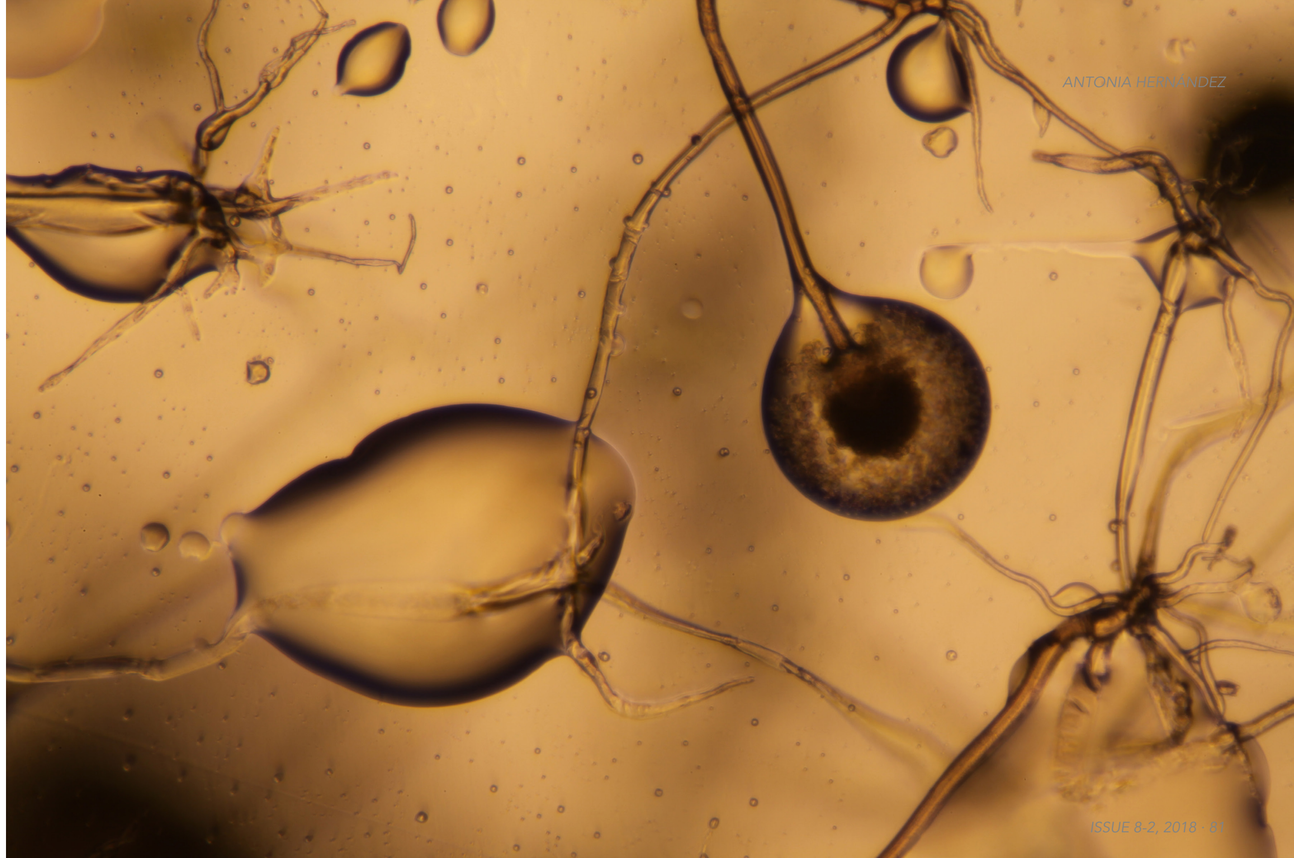
The Moldy Strategy proposes to observe a digital network as a circulation of affects, a transactional reality that, rather than being constrained to a computer screen, involves the domestic space and the bodies of their inhabitants. It is an exercise in thinking through the speculative (but possible) encounters with mold that gives insight into the nature and behaviour of that network, as well as clues about an imagined non-human domesticity.

Mold appears here not as a metaphor for a network but rather as a vehicle that allows the imagination of some virtualities discarded in a human-based model. By stressing the importance of non-human elements, an affective consideration of the ecology of domestic space shows how bits from different sorts can be mixed, creating new and unexpected entities. An exploration of domesticity in a networked context offers an opportunity to reflect on the entangled relationship between bodies and media, physicality, and metaphorical language. This complex interaction presents an alternative perspective to the current uniform model and vocabulary used to describe any kind of network, while taking into account processes, influences, and relationships among their components.

