Fragile connections

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Community computer networks, human infrastructures, and the consequences of their Breakdown in Havana

INTRODUCTION

In response to the constraints of internet access in Cuba, technology enthusiasts around the country for many years have built their own community computer networks. These networks allow users to play multiplayer video games, chat, send messages, debate in forums, share files, or host websites. The largest of these, Havana's SNET (Street Network) organically evolved from hundreds of neighborhood Local Area Networks (LANs) connecting with each other and is believed to be the largest community network in the world that is entirely isolated from the internet, linking tens of thousands of users (Dye et al. 2019; Pujol et al. 2017).[1] Its material base consists of miles of Ethernet cables running across streets or balconies, Wi-Fi antennas mounted on poles on rooftops, and servers and network switches operated by an army of volunteer node administrators. It relies on a network of thousands of participants who collaboratively create, operate, and maintain its hardware and software infrastructure (Figure 1). This underlying social structure is crucial to the network's evolution and persistence, as its members collectively provide the funding for its technological basis, connections between individual nodes are mediated by personal relationships, and admins and users must work together to ensure its survival in a complex social and political context. While SNET effectively became illegal in August 2019, when the Cuban government introduced new regulation on the use of Wi-Fi, some of its admins successfully negotiated its integration into Tinored, the official nationwide intranet that connects the state's network of Joven Clubs de Computación (Youth Computer Clubs). While this process is still underway, and negotiations between administrators and state

1 While SNET (Street Network) seems to be the most widely accepted, there existed many names for this network, such as Society Networks for Entertainment and Technology, SociedadNet, La red, or la red de La Habana. SNET was the name of the regional pillar in Havana's Playa district that used to be a very important nodal point in the architecture of the network which is why the name stuck (Rodríguez Fernández 2019).

officials about unsolved questions continue, parts of SNET remain in operation and smaller, much more local networks have adapted their services to meet the needs of their respective neighborhoods.

In Cuba, as in many other places in the world, such vernacular infrastructures that are sustained by relationships between people often compensate for the limitations of state-run projects of infrastructural provision by extending, bypassing, or replacing them.

Anthropologists have described how social networks come to constitute a form of infrastructure, forming webs of connections between actors through which they can find support for all kinds of social, economic, or political projects (Elyachar 2010; Simone 2004). They oftentimes have celebrated the creative, flexible ways in which such networks step in when official infrastructures fail to deliver (Larkin 2004; Schwenkel 2015; Storey 2021; Victor 2019). We intervene in this literature by highlighting the "dark sides" of such human infrastructures, the immense stresses that often rest on the underlying social networks, and the conflicts or breakdowns that inevitably arise when the people involved in them have conflicting visions, are involved in power struggles, or respond differently to outside pressures. By calling attention to their inherent fragility and the consequences of their breakdown, we demonstrate how attempts to repair or renegotiate the interpersonal relationships that support these human infrastructures fundamentally shape the ways in which they are experienced and how this impacts their generative potentials.

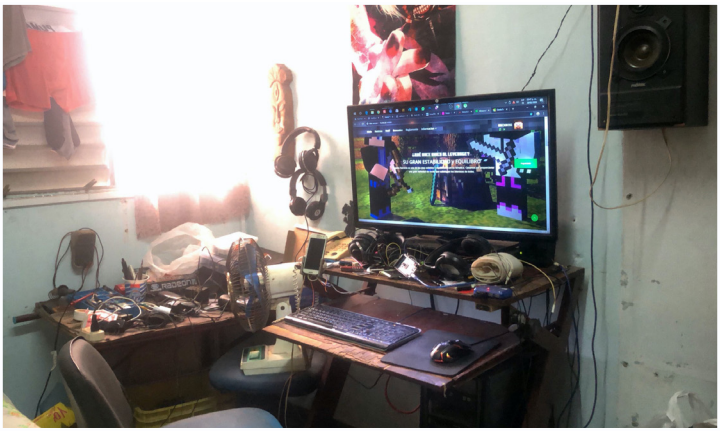
Moments of material breakdown have been identified as central to the basic operation of infrastructures in many seminal writings on the concept, such as in Star and Ruhleder's (1996) definition of infrastructures as "invisible until breakdown," Larkin's (2008) insistence on technological collapse and repair as constitutive elements that form both people's relationship with infrastructures and the imaginaries these produce in the Global South, or Jackson's (2014) call for "broken world thinking" that accounts for the fragility of the technical worlds around us. For Howe et al. (2016), ruin is a central paradox of infrastructure, as it is doomed to degenerate despite its generative qualities, deteriorating in spite of its inherent promise of progress.

