An aerial photograph of a large industrial or data center facility. The central focus is a large, white, rectangular building with a flat roof. To the left of this building is a complex network of pipes and structures, possibly a cooling system or a network of conduits. The surrounding area is a mix of green grass and paved surfaces. In the bottom left corner, there is a white text overlay.

Hyperscale:
Cloud materialities

Here,

but mostly elsewhere

*James
Maguire*

It is not uncommon to imagine our data as residing in the cloud. Although this metaphor provides a seductive grasp on the complexity of a distributed internet, it obscures as much as it reveals. How data is organized and where it is located is rendered in graspable, naturalized terms, as if our digitalised traces roam the heavens free from social and political complexities; ethereal, immaterial, uncomplicated. But the abrupt materiality of data centres belies such a technicalised metaphor, grounding the cloud in what have become known as '21st century factories.' Not only are these places not free of politics and sociality, they are brimming with them.

Data centres are both utterly located; megaprojects on open landscapes that devour energy and other resources, while also entirely dislocated; crucial nodes without which planetary wide computational infrastructures would cease to function. But they are about far more than just data storage and retrieval. The micro digital attentions, senses, and behaviours of people, organizations, and nations are collected, collated, processed, sorted, categorized, and analysed as actionable units for machine learning interventions. Critical services—hospitals, power systems, traffic systems, banking activities, mobile phone networks, data and knowledge infrastructures—rely upon them, just as

surveillance systems piggyback upon them, and citizens dump their digital waste into them.

Data centres are interventions into physical and social landscapes; vast quadrants of re-zoned land occupied by low-rise enclosures with few workers. "A farm of sorts, but not for cows," a taxi driver jokingly said to me as I visited Apple's facility just outside Viborg, Denmark. "Just servers, servers, and more servers. Imagine that."

But they also intervene in political landscapes as the bureaucratic resources of the state are mobilised to facilitate the plethora of permissions, permits, plans, and provisions that hype-scalers generate. Tellingly, Big-Tech firms are enamoured with the efficiency of Danish rank and file municipal officials as they readily access archaic documents with an ease unmatched elsewhere. Bureaucracy as a competitive advantage is not something one oftentimes hears from more liberally inclined political folk.

But hyper-scalers are, for the most part, off-limits to over-curious researchers. My taxi driver was the one and only guide I got of the facility that day, as we looped the high ringed security fencing scavenging for a photograph able to compete with the curated versions that Big-Tech produce of themselves.

Elsewhere, on another day, people are conspicuous by their absence in the halls of a data centre. "That's mostly it, beyond cleaners," my guide says as we wave goodbye to a couple of security guards. The clinical monochrome aesthetic of this data centre imbues an eerie sense of the displacements that come with automation. Servers here, people elsewhere. Electricity here, grids elsewhere. Equipment here, investment elsewhere. Friction-less digital interactions here, friction-full labour relations elsewhere, the promises of futures-to-come here, their lived realities elsewhere. The list could go on.

Such a dyad is also noticeable in the material and sensory forms that occupy these places, forms that deeply implicate the global infrastructures that keep data centres up and running. Embedded in each form is a series of relationships, organizations, histories, and temporalities.

Blinking. A luminous atmospherics of flashing lights in manifold colours, signalling the reception of photons refracting through fiber-optic cables in billions per second beats. *Humming.* An acoustics of alternating current buzzing through the endless racks of server stacks piled tightly, one against another, one over another. *Whooshing.* A soundscape of air cooling within ventilators,

pulsating through corridors, relieving the infernal heat of sensitive silicon servers. *Silencing.* All the while invisible, noiseless AI; analysing, calculating, and controlling; unnoticed, in the background. Ones and zeros, light and optics, current and heat, air flow and cooling, machine intelligence. And us, devices in hand, somewhere; searching, posting, sharing, commenting.

As our attentions fragment and our distractions accelerate, data accumulates, and storage necessitates, data centres. But data only lives in centres with particular conditions of possibility. Thermal loops of heating, over-heating, and cooling preserve data's silicon form within more temperate bandwidths. The thermo-politics of energy, the cryo-politics of preservation, the material-politics of land, the knowledge-politics of labour, all have to be arranged, just so. None are ethereal, immaterial, uncomplicated, like the clouds of engineering fantasies. All are dense, foreboding, portentous, like the clouds of intemperate realities.



