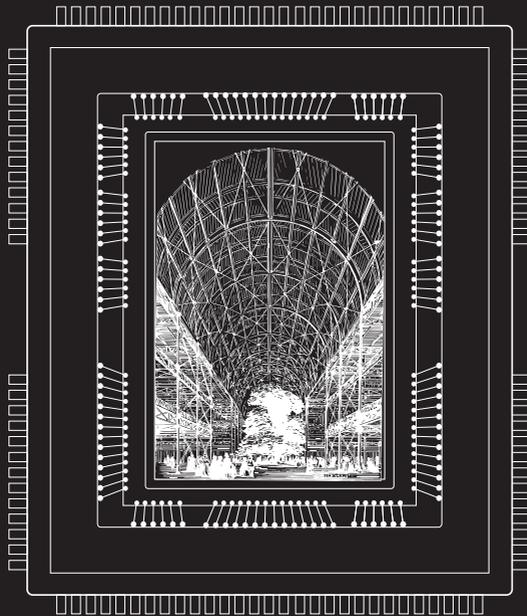# Sensing Domesticity
Towards a World Interior

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Sensing Domesticity
Towards a World Interior

Research Book
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TABLE OF CONTENT

SENSING DOMESTICITY

SENSING DOMESTICITY

"Our interaction with architecture is mediated through a vast universe of sensors and controlling devices."
Evangelos Kotsioris, "Sensing Architecture", Perspecta, The Yale Architectural Journal 51 (2018): pp. 227-243, 227.

Sensing

The photoelectric sensors of doors, the ambient light sensor of a computer, the ionization chamber of a smoke detector, the night-vision cameras and microphones of a home alarm system, the temperature sensor of a 'smart home' thermostat, all unconsciously compose our daily interactions with the built environment. These encounters are a continual negotiation with large networks of interconnected electronics that can detect human presence, 'tell' how heavy something is, 'smell' fire, 'see' in the dark, 'hear' sounds, and 'feel' the temperature of a space. All of these sensors continuously monitor and adjust our environment for us. The operation of our houses is no longer imaginable without them.[1] Sensing architecture is literally all around us, but there is a lack of an architectural understanding of it:

The architectural discipline lacks a media study approach and an understanding of the technical systems we are embedded in and know or 'see' the world with. These systems can turn out to have more agency on space than we realize: In the digital age, we are surrounded by both invisible systems of radio signals or microwaves, and their visible manifestations in cell towers, satellites, wireless access points, controlling devices and sensors. The latter are the material infrastructures we depend on to navigate in the new world, or as Marshall McLuhan famously described media - a "nervous system" that connects the different points of a territory and allows the circulation of information.[2] Further, he regarded this nervous system as extensions of our human senses that "work as environments". But in the era of "electric drama", he argued,

PROBLEM
STATEMENT

1 Evangelos Kotsioris, "Sensing Architecture," Perspecta 51, The Yale Architectural Journal, 2018, pp. 227-244, 227.

2 Marshall McLuhan cited in Francesco Casetti, "Mediascapes: A Decalogue," Pespecta 51 The Yale Architectural Journal, 2018, pp. 21-43, 27.

the "really total and saturating environments are invisible. The ones we notice are quite fragmentary and insignificant compared to the ones we don't see."[3]

Sensors 'perceive' - control, monitor and generate - their material environment in very distinct spectral ranges. Most of these spectral ranges lie exterior to the human ranges of perception and thus seem to us invisible. Nevertheless, sensors are capable of sensing these humanly imperceptible realities (signals) and every signal can, in turn, be translated into an image, which can produce a deeper understanding of our environment and the ecologies of human and machinic entanglements.[4]

Domesticity

The house (lat. domus) has progressively become a mediascape.[5] It has outgrown itself. The increasing conquest of the house by sensing technologies has embedded it in a continuously expanding field of infrastructural nodes and repetitive elements. The primordial environment of the house has been replaced by a planetary system in which the house itself becomes an infrastructural and multipliable node. This renders definitions such as ,inside' and ,outside' or ,natural' and ,artificial' obsolete and makes an understanding of the world as an anthropogenic construct all the more significant: a global interior emerges, a shared domesticity within a *World Interior*, which is appropriated through the process of domestication.[6] Domestication is understood in this context as an architectural practice that constantly expands the scope of agency of the house through technological means making the world interior controllable. This largely unrecognised development brings with it the problem of representing and designing the house as a singular entity and testifies to the need for a technical and material understanding of the infrastructural spaces that form the new domestic.

It becomes clear that a new way of reading, understanding and visualizing the contemporary domestic condition is required, superseding the house as a mere cultural construct and acknowledging it as part of a dynamic process of constant change. In this regard *Sensing Domesticity* raises the question: *What new spatial articulations of domesticity can be achieved when sensors are instrumentalised as mapping tools, thus liberated from their background role and integrated directly into the design process?*

3 Marshall McLuhan, "The Invisible Environment: The Future of an Erosion," Perspecta 11 The Yale Architectural Journal, 1967, pp. 161-167, 164.

4 "Everything that exists as a signal can also exist as an image." Jussi Parikka, "On Seeing Where There's Nothing to See," in Photography Off the Scale: Technologies and Theories of the Mass Image. Technicities. , ed. Dvorak Tomas (Edinburgh: Edinburgh University Press, 2021).

5 Merriam-Webster.com Dictionary, s.v. "domus," accessed January 3, 2022, https://www.merriam-webster.com/dictionary/domus.

6 Peter Sloterdijk, Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung (Frankfurt am Main: Suhrkamp, 2006).

RESEARCH
QUESTION

Since "virtual environments - {defined by sensors and systems} - became the new site of architecture", a technological understanding within the architectural discourse must be manifested.[7]
This work feels the urge to explore, visualize and retool the interrelations of 'spectral topographies' - a term coined by designer and researcher Sophie Dyer - and the environments they compose. In her research, Dyer aims to shift the focus from familiar structures and bodies that populate space to their electromagnetic radiation and infrastructural traces: We are unable to experience the dense and codified electromagnetic milieu they create, yet they shape and are shaped by the material worlds we inhabit.[8]

In her book *Enduring Innocence*, architect Keller Easterling labels this extensive occupation of the spectrum (mostly in the range of microwaves) as 'c-band urbanism'. With 'c-band', she refers to a set of frequencies that were formerly reserved for satellites but are now utilized by nearly every smart device. While Easterling's c-band urbanism is a way to grasp the spatial dimension of this media phenomenon on the urban scale, *Sensing Domesticity* will question its impact on the definition of the domestic.[9]

Doing so, the project shifts the understanding of the domestic as a secluded and intimate space towards a *World Interior*. This concept is not only linked to Sloterdijk's philosophical understanding of the world, but also to Benjamin Bratton's Terraforming program at the Strelka Institute.[10][11] There, urbanism on a planetary scale is explored, opening up notions important to this research: The acknowledgement of an artificially sentient planet, a mediascape, that through scattered sensing technology interiorizes - measures and controls - planetary flows.

When analyzing this mediascape, the project applies Jussi Parrika's take on media as extensions of earth.[12]
Media technologies should be considered in the context of geological processes, from the process of formation and transformation up to the movement and profound depletion of natural elements from which media are built.[13] Viewing media and technology as geological processes not only allowed us to find the material aspect in the seemingly immaterial, but also to expand the defintion of the 'material' from ressources to labour, from landscapes of extraction to living conditions.

7 Evangelos Kotsioris, "Sensing Architecture", Perspecta 51, The Yale Architectural Journal, 2018, pp. 227-244, 232.

8 Sophie Dyer and Eline Benjaminsen , "Spectral Topographies", Migrant Journal 2 (2018): pp. 34-47.

9 Keller Easterling, Enduring Innocence (Cambridge , MA: The MIT Press, 2005).

10 Peter Sloterdijk, Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung (Frankfurt am Main: Suhrkamp, 2006).

11 Benjamin H. Bratton, The Terraforming (Moscow, Russia: Strelka Press, 2019).

12 Jussi Parikka, A Geology of Media, vol. 46 (Minneapolis: University of Minnesota Press, 2015).

13 Kate Crawford and Vladan Joler, "Anatomy of an AI System," Anatomy of an AI System, accessed October 14, 2021, https://anatomyof.ai/.

FIG 1 La Casa Telematica 1983,
Ugo La Pietra

SENSING DOMESTICITY

Genealogical Analysis

To answer the research question, domestic sensors are to be transformed from agents of the 'problem' to tools of the research method. As such, a selection of such sensors must first be made, a process that in itself determines the starting points of the analysis. Acknowledging that the narrative of the historical evolution of the building as an architectural form occurs in parallel with that of the sensing system that inhabits it, the research first departs from a genealogical analysis of the 'sensing house' in four degrees of domestication.[14]

This process establishes a selection of three sensing objects that inhabit the contemporary house; The WiFi Router, the CCTV camera and the Thermostat are seen more than just mere objects, but rather, as strategies to construct a newfound understanding of the 'sensing house' through inherently domestic notions of communication, security and comfort.

Dissection

Through visualising the 'degrees', these three sensors are revealed to be nodes of a system that is dependant on a growing infrastructure. It is these systems that become the core of this research body: each of the three sensors is developed into chapters that retrace the physical complexity of the sensor's footprint. By looking inside the sensor itself, we explore the global implications of its performance.

Negotiating the three

The sensor is dissected through three different approaches, each exposing a specific aspect of the system. Consequently, the chapters become sites of a diffracted dialogue between the three of us. We depart for and eventually return to a collective field of investigation, that is constantly reviewed with three different lenses, claiming their own area of expertise:

Language // Each sensor is capable of communicating in a different language, since it is calibrated to receive and transmit information at a very specific frequency. This approach looks towards the spectral topographies: the invisible residues of the sensor's language that occupy and construct the "infosphere". It situates the sensor's frequency on the electromagnetic spectrum, and acknowledges the technological processes by which the sensor 'talks' and 'listens'. In doing so, it also investigates the

14 This genealogical analysis is inspired by Studio Fabula's project *Towards A Flying Bunker*, 2020.

direct effects of physical space on the sensor's language, and how its performance depends to distance, geography, and weather conditions.

Material // The sensor's exterior casing is peeled off, and the elements that allow it to function are reduced to the raw materials that compose them. This thinking method investigates the geologic occurrence of metals and minerals that are vital for the sensor's performance, understanding them first and foremost as products of the Earth. Through the tool of cartography, this approach maps the extraction and implementation of materials from Earth to Media, exposing sites of resource mining to the operative infrastructure that owes its performance to the studied material.

Scale // This methodology investigates the territorial and geopolitical implications of the sensor's planetary reach. It charts a diagrammatic representation of physical agents that contribute to the sensor's performance: the node points of data collection, its transmission and its storage. It acknowledges these points as physical architectural typologies that exert a change to the signal along the system, switching it from one state or frequency to another.

Teamwork is seen as the pedagogical method to not only increase the quantity but more importantly the quality of the work: as an enrichment of complexity in the thought and design process. We will leave the echo-chamber of a self-reflective hermetic way of thinking and dive into a negotiation between the three of us, constantly challenging the research topic: by explaining and debating individual ideas as well as reformulating and agreeing on common ground. A shared dynamic glossary which can also be found in the appendix will help to exchange, clarify and nuance key terminology.

Gizmos

The three approaches will simultaneously develop an inventory of physical objects, all gathered from the represented systems. The 'language' approach will assemble a series of compact sensors, microchips and small-scale hardware which enable the functioning of the sensing objects; the 'material' approach will extract the machinery used in the mining and distribution of the precious metals and minerals that compose them; while the 'scale' approach will document the architectural enablers of transmission and reception.

All of these physical agents are compiled to form an extensive Gizmo's catalogue, ranging in scale from 2:1 to 1:200, which aims to address the vast range in scale of the so-called 'World Interior'.

FIG 4 *Copper Geographies*
photographed by
Ignacio Acosta

"The limits of my language mean the limits of my world."
Ludwig Wittgenstein, Tractatus Logico-Philosophicus (1921),
trans. Charles K. Ogden and Frank P. Ramsey (New York, NY:
Harcourt, Brace & Co., 1922), 149.

Sensing Domesticity has formed, within its (time) limitations, a
selection of research narratives on how sensing devices can be
understood in resonance with our built environment - to be able to
incorporate them into the design process. The point is neither to
glorify technology nor to demonize it. It is about looking at humanity
and technology in an ever-existing co-evolution and understanding
technicities in this regard. With the increasing atomization of
technological objects and sensors, they continuously step out of
our field of vision and language - interfaces become ubiquitous
and thus unconscious. We need to distance ourselves from
being mere users to be able to understand the systems we are
embedded in and to eventually hack them.
As we are living in a turn from a language-based to a data-based
civilisation, this research approaches the built environment from
a machinic point of view: It investigates how objects and data
transform our built environment, reflecting onto this "media-
ontological shift."[15]
The attempt is made to overcome the limits of our language and
to make ourselves related to another "sort of language" - to learn
how to read and write it spatially.

15 Peter Weibel and Georg
Vrachliotis, "Open Code 'We
Will Experience an Uprising to
Reclaim Our Data,'" Project
Bauhaus: Can Design Change
Society?, 2019.

TOWARDS A WORLD INTERIOR

5 Degrees of Domestication

Panel 1

The Primitive Hut

communication	security	comfort		range of control	relicts
stone drawing	slingshot	sun		max. speed	
smoke signal	primitive structure	animal skin		13km/h (human)	
		water supply – river		100 km/h (slingshot)	
		primitive structure			
		wind			

Panel 2

The Solidified House

communication	security	comfort	range of control	relicts
letter	dog (domesticated wolf)	sun	max. speed	
carrier pigeon	goose	candle	13 km/h (human)	
post horse	door lock	petroleum lamp	48 km/h (dog)	
	door bell	animal warmth	35 km/h (post horse)	
	Gargoyles	water supply – well		
	fire extinguisher	solidified structure	max. noise	
	solidified structure	wind-ow	88.0 dB (goose)	
		crop	100.0 dB (dog)	

Panel 3

The Electrified Field

communication	security	comfort
telegraph	dog (domesticated wolf)	sun
telegraph line	electric alarm system	floor lamp
cable lying boat	electric door bell	electric light bulb
telephone	peep hole	light switch
radio	porter's telephone	indoor plumbing system
electric gramophone	fire extinguisher	sanitary system
TV	brick wall	single glazed wood-
electric outlet		window
post car		gas boiler
		radiator
		water pump

	range of control	relicts
electric ventilation	max. speeds	candle
boiler	12 km/h (human)	dog
brick wall	100 km/h (pod car)	
thermostat	50 bauds (50 characters per second - telegraph)	
canned food		
	max. noise	
	135 dB (alarm)	
	frequencies	
	87.5-108.0 MHz (radio)	

The Media Landscape

communication	security	comfort		range of control	relicts
wifi router	CCTV	sun	boiler	max. speeds	animal skin KoldBy by IKEA
5G tower	NVR	wireless led lamp	ETICS	12 km/h (human)	candle
Internet Service Provider	remote monitoring	electric light bulb	smart home thermostat	25 km/h (ebike)	dog
glass fibre cable	security company	motion detector	fresh tomatoes	297 000 km/s (glass fibre cable)	
cable lying boat	video door bell	indoor plumbing system	green house		
smart devices (phone,	peep hole	sanitary system	air quality sensor		
tablet, laptop, watch, TV,	fire extinguisher	double glazed plastic	solar panels	max. noise	
Amazon Echo)	sprinkler	window		125 dB (alarm)	
e-bike delivery	smoke detector	ventilation			
	motion detector	radiator		frequencies	
	concrete wall	water pump		2.4 GHz, 5 GHz (wifi)	

The Interiorized World

communication	security	comfort	not included	relicts
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM

TOWARDS A WORLD INTERIOR
5 Degrees of Domestication

Theoretical Outline

The first chapter, *Towards a World Interior* analyses how the house (lat. domus), with increasing degree of domestication, acquires independence from its natural environment, while at the same time growing into constantly expanding infrastructures of repetitive elements: it thus extends its boundaries into the invisible territory of diverse frequencies and their material manifestations in the form of radio towers, weather stations, power plants or data storages.[16] The primordial environment of the house is replaced by a planetary system in which the house itself becomes an infrastructural and multipliable node.[17]

This system, in which the house is embedded, is what we call the World Interior: The World Interior is the interiorised space that is being appropriated through the process of domestication. Domestication is understood in this context as an architectural practice whose core is the technology of control. Domestication thus goes hand in hand with control: control over external conditions, the interiorisation of which allows independence from precisely those conditions.

The World Interior is the creation of interior climate zones and wind flows, by means of walls and wind-owes.[18] It is the creation of interior water reservoirs, using water pipes and taps. It is the construction of interior light zones, by lamps and light switches. But it is also the production of monitored spheres via cameras, warning systems, security companies, and remote sensing. The World Interior is the controllability of information in space, through the creation of an "infosphere" [see glossary] *, made possible by the conscious shaping of conductive material.*

The evolution of the World Interior is represented in different degrees of domestication, as control can always be understood

in different spectra of ranges and speeds.[19] These spectra are generated by the increasing automation of domestic processes, which leads to a simultaneous increase in the density of new infrastructural nodes.

       From ‚discovering fire' - understanding natural processes - to ‚making fire' - mimicking them through labour. From ‚turning up the heat' - automating labour by retrieving energy from, for example, local power stations - to ‚controlling temperature through the thermostat' - automating demand, for instance, by correlating user data with weather information from surrounding weather stations.

While the boundaries of the World Interior are expanding, the confrontation with its agents is becoming gradually reduced: due to the increasing miniaturisation of control technologies, which are no longer actively operated by the user but passively influenced by user behaviour, they fade not only visually but also cognitively into the background. What remains are the seemingly redundant relics of earlier technologies that shape the understanding of our environment.[20] They are symbol carriers of the actions that have been associated with them over time. Thus the relics become semiotic surfaces whose existence anchors us in their time and protects us from the mortification of constant technological change.

       It is the flickering fire on the flatscreen that gives us a cosy ambience. Or the quarry stone wallpaper that suggests a feeling of solidity and security. It is the wave-shaped tiles on the bathroom wall that make us dream of feeling natural waters. It is the potted plants in the living rooms that express our longing for lost nature. It is the Ikea Kolby animal fur rug that revives our primitive comfort needs. It is the watchdog that has served its time and is now happily waiting to entertain its owner. One could almost think it is the image of the house itself that has become a relic. The lonely, detached house with gable roof and steaming chimney, nestled in the romantic landscape - almost as it has been drawn since early childhood.

It is this longing for what has lasted so long that blinds us to what *Towards a World Interior* is trying to portray, and yet it is an integral part of that interior.

16 The term world interior is inspired by Peter Sloterdijk's philosophical understanding of the world in *Peter Sloterdijk, Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung* (Frankfurt am Main: Suhrkamp, 2006), pp.265.

17 see "multiplier" as described by Keller Easterling in *Extrastatecraft: The Power of Infrastructure Space*, pp. 73 - 75, 2016 - "The multiplier is a active form assessing or adjusting a disposition and is present in almost all of the software of infrastructure space."

18 "an eye for the wind": from Old Norse *vindauga*, from *vindr* wind (akin to Old English *wind*) + *auga* eye; akin to Old English *eage* eye, see Merriam-Webster.com Dictionary, s.v. "window," accessed January 3, 2022, https://www.merriam-webster.com/dictionary/window.

19 see the drawing's annotations "range of control" and "relics"

20 see the drawing's annotations "relics"

The 5 Drawings

Towards a World Interior is divided into five drawings. These represent a genealogy of the house, focusing on the three notions of communication, security and comfort. The main research that follows (see p. 29) will dissect the current state of the *Media Landscape* analysing three representational objects as "strategies of domestication". The final degree gives a glimpse and speculates on a future interior.

All drawings thus build on each other chronologically, yet are never intended to represent a specific moment in time, but rather transformation due to certain turns.

1 The Primitive Hut

The point of departure forms the architectural myth of the primitive hut. One finds the first man-made structure that embeds its inhabitants in the natural landscape. This landscape is the carrier of all existing resources and information. The positioning of the hut is existentially crucial to the lives of its inhabitants.
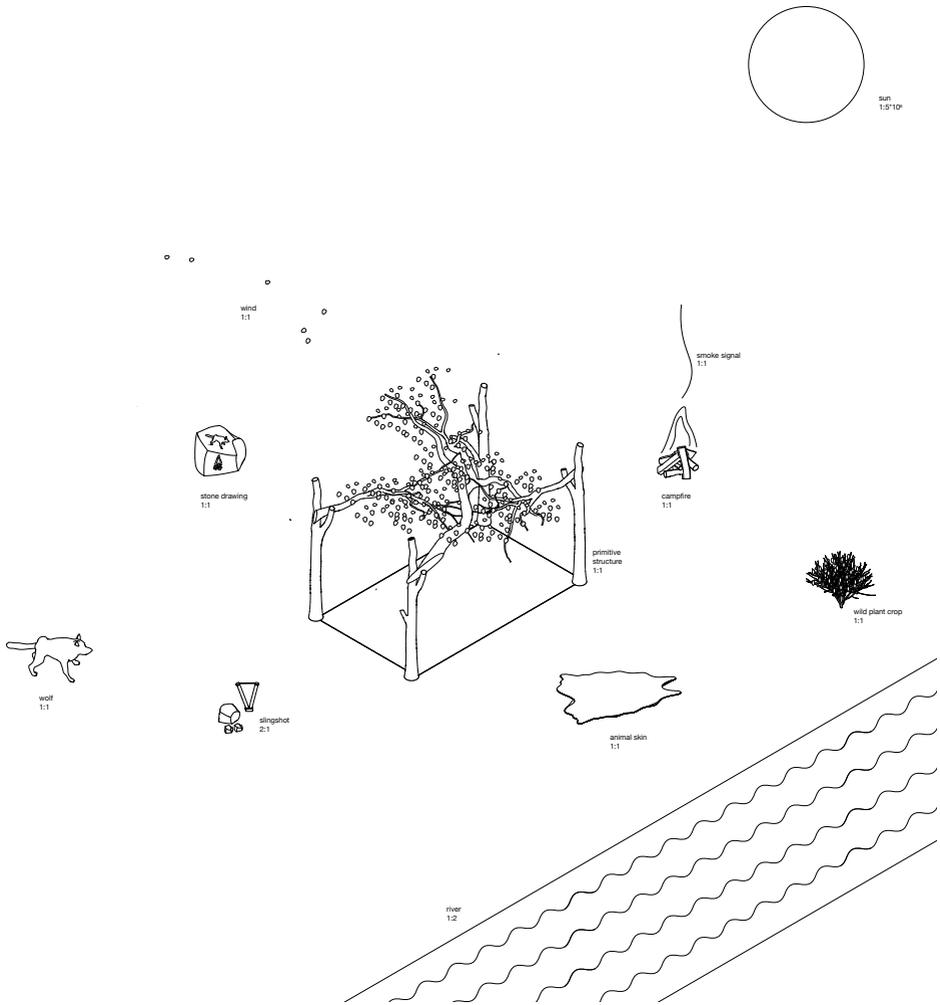
sun
1:5*10⁶

wind
1:1

smoke signal
1:1

stone drawing
1:1

campfire
1:1

primitive
structure
1:1

wild plant crop
1:1

wolf
1:1

slingshot
2:1

animal skin
1:1

river
1:2

The Primitive Hut

communication	security	comfort		range of control	relicts
stone drawing	slingshot	sun		max. speed	
smoke signal	primitive structure	animal skin		13km/h (human)	
		water supply • river		100 km/h (slingshot)	
		primitive structure			
		wind			

2 The Solidified House

The solidification of the house represents the programming of architectural elements through internal protection and comfort needs. At the same time, it serves to control external conditions through the architectural means it has generated. These decisively shape the understanding of the house as a construct of floor, wall and roof, which is controlled by opening strategies such as windows, doors or chimneys according to the needs of the inhabitants.
The first water systems, such as wells, allow the house to distance itself from open water and to spread out into the landscape: „All cities have now become {...} port cities, for where the cities have not gone to the sea, there the seas come to the cities."[21]