Further information at artwork.cordltx.org/the-moldy-strategy/

*The Moldy Strategy* would never have been possible without the support of Dr. Tagny Duff and FluxMedia, and Dr. Kim Sawchuk and the Mobile Media Lab, both at Concordia University.

Featured Image Credit: Antonia Hernández





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# COLLECTING CRYOGRAPHIC CLIMATE DATA, REMEMBERING ALBERTO BEHAR

RAFICO RUIZ

On Friday, January 9, 2015, a single-engine Lancair aircraft flown by Alberto Behar fatally crashed shortly after takeoff from Van Nuys Airport near Los Angeles. Behar was a 40-year-old robotics engineer and polar researcher who worked on various missions at NASA's Jet Propulsion Laboratory while also running Arizona State University's Extreme Environments Robotics and Instrumentation Laboratory. In the photograph that accompanies the story that appeared on the website of the *Los Angeles Times* that same day, two crash investigators examine the debris of the plane (Ryan, "JPL scientist killed in Van Nuys plane crash). In the bottom right foreground of the image, the lettering of the word "EXPERIMENTAL" can be made out through thick black grillwork.

I came to know of Behar's work inventing and developing sensors, cameras, and autonomous vehicles through the labyrinthine notes of a series of scientific articles dedicated to better understanding how Greenland's ice sheet is melting (see Smith et al.; Leigleiter et al.; Carsey et al.). While for decades glaciologists operated on the premise that Greenland primarily shed ice mass via calving events that produced icebergs (see Rignot and Kanagaratnam; Rignot et al.), around 2010 this paradigm shifted as sharper attention was given to the glacial lakes, streams, rivers, and moulins that account for the meltwater that leaves the ice sheet each year (see Gleason et al.; Bennartz et al.; Colgan et al.). Trying to monitor and project the melting of Greenland's ice sheet has taken on increased urgency as climate change, through such mechanisms as the albedo effect and other accelerating environmental conditions, is reshaping the island's ecological future while significantly contributing to global sea-level rise.



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Behar was a behind-the-scenes engineer who had to grapple with the challenges of how to render global climate data that is situated and responsive to often difficult-to-access polar field sites. His sensors, cameras, and crafts were designed to capture in-situ glaciological and hydrological data by going into the fast-moving and circuitous moulin drains and supraglacial channels that are increasingly appearing across the surface of the Greenlandic ice sheet. For instance, in one study that attempted to map the patterns and rates precipitated by an extreme 2012 melt event, Behar designed and built a small-scale drone vessel that was deployed to collect water depths and spectral reflectances, with the latter data crucial for calibrating satellite readings related to the channels' variable depths and levels of discharge (see Gleason et al.). The vessel not only enabled field scientists to obtain accurate and timely measurements from the safe remove of shore (as the vessel was remote controllable from up to one kilometre away), it also foregrounded the specific spatial demands of the Greenlandic ice sheet when it comes to conducting climate-related field science. By gathering data across a section of southwestern Greenland comprised of a large lake (Napoli) and two shallow meltwater streams (Olsen River and Cold Creek), the vessel was able to improve satellite-based forms of remote sensing by enabling these instruments to more accurately account for the bathymetric dimensions of these fast-moving bodies of water with increasingly large depth fluctuations precipitated by rising glacial melt rates. The vessel ultimately allowed these climate scientists to correlate optical satellite imagery with the estimated depths of supraglacial bodies of water, thus facilitating the mapping of the Greenlandic ice sheet not as a static site of storage and slow change but rather as a mobile geography of "transient flux conveying meltwater to moulins" (Gleason et al. 216). Behar's vessel was responsible for drawing out the volumetric dimensions of glaciers and tracking how meltwater circulated across its various strata.

I want to give Behar this posthumous recognition as the in-situ readings and images he captured can reshape our experience of the scales of anthropogenic climactic change and the global networks of data that form their evidentiary base. While recent studies have found microscopic algae and airborne dust playing a part in accelerating the melting of the ice sheet (Kintisch, "The great Greenland meltdown"), Behar's data-driven media of capture remind us of the mobility of water as it crosses from one phase state to another. From immobile ice to racing water, his attentive designs redefined understandings of polar in situ technologies as being responsive to the elemental scale of climate science.