Hyperscale, Spanien 19
Installation view



NEDSTRØMSANLÆG

HOLSPÆNDINGSSTATION

DATA HAL

DATA HAL

REGNVAND FØRSINKELSES-BASSINER

DIGE

DATA HAL

SEKUNDÆR REDNINGSVEJ

DIGE

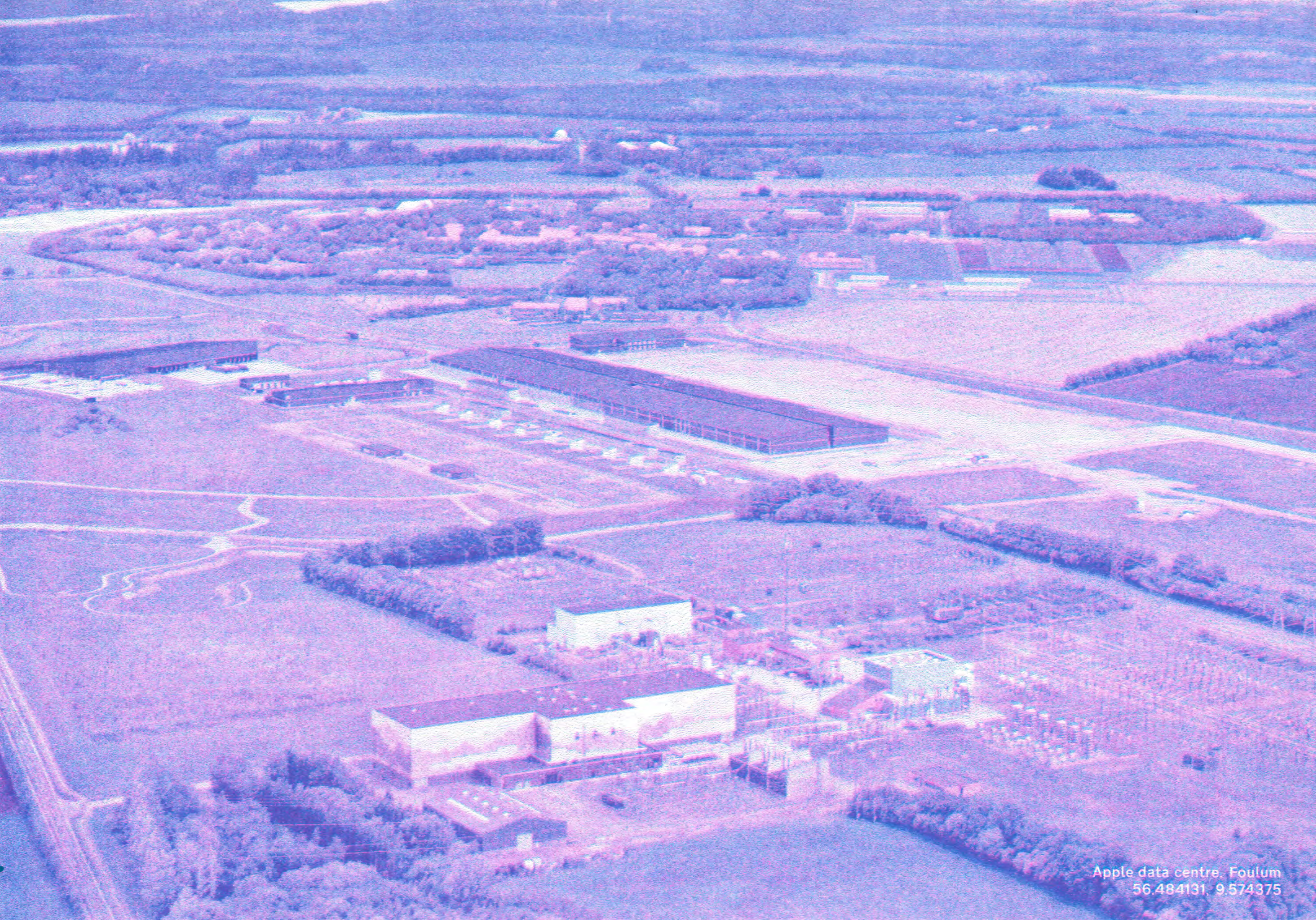
BLICHERS ALLÉ (SYD)

EKS. LAVNING

63 50

EXTENSIVT GRØNT AREAL

OVERLUNDVEJ



Apple data centre, Foulum
56.484131, 9.574375

Hypernoia

8

*Gustav
Johannes
Hoder*

For most people alive today, communication takes place through images and emojis, messages and calls, rather than via texts in the literate sense of the word. No matter whether these words are reaching you through the reflective surface of repurposed wood, or through a light-emitting diode parsing the contents of a PDF file, some of us have still not learned to come to terms with this fact. A certain unease with the hegemony of our techno-semiotic image cult seems today to be a telling hallmark of many contemporary countercultures.

Yet while mainstream political discourse is still caught up in antiquated binaries of local job creation versus global regulation of multinationals, human exceptionalism versus machine intelligence, privacy versus surveillance, progressivism versus Luddism (just to name a few), the actual changes on the ground are somehow regarded as mere “material” aspects of the important “historical” agreements. That somehow, dizzying investments of foreign capital, massively complex installations of metal and plastic, grand geopolitical dramas and local labour conflicts, are not connected in the slightest.

With the project *Hyperscale*, visual artist Jacob Remin and I attempted to unravel a few threads of these ongoing developments. We were intrigued by the fact

that so many hyper scale data centres were being built in Denmark, and how the state and private corporations were working together on such large, energy-heavy and infrastructure-demanding projects. Reading the official projection that nine data centres would account for 33% of the national energy consumption in 2040 was beyond our human scale of comprehension. The only object here that made some sort of sense, were the data centres themselves.

With the help of Natalie Koerner and a reading group of open-minded individuals, we quickly discovered that these massive power-hungry palaces, built around the abstraction called “data” to house endless server arrays, and placed among farming operations in the industrialised Danish countryside, can be understood as massive archives. Apart from the fact that they are run by private corporations instead of governments as with traditional archives, and access to their contents passing through the fictional image of the “cloud” instead of physical shelves and librarians, the data centres are nothing special in themselves. It is only when one considers the particular part they play within the grander scheme of things, that they begin to make sense.

Any archive is embedded in a context of sovereignty, as Derrida tells us. This



Hey Grandpa, why does the cheese

have such big holes?!

A Swiss cheese is like the mountains -

full of holes.

And what's inside the holes?



Lookouts of money...