21 Peter Sloterdijk, *Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung* (Frankfurt am Main: Suhrkamp, 2006), pp.218.
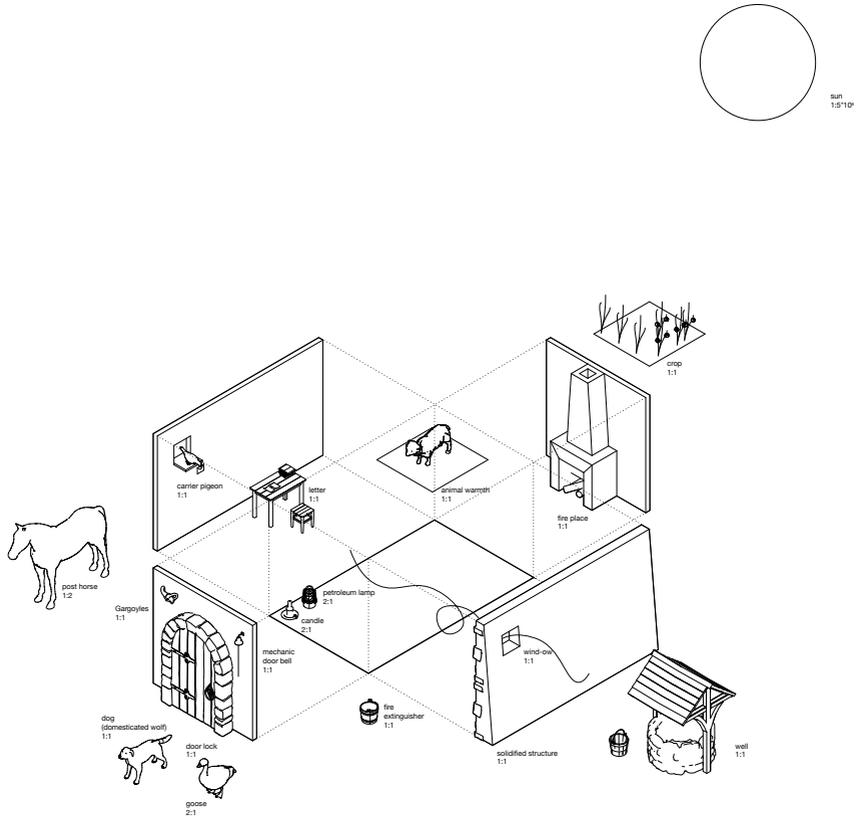
sun
1:5*10⁶

crop
1:1

carrier pigeon
1:1

letter
1:1

animal warmth
1:1

fire place
1:1

post horse
1:2

Gargoyles
1:1

petroleum lamp
2:1

candle
2:1

mechanic
door bell
1:1

wind-ow
1:1

dog
(domesticated wolf)
1:1

door lock
1:1

fire
extinguisher
1:1

solidified structure
1:1

well
1:1

goose
2:1

The Solidified House

communication	security	comfort		range of control	relicts
letter	dog (domesticated wolf)	sun		**max. speeds**	
carrier pigeon	goose	candle		13 km/h (human)	
post horse	door lock	petroleum lamp		48 km/h (dog)	
	door bell	animal warmth		35 km/h (post horse)	
	Gargoyles	water supply • well			
	fire extinguisher	solidified structure		**max. noise**	
	solidified structure	wind-ow		88.0 dB (goose)	
		crop		100.0 dB (dog)	

3 The Electrified Field

Electrification induces the dissolution of the singular unit of the house. The latter becomes embedded in a material network of power stations, cables and sockets. In this circuit, the switch becomes the central control element of the house and extends its boundaries into the electric field.
Electrification also marks the beginning of a media turn that will be further intensified in the next degree.

sun
1:5*10⁶

cable lying boat
1:20

telegraph line
1:10

electric alarm
1:1

canned food
2:1

light bulb
1:1

thermostat
1:1

light switch
1:1

radio
1:1

TV
1:1

canned food
2:1

radiator
1:1

post car
1:5

electric
outlet
1:1

telegraph
1:1

electric
grammophone
1:1

electric
ventilation
1:1

telephone
1:1

indoor plumbing
system
1:1

boiler
1:1

water pump
1:1

peep
hole
1:1

candle
2:1

floor lamp
1:1

dog
1:1

brick wall
1:1

electric
door bell
1:1

fire
extinguisher
1:1

sanitary
system
1:2

single glazed
wood window
1:1

portier's
telephone
1:1

The Electrified Field

communication	security	comfort		range of control	relicts
telegraph	dog (domesticated wolf)	sun	electric ventilation	max. speeds	candle
telegraph line	electric alarm system	floor lamp	boiler	13 km/h (human)	dog
cable lying boat	electric door bell	electric light bulb	brick wall	100 km/h (post car)	
telephone	peep hole	light switch	thermostat	50 bauds (50 characters	
radio	portier's telephone	indoor plumbing system	canned food	per second · telegraph)	
electric grammophone	fire extinguisher	sanitary system			
TV	brick wall	single glazed wood-		max. noise	
electric outlet		window		125 dB (alarm)	
post car		gas boiler			
		radiator		frequencies	
		water pump		87,5-108,0 MHz (radio)	

4 The Media Landscape

Building on the maritime routes of old telegraph lines, submarine fibre optic cables are being laid to allow (almost) planetary communication. At speeds of up to 200,000 km/s, data is transformed into light signals that enable an intercontinental expansion of the range of influence of the house. Moving further and further away from the user's field of vision, data is rendered in frequencies invisible to the human eye. As a material consequence of this, one finds new places of inhabitation that are already shaping the World Interior as architectural manifestations (see p.46).
Moreover, the constant media reproduction of images makes the image of the house travel, and enables its surveillance from distant places (see remote security control at "Palm Beach").
The control of this expanding landscape is above all enabled by the implementation of sensors, which have become catalysts for the automation of the house.

5 The World Interior

For first speculations see p. 108.

satellite
1:2

sun
1:5*10⁶

cable lying boat
1:20

ISP
1:10

glass fibre cable
1:10

5G tower
1:10

green house
1:10

Server
1:2

motion detector
1:1

air quality
sensor
1:1

smart home
thermostat
1:1

light bulb
1:1

e-bike delivery
1:2

smoke detector
1:1

Amazon
Echo
2:1

smart TV
1:1

fresh
tomatos
2:1

sprinkler
1:1

radiator
1:1

smart phone
2:1

Laptop
1:1

Wifi router
1:1

electric boiler
1:1

tablet
1:1

smart watch
2:1

IKEA Koldby
animal skin
1:1

solar panels
1:1

indoor plumbing
system
1:1

water pump
1:1

NVR
2:1

CCTV
1:1

candle
2:1

wireless led lamp
1:1

ventilation
1:1

concrete wall
1:1

ETICS
1:1

peep
hole
1:1

dog
1:1

sanitary
system
1:2

double glazed
plastic window
1:1

video
door bell
1:1

fire
extinguisher
1:1

remote security
monitoring company
1:1

remote security
monitoring
1:1

The Media Landscape

communication	security	comfort		range of control	relicts
wifi router	CCTV	sun	boiler	max. speeds	animal skin Koldby by
5G tower	NVR	wireless led lamp	ETICS	13 km/h (human)	IKEA
Internet Service Provider	remote monitoring	electric light bulb	smart home thermostat	25 km/h (ebike)	candle
glass fibre cable	security company	motion detector	fresh tomatos	297 000 km/s (glass fibre	dog
cable lying boat	video door bell	indoor plumbing system	green house	cable)	
smart devices (phone,	sanitary system	air quality sensor			
tablet, laptop, watch, TV,	sprinkler	sanitary system	solar panels	max. noise	
Amazon Echo)	fire extinguisher	double glazed plastic		125 dB (alarm)	
e-bike delivery	smoke detector	window			
	motion detector	ventilation		frequencies	
	concrete wall	radiator		2.4 GHz, 5 GHz (wifi)	
		water pump			

COLLECTION OF SENSING OBJECTS

smoke detector
22

smart phone
1 2 4 5 6 7 9 10 11
12 17 18 21 24 29
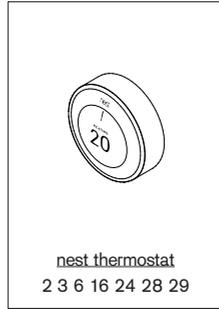
nest thermostat
2 3 6 16 24 28 29

p.85

motion detector
19 23 33 34

wifi router
4 27

p.33
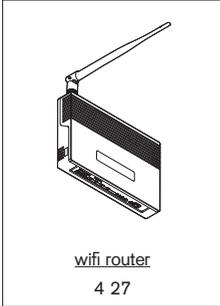
video doorbell
3 13 15 17 18 23

amazon echo
1 3 18
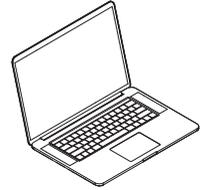
laptop
1 3 6 10 13 15 18 24 29

temperature sensor
26 31 32

overflow water sensor
2 35

mist humidifier
2

smart light switch
3 6 23

smart TV
1 11 18 23

tablet
1 2 4 5 6 7 9 10 11
12 17 18 21 24 29

CCTV
13 15

p.59
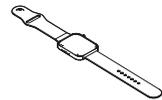
smart watch
1 5 10 12 25
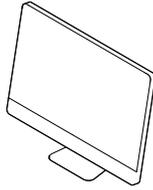
CO sensor
8

screen
3 13 15 18

smart lock
6 20

sprinkler
30

door and window sensor
16
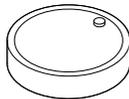
iroomba vacuum cleaner
14

water leak detector
2 29 35
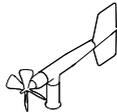
private weather station
36

list of sensors included
in objects

1	accelerometer
2	(air) humidity sensor
3	ambient light sensor
4	antenna
5	barometer
6	capacative touch sensor
7	CCD Sensor
8	electrochemical CO sensor
9	finger print sensor
10	GPS
11	gyroscope
12	heart rate sensor
13	image sensor
14	IR optical bump sensor
15	lens
16	magnetic sensor
17	magnetometer
18	microphone
19	microwave sensor
20	optical sensor
21	pedometer
22	photoelectric sensor
23	PIR sensor
24	proximity sensor
25	pulsoximeter
26	resistor
27	rssi-sensor
28	soli sensor
29	temperature sensor
30	thermic sensor
31	thermistor
32	thermocouple
33	tomographic sensor
34	ultrasonic sensor
35	water sensor
36	wind sensor

TP-LINK

150Mbps Wireless N
ADSL2+ Modem Router

TD-W8901 ND

THE WIFI ROUTER

From Proximity to Distance

"On 14 electromagnetic channels, 14 highways invisible to us, the Wifi router enables together with others of its kind the fastest ride to the cloud."

The Object

The small box stands in the corner of a room. A black plastic shell - smooth and shiny - encases its sensitive body. The antenna stands 14 cm high in the air. A single blue light reveals its activity. It is silently present as it undertakes the passive scanning of invisible surrounding communication channels. It senses its neighborly likeness on the third floor called Slaapkammer 123. Or the activity of Maria's hotspot in the hair salon diagonally across the street. On 14 electromagnetic channels, 14 „highways" invisible to us, the Wifi router enables together with others of its kind the fastest ride to the cloud.[22]

"Beneath the paving stones, the cloud"[23]

Today, the cloud is the central metaphor of the Internet: an attempt to reduce its complexity. Yet the cloud is less a structure of water vapor than one of frequencies.[24] The Wifi router occupies the 2.4 GHz range of a spectral territory. Data is inscribed in 12 cm long electromagnetic waves to send that red pair of shoes from the other side of the world to your home.
But even more important than the knowledge about those frequencies is the understanding of their generation by controlling material properties through form.
Every order online, every zoom call, every connection to the cloud, means not merely entering the field of frequencies, but much more claiming physical infrastructures and material realities.
Dusty and almost forgotten, between cables and sockets sits the wifi router, as a domestic incarnation of planetary spaces of information transmission, and is now to serve as a starting point for a material exploration - beneath paving stones and blue waters.

22 Richard Vijgen, "Spectrum Tapestry: Information as a Machine for Living," Perspecta 51, The Yale Architectural Journal, 2018, pp. 119-132.

23 James Bridle, "The Cloud," ICON Magazine, February 16, 2015, https://www.iconeye.com/opinion/icon-of-the-month/the-cloud.pp. 21-43, 27.

24 James Bridle, New Dark Age: Technology, Knowledge and the End of the Future (London, UK: Verso, 2018), p.13.

1/4 λ

1/4 λ

1

2

3

4
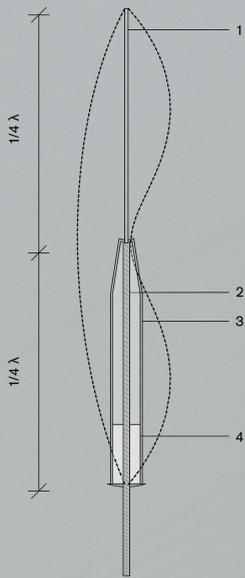
Antenna Dipole
in Home Wifi Router

1 Coax cable
2 Copper cable
3 Aluminium tube
4 Plastic spacer

Each half of the dipole is a 1/4 wavelength, with the length corrected based on the velocity of the coax being used. Assuming a centre frequency for 802.11b of 2.44 GHz, a 1/4 wavelength in free space is 30.7mm.
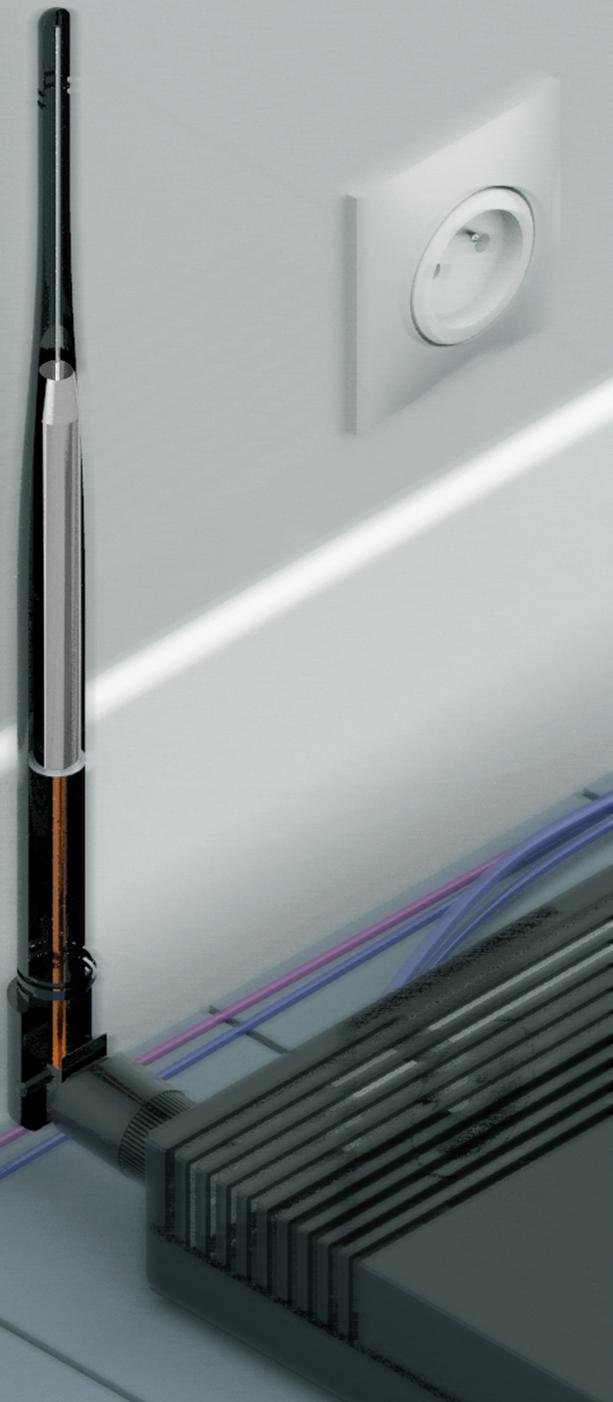
Antenna Dipole
in Radio Antenna

1 Power divider coat
2 Dipole to boom brackt
3 Drip hole
4 Aluminium tube
5 Adhesive shrink tube
6 Polyethylene pipe
7 Solder lug
8 Flexible wire
9 Di-electric conductor
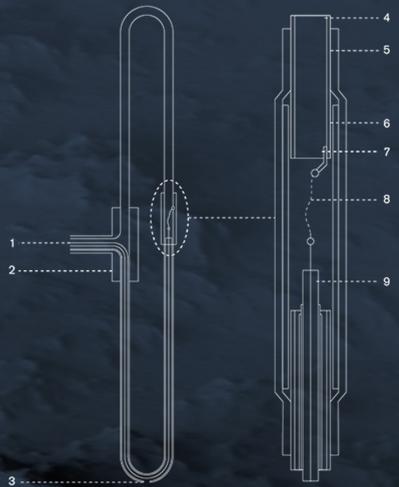
Language

How the antenna "speaks".

The antenna is the sensor of the Wifi router that picks up electromagnetic signals from its environment and emits them into it. It is only through its existence that wireless communication is possible: it is the interface between the transmitter or receiver and the transmission medium, the free space, which is also referred to as the propagation medium.

Both the materiality and the shape of the antenna are decisive for its capacity to „speak", i.e. to translate digital code into analogue waves. The dipole - the heart of the antenna - consists of two metal rods of equal length, with the help of which electromagnetic fields are generated. In order to do that, alternating current runs through the dipoles, alternately charging (+) and discharging (-) the two poles. FIG. 6 Therefore, a metal, such as copper, with high conductivity is needed.[25]

While the materiality of the metal makes the generation of the wave possible, it is its shape that determines the wavelength. The latter is directly dependent on the length of the antenna: with a so-called 1/4 dipole antenna, the total length of the antenna is half the length of the resulting wavelength. FIG. 7 The larger the antenna, the longer the wave that propagates through space. In addition, the wave is dependent on obstacle-free movement: Environmental influences such as heavy rain or high topography as well as structural obstacles interrupt the flow of communication.[26] Materials such as wood, plaster or glass have low attenuation, while concrete or metal react insultingly to electromagnetic waves.

25 Carlo G. Someda, Electromagnetic Waves (London, UK : Tayler & Francis Group, 1997).

26 Sophie Dyer and Eline Benjaminsen , "Spectral Topographies ," Migrant Journal 2 (2018): p. 46.
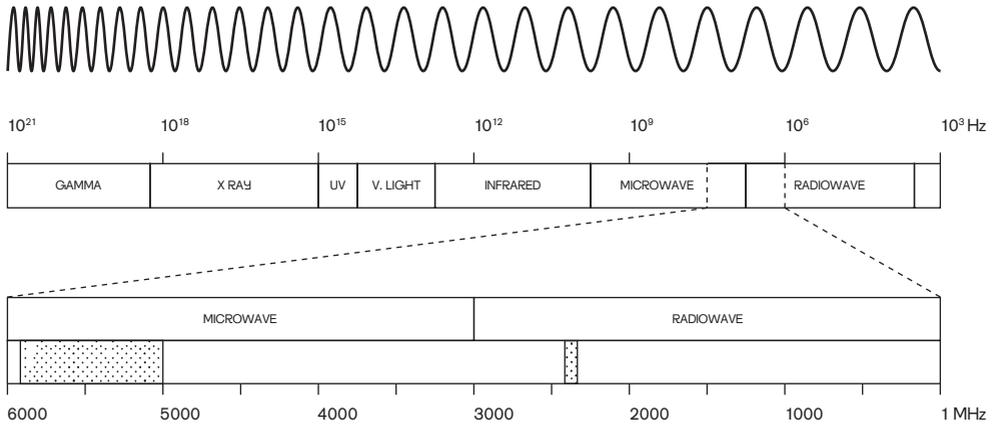
FIG. 5 Spectral Ranges Wifi Router: 5800-5000 Mhz & 2400 Mhz

ab   c
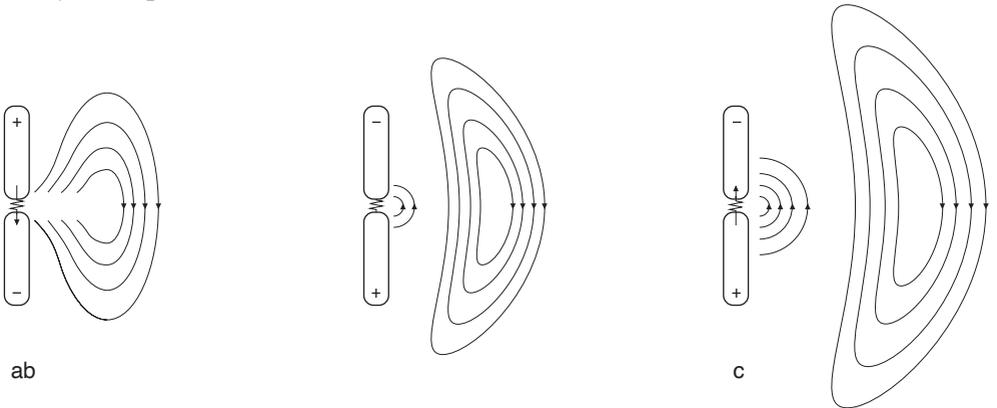
FIG. 6 Dipole Antenna: creation of electromagnetic field
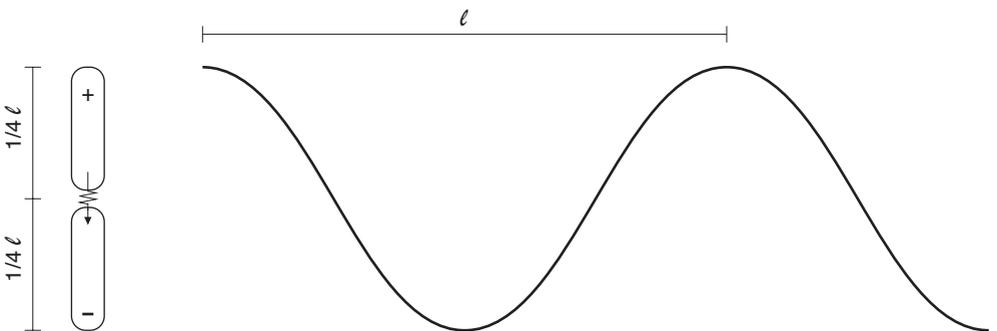
FIG. 7 Dipole Antenna: depence of dipole form and wavelength

Materiality

Copper

Out of the 83 known stable elements, 60 of them compose the interior of the router. Almost the entire periodic table is required for it to function. All of these materials are part of a colossal supply chain that embraces the whole planet, each having been extracted, transported, processed and assembled into a myriad of individual components that compose the router. One noticeable component projects upwards. Peeling back the 'Acrylonitrile butadiene styrene' plastic that protects the tubular form, an antenna is held in place: a centrepiece composed of a distinctive, reddish metal.

Copper is characterised by high electrical and thermal conductivity. It plays a key role in worldwide information and communication technologies, manifesting itself in the wires and antennas that lace and extend outwards from our homes, constructing the global interior.[27] "Hidden in plastic, behind walls, bound to cables, carried as loose change; copper is everywhere yet rarely seen."[28]

What is specific about copper, is that it does not lose any of its properties through recycling, either from raw state or from technological devices. It is estimated that as much as 80% of the metal ever mined is still in use. Ever since the first recorded instances of the metal's use, well over ten thousand years ago, copper has been meant to last for an eternity.[29]

The metal's power as a substance and value as a commodity lie in its capacity to change and to metamorphose. Decommissioned telegraph cables from the 1850s, lie unused next to newly laid out internet cables across the colonial routes of the transatlantic, which extend into an infrastructure of on-land cables, antennas and routers, all relying on copper. Since the advent of telecommunications, the metal has been molten and reshaped, changing in state and adapting in size, thickness and form to the medium of the signal that it transmits.

27 Jussi Parikka, A Geology of Media, vol. 46 (Minneapolis: University of Minnesota Press, 2015), p. 33

28 Ignacio Acosta, "Copper Geographies," Tr-ansfer, March 26, 2020, http://www.transfer-arch.com/delight/copper-geographies/.

29 Mirko Nikolic, "'We (Love) Copper, Copper (Loves) Us,'" Minoritarian Ecologies: Performance before a More-Than-Human World, 2017, https://minoritarianecologi.es.

30 adapted poem of Reyes Franzani Juan de Dios, "Cobre Rojo," in Salitre: Poesía Joven Del Norte (Antofagasta: Universidad del Norte, Direccion de Comunicaciones, 1973).