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# CONTRIBUTOR BIOS

## Editors | Rédacteurs

***Alix Johnson*** is a PhD Candidate in Anthropology at the University of California, Santa Cruz, and visiting scholar at Concordia University in the Milieux Institute for Arts, Culture, and Technology. Her research examines information infrastructures in Iceland in relation to national practices, postcolonial politics, and ideals of remoteness and connectivity.

***Alix Johnson*** est candidate au doctorat en anthropologie à l'Université de Californie à Santa Cruz, et chercheuse invitée à l›Institut Milieux des arts, de la culture et de la technologie de l'Université Concordia. Ses recherches examinent les infrastructures de l'information en Islande par rapport aux pratiques nationales, à la politique postcoloniale, et aux idéaux d'éloignement et de connectivité.

***Mél Hogan*** is an Assistant Professor of Environmental Media in the Communication, Media, and Film (CMF) Department at the University of Calgary. Her research looks at data centres—their social implications, environmental impacts, and biological entanglements.

***Mél Hogan*** est professeure adjointe en médias environnementaux au Département de communication, médias et films (CMF) de l›Université de Calgary. Ses recherches portent sur les implications sociales et biologiques ainsi que sur les impacts environnementaux des centres de données.

## Contributors | Collaborateurs

***Michael Audette-Longo*** is an Instructor in Communication and Media Studies at Carleton University. He received his PhD in Cultural Mediations from Carleton University in 2016. He has published in journals such as *Topia*, *Critical Arts*, and *The Journal of African Cinemas*. His research interests include Canadian independent music, music scenes, and digital media cultures.

***Michael Audette-Longo*** est instructeur en communication et études médiatiques à l'Université Carleton. Il a obtenu son doctorat en médiation culturelle de l'Université Carleton en 2016. Il a publié dans des revues telles que *Topia*, *Critical Arts* et *The Journal of African Cinemas*. Ses intérêts de recherche comprennent la musique indépendante canadienne, les scènes musicales, et les cultures des médias numériques.

***Jutta Lauth Bacas*** is a Fellow at the Royal Anthropological Institute, London, and Research Affiliate at the Mediterranean Institute, University of Malta. She holds a doctorate in Social Anthropology from the University of Zurich with a focus on migration studies. The founder and Coordinator of MedNet, the Mediterraneanist Network of the European Association of Social Anthropologists, she has published widely in English, German, and Greek and acted as editor of special issues of *Ethnologia Balkanica* and the Journal of Mediterranean Studies. Her present research interests include transnational migration studies (labour migration, irregular migration, forced migration) in the Mediterranean and changing political culture (practices of resistance, clientelism, and party patronage), with a special focus on Modern Greece.

***Jutta Lauth Bacas*** est membre du Royal Anthropological Institute de Londres et adjointe de recherche à l'Institut méditerranéen de l'Université de Malte. Elle détient un doctorat en anthropologie sociale de l'Université de Zurich axé sur les études de migration. Fondatrice et coordinatrice du Mediterraneanist Network (MedNet) de l'Association Européenne des Anthropologues Sociaux, elle a beaucoup publié en anglais, en allemand et en grec. Elle a aussi été rédactrice pour des numéros spéciaux de la revue *Ethnologia Balkanica* et du *Journal of Mediterranean Studies*. Ses intérêts de recherche actuels incluent les études migratoires transnationales (migration de main-d'œuvre, migration irrégulière, migration forcée) en Méditerranée et l'évolution de la culture politique (pratiques de résistance, de clientélisme, et de favoritisme de parti), et ce, avec un accent particulier sur la Grèce moderne.

***Oliver Case*** is a recent graduate of the HighWire PhD programme at Lancaster University. His research concerns the post-cinematic experience of time and environment. As an artist and filmmaker, Case employs practice-based research and contributory methods to explore radical new strategies for understanding and applying the "networked image." Current work focuses on fostering communication around sustainability, energy systems, and climate change.

***Oliver Case*** est un diplômé récent du programme de doctorat HighWire de l'Université de Lancaster. Ses recherches portent sur l'expérience postcinématographique du temps et de l'environnement. En tant qu'artiste et cinéaste, Case utilise une recherche axée sur la pratique ainsi que des méthodes de contribution pour explorer de nouvelles stratégies radicales pour comprendre et appliquer « l'image en réseau ». Son travail actuel se concentre sur la promotion d'un dialogue autour du développement durable, des systèmes énergétiques, et des changements climatiques.