My dad says, that there are people

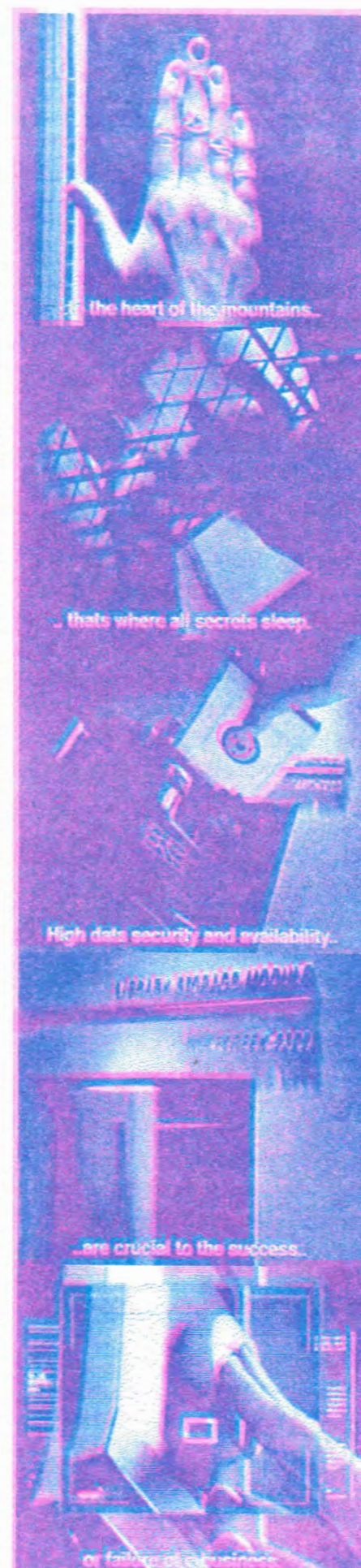
who come in flying machines...

...and they bring all

the secrets of the world with them.



...and then they are allowed.



...the heart of the mountains.

... that's where all secrets sleep.

High data security and availability.

...are crucial to the success.

...or failure of a business.

led us to investigate the various “data fictions”: the privately constructed public imaginaries of technicity, secrecy, globalism, environmental concern, and bureaucracy, that are largely the result of policy, design, and marketing. Digital renderings of data centres, endless rows of blinking diodes and exhaust systems, “artistic” visualisations of the cloud, the strategic placement of windmills with photographic angles in mind, the clean, grey designs that speak of modernity and discretion, the standardised secrecy surrounding these, in our view, projects or public interest.

The term “medium design”, as introduced by Keller Easterling in her book bearing that very title, signifies such a reorientation. It marks a departure from the object to “the matrix of activities that inflects them” – the medium rather than the message, as McLuhan famously said. But not the usual meaning of the word “media,” such as books, radio, TV and the internet. Rather, the way in which all processes are embedded in a medium; the way in which the weather itself constitutes a medium. An ambition to design and sell us “the space in which we’re swimming”.

Yet by swimming as best we could, we also felt a certain unease, a feeling we wanted to embed in the exhibition itself. It slowly dawned that much of

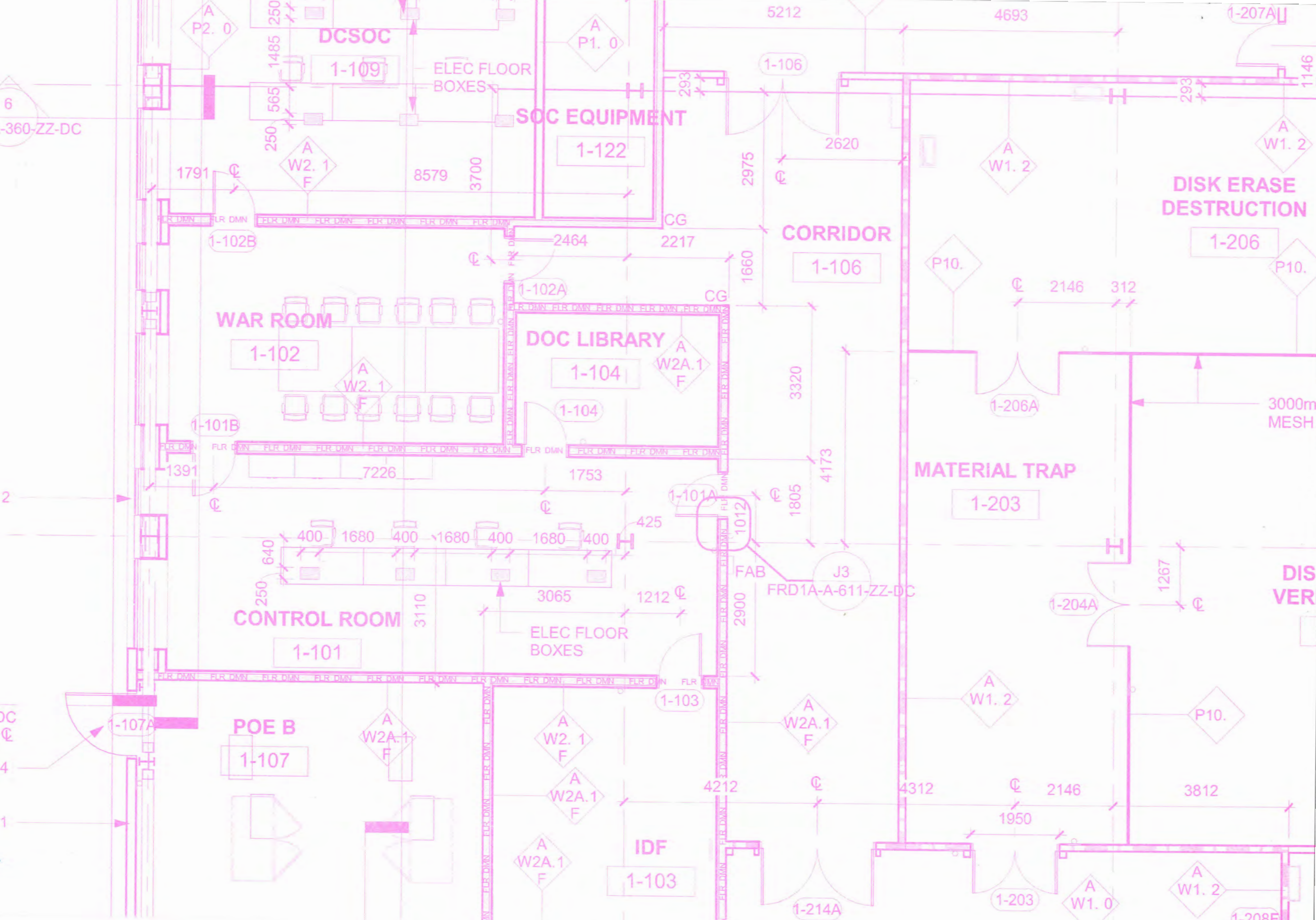
the paranoia induced by working with this subject, was some sort of remnant of the cold war. Take a look at the commercial for the highly secure Swiss data center Mount10 from 2007 (on the previous page), back when it was branded "Swissvaul": utilising all imaginable clichés about a naïve and rural local population of peasants juxtaposed with the spectacle of international business secrets being transported through a *Minority Report*-like science fiction world to their secure location in the data centre. If this is the data fiction we have been served by the PR for this kind of service, no wonder paranoia abounds.