The intercommunicating constellation of different forms of copper can be traced back to its geological formations in the earth. Its extraction leaves in its wake huge mining pits of void, volumes the size of the 'Andes inverted.' Vaporous copper oxides pollute the air of its mines, and its sulfides adorn the surrounding cloudbanks.[30] The once compressed minerals in copper ore are freed to construct a decentralised system of communication: from proximity to distance, from Earth to Media.
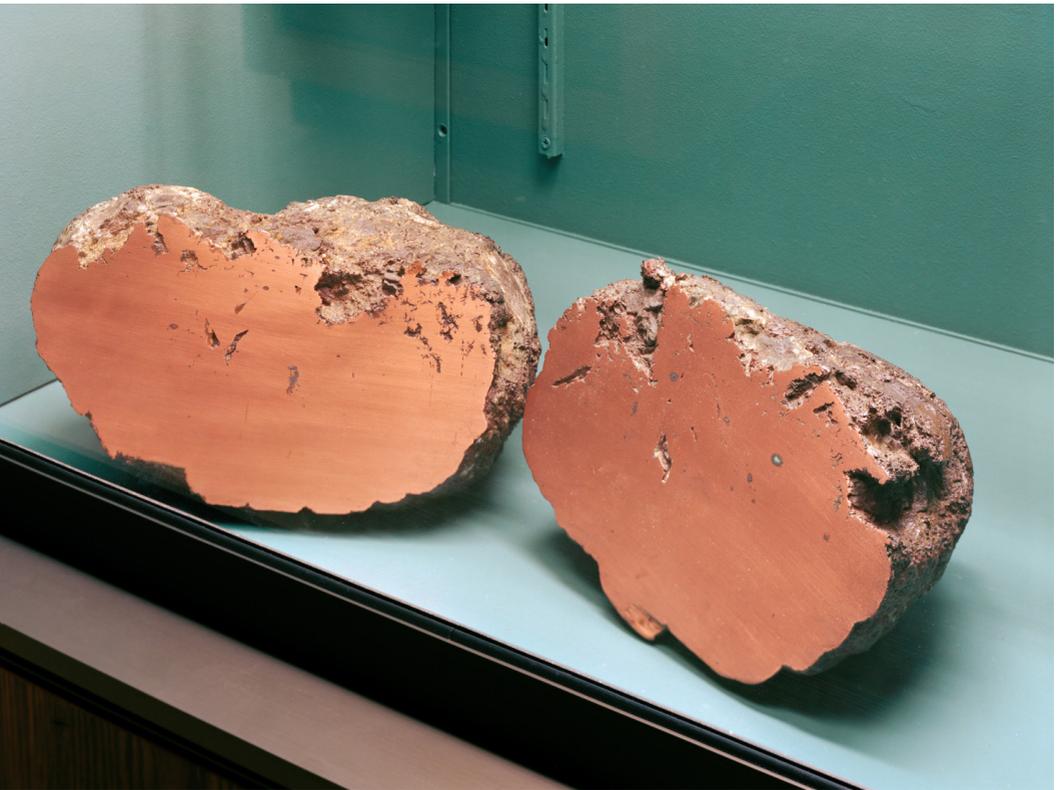
FIG. 8   A chunk of native copper, sliced in half to reveal cross-section.

ATLANTIC OCEAN

PACIFIC OCEAN

Legend:
- Sediment hosted Copper Deposits
- Porphyry copper deposits
- Telecommunication coverage
- Submarine Internet Cables

Scale

The 'instant' transmissions that happen over the 2.4GHz bandwidth can be traced back through a complex infrastructure of a copper-dependant communications network that has nodes scattered across the entire planet. The backbone of the system is a series of undersea communication cables that haul data between intercontinental borders, which have long been the core critical infrastructure of digital communication.

Thousands of undersea fibre-optic cables, instantly delivering 95% of all online financial transactions, emails and voice messages, have virtually changed the geometry of the world that we live in. The financial districts of New York, London, and Tokyo, linked by thousands of wires, are much "closer" to each other than, say, the local districts in the cities themselves. The historic trade routes that were once determined by geography and economic interests are now replaced by submarine cables owned by combinations of private and state-owned entities that follow the same paths, constantly powering themselves through 2m long cable repeaters that boost signals over large distances.[31] Over the last few years, Google and Facebook invested over $300 million each in trans-Pacific cable systems to move data, just to shave a few milliseconds off trade times to Japan and back.[32]

On the shores of these new trading routes, Cable Landing Stations monitor the cables at their most vulnerable point. These points provide both cable-ends with a 4000V power supply, while connecting them to the land-based infrastructure of Internet Exchange Points. Radio towers compose most of the remainder of the system, positioned at intervals allowing a direct line of sight

between them: The larger their distance, the higher the towers need to be in order to overcome the curvature of the Earth.

These high reaching masts are used to host privately-owned antennas belonging to Internet Service Providers to distribute connectivity wirelessly to their customers.

This interconnected infrastructure sets in motion a 'Mother Earth Mother Board' in which copper, in all its different states and capacities aids in the transmission and conversion of signals of information.[33] The system is inherently populated by architectural typologies which, at their core, act as nodes that tune and arrange the state of the signal.

31 Phil Edwards, "A Map of All the Underwater Cables That Connect The Internet," Vox, March 13, 2015, https://www.vox.com/2015/3/13/8204655/submarine-cables-internet.

32 Amit Chowdhry, " Google Invests in $300 Million Underwater Internet Cable System to Japan," Forbes (Forbes Magazine, August 12, 2014), https://www.forbes.com/sites/amitchowdhry/2014/08/12/google-invests-in-300-million-underwater-internet-cable-system-to-japan/?sh=a2c9cd1617a5.

33 Neal Stephenson, "Mother Earth Mother Board," Wired, December 1, 1996, https://www.wired.com/1996/12/ffglass/.

signal

384-789 THz (visible light)

cable lying vessel

①

②

③

④
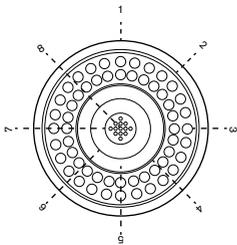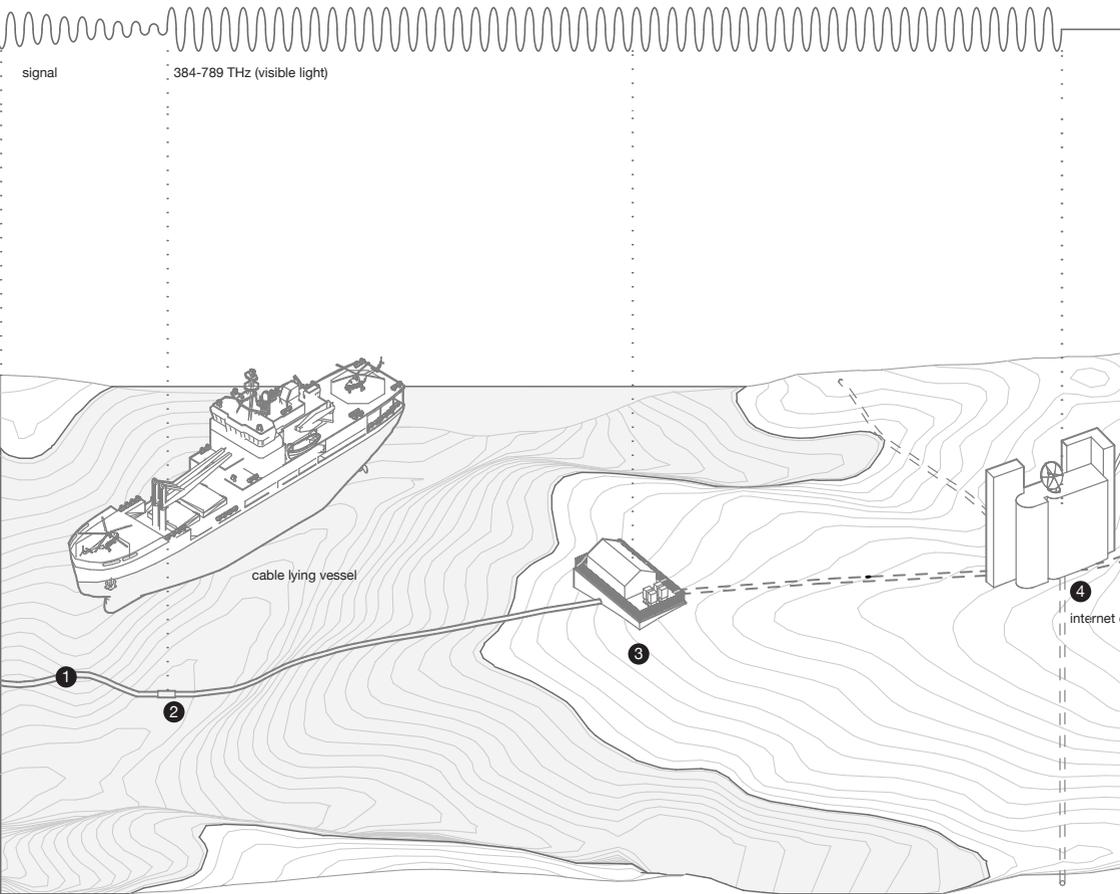
internet
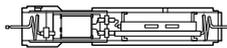
1 glass fibre cable   2 cable repeater   3 generator   4 router

electric signal

2400 MHz

rain fade

⑥

internet service provider

⑤

exchange point

⑦
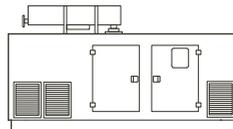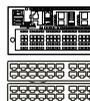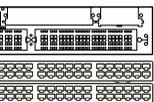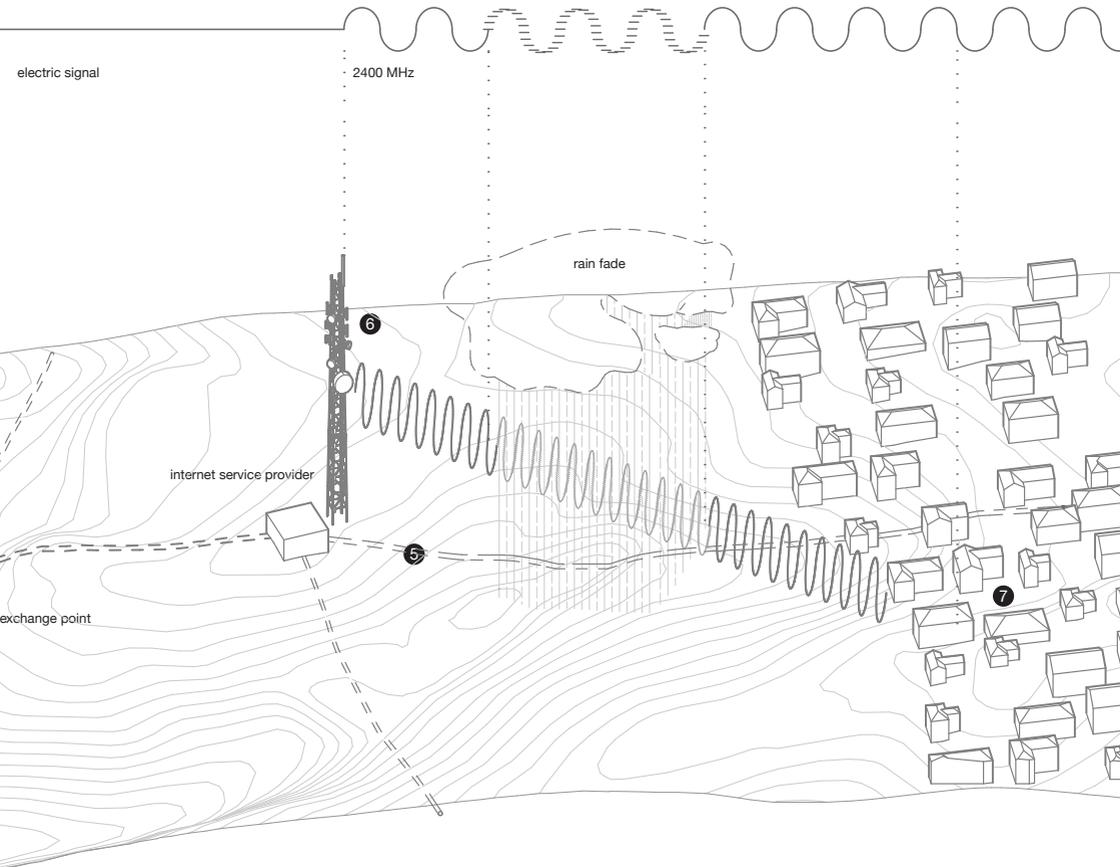
& internet switch
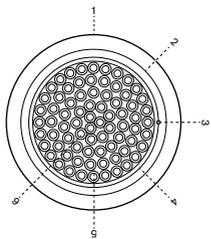
5 telecommunication cable
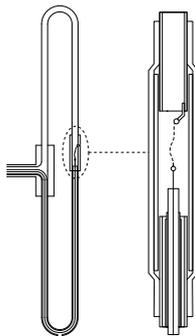
6 antenna dipole
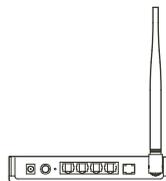
7 wifi router

The Inhabited System

The scales and architectural agents bound to the Wifi router attest both to the connectivity, the proximity, as well as to the remoteness, the distance, of this system. What unites these places in any case is the fact that in each of the mapped nodes one finds inhabitation shaping them: bound to the seemingly automatic process of data transmission, one encounters spaces of human and non-human inhabitation that feed the system on the one hand and are domesticated by it on the other.

Chuquimata Coppermine, Atacama Desert, Chile

Every day at 5 pm, the detonation takes place, releasing tons of rock from the earth. The inverted mountain of the mine grows steadily, forming the largest open-pit mine in the world: an artificially created hole, 5 km long and 3 km wide, disrupts thousand-year-old geological processes in a 24-hour cycle.[34] In the middle of the "most hostile desert in the world", "miñeros" chauffeur trucks the size of single-family houses along the steep faces, while heaped-up rock masses, as well as buildings and homes of the copper company Coldeco, expose the surrounding landscape as man-made.[35] Not far from here lies the town of Chuquimata, affectionately called "Chuqui", which was named after the mine and built just for it: Today a ghost town and already partly devoured by the rubble of the mine, it was once the home of 25 000 miners. Planned by the Guggenheim Brothers at the beginning of the 20th century, the standardisation and mass production of the city's architectural foundations led to a considerable reduction in costs by increasing efficiency, but can also be seen as an expression of the mechanised nature of the

34 Tjerk Brühwiller, "Chiles Tragende Säule," Neue Zürcher Zeitung, January 14, 2014, https://www.nzz.ch/wirtschaft/chiles-tragende-saeule-1.18220429.

35 Florian Quitzsch, "Kupfer – Das Rote Gold Aus Chile," Quetzal Leipzig, 2008, http://www.quetzal-leipzig.de/lateinamerika/chile/kupfer-das-rote-gold-aus-chile-19093.html.

FIG 9-36 City of Chuquimata
© Ignacio Acosta

SENSING DOMESTICITY

2km

FIG. 37 Calama and
Chuquimata copper mine,
Atacama Desert, Chile

SENSING DOMESTICITY

modern mining industry.[36]

In 2007, the residents had to be relocated due to changes in environmental regulations: Exhaust fumes from the copper smelter as well as the resulting dust forced the move to the nearest town, Calama. A satellite image creates the simile of city and mine (p. 50-51): Almost congruently, the two lie opposite each other in the landscape, feeding one another. The mine, as a place of work, makes Calama the richest city in Chile, while the city itself is supposed to provide living space for the miñeros. Every job in the mine creates three more jobs in the city.[37] Consumption is rising, including that of alcohol or drugs, and so is criminality. The town, inhabited mainly by men, is marked by the hard everyday work in the mine: it is a place of inhabitation whose rhythm is shaped by the search for the neighbouring red gold.

Marea submarine cable, Atlantic Ocean

Deep in the sea, at the bottom of the oceans, fibre optic cables run between deep-sea creatures and microorganisms. They make their way through areas previously uncharted by humans and create a space of light and electricity within these existing ecosystems. A new neighbourhood is emerging: Between data flow and ocean current, a shark sets out to inspect the newly laid cable Marea, Spanish for "tide".[38] It tests its consistency with its teeth. The insulating layer of steel reinforcements, twisted metal wires, as well as copper and polyethylene, remains mostly firm, soon even algae, mussels and other marine organisms will wrap themselves protectively and in symbiosis around the cable.[39] Hundreds of metres above, at the water's surface, the trunk of a cable laying vessel can be made out: metre by metre, with the help of human hands, the cable is rolled from huge spools to finally connect two continents. Shift by shift, the crew of the 140m long „Nexus" takes turns to get closer to the end of the cable spool and thus of the 21-day mission. A section through the body of the ship would show the radical vicinity of small and large scale domestication: the crew's 8m² cabins, equipped with beds, tables or armchairs, are used for sleeping, taking meals or socialising, while only a few metres further, on enormous spools, cables as long as an ocean embody the communication of tomorrow.

36 "Miss Chuquicamata, the Slag," Traces of Nitrate, 2012, https://tracesofnitrate.org/filter/Copper-Geographies/2012-Miss-Chuquicamata-the-Slag.

37 Tjerk Brühwiller, "Chiles Tragende Säule," Neue Zürcher Zeitung, January 14, 2014, https://www.nzz.ch/wirtschaft/chiles-tragende-saeule-1.18220429.

38 World Brain, Arte, 2017, https://www.arte.tv/de/videos/050970-001-A/world-brain/.

39 Shark attacks are a common cause of damage to undersea cables. See Amit Chowdhry, "How Google Stops Sharks from Eating Undersea Cables," Forbes (Forbes Magazine, August 16, 2014), https://www.forbes.com/sites/amitchowdhry/2014/08/15/how-google-stops-sharks-from-eating-undersea-cables/?sh=8344aa31f2b5.

FIG. 38 Cable spool and worker in a cable laying vessel.

FIG. 39-42 exploring the intrudor

FIG. 43-46 small laying plough

FIG. 49 big laying plough

FIG. 47-48 cable laying ship

FIG. 50-52 cable spools

FIG. 53-57 inside the ship

FIG. 58-61 landing zone

Data Center SmartDC, Rotterdam

The "white space" houses the servers - a Cartesian layout of blinking LED lights and whirring cooling systems. Standardised white computer floor panels conceal cooling ducts and fibre-optic cables, which are laid at the same length to eliminate negligible speed differences within the building. Here, the "19-inch server rack replaces the human body as the benchmark for design."[40] And yet the human is not absent from the data centres of the 24/7 data economy but instead adopts the operating time rhythm of automation: Technicians and maintenance workers enter the data centers in their clean outfits at any time of the day to install hardware or perform maintenance. Here, the concept of day and night no longer exists.[40]

Multiplied and distributed around the globe, copper mines, deep-sea cables, data centres or radio towers not only intervene on existing habitats but also draw others after them: as described by Keller Easterling, they act as software that programmes space. They are the medium that often recedes into the background because of the "message": "The activity of the medium - what it is doing rather than what it is saying is sometimes difficult to detect".[41] According to Marshall McLuhan, however, the medium is the message.[42] The medium is architecture and must be treated as such.

40 Ludo Groen and Marten Kuijpers, "Automated Landscapes and the Human Dream Of Relentlessness," Strelka Mag, March 3, 2020, https://strelkamag.com/en/article/reporting-from-automated-landscapes.

41 Keller Easterling, Extrastatecraft - The Power of Infrastructure Space (London, UK: Verso, 2014), p.13.

42 Marshall McLuhan and Quentin Fiore, The Media Is the Massage (Berkeley, California: Gingko, 2001).

SENSING DOMESTICITY
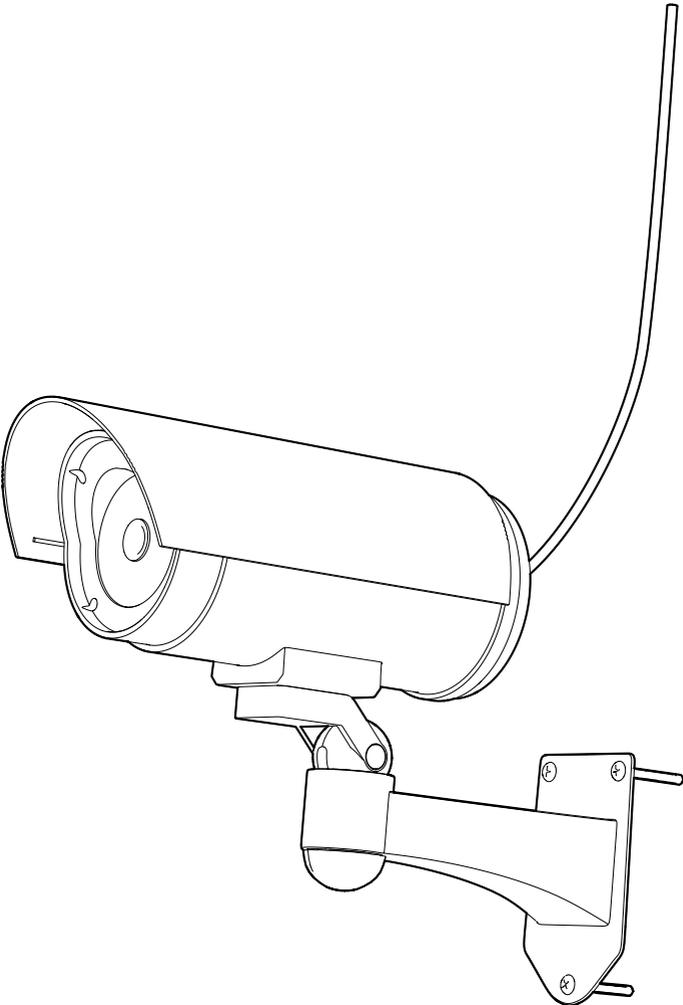
THE (CCTV) CAMERA

From Resolution to Infomation

"Architecture today is immersed in an immense cultural experiment called imaging. We can feel our images changing us. Our relationship to our thoughts, to our sense of time, to the cadence of our attentiveness - all of this is now subject to rapid revision." John May, Signal, Image, Architecture (New York, N.Y: Columbia Books on Architecture and the City, 2019), p.24.

The Object

It peeks out from above building entrances, observing - mostly unnoticed - risk points and spatial lines. Firmly anchored in the façade, three screws hold its plastic body in the air, while black cables embed the camera in its network. The head is rotatable: It changes the field of vision according to interest and focuses the lenses hidden inside: artificial eyes, multiplied and distributed in the built space, become as extensions of our biological eyes the means of spatial appropriation and constant revision.

Image by image, the environment is re-produced to be centralised and re-interpreted elsewhere, detached from physical context.

Pixel by pixel, space is packaged and compressed into data packets that travel as signals from detector to storage, to be finally reprocessed as information.
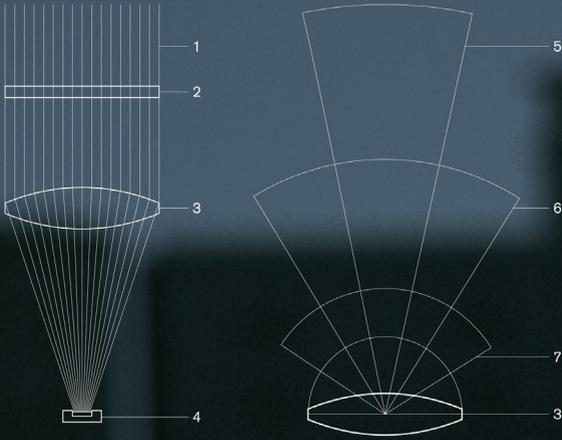
Camera Lens / CCD Sensor

1 Electromagnetic rays (light)
2 Filter e.g. Infrared
3 Optical Glas Lens
4 CCD Sensor
5 24° / 100mm
6 63° / 35mm
7 114 ° / 14mm
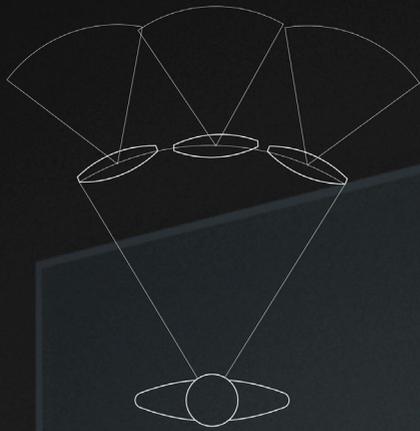
Security Company

Language

 "Unlike photographs, in which scenic light is made visible during chemical exposure, all imaging today is a process of detecting energy emitted by an environment and chopping it into discrete, measurable electrical charges called signals, which are stored, calculated, managed, and manipulated through various statistical methods." John May, Signal, Image, Architecture (New York, N.Y: Columbia Books on Architecture and the City, 2019), p.45.