We expand these materialist perspectives on infrastructural fragility by analyzing similar ambiguities in people-embedded infrastructures such as SNET, where practices of collaborative creation and maintenance create new forms of sociability, belonging, and solidarity among previously unconnected people, but can also provoke internal conflict, require complex negotiations, or even lead to the breakdown of the social ties on which they depend. SNET is a particularly fascinating case in point because the collapse of relationships between high-level admins over their competing ideas of what SNET should be – a horizontal community network or a more hierarchical structure with commercial elements – ultimately led to its physical separation.[2] This eventually made it easier for the state to end the network's anonymity and independence, as users and administrators could not agree on organizing a unified protest against the new regulations.

2 Such conflicting concepts of the network as a site for sharing and collaboration versus the unbridled generation of profits in market exchanges also shape Western perspectives on the Internet, e.g., see Coleman's (2013) work on hacker ethics and the free software movement.

Fleshing out this infrastructure paradox, we begin our account by describing how the generative impulses of SNET's infrastructure have created alternative ways of joining people together, fostering new subjectivities in a political system that still meets private initiative with suspicion. We then discuss how this network is shaped by local cultural ideals of collectively navigating resources and constraints that stem from shared experiences of scarcity. In the main part of our analysis, we explore the flip side of the network's constructive and enabling effects by accounting for its inherent vulnerability, examining the complex ways in which SNET makers have had to fight network entropy by continuously adapting its structure to shifting technical, political, and social realities.

Our analysis is based on long-term ethnographic fieldwork for which we followed users' and admins' activities across the city and within the network as they engaged with the technical or software infrastructure or socialized with fellow users. We conducted a total of twenty-one semi-structured interviews, each ranging between sixty and ninety minutes. In addition, six of these users gave us extended explanatory tours through the network, which we recorded as audio and screen recordings (see our accompanying contribution on the Amer*ican Anthropologi*st website). Nestor Siré is also a former member of SNET and has developed various artistic projects together with its user base. We use pseudonyms for our research participants throughout this text to protect their privacy.



[Fig. 1: PC of a typical SNET gamer]

1.
SNET'S GENERATIVE POTENTIALS

SNET's potential to produce new social and political collectivities around the communal creation and upkeep of the network must be analyzed against the backdrop of a Cuban state that still governs deeply into the most intimate spheres of its citizens' lives. The "infrastructural promise" (Anand, Gupta, and Appel 2018) of the government-orchestrated revolutionary process historically has been to satisfy all possible societal needs, such as housing, employment, food supply, and education, but also access to information, culture, and entertainment, an arrangement that Holbraad (2018) has termed "revolution as infrastructure."

In the sector of information and telecommunication technologies, however, the state prioritized societal over individual uses as authorities came to fear that the transnational decentralized information flow facilitated by digital technology would foster pluralist tendencies (Press 2011). As a result, the state has only been providing paid Wi-Fi hotspots in public places and parks since 2015, and it only rolled out a 3G mobile network in December 2018. These services remain very expensive by Cuban standards and until today do not really allow for data-intensive activities such as the upload or download of larger data files or the streaming of videos. Instead of creating possibilities for private access to the internet, the Cuban government for a long time preferred to employ computer networks as social tools, controlled by the state and serving the greater good of the community in socialist terms. From the 1990s onwards, it invested in a nationwide intranet that provides services like the health information portal Infomed, the cultural platform Cubarte for Cuban artists, and a national email service. This intranet mainly connected institutions but also offered slow home access via modem to a few specialists in sectors prioritized for the country's development (Venegas 2010). The state also created various educational programs through which a young generation could acquire the knowledge required to set up computer networks, such as at the CUJAE (Technological University of Havana), the Joven Clubs de Computación (Youth Computer Clubs) that were opened across the country from 1987, and, finally, the UCI (University of Computer Sciences) that was inaugurated in 2002, where many future SNET admins received their education.