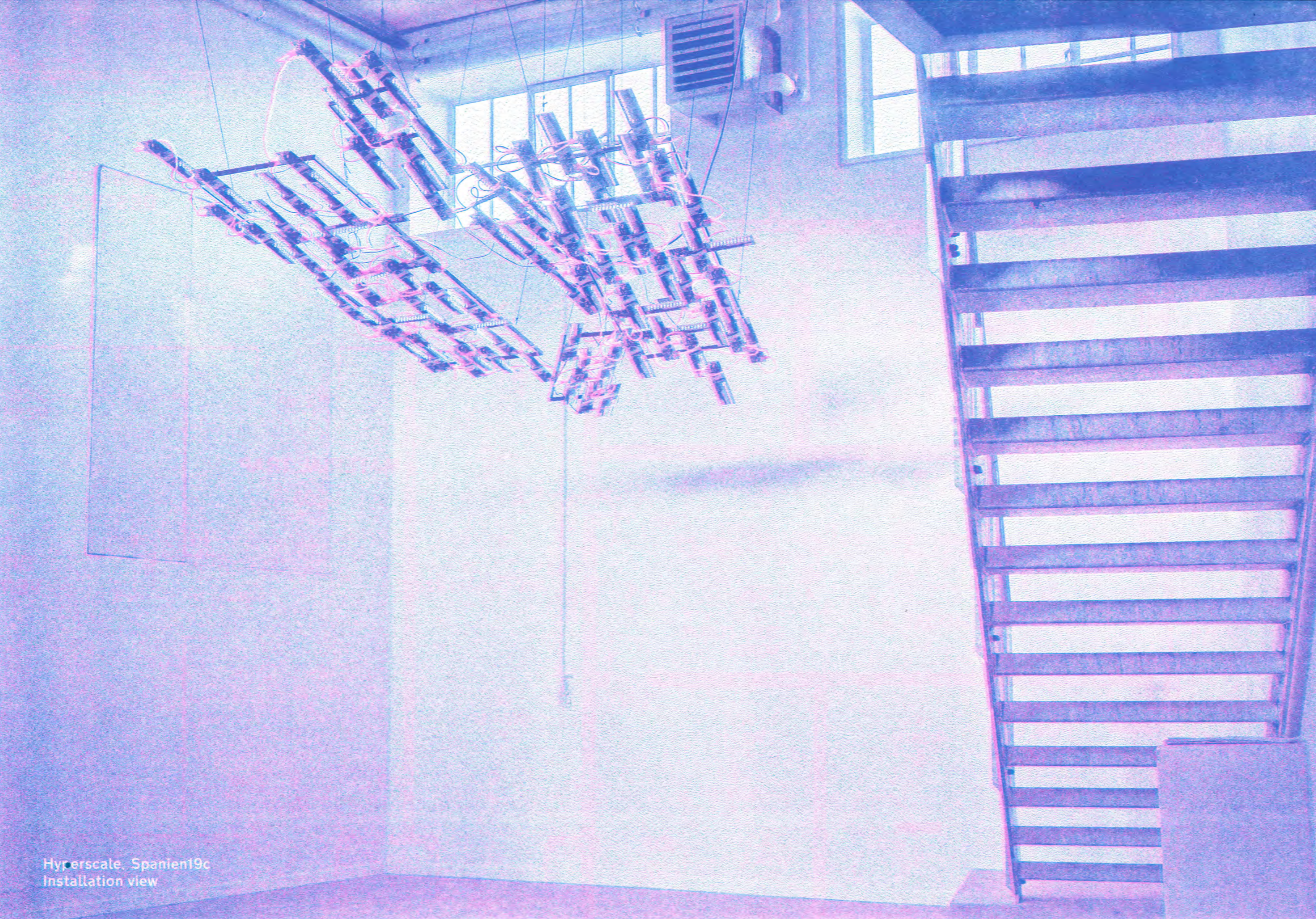
Again, what if this paranoia was not only in the eye of the beholder, but also embedded in the architecture itself? An example can be found in the architectural drawings for one of these centres. Equipped with a "WAR ROOM" next to the "CONTROL ROOM", there is no doubt that the spectre of the cold war haunts the architectural imaginary of these places. As the anecdote goes, after being sworn in as president, Ronald Reagan asked to see the war room, as he had seen it on the big screen in Kubrick's *Dr. Strangelove*. But such a room did in fact not exist outside the movie – the world of fiction and the world of reality as entangled, overlapping and intertwined.

In 2017, Denmark became the first country to appoint a "Tech Ambassador", in effect putting these companies on the same political and formal level as foreign countries. A literal struggle for power continues as management of at least one data centre in Denmark has attempted, in the case of a regional blackout, to get their servers the same priority on the electrical grid as local hospitals. While that was not approved, the installation of a number of on-site diesel generators seriously calls into question how green it is actually possible to go, a question that publicly is largely overshadowed in the attempt to drown out all possibilities of negative PR or public criticism. Hiding behind non-disclosure agreements and white label contracts, it would simply appear naïve not to proceed in an all-round paranoid fashion: "Just because you're paranoid doesn't mean that they're not out to get you." In a culture of generalised hypnoia where NDAs are the norm, the construction of these structures can be described as paranoia by design – what Natalie Koerner has termed "standardised secrecy".