***Abiol Lual Deng*** is a specialist with over ten years' experience in humanitarian questions, conflict studies, human rights, and Africa studies, particularly questions of social media and ICT use in conflict and political violence in sub-Saharan Africa. Ms. Deng holds a Bachelor's degree from the University of Virginia and an M.Phil (hons) from the Université de Paris-Sorbonne.

***Abiol Lual Deng*** se spécialise depuis plus de dix ans sur les questions humanitaires, les études de conflit, les droits de l'homme, et les études africaines, en particulier sur les questions des médias sociaux et de l'utilisation des TIC dans les conflits et la violence politique en Afrique subsaharienne. Mme Deng détient un baccalauréat de l'Université de Virginie et une maîtrise en philosophie (avec distinction) de l'Université de Paris-Sorbonne.

***Daphne Dragona***, born in Athens, lives and works in Berlin. She is the conference curator of transmediale festival. She has collaborated with a number of institutions for exhibitions, conferences, workshops, and other events. Her interest lies in emerging or recurring artistic practices and methodologies that challenge contemporary forms of power. Her articles have been published in various books, journals, magazines, and exhibition catalogs. She holds a PhD from the Faculty of Communication and Media Studies at the University of Athens.

***Daphne Dragona*** est née à Athènes et elle vit et travaille à Berlin. Elle est la conservatrice de la conférence du festival transmediale. Elle a collaboré avec plusieurs institutions pour des expositions, des conférences, des ateliers et d'autres événements. Elle est intéressée par les pratiques et méthodologies artistiques émergentes ou récurrentes qui remettent en question les formes de pouvoir contemporaines. Ses articles ont été publiés dans divers livres, revues, magazines et catalogues d'exposition. Elle détient un doctorat de la Faculté de communication et d'études des médias de l'Université d'Athènes.

***Adam Fish*** is cultural anthropologist, video producer, and senior lecturer in the Sociology Department at Lancaster University. He employs ethnographic and creative methods to investigate how media technology and political power interconnect. Using theories from political economy and new materialism, he examines digital industries and digital activists. His book *Technoliberalism* (Palgrave Macmillan, 2017) describes his ethnographic research on the politics of internet video in Hollywood and Silicon Valley. His co-authored book *After the Internet* (Polity, 2017) reimagines the internet from the perspective of grassroots activists and citizens on the margins of political and economic power.

***Adam Fish*** est un anthropologue culturel, un producteur vidéo et un maître de conférences au Département de sociologie de l'Université de Lancaster. Il emploie des méthodes ethnographiques et créatives pour étudier comment la technologie des médias et le pouvoir politique s'interconnectent. En utilisant des théories de l'économie politique et du nouveau matérialisme, il examine les industries et activistes numériques. Son livre *Technoliberalism* (Palgrave Macmillan, 2017) décrit sa recherche ethnographique sur la politique des vidéos Internet à Hollywood et Silicon Valley. Il est coauteur du livre *After the Internet* (Polity, 2017) qui réinvente l'Internet du point de vue des activistes de terrain et des citoyens en marge du pouvoir politique et économique.

***Bradley Garrett*** is a social geographer at the University of Sydney. With a focus on cities, society, and infrastructure, Brad's work spans the range of human geography. As an ethnographer, his primary research method is immersive participation, but he is also an advocate for and practitioner of "experimental" or "creative" geographies—telling ethnographic stories

through audio/visual outputs in addition to writing. Brad is the author of four books, including *Explore Everything: Place-Hacking the City* (Verso, 2013), and is currently working on a book entitled *Bunker: the Architecture of Dread,* on communities preparing for the apocalypse.

***Bradley Garrett*** est un géographe social à l'Université de Sydney. En mettant l'accent sur les villes, la société, et l'infrastructure, le travail de Brad couvre l'éventail complet de la géographie humaine. En tant qu'ethnographe, sa principale méthode de recherche est la participation immersive, mais il est également un défenseur et praticien des géographies « expérimentales » ou « créatives », en racontant des histoires ethnographiques par des réalisations audio et visuelles en plus de l'écriture. Brad est l'auteur de quatre livres dont *Explore Everything: Place-Hacking the City* (Verso, 2013) et travaille actuellement sur un livre intitulé *Bunker: the Architecture of Dread*, sur les communautés qui se préparent à l'apocalypse.