The scarcity of individual internet access resulting from the state's infrastructural policies led Cubans to develop a number of alternative data-distribution networks that compensate for the limitations of the state-sponsored digital architecture by informally reallocating access to global media content. The most well-known of these is El Paquete Semanal (The Weekly Package), a one terabyte collection of data (such as international movies, TV series, YouTube videos, video games, antivirus software, pdfs of international newspapers, or mp3 music albums) that is compiled by a network of people with various forms of privileged internet access at universities or government workplaces. It circulates nationwide on external hard drives via an elaborate network of deliverymen (Köhn 2019). In addition to this "sneakernet," where digital information is transferred from person to person by physically moving storage media, some Cubans began tinkering with the technological components necessary to form computer networks when these slowly began to arrive in the country in the early 2000s. As Cuban law (with its 1992 decree No. 171) prohibited the private use of the radio spectrum without authorization from the state (initially to ban private ham radio operators), wireless technology was only available on the black market. Around the same time, the proliferation of desktop computers on the island made private LAN parties popular, where young gamers would carry their computers to a friend's house and join them via Ethernet cables to play multiplayer video games like *StarCraft or Defense of the Ancients (DotA)* (Figure 2). To avoid the tiresome moving of gear, some of these gamers eventually began to string cables through windows and across balconies or even streets to permanently connect to friends in their vicinity. These basic computer networks then grew with the increased availability of wireless access bridges (locally called "nanos" after a popular model, Ubiquiti's NanoStation) so that soon whole neighborhoods became interlinked. Ernesto (26), a former admin and early SNET member who lives in Plaza de la Revolución and who currently works as a software developer in the state sector, explains how this technology generated new connections between hitherto unconnected people:

“Someone from the neighborhood got a switch, we got network cable, so we managed to start assembling a network infrastructure. At first it was only in my building, in my neighborhood, but soon after we had started, someone said, “Look, we have something similar a few blocks away. Let’s join the two networks.” We could not do it wired because it was more than a hundred meters and a lot of signal was lost, so we decided, “Well, let’s do it wireless,” and so it started to grow in such an organic way that I don’t think anybody saw where it was going.”

[Fig.2: Cuban gamers at a DOTA 2 LAN party]

The practice became so popular that by around 2009 almost every municipio of Havana had its proper gaming network, and soon, the idea took shape to connect these individual nodes to form a much larger network. Around 2011, groups of nodes began meeting regularly to explore how the growing network could be cooperatively sustained, with new forms of collective action and new political subjectivities emerging along the way. In a tightly controlled society based on centralized economic planning, the members of these nodes established new forms of community organization and decision-making. A pyramidal structure was created in which smaller local area networks (linked by Ethernet cables and network switches) as subnodes came to be connected to larger nodes via wireless bridges (or access points). These nodes were managed by local administrators who also provided technical support for the hundreds of users connected through their node. Individual nodes, in turn, became linked to one of nine regional pillars (grouped by geographical proximity and run by general administrators) via long-range directional Wi-Fi devices. These pillars were joined by fixed wireless links, with each pillar peering with at least two other pillars and a central backbone. With the growth of the network, more and more people got together to communally develop services that quickly surpassed the net’s early focus on gaming, such as moderated discussion forums (first around video games, then about all kinds of different topics), file-sharing platforms, blogs, mirrors of websites from the world wide web, and even homebrewing social network sites. The most important of these services were hosted at the pillar level (Republic of Gamers [RoG], for example, is the pillar that hosts the servers of the most popular games), while the individual nodes provided FTP (File Transfer Protocol) servers for the sharing of local content. While we only undertook research in Havana, such community networks developed in many Cuban cities. Ernesto describes:

“Holguín has its own variant; Camagüey has its own variant. Almost all the provincial capitals have their own SNET variants, all with their very unique subculture. For

example, here in Havana we had a group that produced electronic music, we had our forum, we had our nonsense, we had a channel to broadcast live audio on TeamSpeak. And then that same community existed in Camagüey. But the goal in Camagüey I remember was more commercial, more trying to get gigs in clubs while the community in Havana was more like, “Listen to this noise I made with my computer and tell me if you like it.” (...) These local networks often exist because of content that is of interest to a particular community.”

SNET thus evolved in the form of ever-widening circles whose diameter increased as their makers’ access to technology improved, allowing for greater connectivity. Likewise, its governance structure evolved in parallel to its technical evolution, with each regional node or pillar deciding on roles and responsibilities among themselves. At the top of these hierarchies were the central administrators (on the pillar level), followed by admins of local nodes. These were usually people who had the most profound technical knowledge and/or had invested the most in network technology and servers and, therefore, had gained the respect of the community (Rodríguez Fernández 2019). They were usually supported by a technical team that operated on a voluntary basis, mainly for the social status this gave them among members, first-hand access to information, or some influence on the structural or normative modifications of the net.