The ship, the railway and the car all dramatically changed the way bodies and belongings are organised across the planet. Our digital infrastructure is on the same drastic course. But we are also living in the past: Just as the first

people to see a car named it a "mechanical horse", we think of the internet as a technological brain. The abstraction of data, the *hivemind*, is currently the answer to all prayers. But if we insist on shifting the focus, data is no longer abstract at all: it depends on electricity, temperature control, silicon, aluminium, plastic, and rare earth metals. Only through this does it become a commodity, that can be bought and sold. Google, Apple and Facebook will be around for as long as we live. Yet it depends on whether we manage to see them for what they have become: private utilities that will perhaps someday become public goods.





Hyperscale, Spanien19c
Installation view

Systems of scale

Jacob
Remin

How does one comprehend the complexity, the vastness, the brutal repetition of “the cloud”? One way is to build your own. When making things real, one is met with very concrete problems, considerations and surprising possibilities.

The light sculpture built for the exhibition *Hyperscale* consists of 85 modular and custom built circuit boards, each fitted with 14 bright white LEDs, totalling 1.190 dynamically controlled LEDs. The circuit boards are arranged in an abstract grid approximately 2x3x0.5 metres in size, hanging under the ceiling, above the spectator. All modules are networked over and drawing power from CAT-6 ethernet cables. Each board carries an ATmega328 microprocessor with 2kB of RAM and 32kB of program memory. This totals 170kB of RAM and 2.72MB of storage.

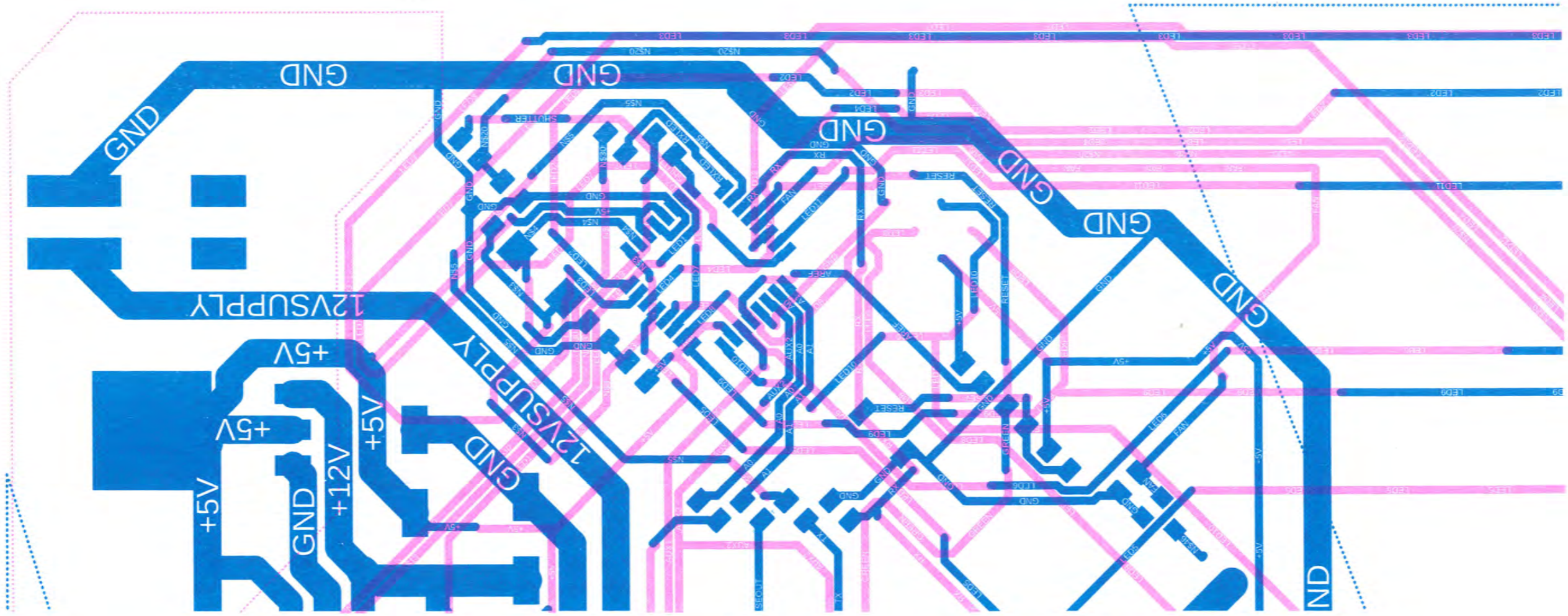
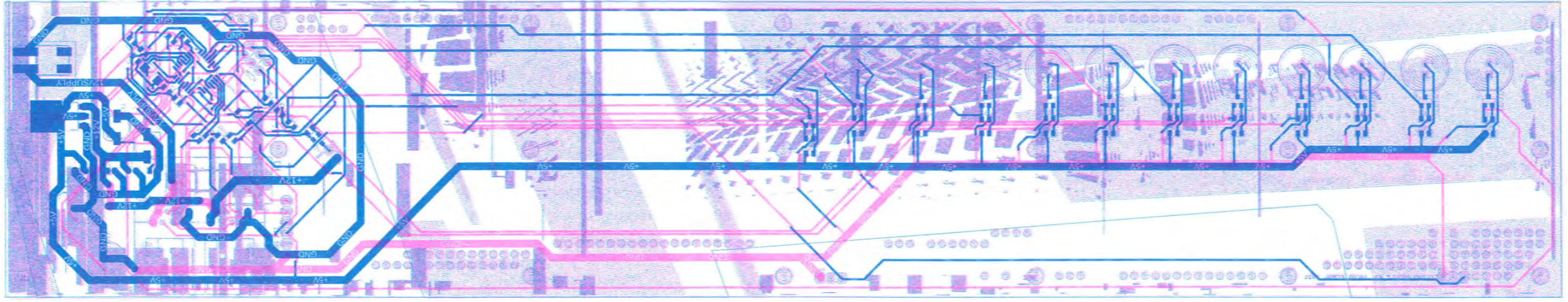
The computational power of the installation is not impressive by today's standards. In fact, to compare it to a hyper scale data centre, or even a single personal computer in 2021, is bordering on the ridiculous. Yet the purpose of the installation is not to show how a data centre works, or how much energy it holds, but to explore and design for emergent behaviour, creating an alternate vision of the network.