How the lens and the CCD sensor "speak".

Crucial to the creation of an image by means of a camera are its lenses and its photo sensor. FIG. 65 While the lens focuses the light - an electromagnetic signal - onto the sensor, the latter converts the signal into binary code.
The materiality is decisive for the sensitivity of the sensor. Common sensors, such as the investigated CCD FIG. 66 , are made of silicon that is sensitive in a range of approx. 350 - 1050 nm. Thereby they fall below as well as exceed the spectrum of humanly perceivable light and thus enter the range of ultraviolet and infrared light.

The CCD sensor consists mainly of an infrared filter, a colour mosaic, and the photodiodes that ultimately make up the pixels of the digital image.
The infrared filter protects the sensor from overheating. The colour mosaic filters the incoming light into red, green and blue, and directs it to the photodiodes. Electrons are released on the photodiodes, a process similar to the photo-effect in a photovoltaic system.
The intensity of the light generates an electrical charge proportional to the amount of light, which is stored on the respective photodiode. It is transported through shift registers to the amplifier, and then converted into binary code in the analogue/digital (A/D) converter.[43] FIG. 67

43 Imaging Electronics 101: Understanding Camera Sensors for Machine Vision Applications," Edmund Optics Worldwide, accessed December 20, 2021, https://www.edmundoptics.com/knowledge-center/application-notes/imaging/understanding-camera-sensors-for-machine-vision-applications/.
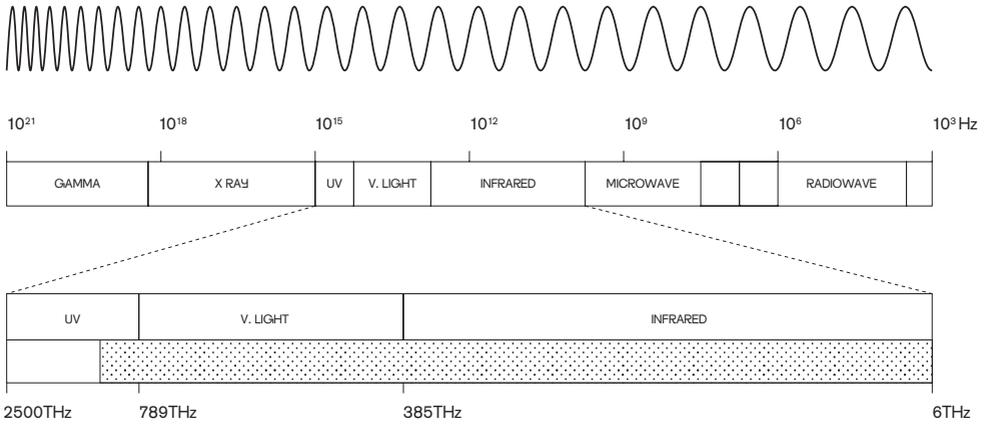
FIG. 64 Spectral ranges: sensitivity of CCD Sensor
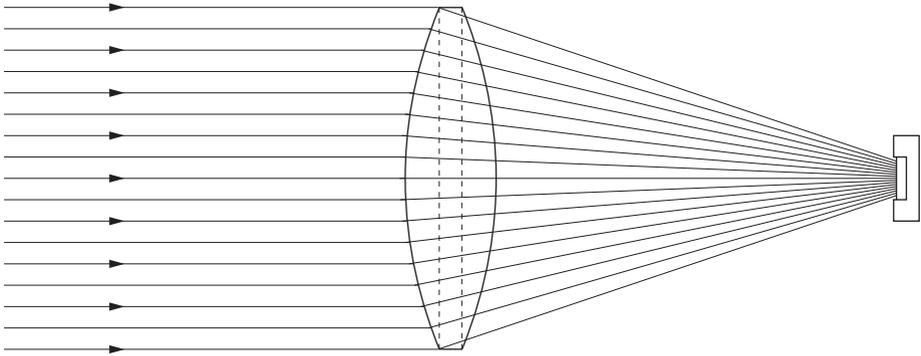
FIG. 65 Interaction of Lens and CCD Sensor

FIG. 66 CCD Sensor

Photodiode / Pixel

0010100010111001010101011...

A/D
Converter

Shift register
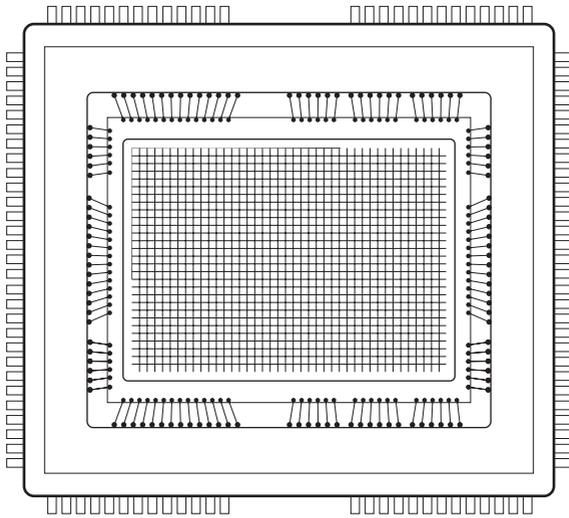
Output
Amplifier
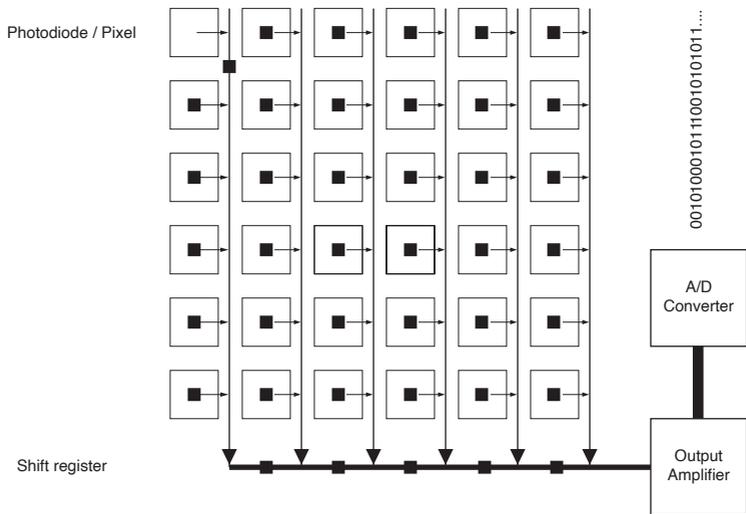
FIG. 67 CCD Sensor: Light is transformed to binary code

Materiality

Silica and Silicon

The 3.6mm thick, diverging lens of the CCTV camera projects an inverted image inwards into its interior, casting an image that cascades through another series of precisely situated inner lenses, eventually landing on the photoactive CCD sensor that registers the image. A process that takes fractions of a millisecond is only made possible through the epochs of geological processes that have given transparency to the silica of which its lenses are made.

More commonly referred to as 'quartz', the mineral is one of the most abundant resources on Earth, manifesting the form of sand along the coasts of passive continental margins. Despite its availability, glass-grade quartz is relatively scarce, and granules used specifically for optics are even scarcer since chemically, the sands must be over 98% pure silica and contain practically no impurities.[44]

The pure white sand, soft as powdered sugar and abnormally translucent at a granular level, has become the centre of a multi-billion-dollar industry of silica and silicon production. Native Americans mined the shiny, glittering mineral and used it for grave decorations and as currency.[45] Nowadays, the material is found largely in two states: silicon that not only composes the CCD sensor in the camera, but also computer chips, packed with transistors numbering in the billions, while silica in its natural state is mined excessively to form billions of decentralised lenses that surveil, monitor and spectate. Eyes of quartz inhabit both the far reaches of the planet's atmosphere in the form of satellite imagers, and the most personal, intimate of interiors, propped up as webcams and anti-theft security cameras.

44 Australian Science Archives Project, "The Giant's Eye: Optical Glass," The Bright Sparcs Exhibition, accessed January 02, 2022, https://www.asap.unimelb.edu.au/bsparcs/exhib/omp/bgrnd/glass.htm.

45 Vince Beiser, "The Ultra-Pure, Super-Secret Sand That Makes Your Phone Possible," Wired , 2018, https://www.wired.com/story/book-excerpt-science-of-ultra-pure-silicon/.

FIG. 68 Silica found in its natural granular state in the form of silica sand.

SENSING DOMESTICITY
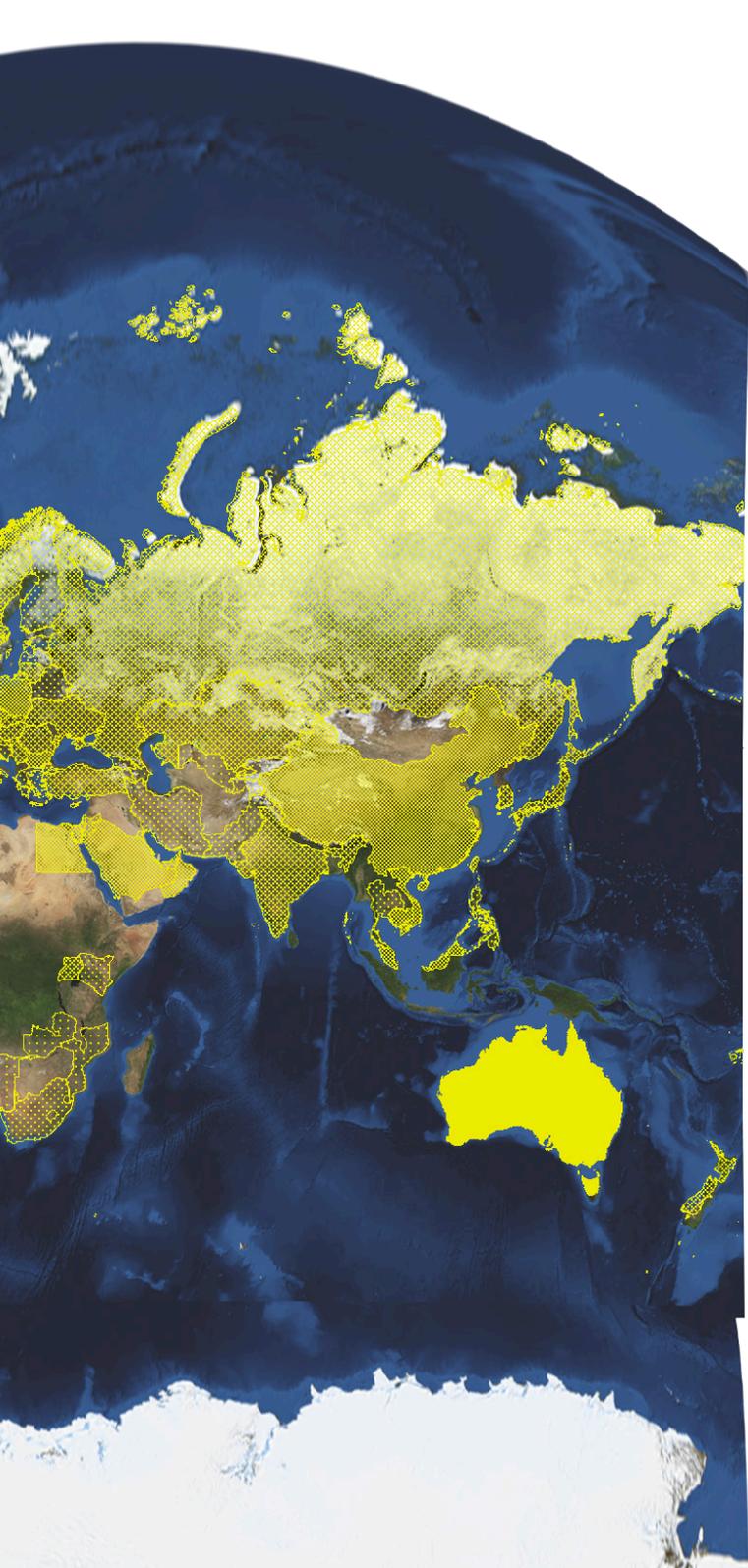
Gross export of Silica Sand (2018)

$ 1k-10k

$ 10k-100k

$ 1m-10m

$ 10m-100m

$ 100m+
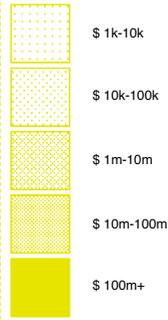
Under-layer:
Composite satellite image, adapted
to IGNF:GLOR77MD projection.
Source: VisibleEarth, NASA

Scale

The range of the CCTV camera is limited to its peripheral vision. It is fixated towards a hotspot of interest. The most valuable view in the house: a direct gaze at the entrance door, recording everyone that comes in and goes out. 24 frames of the view are recorded every single second. The footage is transmitted through an auxiliary cable and fed into a hard drive to be stored temporarily.

Countless other images are perpetually being created in this „interior“: by the doorbell camera or the laptop webcam during an online meeting. The interior is continuously captured at different angles, resolutions and frame rates. The footage becomes frames, the frames become pixels, the pixels become bytes.

The lifecycle of each captured image starts at its reduction into bytes. At the point that light is converted to a signal, a set of bytes, and further to an image, the latter becomes valuable; it is converted from resolution to information.

The converted image extends outwards from the confines of the house, its traces only to be found in the stored, monetised, and datafied bits scattered globally. It is stored on the discs of a 500GB Network Video Recorder, capable of holding 9.7 days of footage.[46] It is transferred intercontinentally over a conference call, tracing the global copper infrastructure. It is saved in a data centre hundreds of kilometers away, stored in the ‚cloud‘, only to eventually be used as a training dataset for a machine learning algorithm.

46 "How Long Can 500gb/1tb/2tb/3tb Hard Drive Record?," Unifore Security, accessed December 30, 2021, https://www.unifore.net/ip-video-surveillance/how-long-can-500gb-1tb-2tb-3tb-hard-drive-record.html.

signal

384-789THz (visible light)

2400MHz

71.920px

329.231px

102.214px

414.201px

320.194px

423.918px

1.920x1.080px
field of view: 70mm

720x480px
field of view: 64mm

❶

❷

❸

❹

❺
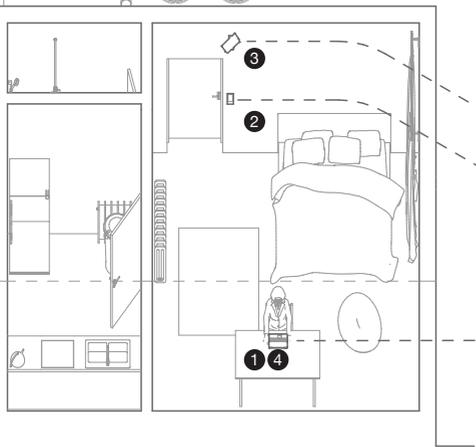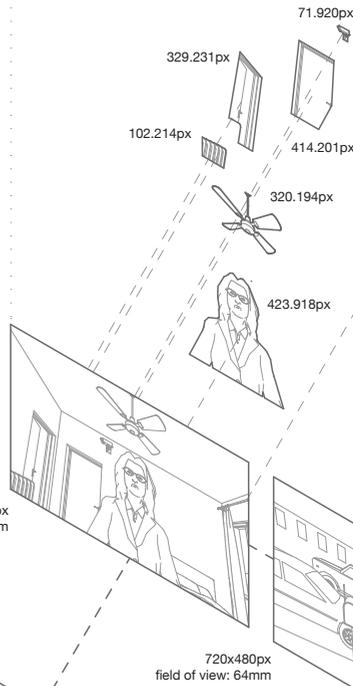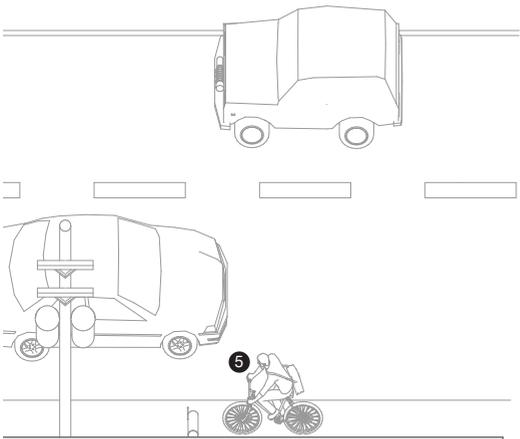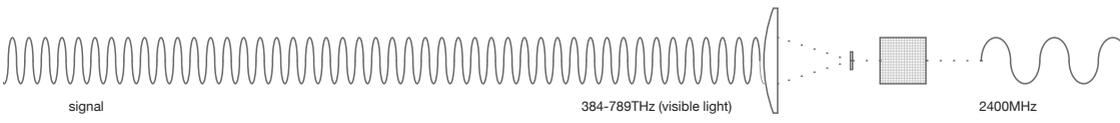
1 webcam

2 video door bell
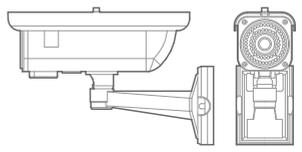
3 cctv camera

digital signal

91.902px

392.291px

83.921px

312.902px

81.832px

243.910px

202.429px

189.429px

251.992px

182.931px

223.412px

203.192px

253.141px

321.192px

383.441px

1.080x720px
field of view: 50mm/

in house storage
(NVR)

6

off-site remote live monitoring
(security firm)

peer-to-peer telecommunication
(conference call)

4

training of data-sets
(data labelling)
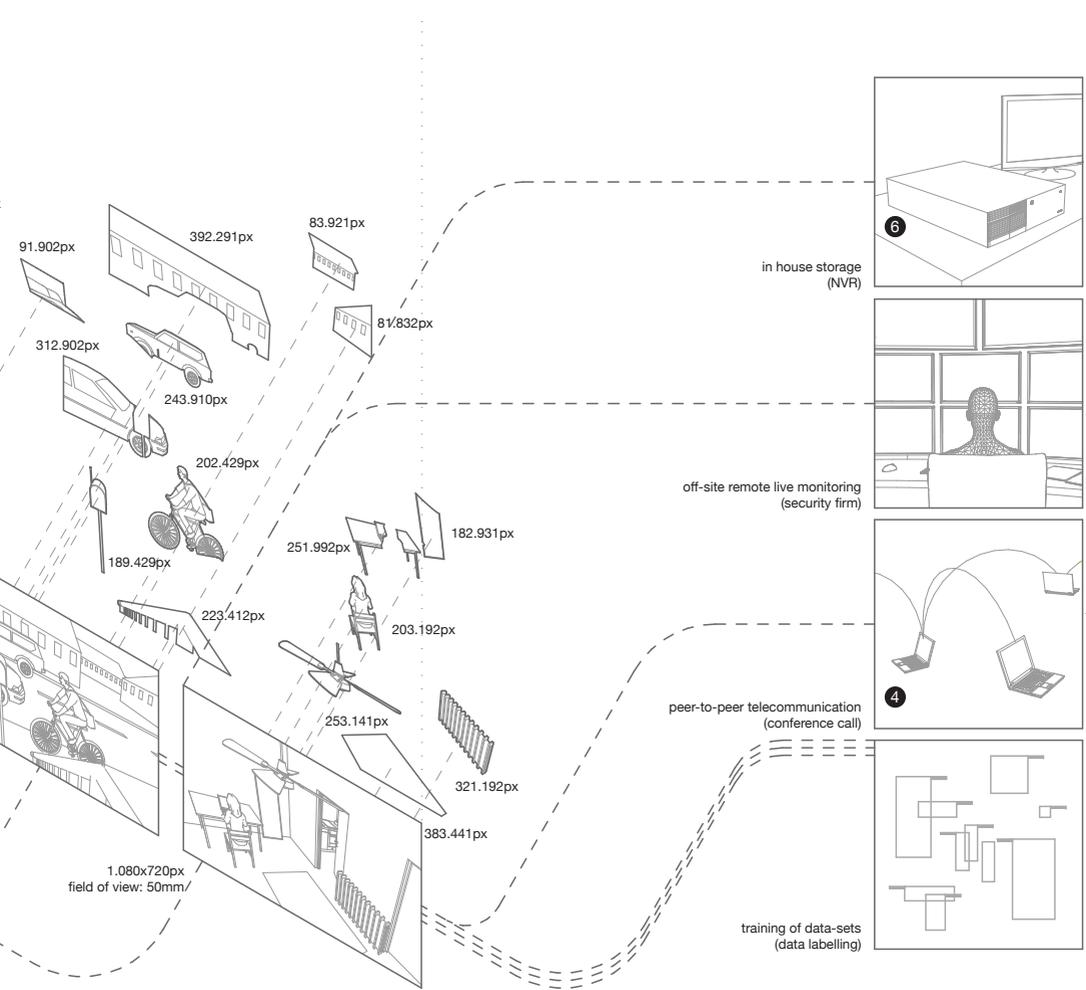
4 laptop

5 smartphone

6 network video recorder

Machine Vision

"This is a resolution target. It measures the visibility of a picture. {...} This is a resolution target. It measures the resolution of the world as a picture. {...} Resolution determines visibility."
Hito Steyerl, *How Not to Be Seen: A Fucking Didactic Educational .MOV File*

The camera has reached societal eye level. Its integration into numerous devices serves not only to represent its environment but also to construct it.

An example of this can be found in the spaces where the camera has long played one of the most important protagonists: the film studios which, since the beginning of the 20th century, have fundamentally contributed to our perception being shaped by images of what we have never seen with our own eyes, but only on the screen.

Here we find the architectural by-product of what these technologies have produced: The Greenscreen. A wall designed to disappear. A wall that constructs a projected virtual environment existing on a two-dimensional plane, detaching a view from a context and collaging it into another. A physical object that constructs an artificial contextuality without being visible itself.[47]

Zooming out of the film studio and into the landscape, we find typologies solely built for the camera itself. Huge fields of different colours and patterns serve the calibration of cameras that circle our globe attached to satellites. Only the existence of these simple patterns allows the camera to record and monitor the complexity of the landscape in optimal sharpness. The landscape as an image could not exist without the creation of a new artificial landscape of precise geometric shapes and extreme contrasts. These constructs are instruments that people use to teach machines how to perceive the world.

Rarely do physical objects act as manifestations of digital data-sets as much as these structures. What is essential for the machine has no semiotic meaning for humans (yet). There is thus a tendency for our environment to take on a new legibility, a machine legibility that necessitates architectural forms whose function overcomes what is obvious to humans - a physical infrastructure that reorients the non-human eye.

However, apart from these architectural structures, the growing use of machine vision in the built environment have resulted in new spatial operations. The machine-enabled ability to enhance our vision beyond the limits of visible light, and 'see' in different wavelengths has further redefined architectural elements in the process of such operations. Thermal imagery, for example, developed initially for use in military technology has adapted to domestic needs, and are becoming increasingly common in cities: infra-red cameras see through the walls of the house, inspecting pipes in case of overheating and cracking.[48]
In landscapes, too, drones equipped with (heat) cameras are used to carry out re-forestation and monitor heat development of burnt forest areas.

From this point of view, cameras can foresee what might happen but needs to be "prevented". The implications are still largely unknown, but they raise questions about the lack of adaptation in architecture: Can cameras influence the role of architectural elements in terms of anticipating threats and protecting against them? Is an architectural border for example something that must exist constantly, or can be created at the moment the machine envisages the need for it?

47 Hito Steyerl, *How Not to Be Seen: A Fucking Didactic Educational .MOV File*, Artforum, 2013, https://www.artforum.com/video/hito-steyerl-how-not-to-be-seen-a-fucking-didactic-educational-mov-file-2013-51651.

48 Fernando Barrera, " Multimodal Stereo from Thermal Infrared and Visible Spectrum," ELCVIA Electronic Letters on Computer Vision and Image Analysis 13, no. 2 (2014): pp. 63-64, https://doi.org/10.5565/rev/elcvia.619.