***Antonia Hernández*** is a Chilean Montréal-based visual artist and PhD candidate in Communication at Concordia University. Mixing media practice and theoretical research, her interests involve the domestic side of digital networks, maintenance practices, and the laboring of affect. You can see her work at http://artwork.cordltx.org.

***Antonia Hernández*** est une artiste chilienne établie à Montréal et candidate au doctorat en communication à l'Université Concordia. Combinant les pratiques des médias et la recherche théorique, ses intérêts portent sur le côté domestique des réseaux numériques, les pratiques de maintenance et le travail de l'affect. On peut voir son travail à http://artwork.cordltx.org.

***Evan Light*** is an Assistant Professor of communication and organizations at the School of Translation, Glendon College, York University, in Toronto, Canada. His research focuses on contemporary issues of surveillance and privacy, the evolving nature of the Canadian-American border, and telecommunications infrastructure and policy. His translation of Aimé-Jules Bizimana's *The Embedding Apparatus: Media Surveillance During the Iraq War* was published by Peter Lang in 2017.

***Evan Light*** est professeur adjoint de communication et d'organisations à l'École de traduction du Collège universitaire Glendon à l'Université York à Toronto, Canada. Ses recherches portent sur les questions contemporaines de la surveillance et de la vie privée, sur la nature évolutive de la frontière canado-américaine et sur l'infrastructure et la politique des télécommunications. Sa traduction du livre d'Aimé-Jules Bizimana, *The Embedding Apparatus: Media Surveillance During the Iraq War*, a été publiée par Peter Lang en 2017.

***Katrin M. Kämpf*** is currently finishing her PhD in Cultural Studies at Humboldt University in Berlin. Her research focuses on the intersections of the History of Sexuality, Science and Technology, Surveillance Studies, and Queer Theory. At the moment, she is co-editing (with Jutta Weber) a special issue of *Science as Culture* on the topic of technosecurity.

***Katrin M. Kämpf*** termine son doctorat en études culturelles à l'Université Humboldt à Berlin. Ses recherches portent sur les intersections de l'histoire de la sexualité, de la science et de la technologie, des études de surveillance, et de la théorie queer. À l'heure actuelle, elle est corédactrice (avec Jutta Weber) d'un numéro spécial de *Science as Culture* à propos de la « technosécurité ».

***Marta Peirano*** is a Spanish writer, journalist and activist. She is editor of the cultural section of eldiario.es and has written extensively on surveillance, hacking, and new technologies.

***Marta Peirano*** est une écrivaine, journaliste et militante espagnole. Elle est rédactrice de la rubrique culturelle de eldiario.es et a beaucoup écrit sur la surveillance, le piratage, et les nouvelles technologies.

***valentina hvale pellizzer*** is president of OneWorld Platform, an organization that tackles and researches the intersection between Internet rights, women's rights, and the transformative power of technology. As an activist she connects women's rights, sexual rights, and the Internet, advocating for feminist principles of the Internet and the commons. Since April 2017 she started a new professional adventure at the Women's Rights Program of the Association for Progressive Communication (www.apc.org).

***valentina hvale pellizzer*** est présidente de OneWorld Platform, une organisation qui aborde et fait de la recherche sur l'intersection entre les droits Internet, les droits des femmes, et le pouvoir transformateur de la technologie. En tant qu'activiste, elle relie les droits des femmes, les droits sexuels, et l'Internet, en militant pour des principes féministes de l'Internet et du bien commun. En avril 2017, elle a commencé une nouvelle aventure professionnelle au Programme des droits de la femme de l'Association pour le progrès des communications (www.apc.org).

***Graham Pickren*** is a broadly trained human geographer living and working in Chicago. His areas of expertise converge around three interrelated themes: an urban political ecology approach to the study of cities and nature; an interest in green political economy and debates about sustainability; and a constructive engagement with environmental governance and policy, specifically around the role of markets in driving socio-environmental change. Over the past three years, he has written papers on computing infrastructure and the physical, material conditions necessary to support a data-driven society. Much of his recent work has looked at the growth of data centres, particularly the way that the development of data centres tends to involve the repurposing of older, "analog" infrastructure (buildings, roads, and rail) to suit the needs of new digital practices. He is an Assistant Professor of Sustainability Studies at Roosevelt University.