The code running on each board is identical: The emergent behaviours of

the system are produced by the interplay between the boards, the network constellation, and the steady stream of control signals.

By physically scaling up network processes, by making them visible and bigger-than-human, it becomes possible for us to fall into them, to swim in them. By tweaking the algorithms which generate the control stream, the installation allows us to play with the meta-behaviours that appear, once a certain threshold of complexity is surpassed. We find that human perception is more than ready to accept the collective behaviour of the LEDs as a starry sky, or a shimmering water surface reflecting sunlight. At this moment the sculpture becomes more-than-object, it also becomes a space.

From a design perspective, making a *data space* is an interesting challenge: What works for the human onlooker? What draws you in? How does one show the different temperaments and wants of the network? How far can we push glitches and complexity without losing the emergent meta-qualities, breaking the hypnosis? In this space, can we render a new vision of the network?



Digital clouds, fallout clouds

*Natalie P.
Koerner*

In 1966, never-realised plans for America's first centralised data centre were made public. The proposed federal archive was to gather, in one place, digitised information on US citizens from various government agencies. The promise of unprecedented archival efficiency immediately caused strong unease and resulted in the creation of a special subcommittee to evaluate "the computer and invasion of privacy". At the end of July 1966, the committee gathered computer scientists, law professors, sociologists and state officials to a hearing on the proposed "National Data Centre". The speakers issued statements assessing the problem of privacy this centralised Data Bank would engender, besides its promise of economic benefits and improved organisation. Their criticism resonates strongly with today's critique of the barely checked, invasive power of the digital cloud and big data practices.

At the time, the controversy was perceived to play out between efficiency and privacy. Promoters of a national data centre stressed the need for a shared and coherent data flow beyond and between departmental boundaries. But it was precisely this vision of uninterrupted digital information flow that alarmed those investigating the computer's infringement of privacy. Digital information movement, unimpeded by human scrutiny, was apprehended as

the cornerstone of looming authoritarian government.

The computational force was seen as so potent, that the potential for abuse was considered a serious threat. In his statement, computer scientist Burton Squires emphasised the unprecedented archival capacities of computers. He attempted to make this new sheer immensity imaginable, by using the comparison of a building with storage space of 930 square meters, which "could conceivably store a book of information about every man, woman, and child in the United States". This information could be read at more than 100,000 characters per second and be "transmitted along any given telephone line within a few minutes".

While this scenario has become normal in today's information society, it caused serious unease just 50 years ago. The data centre would not produce new information, but rather organise and compile in one place all the data that would previously have been scattered, duplicated and independently annotated by different agencies. The fear was that making data coherent, ostensibly correct, irrefutable (because of its existence in only one place), up-to-date and available to all states would undermine the privacy-enhancing, loophole-enabling, questionable nature of data. Chairman

Frank Horton summarised this point in his opening statement:

“Good computermen know that one of the most practical of our present safeguards of privacy is the fragmented nature of present information. It is scattered in little bits and pieces across the geography and years of our life. Retrieval is impractical and often impossible. A central data bank removes completely this safeguard.”

In other words, the prevailing mess was seen as the most efficient precaution against the creation of “Computerised Man”, who in the words of Democratic representative Cornelius E. Gallagher “would be stripped of his individuality and privacy”. An archived person would lose her right to annotations or updates. Gallagher was horrified by the idea of momentous and statically assembled information on an individual “neatly bundled together into one compact package”, an easy target for information abuse. He opened the hearings with an outline of his apprehension of the Computerised Man whose societal status would be “measured by the computer”. Computerised Man’s “life, his talent and his earning capacity would be reduced to a tape with very few alternatives available”.

Not only would one’s individuality be subjected to an archived representation, but it would also be accessible to any hypothetical enquirer from any imaginable place, via a mere phone call. Thus, while all data was to be gathered in

one location, access by phone would be possible from anywhere. Vance Packard, author of *The Naked Society* (1964), warned the committee that beyond the data centre, the new networks of computers, (such as ARPANET, the precursor to the Internet), represented the threat of accessibility. From these “giant systems”, he said, “information can be either put in or retrieved from a number of different locations, including distant ones and even including telephoning information [in and out of] the computer”. This dreaded scenario characterises today’s computer omnipresence, which precedes the analogy of the digital cloud.

It may have been this omnipresence that prompted subcommittee chairman Frank Horton (who later introduced the Whistleblower Protection Act while a Republican congressman in 1987) to relate the data centre to the nuclear threat: “I have become convinced that the magnitude of the problem we now confront is akin to the changes wrought in our national life with the dawning of the nuclear age”. This drastic assessment is further developed in a later statement by computer scientist Burton Squires. He points out that despite the comparable gravity of both threats, the looming invasion of privacy is stealthier than the obvious destruction caused by an atomic bomb: digitising and centralising personal information “threatens to carry out a destructive mental process on a gradual, less perceptible scale, under the guise of causes that individually seem justified”.

Squires’ and Horton’s nuclear analogies to the invasion of privacy by digitalisation is in fact more accurate than they likely knew. As Richard Miller shows in his book *Under the Cloud: The Decades of Nuclear Testing* (1991), there was little awareness of the devastating effects of fallout carried by clouds and winds due to the bomb testing at the Nevada site, where more than 900 documented nuclear detonations were carried out between 1951 and 1992. Until 1963 these were mostly detonated above ground, resulting in the atmospheric release of over 115 million curies of iodine-131 (for comparison, Chernobyl leaked an estimated 7.3 million curies). The dispersal of radioactive fallout was supported by its unpredictable and unrelenting mobility via atmospheric, cloud-bound movement.