SENSING DOMESTICITY
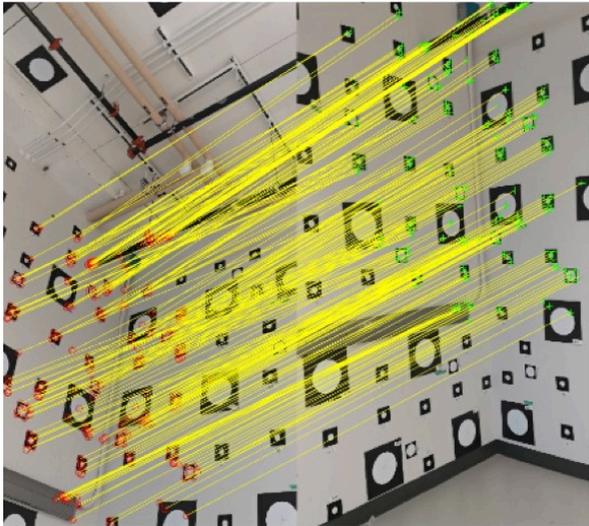
FIG. 73 Human Vision: drone navigating through fog in a coded landscape

SENSING DOMESTICITY

FIG. 74 Machine Vision: drone's
capability to detect code
through fog

FIG. 75 Human Vision: Satellite
Callibration Field
© Hito Steyerl, How Not to Be
Seen.
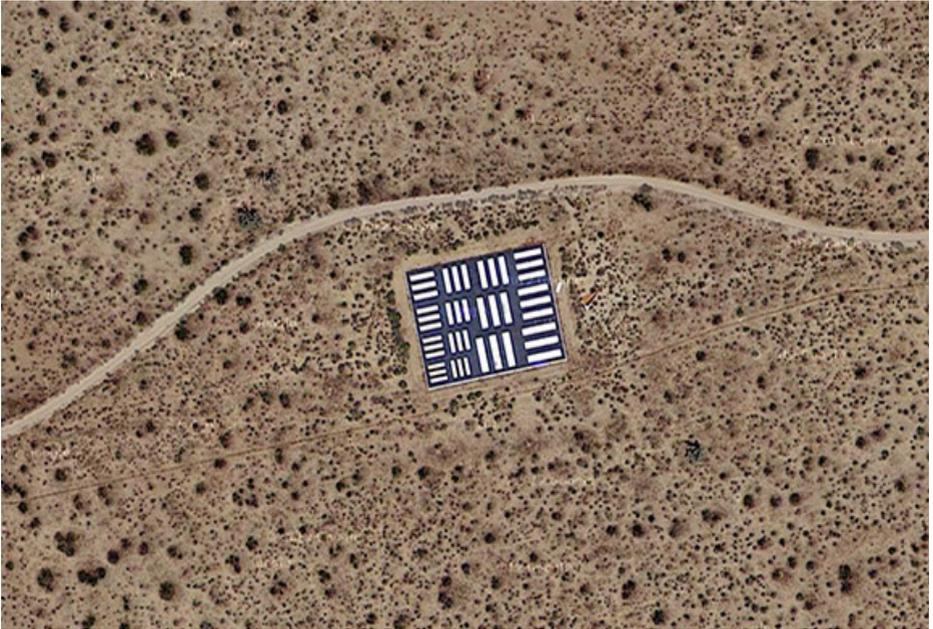
FIG. 76 Machine Vision: Satellite
Callibration Field
© Hito Steyerl, How Not to Be
Seen.
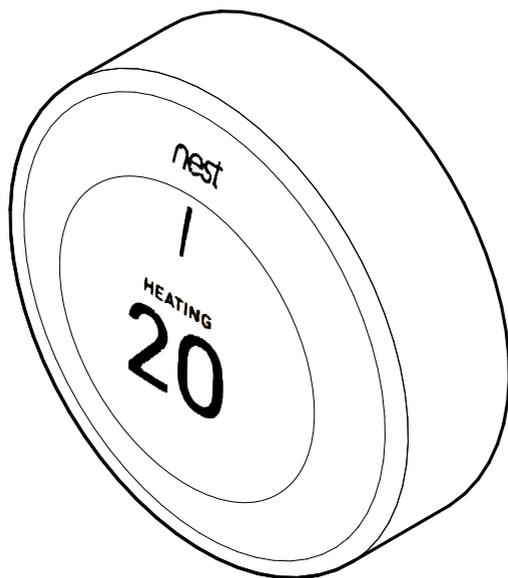
THE THERMOSTAT
From Exterior to Interior

The Ob ject

"Meet the third generation Nest Learning Thermostat."[49]
The small cylinder stands out three centimeters from the wall.
Its shiny ring of polished steel frames the black display. On it,
one can detect four white shining digits: 21°C. And a green leaf.
The message is clear: this device helps to be ever-green, cost-
saving and independent of weather and seasons. But behind
this seemingly simple user interface lies a complex construct of
microscopic sensors that can not only detect the temperature
but also the humidity and ambient light of a room as well as the
position and movement of people in it.

"It's in millions of homes around the world."[50]
The Nest thermostat radiates from blue, green or beige walls around
the world: From old wallpaper, next to squeaky doors, expensive
windows, in corridors and living rooms. It is a fixed component and
operator of these architectures, actively "designing" their interior
climate. First, it constantly analyses its surroundings. One could
claim that this thermostat cartographically records the processes
that take place in these interiors: at what time the front door
closes, when the window is opened or if the user (the occupant)
is present or absent and at what moment he or she finds the given
temperature pleasant.

 "It's even better at learning what you like."[51]
After this cartographic analysis and the comparison to similar user
data, the thermostat begins to anticipate. A "climate design" is
suggested to the user and is continuously adapting according to
the occupant's reaction.

Now, "you are probably thinking, oh, wow, but how?"[52]

49-51 Nest, "Meet the 3rd
Generation Nest Learning
Thermostat," YouTube
(YouTube, November 17, 2015),
https://www.youtube.com/
watch?v=4jp1axFycgQ.

52 Nest, "Introducing the New
Nest Thermostat from Google,"
YouTube (YouTube, October 12,
2020), https://www.youtube.com/
watch?v=20367DapHlc.

SENSING DOMESTICITY

Nest Thermocouple in Nest Thermostat
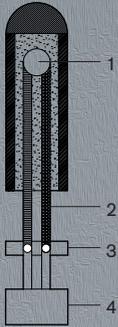
1 Temperature Measuring Junction
2 NiCr-Ni Wire
3 Connection Head
4 Volatge DifFerence Measurement

Language

How the thermocouple "speaks".

Due to its complex structure of a multitude of sensors (Humidity Sensor, Proximity Sensor, Capacitive Touch Sensor, Optical Magnetic Sensor and flexible PCR Antenna FIG. 78), the thermostat communicates in a very broad spectrum. FIG. 77

It detects the visible light of its environment, understands the movement of objects via infrared, sends and receives information by radio waves, just like the Wifi router on 2.4 GHz.

However, the most characteristic sensor for the thermostat is probably the thermocouple, which is responsible for measuring the temperature. Each thermocouple consists of a combination of two rod-shaped metals that make up the appearance and performance of the sensor.

The metal ‚Nickel' forms the basis of the thermocouple, and is mixed as an alloy with other metals, most commonly chromium and platinum, depending on the required temperature ranges. A nickel-chromium composition for example, measures temperatures in the range of -270° to 1000°C.[53]

As soon as the room temperature rises or falls, i.e. a temperature difference occurs in the sensor, the oscillation of molecules in the metals changes. Free electrons start to move from the hot to the cold side along the rods. Due to the different properties of the metals to conduct heat, a voltage difference occurs at the metal ends, which can be measured in millivolts (mV). FIG. 80 Finally, the temperature can be deducted from the voltage measurement.[54]

53 Robert L. Powell and George W. Burns, Thermocouple Reference Tables Based on the IPTS-68: Reference Tables in Degrees Fahrenheit for Thermoelements versus Platinum (PT-67) (Washington, D.C.: U.S. Department of Commerce . National Bureau of Standards, 1975), p.2.

54 "Thermocouple Theory," Capgo, 2013, https://www.capgo.com/Resources/Temperature/Thermocouple/Thermocouple.html.
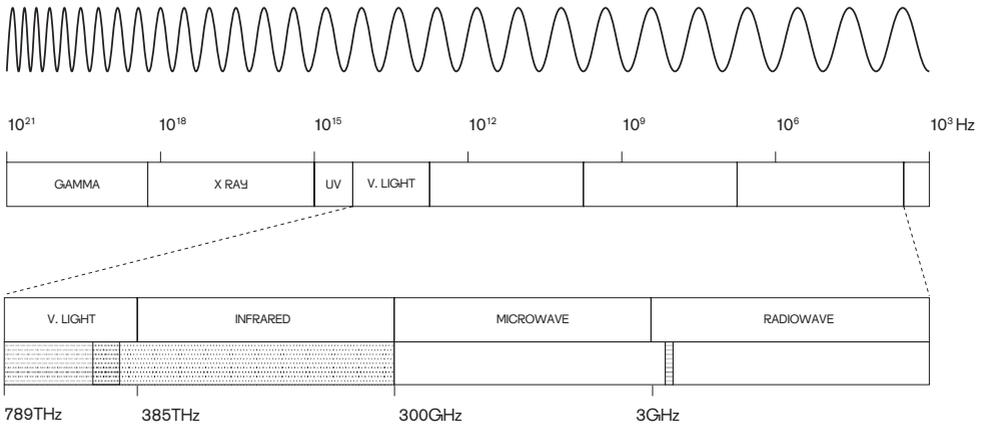
FIG. 77 Spectral ranges: Ambient Light Sensor, Proximity Sensor, PCR Antenna
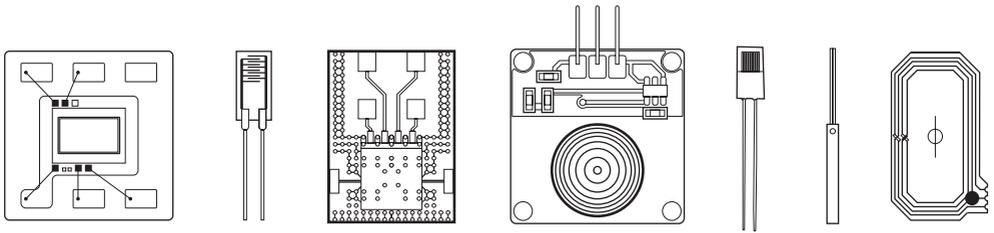
FIG. 78 Ambient Light-, Humidity-, Soli, Capacative Touch-, Thermocouple, Proximity-, PCR Antenna Sensor
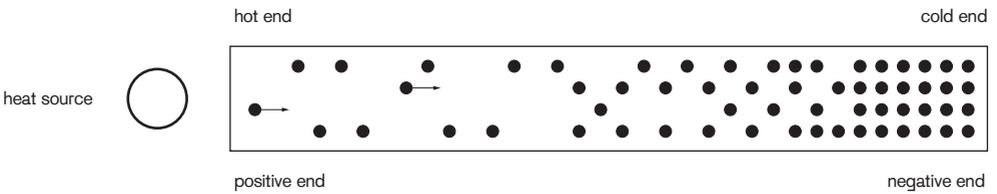
FIG. 79 Free electron movement in metal bar
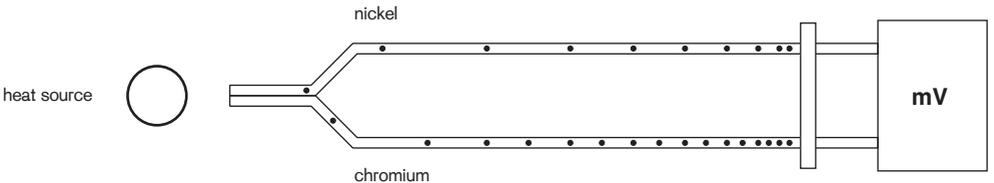
FIG. 80 Chromium Nickel Thermocouple: Seebeck Effect

Materiality

Nickel

In the 15th century mines of central Germany, miners would often unearth a notorious brown-red ore which they believed to be Copper. When attempting to recover the metal from it, the ore would break apart when heated, not yielding anything. Nicknamed 'Kupfernickel', or the 'Devil's Copper', it took until the mid-1700s for the newly named metal 'Nickel' to be discovered.[55]

Nickel makes up only about 0.01 to 0.02 percent of the Earth's crust. It is thought to be much more abundant in the planet's core, which is believed to consist almost entirely of iron and nickel. The metal is found in great quantities in extraterrestrial meteorites.[56] Most of the planet's Nickel deposits are in fact believed to be ancient sites of meteor impacts, with the largest Nickel mine being the Sudbury Crater in Ontario, Canada.

The silvery-white lustrous metal with a slight golden tinge is highly conductive and exceptionally resistant to environmental corrosion. It is one of the most widely used alloying elements, which when mixed with other metals, enhances their material properties, making its applications more versatile. For these reasons, Nickel makes up a fundamental feature of most temperature sensors on Earth and beyond. Nickel composes the alloy thermocouple that makes up both the Nest's temperature sensors and global weather station's thermometers. Continuously expanding and contracting, the metal sets in motion a worldwide dataset of fluctuating temperature values.

55 "History of Nickel," Nickel Institute, accessed December 27, 2021, https://nickelinstitute.org/about-nickel-and-its-applications/history-of-nickel/.

56 "Metal, Iron, & Nickel," Some Meteorite Information, 2022, https://sites.wustl.edu/meteoritesite/items/metal-iron-nickel/.

FIG. 81 Electrolytically refined pure (99.9 %) nickel nodules and processed 1cm³ cube.
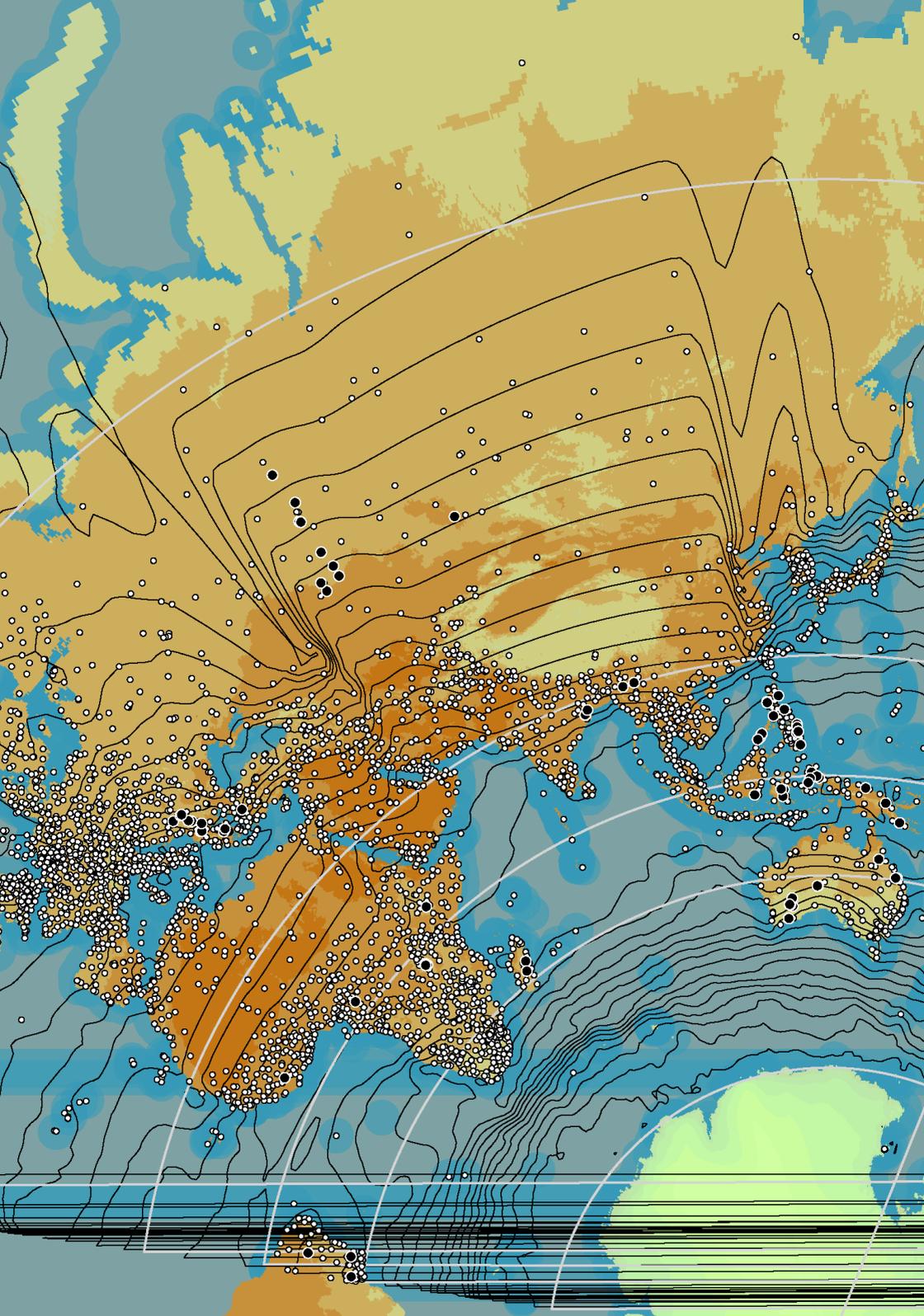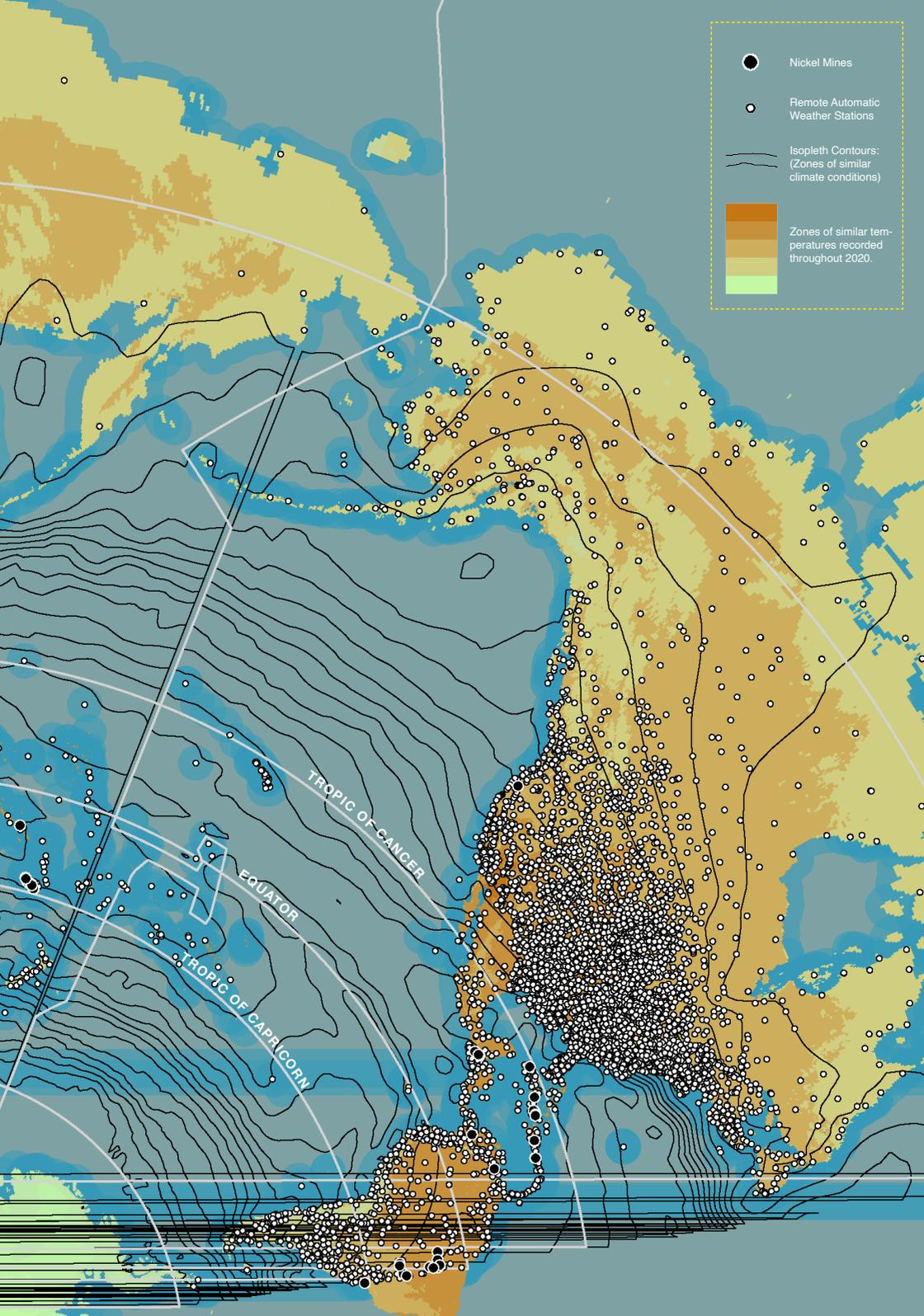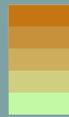
TROPIC OF CANCER

EQUATOR

TROPIC OF CAPRICORN

Scale

After first being installed, the Nest thermostat tracks its location via GPS, recording the address of the user's house. It immediately links to a global network of privately-owned weather stations: 15 satellites, 700 buoys, 3,000 aircraft, 7,300 ships, and some 10,000 land-based stations, each measuring temperature and air pressure.[58] Relating the house's address with the network of weather stations, the Nest establishes a connection across the 2.4GHz band with the closest stations, and starts estimating a tailored weather prediction at the location of the user. By knowing the outside forecast at this calculated point, the thermostat can anticipate interior temperature changes, reacting accordingly.

Within the confines of the house, a set of remote temperature sensors, strategically placed across the interior, connect through WiFi with the thermostat to extend its reach. They passively measure the fluctuating temperature, letting the Nest know the thermal state of each room. While gathering the interior's temperature data, the thermostat simultaneously sends signals to the so-called 'HeatLink': a mediator between the thermostat and the house's heating system, which maintains a constant connection through a wireless mesh network.

The web of overlapping wireless signals create an 'intelligent' sensing, thermal ecosystem which adapts between the needs of the market and the user. This newly constructed global network becomes a shared site, constructed from a planetary grid of 'interior climates'.

58 "Collecting Weather Data," Lumen Physical Geography, accessed January 5, 2022, https://courses.lumenlearning.com/geophysical/chapter/collecting-weather-data/.