***Graham Pickren*** est un géographe humain avec une formation étendue vivant et travaillant à Chicago. Ses domaines d'expertise convergent autour de trois thèmes interdépendants : une approche de l'écologie politique urbaine pour l'étude des villes et de la nature; un intérêt pour l'économie politique verte et les débats sur le développement durable; et un engagement constructif avec la gouvernance et la politique de l'environnement, en particulier autour du rôle des marchés en tant que moteurs des changements socio-environnementaux. Au cours des trois dernières années, il a écrit sur l'infrastructure informatique et les conditions physiques et matérielles nécessaires pour soutenir une société axée sur les données. Une grande partie de son travail récent a porté sur la croissance des centres de données, en particulier sur la façon dont le développement des centres de données tend à impliquer la conversion d'infrastructures « analogues » plus anciennes (bâtiments, routes et chemins de fer) pour répondre aux besoins des nouvelles pratiques de technologies numériques. Il est professeur adjoint en études sur le développement durable à l'Université Roosevelt.

***Christina Rogers*** is a research assistant and graduate student of the ERC-Project "The Principle of Disruption" at the Technical University of Dresden. She is a cultural studies scholar with research interests in surveillance, border and migration studies, queer-feminist theory, and visual culture.

***Christina Rogers*** est assistante de recherche et étudiante diplômée du projet ERC « The Principle of Disruption » à l'Université technique de Dresde. Elle est étudiante en études culturelles avec des intérêts de recherche dans les domaines de la surveillance, des études sur les frontières et les migrations, de la théorie queer-féministe, et de la culture visuelle.

***Jaron Rowan*** is Head of Research and Doctoral Studies at BAU, Centro Universitario de Diseño de Barcelona, where he is also a lecturer on "Economy, Business and Design." He is a member of the GREDITS research group. His research focuses on cultural policies, political economy of culture, and the role of experimental and critical cultural practices. His latest book is *Cultura libre de Estado* (Traficantes de Sueños, 2016).

***Jaron Rowan*** est responsable de la recherche et des études doctorales à BAU, Centro Universitario de Diseño de Barcelona, où il est également chargé de cours en « Économie, affaires et design ». Il est membre du groupe de recherche GREDITS. Ses recherches portent sur les politiques culturelles, l'économie politique de la culture, et le rôle des pratiques culturelles expérimentales et critiques. Son dernier livre s'intitule *Cultura libre de Estado* (Traficantes de Sueños, 2016).

***Rafico Ruiz*** is a Social Sciences and Humanities Research Council of Canada Banting Postdoctoral Fellow in the Department of Sociology at the University of Alberta. In the winter of 2018, he will be the Fulbright Canada Research Chair in Arctic Studies at Dartmouth College. He holds a PhD in Communication Studies and the History and Theory of Architecture from

McGill University. He studies the relationships between mediation and social space, particularly in the Arctic and Subarctic; the cultural geographies of natural resource engagements; and the philosophical and political stakes of infrastructural and ecological systems. His work appears in a number of journals and edited collections, including the *International Journal of Communication*, the *Journal of Northern Studies*, *Continuum: Journal of Media & Cultural Studies*, and *Communication +1*. His work has been supported by the Social Sciences and Humanities Research Council of Canada, the Smallwood Foundation, Media@McGill, the McCord Museum and Archives, and Harvard Medical School, amongst others.

***Rafico Ruiz*** est récipiendaire de la bourse postdoctorale Banting du Conseil de recherches en sciences humaines du Canada au Département de sociologie de l'Université de l'Alberta. À l'hiver 2018, il deviendra titulaire de la chaire de recherche Fulbright Canada en études arctiques au Dartmouth College. Il détient un doctorat en communication et en histoire et théorie de l'architecture de l'Université McGill. Il étudie les relations entre la médiation et l'espace social, en particulier dans l'Arctique et le Subarctique, les géographies culturelles de la mobilisation des ressources naturelles, et les enjeux philosophiques et politiques des infrastructures et systèmes écologiques. Son travail apparaît dans plusieurs revues et ouvrages collectifs, y compris l'*International Journal of Communication*, le *Journal of Northern Studies*, *Continuum: Journal of Media & Cultural Studies*, et *Communication +1*. Son travail a été appuyé, entre autres, par le Conseil de recherches en sciences humaines du Canada, la Smallwood Foundation, Media@McGill, le Centre d'archives du Musée McCord et la Harvard Medical School.