Drawing on one of the reports of the Atomic Energy Commission, Miller traces the full extent of fallout following the firing of Upshot-Knothole Simon (“the most powerful continental shot to date”) on 25 April 1953. After the explosion, monitors measured the Simon cloud, a “stream of nuclear debris—300 roentgens/hour hot”, roughly 130 kilometres wide, its tip reaching up to 13 kilometres above sea level. As the cloud caught up with different winds at different altitudes, it left an enormous footprint across the continent. The cloud delivered fallout to southern Utah, South Dakota, and from Idaho all the way to Ohio, until more fallout rained down to cover “each square foot of Albany, New York” during the night, before the cloud



Facebook data centre, Odense
55.366721, 10.465231

left the country. Apparently, some people tried to scrub the radiation off roofs and walls, but it “stuck like glue”.

When Miller concludes that “every person alive during the 1950s and early 1960s lived under the atomic cloud”, this strongly resonates with the title of another statement from the *Computer and Invasion of Privacy* hearings. Computing and its invasion of privacy through digital archiving was correlated with the intangible, not fully understood, not directly perceivable and often classified effects of radioactivity. Sometimes radioactivity appeared on Geiger counters by chance, in unexpected places. Eventually, its traces were confirmed in the baby teeth of the nation. Born in an epic cloud, radioactivity is dispersed as tiny particles. It merges with the wind and the rain to become part of the weather. The radioactivity released by a nuclear explosion radically changes its environment without being directly perceptible to humans. Only its effect can be perceived, not the radioactive force itself.

In the imagination of the assessment committee, there was a link between the not-directly-perceptible force of radioactivity and the not-quite-comprehensible power of computing. Tangible, physical files that used to be distributed all over the country inside different

government agencies, were now to be on magnetic tape. These tapes were like today’s server disks, decipherable only via a computer and interface—just as radioactivity levels are only legible on a Geiger counter. One witness referred to the “blind force of the computerized age”, pointing on the one hand to the morally indiscriminating information processing power of the computer, and on the other hand to its invisible and impenetrable realm of action. Squires spoke of the need to contain this power of computerisation—to “put boundaries around” it, so that it would serve “rather than become a tyrant”. In retrospect, it might have been interesting to develop the data centre then, in such a critical climate, which might have ensured more stringent privacy protections, which later, with the growing “tyranny of convenience”, were sidestepped.

When tracing the morphology of clouds that saturates the spatial imagination of today’s data banks, the mushroom clouds form an important part of the feverish origins of the digital cloud. The fallout cloud and the digital cloud impact our daily lives directly and imperceptibly, as both form a constant and elusive background. The data they contain, be it radioactive or digital, is sticky, pervasive and can be found or accessed from anywhere.

This is an edited excerpt from the PhD thesis *Towards the Meteorological: The Architecture of Data Centres and the Cloud*, submitted in January 2019 at the Royal Danish Academy of Fine Arts.

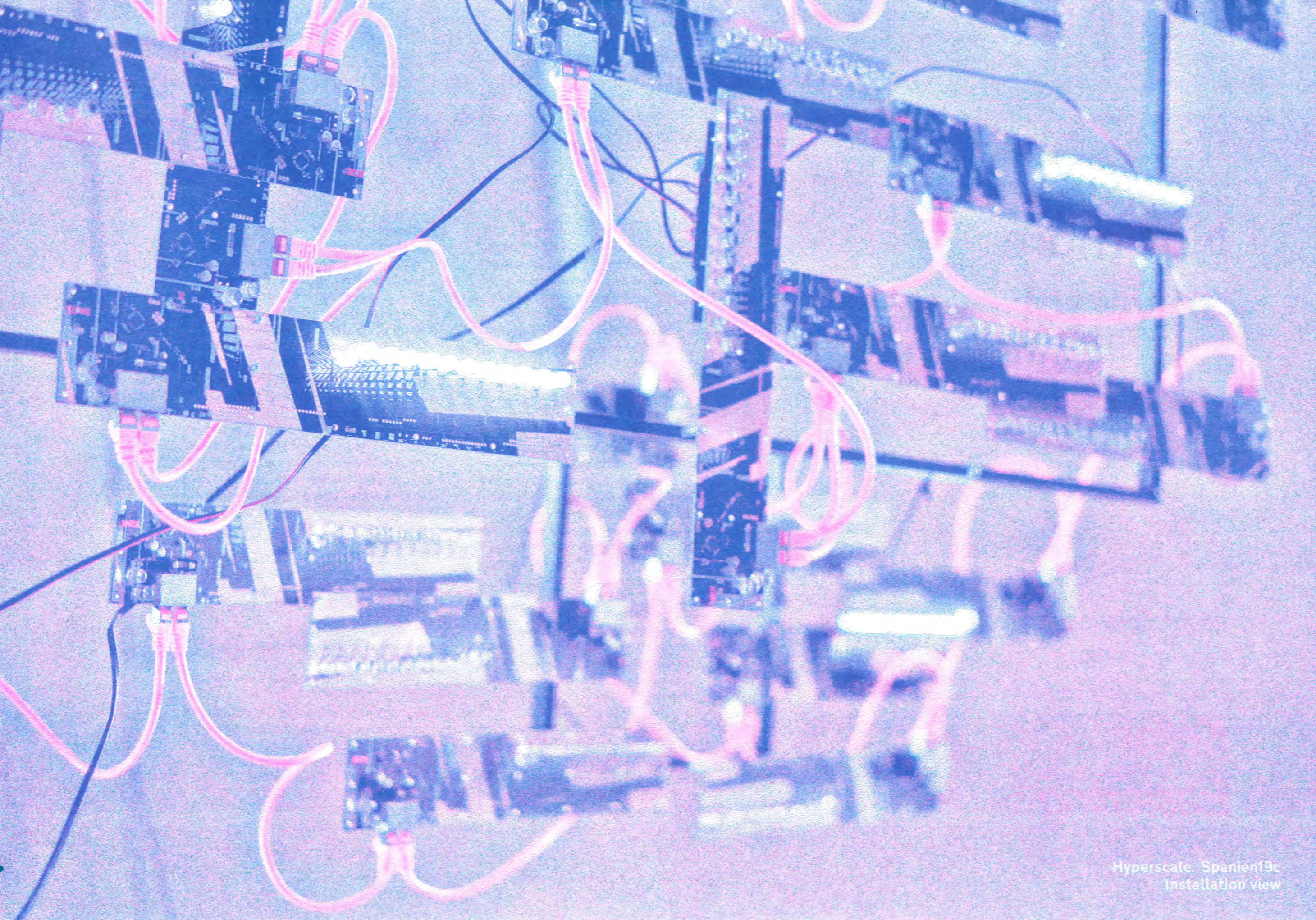
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Not more universal