437Mhz   signal   2400Mhz

17 ☐ 022
19 ● Weather Station A
④⑤⑥⑦

21
19

③
17 ☐ 023
6

2

19
18

17 ☐ 022
19 ● Weather Station B
④⑤⑥⑦

21

G
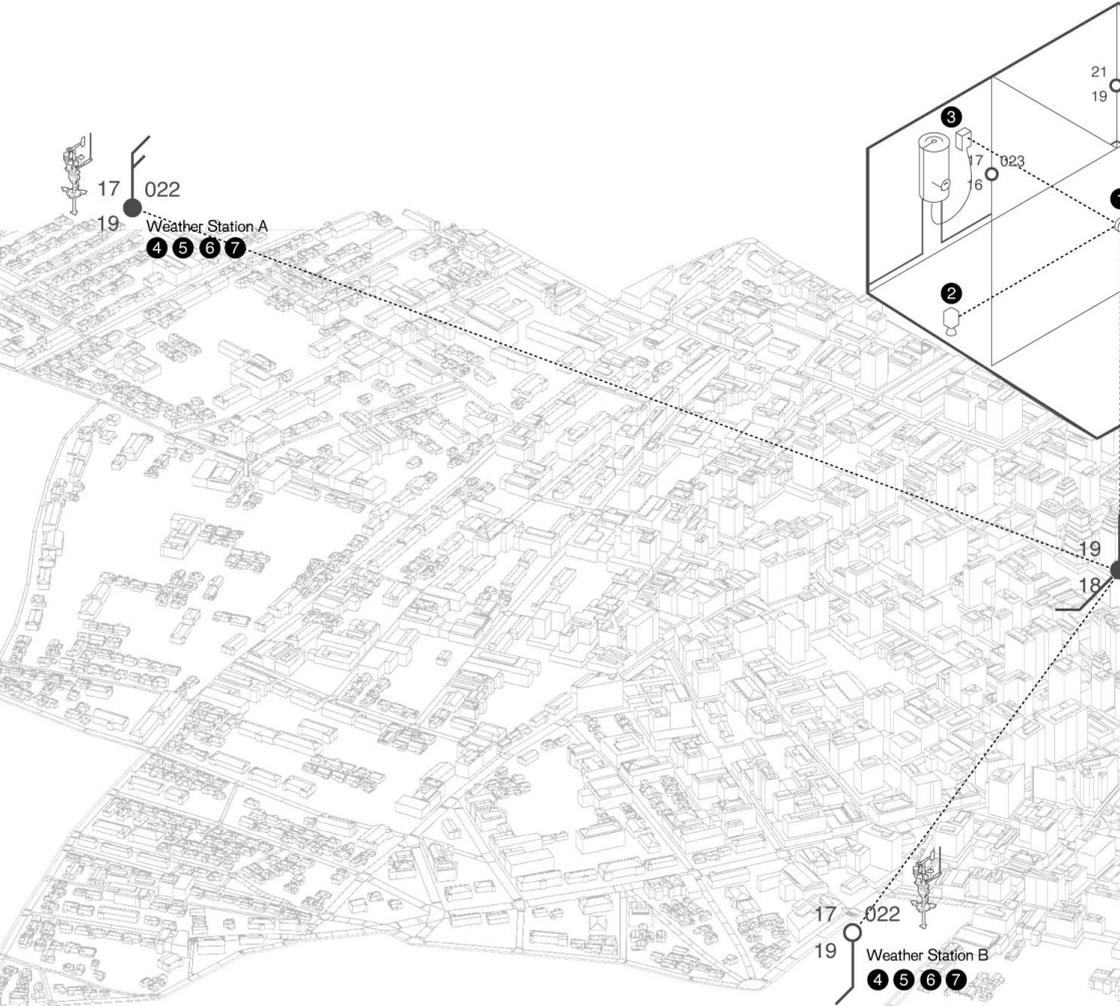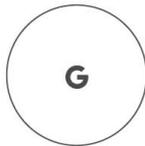
1 nest thermostat   2 remote sensor   3 heat link   4 temperature and humidity sensor
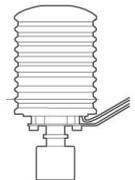
079

23　78
19

082
Predicted Weather

17　022
19

Weather Station C
8
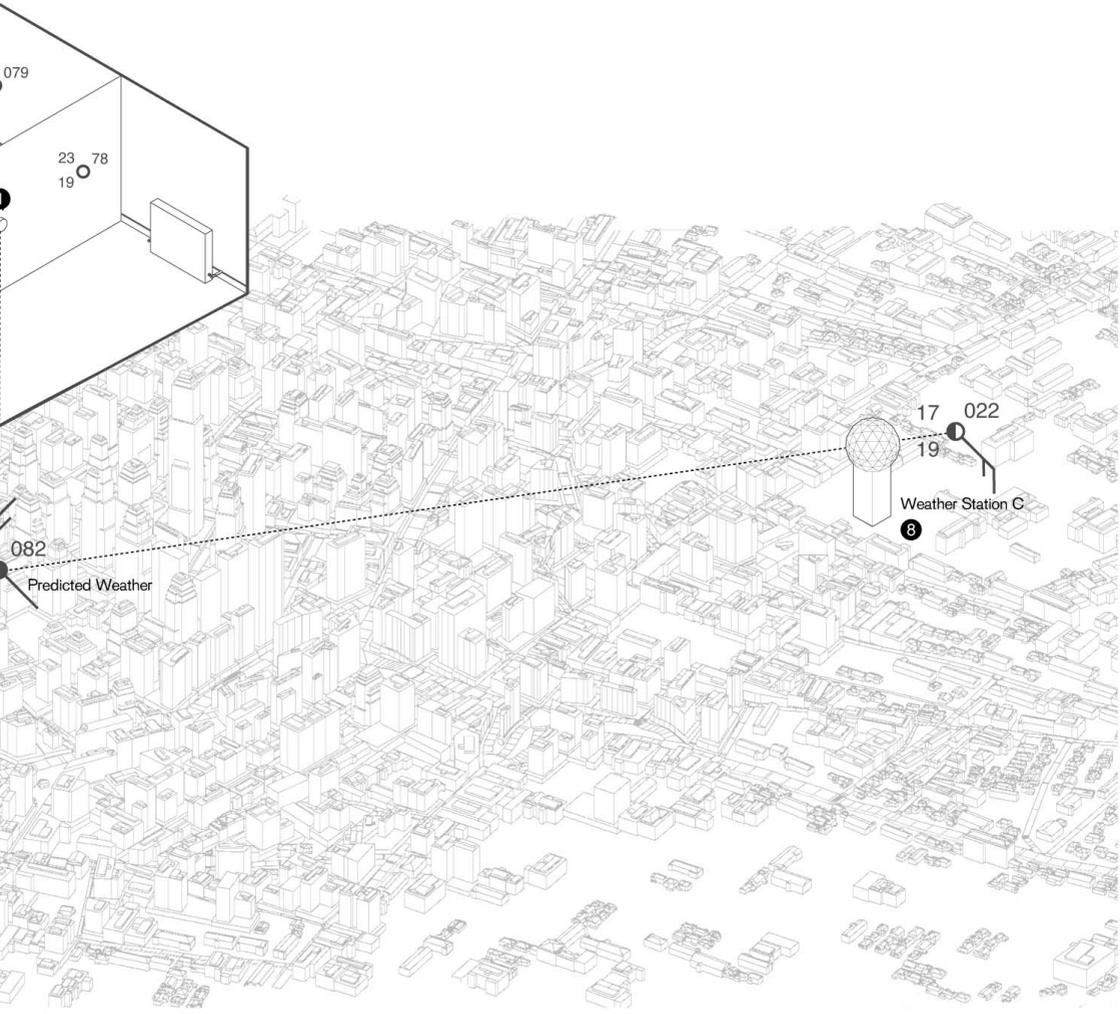
5 soli sensor
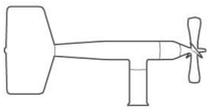
6 wind sensor

7 437 Mhz antenna
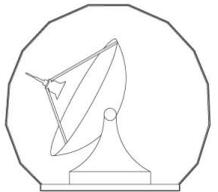
7 weather radar antenna

Interior Weather Maps

The interior climate finds itself in the centre of a planetary field of conglomerate giants. Since 2013, Nest is in several partnerships with global electric companies and energy providers, that have started promoting the technology with the promise of lowering customers' power consumption. Home insurance firms have also seen massive monetary potential in the 'Nest', since the thermostat could potentially be used to tell when the heat breaks, and by extension, when the pipes freeze or when the power goes out.[59] With Google's resources, Nest's partnerships could expand still further to development contractors, commercial builders, and deeper into the field of construction. Speculating on the availability of all the data that is connected to a Nest ID and collected by Google, this chapter maps out fictional interiors.

The rendered data forms one weather map that confuses the idea of inside and outside, to the degree that the outside becomes a singular point of reference in the innermost of the inside, a coordinate dictating the centre of the interior. FIG. 82 This centre point is a data point. It consists of information about the size of the sensed interior, a precise record of its energy consumption, the presence or absence of its users and a precise weather forecast for this exact location, made possible by thousands of weather stations scattered across the globe.

Around this centre point, spatial information evolves purely through the difference in gathered data: From the difference in temperature between the weather forecasted outside and the sensed interior temperature in combination with the energy consumed we can estimate the volume of a space.

59 Casey Johnston , "What Google Can Really Do with Nest, or Really, Nest's Data," Ars Technica, January 16, 2014, https://arstechnica.com/information-technology/2014/01/what-google-can-really-do-with-nest-or-really-nests-data/.

~ 35m2 15kWh/d

47°34.4'N 009°02.3'O

16°C 37% 1207Pa
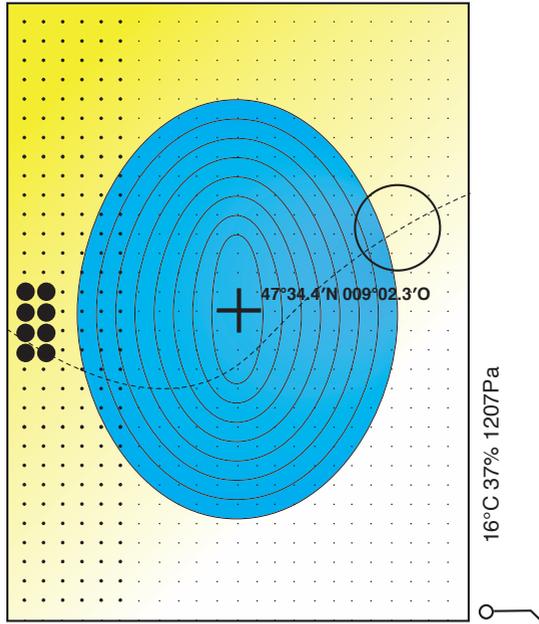
FIG. 82 Interior Weather Map 1

As more sensors are integrated in the interior, not only does the precision of the estimated volume increase but also the capacity to detect energetic differences that occur between the sensors themselves. As a result, it becomes possible to record energy flows within the interior - the flow of temperature, light and humidity. FIG. 83

These cartographies do not only contain weather information but also human behavior, that is directly linked to the "climatic changes" of the interior. By tracking the users' position within the interior, patterns of their climatic preferences are recorded.

The constant mapping of all that has been described allows finally a forecast that acts as a blueprint for the thermostat to react accordingly, with the aim of creating the most comfortable environmental and financial climate for the user.

With each user that logs into Nest's system, the data pool grows. FIG. 84 One interior weather map becomes an atlas of thousands, each centre point symbolising its dependence on the others. From exterior to interior: What was once "outside" is now only the space of differences between multiple insides.

60 homeostasis: a relatively stable state of equilibrium or a tendency toward such a state between the different but interdependent elements or groups of elements of an organism, population, or group. from Merriam-Webster.com Dictionary, s.v. "homeostasis," accessed January 18, 2022, https://www.merriam-webster.com/dictionary/homeostasis.

SENSING DOMESTICITY

~ 50m2 22kWh/d

47°34.4'N 009°02.3'O

12°C 22% 1089Pa
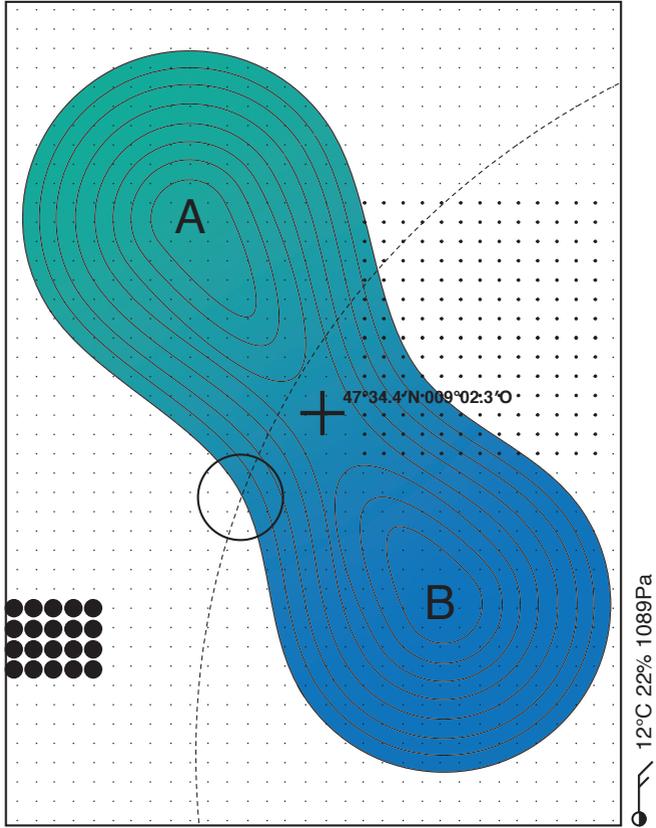
FIG. 83 Interior Weather Map
2: Temperature flow between
sensor A and B
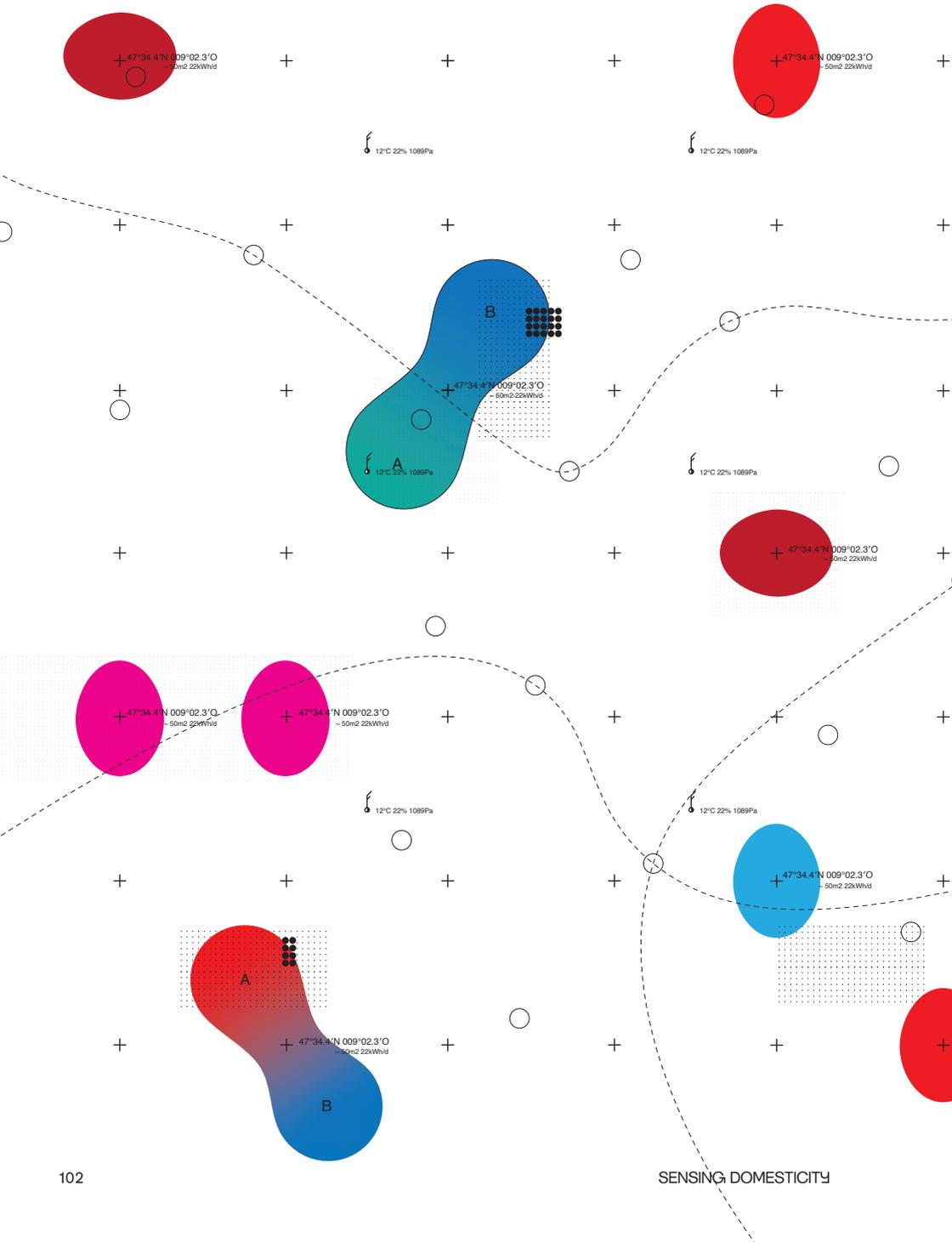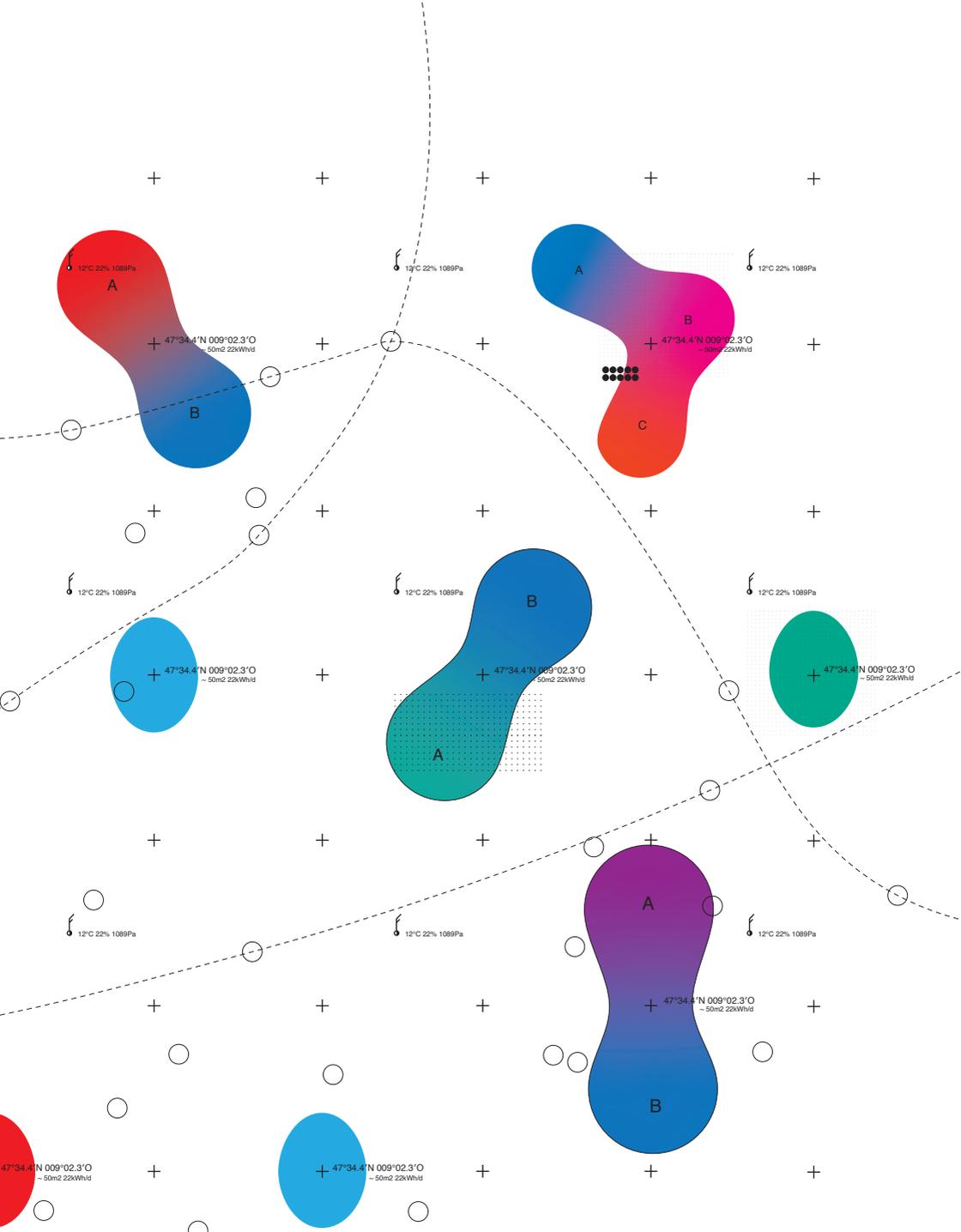
FIG. 84 One shared interior weather map.

AES Indiana
Alliant Energy
Ameren Missouri
Appalachian Power
APS
Austin Energy
AutoGrid Flex Saver
Beat the Peak
BGE
Blue Ridge Energy
Cape Hatteras Electric Cooperative
Cape Light Compact
Carteret-Craven Electric Cooperative
CenterPoint Energy
Clean Power Alliance
CNG and SCG
ConEdison Electric
ConEdison Gas
Connexus Energy
Consumers Energy
Cooperative Rewards
CoServ
CPS Energy
Delmarva Power
DTE
Duke Energy
Duke Energy Florida
Duke Energy Indiana
Duke Energy Progress
El Paso Electric
Energy Provider
EnergyUnited
Entergy New Orleans
Evergy
Eversource
Farmers EC
Georgia Power
Green Mountain Energy
Guadalupe Valley Electric Cooperative
Jones-Onslow Electric Membership
Cooperative
LADWP
LES
Local Energy Provider
Local Utility

Lumbee River Electric Membership
Corporation
Madison Gas and Electric
Magic Valley Electric Cooperative
MidAmerican Energy Company
MidSouth
MVEC
National Grid
National Grid NY Gas
National Grid Upstate New York
Northeastern REMC
NYSEG
OhmConnect
Omaha Public Power District
Orange and Rockland
Peak Savers
Pepco

PG&E
Piedmont Electric Membership
Corporation
Portland General Electric
Poudre Valley REA
Power Provider
PowerShift
PSEG Long Island
Reliant
RG&E
Roanoke Electric Cooperative
Sawnee EMC
SDG&E
Smart Savers California
Smart Savers Ontario
Smart Savers Texas
Sonoma Clean Power
South Fork Peak Savers
South River Electric Membership
Corporation
Southern California Edison
SRP
Touchstone Energy Cooperatives
United Cooperative Services
United Illuminating
Unitil
Westerville Electric Division

FIG. 85 Nest's partnership with global electric companies energy providers.

SENSING DOMESTICITY

TOWARDS A WORLD INTERIOR

Reflection and Outlook

"The interior steps outwards, it is as if the citizen was so sure of his consolidated prosperity that he spurns the façade to declare: my house, wherever you may cut through it, is a façade: the street becomes room and the room becomes street, the contemplating passer-by stands, as it were, in the bay window." trans. by the authors from Walter Benjamin, *Das Passagen-Werk* (Frankfurt am Main: Suhrkamp, 1982), p.512.

The planet has become domestic. The large scale implementation of sensor technology accelerates the process of datafication of our world. Constant monitoring, analysing and controlling is not only constructing the world we inhabit by description but also forming it actively by building. The house has become a multimedia device, constructed of a diverse set of sensors, which are integrated into wifi routers, cameras, or thermostats. Their agency reaches far beyond the walls of the stereotypical house we imagine. A new type of house is created - manifested in the material infrastructures that the performance of the house necessitates. The house is not only a wifi router, it is a copper mine of untapped resources. The house is not only a camera, it is a focusing target in the landscape. The house is not only a thermostat, it is a weather station. Lastly, the house itself is a strategy of domestication. And as it constantly expands and solidifies its connections, the house is part and parcel of one sensing interior: *The World Interior*.

In our investigations on the wifi router, the camera and the thermostat, each concluding chapter has reflected on the respective object describing a new domestic condition: The Inhabited System, Machine Visions and Interior Weather Maps. However, those outlooks must also be considered in interrelation with the other objects. Thus, in each of the three objects studied

and in their agency, we find an inhabited system, a new meaning of machine legibility of the built environment, and new understanding of interiority. This is no coincidence: dissecting the objects, we notice that they form different kinds of assemblages of the very same sensors. The thermostat is at the same time a camera, while the camera, like the wifi router, is also an antenna. This interoperability of these technical objects naturally causes an overlap of the physical infrastructures needed to generate the performance of the objects. Interactively, they reinforce each other's existence: The cable-laying ship, whose primary mission is to create a new transcontinental data link, holds also a weather station feeding information into the planetary weather system. The weather balloon, which collects atmospheric data, is instrumentalised to enable data transmissions by the means of light itself.

The three gained domestic notions have not only opened up related sites as architectural planning fields but have also enabled us to speculate on the "role of the building" in the 5th degree of domestication.

The Inhabited System: "The building as system."

The building is on the one hand the consequence of infrastructural action, on the other hand, its condition. As buildings are shaped by infrastructure, they have become a medium of information themselves. The information is contained in invisible activities that dictate how objects and content are structured and distributed. Infrastructure is an operating system for shaping the building and its environment. From Proximity to Distance we have traced the system bound to the Wifi router which has led to the site of copper extraction, the birthplace of the material hidden in the wifi's antenna. The outgrowth of the world biggest copper mine is evident. It is not only a gigantic inverted mountain that shapes the man-made landscape, but its structural equivalent: the city of Calama. The systematic extraction of the earth's layers is reflected in the monotonous grid of the city. Its economic dependence on mining dictates the daily life of the city. However, this dependence can also be understood the other way around. Without the houses of the mineworkers, the mine could not exist. Only by making the landscape habitable can the landscape be extracted. Only by building the house, can the house domesticate the landscape.