***Florian Sprenger*** is Professor for Media and Cultural Studies at Goethe University Frankfurt. He is author of *Politics of Microdecisions: Edward Snowden, Net Neutrality and the Architecture of the Internet* (Meson Press, 2015) and recently co-edited (with Armin Beverungen) a special issue of *fibreculture* on "Computing the City." He has published on topics such as the Internet of things, the history of electricity, artificial environments, and media ecology.

***Florian Sprenger*** est professeur en études culturelles et des médias à l'Université Goethe de Francfort. Il est l'auteur de *Politics of Microdecisions: Edward Snowden, Net Neutrality and the Architecture of the Internet* (Meson Press, 2015) et il a récemment corédigé (avec Armin Beverungen) un numéro spécial de *fibreculture* sur « L'informatisation de la ville ». Il a publié sur des sujets tels que l'Internet des objets, l'histoire de l'électricité, les environnements artificiels, et l'écologie des médias.

***A.R.E. Taylor*** is a PhD Candidate in the Division of Social Anthropology at the University of Cambridge. His current ethnographic research explores the sociopolitical dynamics underlying the configuration of space weather and electromagnetic pulses (EMPs) as security threats to the data centre industry.

***A.R.E. Taylor*** est candidat au doctorat au Département d'anthropologie sociale de l'Université de Cambridge. Sa recherche ethnographique actuelle explore la dynamique sociopolitique sous-jacente à la configuration de la météorologie spatiale et des impulsions électromagnétiques (PGE) en tant que menaces à la sécurité de l'industrie des centres de données.

***Kristin Veel*** is an Associate Professor at the Department of Arts and Cultural Studies, University of Copenhagen. Her research interests focus on the impact of information and communication technology on the contemporary cultural imagination, with a particular interest in issues of information overload, surveillance, invisibilities, and big data archives, and the way in which these are negotiated in film, art, and literature. She has co-organised the research network Negotiating (In)Visibilities since 2011 and is currently PI of the collaborative research project Uncertain Archives: Adapting Cultural Theories of the Archive to Understand the Risks and Potentials of Big Data.

***Kristin Veel*** est professeure agrégée au Département des arts et des études culturelles de l'Université de Copenhague. Ses intérêts de recherche mettent l'accent sur l'impact des technologies de l'information et de la communication sur l'imagination culturelle contemporaine, avec un intérêt particulier pour les questions de la surinformation, de la surveillance, des invisibilités, et des vastes archives de données, et la façon dont ces questions sont négociées dans le domaine du film, de l'art, et la littérature. Elle a coorganisé le réseau de recherche Negotiating (In)Visibilities depuis 2011 et est actuellement co-chercheuse principale du projet de recherche collaboratif *Uncertain Archives: Adapting Cultural Theories of the Archive to Understand the Risks and Potentials of Big Data*.

***Asta Vonderau*** is an Assistant Professor of Social Anthropology at Stockholm University. Vonderau's research focusses on political and economic developments in Europe after 1990, particularly their material-technological and bodily forms.Her research includes studies of post-socialist transformation processes in Eastern Europe, and of the adoption of EU policies and standards in various local contexts. Vonderau's current project, *Farming Data, Forming the Cloud: The Environmental Impact and Cultural Production of IT Technology*, is based on an ethnographic study of the social and environmental effects of the data centre industry in Sweden, investigating the relation between global IT infrastructures and their local sites.

***Asta Vonderau*** est professeure adjointe en anthropologie sociale à l'Université de Stockholm. Les recherches de Vonderau se concentrent sur les développements politiques et économiques en Europe après 1990, en particulier sur leurs formes matérielles-technologiques et corporelles. Ses recherches comprennent des études sur les processus de transformation postsocialistes en Europe de l'Est et sur l'adoption de politiques et de normes de l'UE dans divers contextes locaux. Le projet actuel de Vonderau, *Farming Data, Forming the Cloud: The Environmental Impact and Cultural Production of IT Technology*, repose sur une étude ethnographique des effets sociaux et environnementaux de l'industrie des centres de données en Suède. Elle étudie la relation entre les infrastructures informatiques globales et leurs sites locaux.