20

an interview with

*Keller
Easterling*

GJH: You write in the short essay “The Year in Weather” in *Artforum*: “Seen with the naked eye, the movement of clouds in the atmosphere would be a wet information system more common than a digital cloud.” What are your thoughts on the notion of the digital “cloud,” when it is used in everyday techspeak?

KE: I have been trying to emphasise not just digital information, but heavy information. We live in a culture that currently values abstracted forms of information (anointed legal, econometric, or digital languages), that are sometimes not very information-rich compared to mixtures of different species of information-heavy as well as abstracted forms. Maybe more information-rich organizations are messier, patchier and not parsed with an elementary particle.

GJH: How do you translate this notion of heavy information into the physical reality of these large infrastructures of data centres, undersea cables and massive power grids needed to support these systems?

KE: Looking at the virtual world together with its heavy precipitants is something that many people have done. Think of Allan Sekula’s work exposing the heavy infrastructure of container shipment—the slow, heavy, massive and environ-

mentally abusive stuff on the other end of a virtual click. In my work, it is also a matter of pointing to the incredible assets and values in the heavy world that do not work like financial or digital abstractions: they can sometimes redouble value in ways in a completely different way. Capital is so stupid: it thinks that if you want to double resources, you have to come up with sneaky ways of tilting the playing field, hoarding, and abusing. But if you simply plant a seed, you get ten seeds. That is always there. You just have to get out of the way. Physical regenerative forms of community exchange—all the heavy sequences, proximities and positions in culture—produce all kinds of compounding values, that are so far beyond a thin financial abstraction.

GJH: So it is also this idea of the field over the object?

KE: Maybe being able to see many species of exchanges and transactions—heavy and abstract—can overwhelm one, thin dominant notion of market.

GJH: By researching this infrastructure of data centres, we talked to people working on these projects, that confirmed to have read your book *Extrastatecraft*.

KE: Really?

GJH: Do you see a role played by your writing in these developments?

KE: I am shocked to hear that someone working on this has actually read my work. It is a pretty withering critique of how global capital has created abusive spatial engine rooms of neoliberalism. *Extrastatecraft* probably tracks the abuses to labour more than it tracks the abuses to the environment. And it tracks the remainders of colonial power in new mixtures. I do not think you can miss that critique, if you read the book. It is not a celebration of these things [laughs].

GJH: In the context of your work as a whole, could one very roughly say, that a shift takes place from *Extrastatecraft* to *Medium Design*, from a geopolitics of infrastructure to a general theory of media, where this notion of medium dissipates the binary of natural and technological?

KE: I was always a little uncomfortable with the word infrastructure, as it usually means something hidden. And what I am trying to describe in *Extrastatecraft* is the all-too-visible stuff—the enveloping space that you are swimming in. Sometimes this means pipes and wires in the ground like cable, but that cable is attached to microwaves, that in turn broadcast urban forms. So I was looking

at protocols, spatial products and so on, that would constitute some kind of matrix space. But I was asked to use the word infrastructure instead of matrix. *Medium Design* looks at that matrix by returning to the Latin root *medi-us*, meaning “middle” or “milieu,” and making it about the middle or the space in-between. The book is trying to speak not just to architects but to any discipline that works on this matrix. I want to avoid diluting the word or confusing any of its particular uses in media studies. But I also want to pick up the other end of some fascinations among media theorists, particularly those who are considering elemental media. I thought a spatial perspective might link arms with them.

GJH: This also points to something that is intensely fascinating in *Extrastatecraft*, namely the chapter on ISO standards and quality management. Do you see here a task for a coming politics?

KE: Our activism is largely oppositional: marching, uprising, boycotting, sanctioning, sabotaging. It is very clear that we need to keep up that drumbeat. But I am also trying to expand that activist repertoire. There is redoubled territory with extra political capacities on the other side of a shift in habit of mind. Looking for singular solutions or singular evils—this ideational monotheism that

is a symptom of a modern Enlightenment mind—can create unnecessary endgames in activist work. Putting faith only in the next new technology to provide the solution is one example of this solutionist thinking. And Quality management is an example of the ways that solutionist thinking can become completely vacuous. It is basically a kind of gibberish of non-binding forms of camouflage—seals of approval that inoculate against change. Culture is still primed to want the new thing, the one-and-only, the manifesto, or the Turing complete world. It is not waiting for the moment that things get curdled, patchy, and mixed up. But maybe that is the moment of innovation—using intermediate organs of interplay that mix many different kinds of information, scales, and situated contexts. As you try to address planetary issues, maybe it becomes not more universal but more patchy and polycentric.

HYPERSCALE: CLOUD MATERIALITIES

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