Machine Visions: "The building as code."

The building is visible, not only to humans. The integration of the camera creates a tendency in which our environment acquires a

new legibility, a machine legibility that generates architectural forms whose function overcomes what is obvious to humans. A new language emerges, digital code inscribed in materiality that informs, calibrates and navigates the machine eyes. The results of this, however, are not only encoded architectural elements, but also the spatial operations made possible by their existence. Through its material and formal nature, the camera becomes an energy detector capable of rendering energetic flows: It is able of detecting and controlling temperature, humidity or light conditions. It is thus capable to expand the classical set of architectural elements to include different data spheres.

Interior Weather Maps: *"The building as mediator."*

The building's inside and outside collapse. The constant recording of temperature changes of the 'inside', its comparison with calculated site-specific weather forecasts of the 'outside' and the combination of this data in global data banks finally confuses the idea of the interior and the exterior or ,inside' and ,outside'. The building becomes an inter-face that mediates but does not separate.

BUILDING AS SYSTEM

INFORMATION ENCODED INTO LIGHT

AUTOMATED URBAN MINE

POLAR BEAR SENSOR

RADIO STRIPE

CODE TRANSCRIBED INTO MATTER

SOLAR ENERGY

HOT WATER STORAGE

BUILDING AS CODE

WEATHER INTERFACE

BUILDING AS DEVICE

The Interiorized World

communication	security	comfort		not included	relicts
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM		BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM		BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM		BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM		BUILDING AS SYSTEM	BUILDING AS SYSTEM
BUILDING AS SYSTEM	BUILDING AS SYSTEM	BUILDING AS SYSTEM		BUILDING AS SYSTEM	BUILDING AS SYSTEM

GIZMOS

2:1
1:2
1:5
1:20
1:200

2:1

measurements
in mm

10

2

14

thermocouple

2:1

measurements
in mm

10
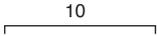
2

10

humidity sensor

2:1

measurements
in mm

10

2

2

ambient light sensor

2:1

measurements
in mm

10

34
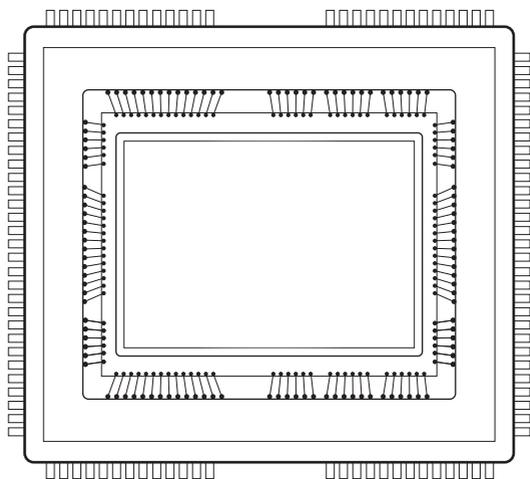
30

CCD sensor

2:1

measurements
in mm

|— 10 —|

12

17

soli sensor

2:1
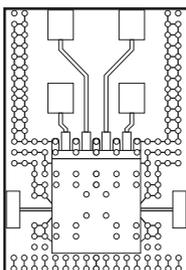
measurements
in mm

10

9
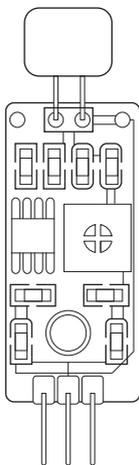
30

microphone

2:1

measurements
in mm

10

14

17
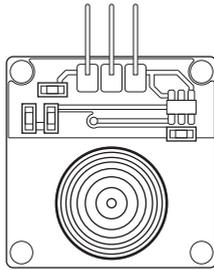
capacative touch sensor

2:1

measurements
in mm

10

23
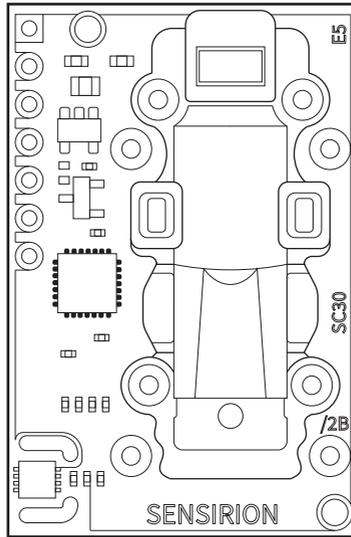
E5

SC30

/2B

SENSIRION

35

CO Sensor

2:1

measurements
in mm

10

3

32

proximity sensor

2:1

measurements
in mm

10

20

20

lens

2:1

10

25
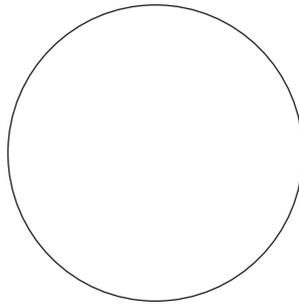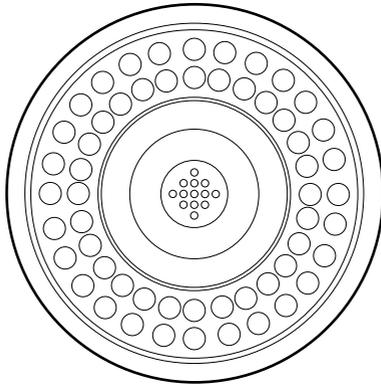
optical glas fibre submarine cable

2:1

measurements
in mm

10

32
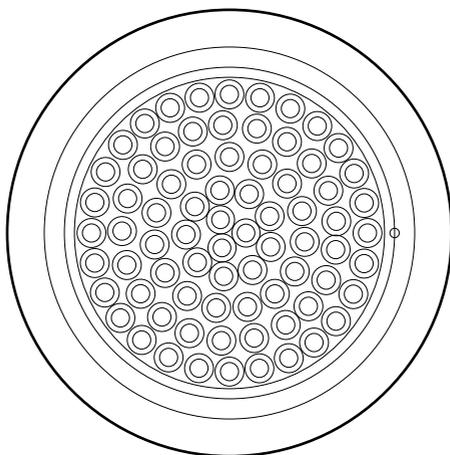
telephone cable

1:2

measurements
in mm

40

84

21
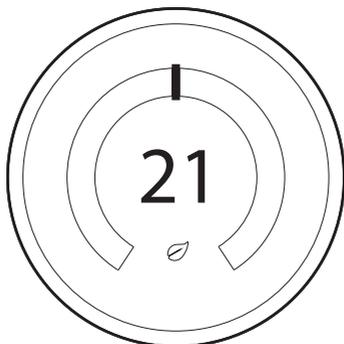
nest thermostat

1:2

measurements
in mm

40

50

G
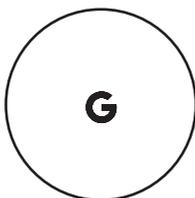
nest remote sensor

1:2

measurements
in mm

40

117
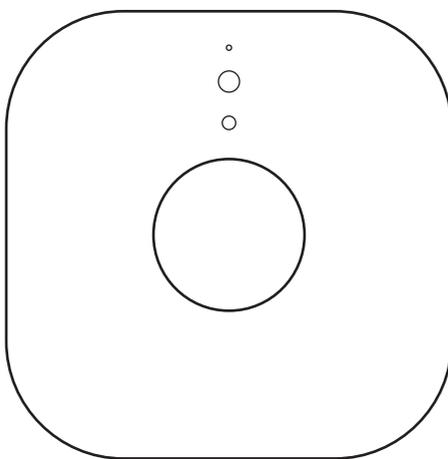
heat link

1:2

measurements
in mm

40
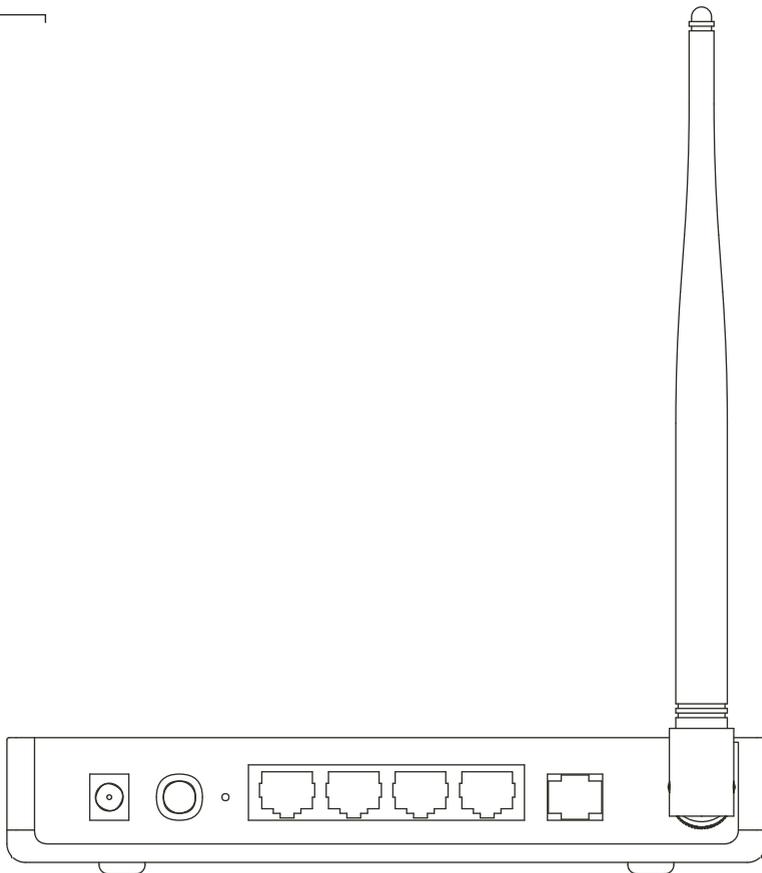
144

200

wifi router

1:2

measurements
in mm

40
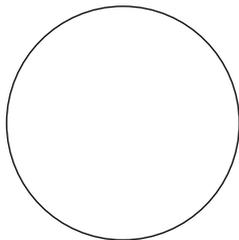
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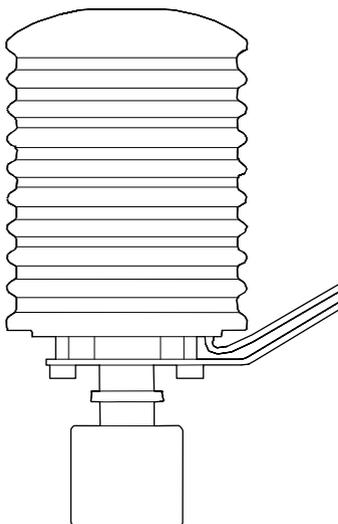
340

temperature and humdity sensor

1:2

measurements
in mm

40
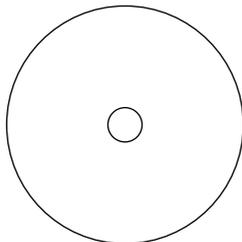
170
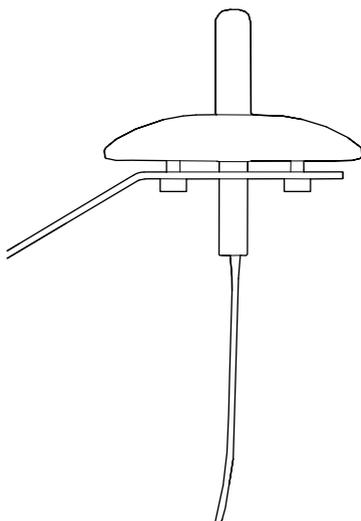
160

solar sensor

1:2

measurements
in mm

40

190
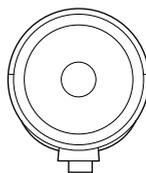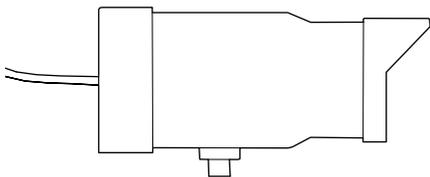
80

camera

1:2

measurements
in mm

40
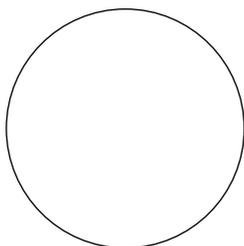
150
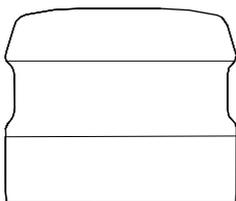
130

radar

1:5

measurements
in mm

100

620
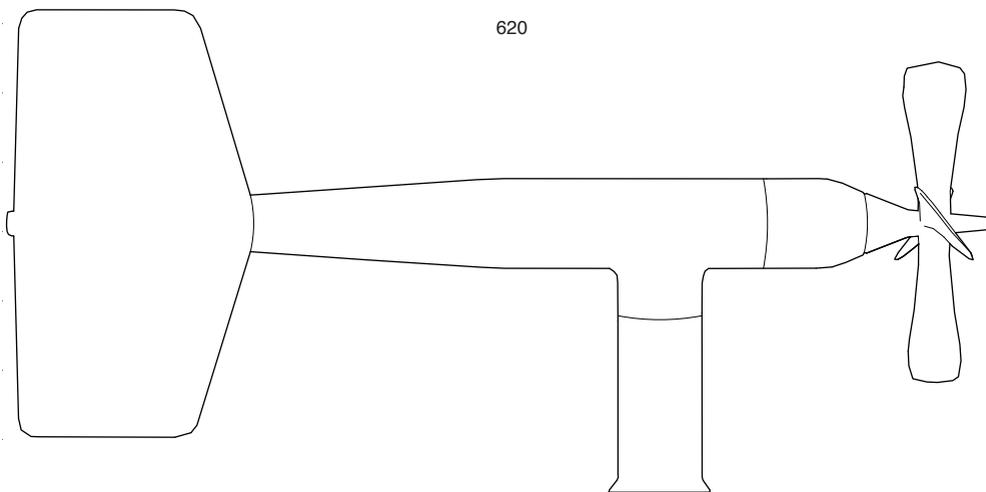
wind sensor

1:5

measurements
in mm

100

12

740

radar

1:5
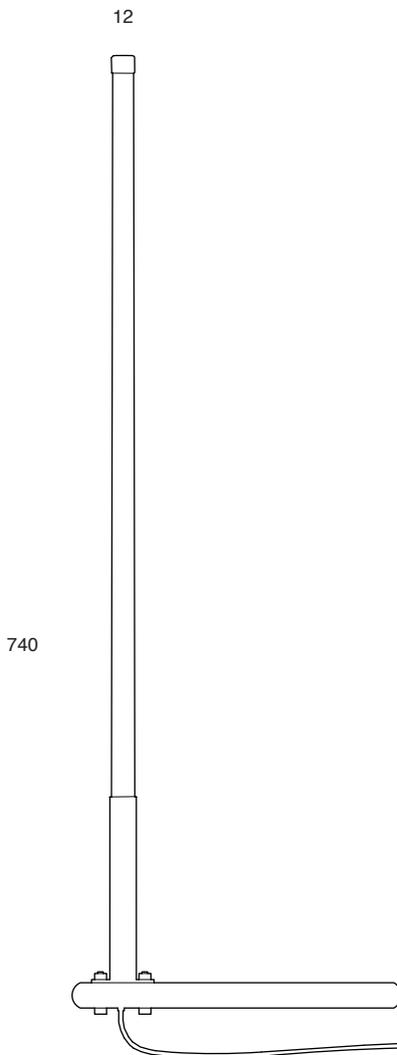
measurements
in mm

100

650
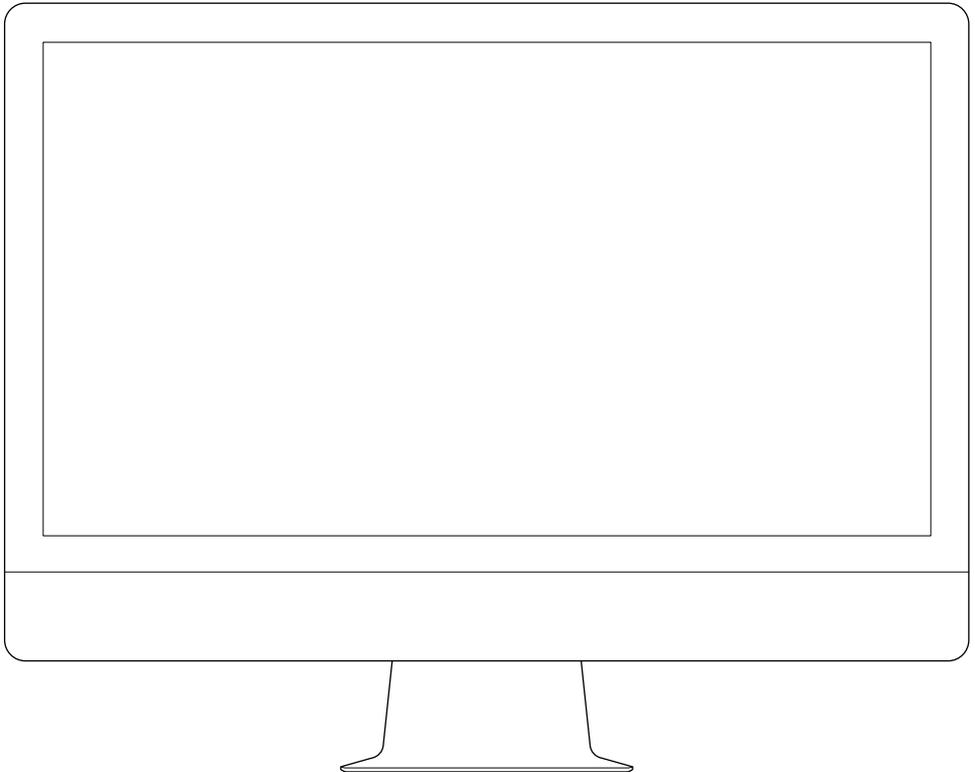
computer screen

1:5

measurements
in mm

100

350
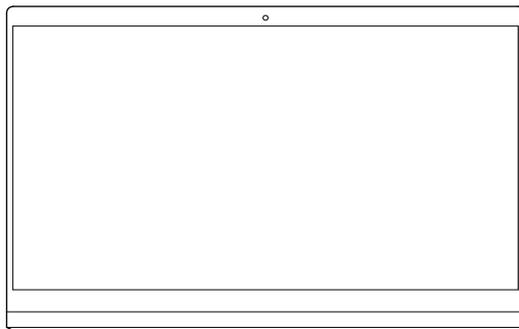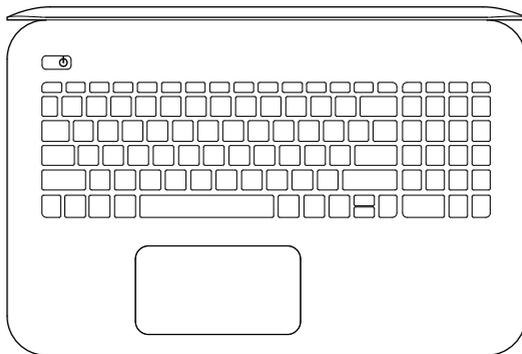
laptop

1:5

measurements
in mm

100

70
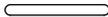
143

iphone

1:5

measurements
in mm

100

275
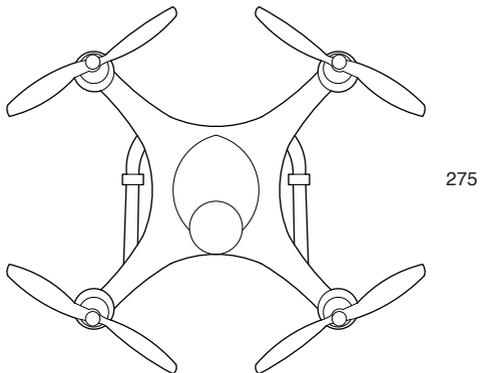
275
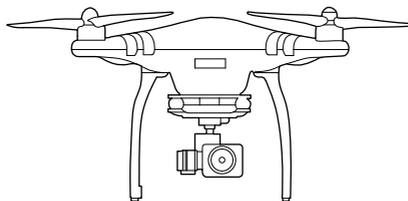
camera drone
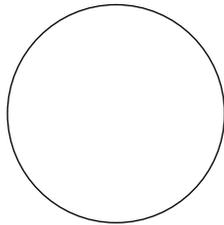
1:5

measurements
in mm
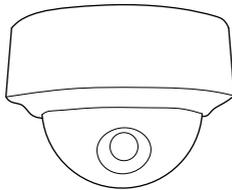
100
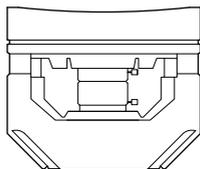
106

126
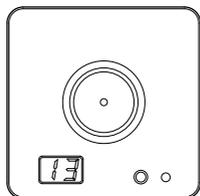
126

motion detector

1:5
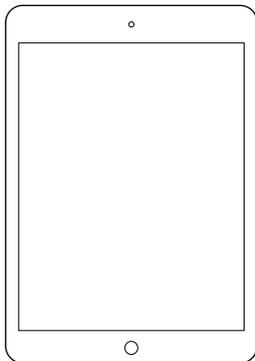
measurements
in mm

100

150

115

cctv camera
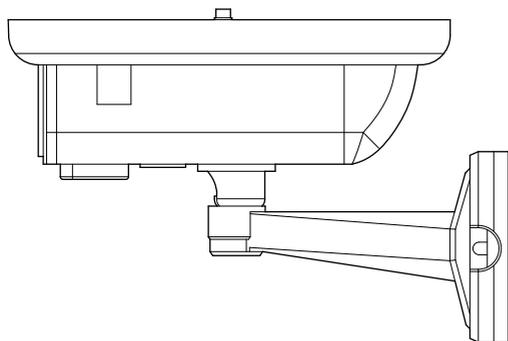
1:5

measurements
in mm
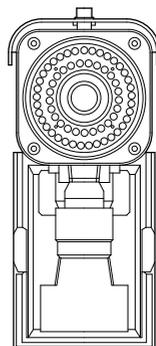
100

170

240

tablet

1:5

measurements
in mm

100

300   100

219

infrared cctv camera

1:20

400
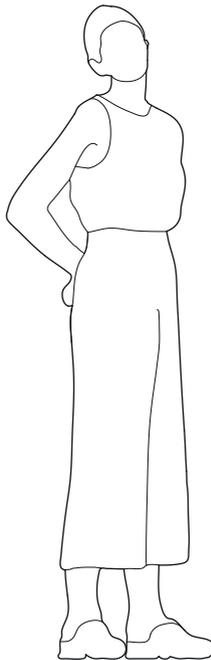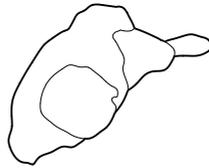
1720

human

1:20

measurements
in mm

400
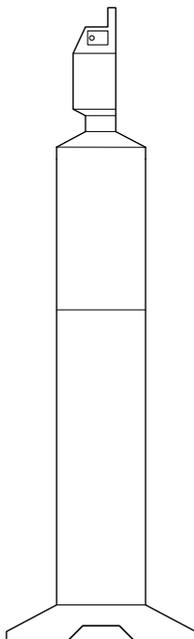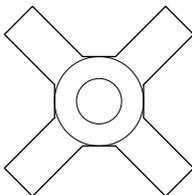
2000

500

profiling float

1:20

measurements
in mm

400

1124
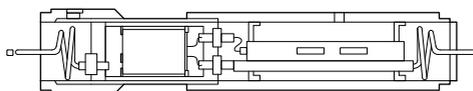
220

cable repeater

1:20

measurements
in mm

400

1860
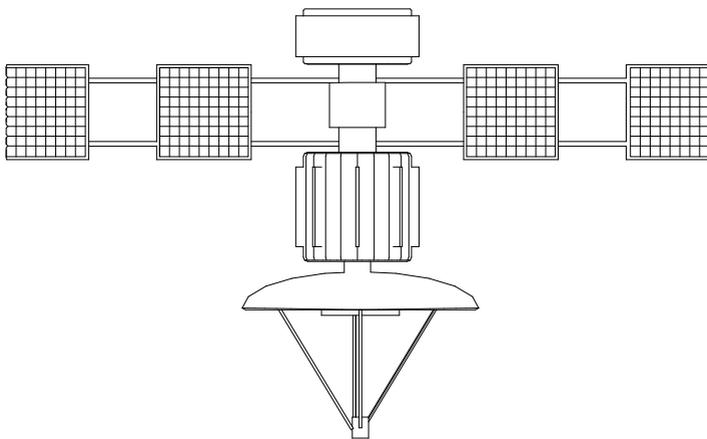
satellite

1:20

measurements
in mm

400

750
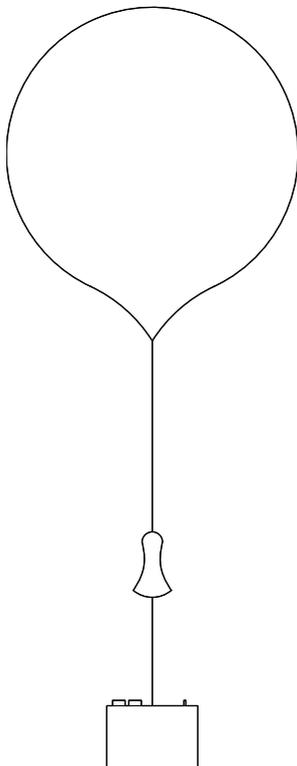
2000

weather balloon

1:20

measurements
in mm

400

740
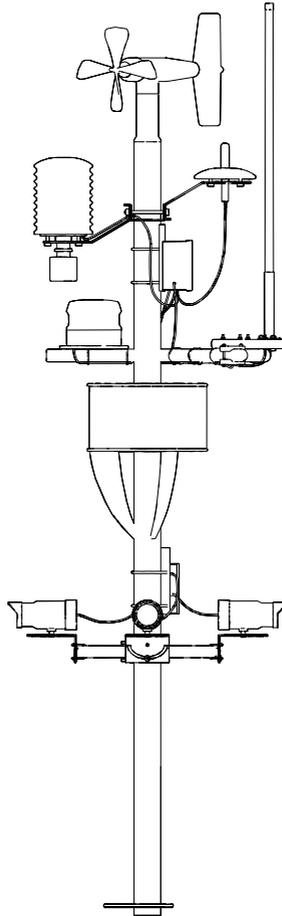
2400

weather station

1:50

measurements
in mm

1000

4750
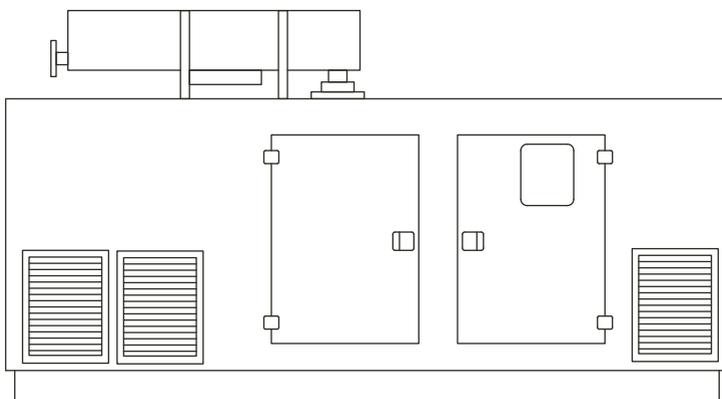
2600

generator

1:50

measurements
in mm

1000

500

2000

server rack

1:50

measurements
in mm
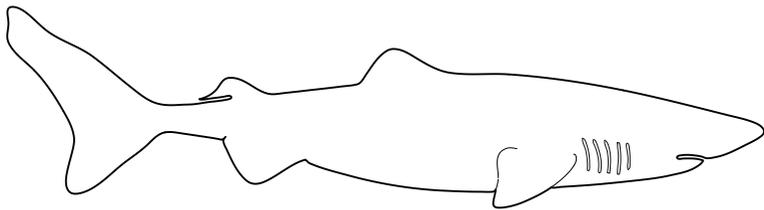
1000

5000

green land shark

1:50

measurements
in mm
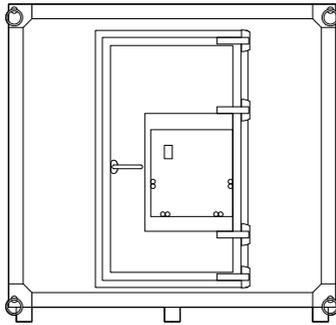
1000

2200

2200

radio tower equipment shelter

1:50
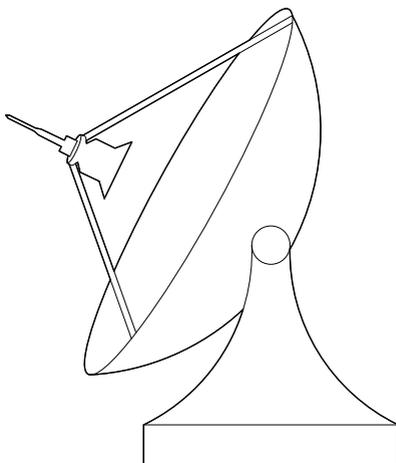
1000

3000

2500

doppler radar

1:50

3400

measurements
in mm

1000

7100

weather buoy

1:200

measurements
in mm

4000

12000

5000

doppler radar tower

1:200

measurements
in mm

4000

31600
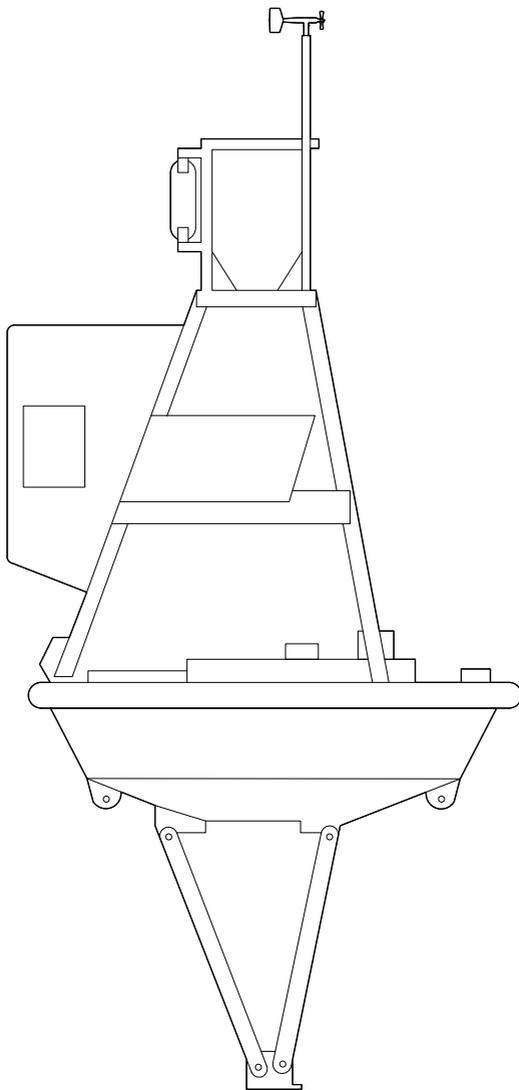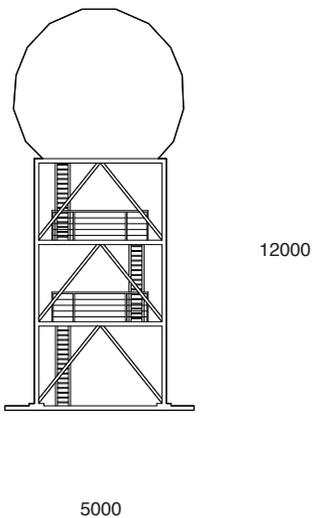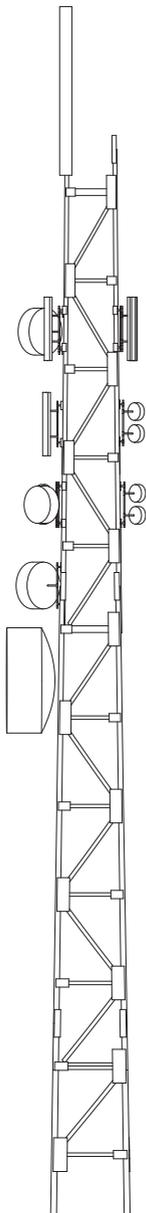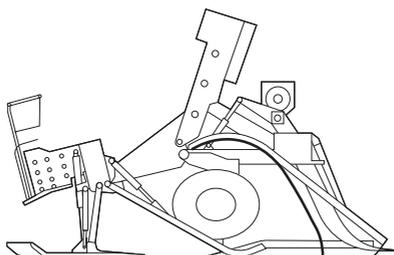
radio tower

1:200

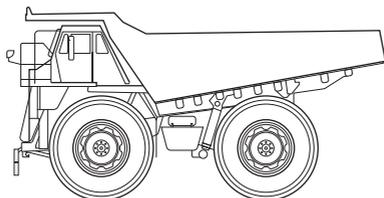measurements
in mm

4000

6500

10300

submarine cable plough

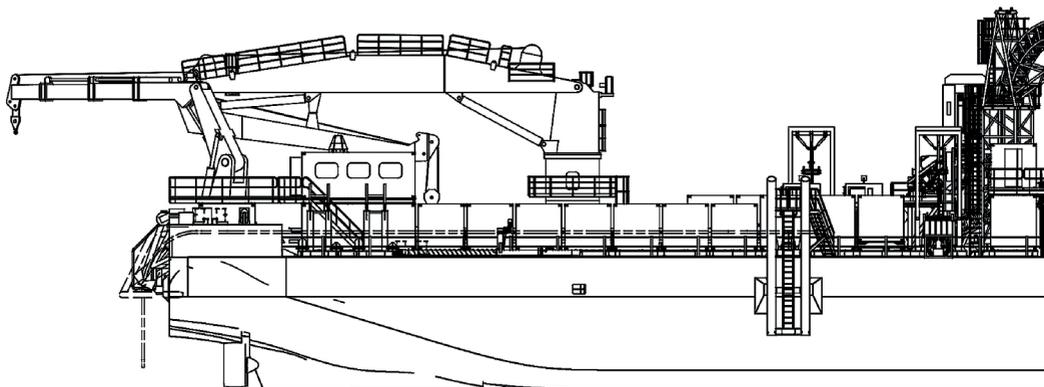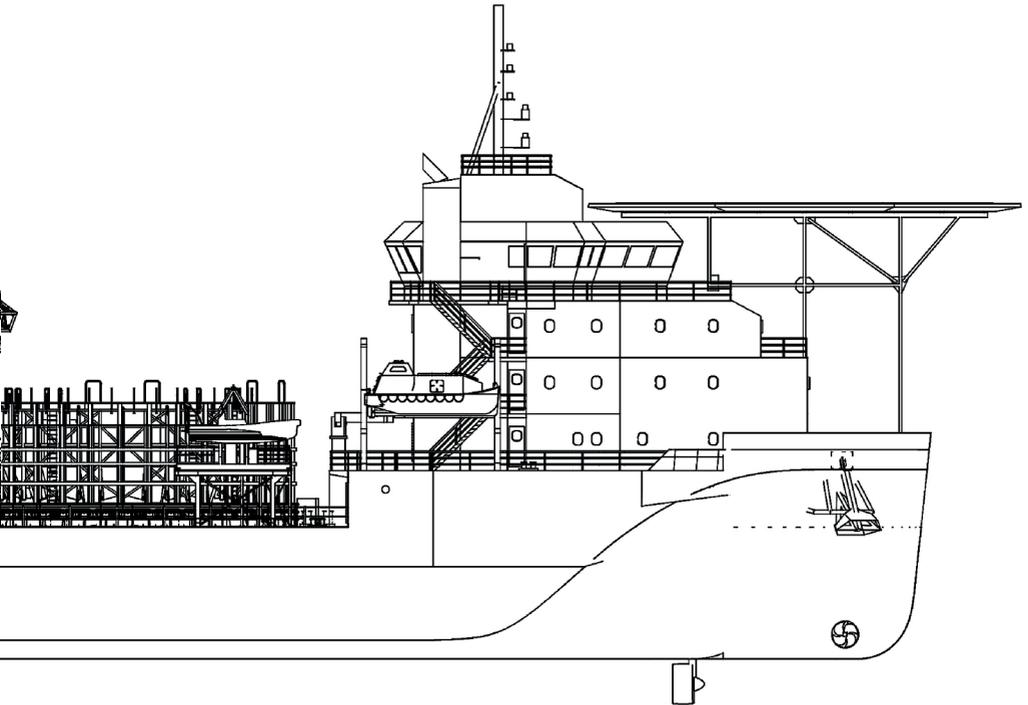**1:200**

measurements
in mm

4000

4730

10004

caterpillar 777E

1:200

measurements
in mm

4000

99000

cable laying vessel

GLOSSARY

A dynamic glossary is used to share and nuance terminology important to the project. It is continously extended during the research and design phase and is thus part of the pedagogical research method. Quotations aim to provide apt definitions.

// actant
"Bruno Latour defines an actant as something that modifies 'other actors through a series of trials that can be listed thanks to some experimental protocol.'"[1]

// agency of assemblages
"The distinctive efficacy of a working whole made up, variously, of somatic, technological, cultural, and atmospheric elements. Because each member-actant maintains an energetic pulse slightly "off" from that exuded by the assemblage, such assemblages are never fixed blocks but open-ended wholes."[2] ● see assemblage

// apparatus
a medium of investigation. A method. ● see object

// assemblage
"An assemblage is, first, an ad hoc grouping, a collectivity whose origins are historical and circumstantial, though its contingent status says nothing about its efficacy, which can be quite strong. An assemblage is, second, a living, throbbing grouping whose coherence coexists with energies and countercultures that exceed and confound it. An assemblage is, third, a web with an uneven topography: some of the points at which the trajectories of actants cross each other are more hea-vily trafficked than others, and thus power is not equally distributed across the assemblage. An assemblage is, fourth, not governed by a central power: no one member has sufficient competence to fully determine the consequences of the activities of the assemblage. An assemblage, finally, is made up of many types of actants: humans and nonhumans; animals, vegetables, and minerals; nature, culture, and technology."[3]

// becoming
In Manuel DeLanda's lecture on *Extensive and Topological Thinking,* we understand that everything is constantly becoming - at different speeds. The different speeds of becoming define a rate of change.[4] Different speeds of becoming further give apparent stability to the things around us, whereas their rate of change can be translated to our consciousness by representational means.

// c-band urbanism
We may not be aware of its pervasiveness, yet we live in the era of 'c-band urbanism'. In 2005, architect Keller Easterling invented the phrase to characterize the vast 'microwave' sphere that has invaded 21st-century landscapes. C-band is a set of frequencies that were formerly reserved for satellites but are now utilized by nearly every smart device.[5]

// dichotomy
cutting in two, comparing across scales

// diffraction
Diffraction is a matter of differences at every scale, or rather in the making and remaking of scale.[6]

// domestication
is understood in this research as an architectural practice whose core is the technology of control. Domestication thus goes hand in hand with control: control over external conditions, the interiorisation of which allows independence from precisely those conditions.

// ecology
● see **media ecology**

// electromagnetic spectrum
is the entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light. (via Merriam Webster)

// extensive
● see **intensive**

// hertz
In the SI (Système International d'Unités), Hertz is the unit of frequency equal to one cycle per second.

// infosphere

is a term described by artist and designer Richard Vijgen as "an interdependent environment, like a biosphere, that is populated by informational entities. While an example of the sphere of information is cyberspace, infospheres are not limited to purely online environments."[7] The Infosphere is not only a technical issue but an immanent spatial and geopolitical issue, as Georg Vrachiliotis discussed with Peter Weibel, director of the ZKM (Center for Art and Media in Karlsruhe) in an Interview for Arch+ Project Bauhaus in 2019.[8]

// infrastructure

Infrastructure - from radio towers to copper mines, from weather stations to cable lying boats - is seen in this research not only as a multipliable node but also as an operational system that acts as spatial software and programs a space - an Inhabited System.

// intensive

While extensive quantities (such as volume, area, length, amount of energy or entropy) are additive, intensive quantities are not. In Manuel DeLanda's text *Space: Extensive and Intensive, Actual and Virtual* he refers to intensive spaces as the site of processes which yield as products the great diversity of extensive spaces. "Indeed, it may be argued, wherever one finds an extensive frontier (e.g. the skin which defines the extensive boundary of our bodies) there is always a process driven by intensive differences which produced such a boundary (e.g. the embryological process which creates our bodies, driven by differences in chemical concentration, among other things.)"[9]

// media archeology

"Media history conflates with earth history; the geological materials of metals and chemicals get deterritorialized from their strata and reterritorialized in machines that define our technical media culture.", writes Jussi Parikka in *Media Geology*.[10] Francesco Casetti adds in *Mediascape: A Decalogue*: "Media archeology is interested in retracing the long history of a technological device: it identifies borrowings and debts, ancestors and lost relatives, a possible lineage and the creation of new families."[11]

// media ecology

In his article *Mediascape: A Decalogue*, Francesco Casetti describes media ecology as complementing media archeology. ● see media archeology
He further states that Media Ecology focuses on "media as components of an environment or as environments as such. Media are not defined on the basis of identities that are stable regardless of the space they occupy, but media are identified by the positions they occupy in a space, and by the articulation or re-articulation they produce within a space."[12]

// mediascape

Francesco Casetti writes in *Mediascape: A Decalogue*: "When a medium is intimately integrated into a space, or when it constitutes a prominent presence within it, we may consider this space to be a mediascape." He borrows the term from Arjun Appadurai, who defines it as a concentration of tools for communication and expression in a world dominated by flows.[13]

// milieu

The electromagnetic milieu can be understood as an ecology of different frequencies, and is thus different from the indexical spectral understanding.

Gilles Deleuze and Félix Guattari describe the milieu, the agentic force of human-nonhuman assemblages as follows: "Thus the living thing . . . has an exterior milieu of materials, an interior milieu of composing elements and composed substance, an intermediary milieu of membranes and limits, and an annexed milieu of energy sources and actions-perceptions."[14]

// micro wave

Microwave frequencies span from 300MHz to 300 GHz in the electromagnetic spectrum. Their wavelengths range from one meter to one millimetre. The wifi router communicates with 2,4GHz and 5GHz bands that fall within the microwave range.

// negotiation

1. Negotiation as pedagogical method: We, as a team, depart for and eventually return to a collective field of investigation, that is constantly reviewed with three different lenses, claiming their own area of expertise: the lenses of language, materiality and scale that will together and in negotiation form a full picture. This glossary serves as site of exchange to form a common set of vocabulary.
2. Negotiation in the radio spectrum

according to Sophie Dyer: „In a new material politics of radio negotiation is understood as more-than-human: it cosmic, legal, economic and techno-scientific process. Each frequency makes different demands. To give an example, negotiation at 2.4 GHz takes place at the level of individual devices. According to the IEEE 802.11 collision avoidance protocol, a Wi-Fi router will not 'talk' if another device is 'talking'. If two routers begin 'talking' at the same time, they will both wait a random amount of time until 'talking' again."[15]

// object or thing

The three main protagonists of this research, the wifi router, the cctv camera and the thermostat are seen as strategies of domestication. They are as actors or actants part of a distributive and composite nature of agency. ● see actant and apparatus

// radio wave

Radio waves are defined as electromagnetic waves in the range of 30 hertz to 300 gigahertz corresponding to wavelengths of 1,000 kilometres and 1 millimetre.

// relic

Relics are the seemingly redundant leftovers of earlier technologies that shape the understanding of our environment. They are symbol carriers of the action that has been associated with them over time. Thus relics become semiotic surfaces whose existence anchors us in their time and protects us from the mortification of constant technological change.

// representation

Each representation of the researched content reflects on the respective object it is reffering to. While the underlaying image of the worldmap depicting the global silica extraction to form a camera lens is a composite satellite image, the map of the global nickel distribution relfects on its implementation in thermocouples by working with meteorological layers.

// spectrum

The electromgnetic spectrum is distinct to the electromagnetic milieu. The spectrum codifies an ecology of frequencies. ● see also **milieu**

// speculation

Speculation will be the starting point of the design phase that follows this research. While speculating on the future

of a world interior, we create narratives that on the one hand reflect on what we have learned in the previous four degrees of domestication, and on the other hand dare to detach themselves from the present state. ● see world interior

// world interior
This research renders definitions such as ‚inside' and ‚outside' or ‚natural' and ‚artificial' obsolete and makes an understanding of the world as an anthropogenic construct all the more significant: a global interior emerges, a shared domesticity within a World Interior, which is appropriated through different degrees of domestication. Domestication is understood in this context as an architectural practice that constantly expands the scope of agency of the house through technological means making the world interior controllable. ● see domestication

// world interior, Peter Sloterdijk
Sloterdijk takes the Crystal Palace in London, the site of the first world exhibition in 1851, as the most expressive metaphor for the world system that is completed in the end phase of globalization. The palace as comfort structure demonstrates the establishment and expansion of a world interior whose boundaries are invisible, yet virtually insurmountable from without and which is inhabited by one and a half billion winners of globalization; three times this number are left standing outside the door.[16]

// world interior, Benjamin Bratton
The concept of the world interior is not only linked to Sloterdijk's philosophical understanding of the world, but also to Benjamin Bratton's Terraforming program at the Strelka Institute. There, urbanism on a planetary scale is explored opening up notions important to this research: The acknowledgement of an artificially sentient planet, a mediascape, that through scattered sensing technology interiorizes - measures and controls - planetary flows.[17]

(…)

SENSING DOMESTICITY

1 Jane Bennett, The Agency of Assemblages: A Political Ecology of Things (Durham , North Cartolina: Duke University Press, 2010) p.446

2 ibid, p.447.

3 ibid, 445.

4 Manuel DeLanda, "European Graduate School Video Lectures," European Graduate School Video Lectures, (2011), https://www.youtube.com/watch?v=0wW2I-nBlDg.

5 Keller Easterling, Enduring Innocence (Cambridge , MA: The MIT Press, 2005).

6 Birgit Mara Kaiser and Kathrin Thiele, Diffracted Worlds, Diffractive Readings: Onto-Epistemologies and the Critical Humanities (London and New York: Routledge, 2018).

7 Richard Vijgen, "Architecture of Radio," Architecture of Radio, 2016, http://www.architectureofradio.com.

8 Georg Vrachliotis and Peter Weibel, "Open Code 'We Will Experience an Uprising to Reclaim Our Data,'" Project Bauhaus: Can Design Change Society?, 2019, pp.146-151.

9 Manuel DeLanda, "Space: Extensive and Intensive, Actual and Virtual," in Deleuze and Space (Edinburgh, UK: Edinburgh University Press, 2005), https://edinburgh.universitypressscholarship.com/view/10.3366/

10 Jussi Parikka, A Geology of Media, vol. 46 (Minneapolis: University of Minnesota Press, 2015), p.34.

11 Francesco Casetti, "Mediascapes: A Decalogue," Pespecta 51 The Yale Architectural Journal, 2018, p. 42.

12 ibid.

13 ibid, p. 26.

14 found in Jane Bennett, The Agency of Assemblages: A Political Ecology of Things (Durham , North Cartolina: Duke University Press, 2010) p. 461.

15 Sophie Dyer, "0 Hz – 300 GHz*", 2021, http://www.interference.space/Almanac.

16 Peter Sloterdijk, Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung (Frankfurt am Main: Suhrkamp, 2006).

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FIG. 82-85	Drawings by the authors

The house has progressively become a mediascape. It has outgrown itself. The increasing conquest of the house by sensing technologies has embedded it in a continuously expanding field of infrastructural nodes and repetitive elements. The primordial environment of the house has been replaced by a planetary system in which the house itself becomes an infrastructural and multipliable node. This renders definitions such as ‚inside‘ and ‚outside‘ or ‚natural‘ and ‚artificial‘ obsolete and makes an understanding of the world as an anthropogenic construct all the more significant: a global interior emerges, a shared domesticity within a World Interior.

Sensing Domesticity: Towards a World Interior explores the spatial implications of data by gaining a technical and material understanding of the systems bound to sensing technologies. It approaches the problem of representing and designing the house as a singular entity finding ways in which architecture can get engaged with data, its apparatuses, its infrastructural spaces, and its scale.