[Fig. 3: Central SNET pillar in Havana’s Vedado neighborhood]

Aware that the revolutionary Cuban state closely monitors all attempts at autonomous social organization, SNET makers collectively agreed on a set of common rules that every user of the network had to follow. To avoid government repression, they proactively implemented strict policies banning all content that authorities might deem provocative, such as politics or pornography. Users happily accepted such self-censorship because the vast majority of them were not interested in SNET as a potential platform for free expression or political debate but rather approached it in more practical terms as an infrastructure that allowed them networked gaming and file sharing and that emulated some aspects of the internet, such as social media, services otherwise not available to them. When the state finally introduced Wi-Fi in public parks and the Nauta Hogar home service from 2015, admins made sure that no node bridged to the internet, which would have been illegal, as SNET would then have competed with the state telecommunications agency ETECSA. Social misbehavior such as trolling and online vandalism were, of course, also sanctioned. Wrongdoings were classified from light to very severe,

and the corresponding disciplinary measures ranged from brief disconnection to permanent expulsion. For the practical reason of not overloading the network, the admins also set fixed times for playing games and copying data (daytime was play time and file transfer was only allowed from 3 a.m. to noon).

From a legal perspective, the network for a long time existed in limbo. Even though it was made up of Wi-Fi equipment that was forbidden in the country, the SNET community otherwise took pains to avoid any confrontation with the government. While private wireless networks technically also were prohibited, admins felt that much of the legislation (stemming from the 1990s) was obsolete, as it was not yet imaginable back then that a customary mobile phone would one day be able to serve as a wireless access point. SNET users therefore saw it as a positive sign of official recognition when in 2016 the government news website *Cubadebate* published a flattering portrait of the community, complete with a schematic map of the network, fully disclosed names of admins, and even a group photo. A year later, a similarly positive article even followed in the national newspaper *Granma*, the official organ of the Communist Party of Cuba. Such signs of cautious tolerance led to a widespread feeling among users that they finally had received some sort of governmental acceptance.

2.
SNET'S MEMBER BASE

SNET members were mostly male youth between the ages of fifteen and about thirty. A typical SNET user's career peaked before university, when students still have lots of free time to invest in gaming and the kind of voluntary work the maintenance of the network required. Many older users and admins had fond memories of this time in their lives and told us that such intense dedication to the network typically led to two outcomes: people either managed to significantly reduce the time they invested in SNET when they reached university (yet often built on what they had learned by studying informatics, computer science, or a similar career) or they became so hooked that SNET became a central part of their lives. SNET admins tended to be a bit older and had risen in the network hierarchy either because of their technical skills or because they owned the equipment through which many users were connected. In sociological terms, SNET users and admins were mostly middle to upper-middle class, meaning they (or their parents) either had remittances-sending families abroad, a well-paying job in the private sector, or a secure state job that came with "freebies" such as access to computer equipment or the internet. Although we met admins of important nodes who lived in run-down housing and worked on very old machines, many others had the means to regularly acquire new gear through the black market or relatives in the United States. Further, SNET's member base was notably "whiter" than the general population, as phenotypically white Cubans are much more likely to have access to the foreign currency or remittances necessary to buy computers and tech equipment (on the intersection of race and growing class divisions in contemporary Cuba, see Hansing and Hoffmann 2020).

While there are women who actively contribute to SNET as forum moderators, radio-show hosts, or online support, they are markedly absent from all administrative positions that hold some influence or power. As Greta (30), a journalism graduate and member of one of the *World of Warcraft* developer crews, remarked:

“When people chat with me on TeamSpeak, they always think that I’m a man. They call me uncle, brother, dude, are you there, I need help. And at some point, I no longer said, “Hey, I’m a girl or I’m a woman.” I just answered their requests because I had no choice, because it’s too much. People are not adapted to women in administrative positions, and they are not adapted to women who develop. It’s quite shocking. “

Such gendered dynamics of power are prevalent in many global tech and gaming cultures that are marked by the exclusion of women and sometimes even outright misogyny (Vickery and Everbach 2018), and SNET is no exception. Moreover, in Cuba, the pervasive ideology of self-making, which we will discuss in the next section, is strongly associated with male spheres of domestic chore or economic activity (Härkönen 2016, 14), which further reinforced the network’s lack of diversity.

3.
INFRASTRUCTURING AS A CULTURAL IDEAL

Due to its organic evolution, SNET never had a solid structure and continuously faced many problems: a material basis insufficient for its expeditious growth, occasional crackdowns by local authorities (such as neighborhood “Committees for the Defense of the Revolution” checking for antennas on rooftops in order to keep Cubans from receiving the US propaganda broadcaster Radio Televisión Martí), and disagreements and rivalries among administrators. A key reason for its resilience was its decidedly distributed infrastructure, which guaranteed that the network continued to work even when parts of it became unavailable. As a mesh network, SNET’s individual nodes connected directly, dynamically, and nonhierarchically to as many other nodes as possible. The lack of dependency on one node allowed for every node to participate in the relay of information. This distributed infrastructure was deliberately designed so that it could easily be modified to adapt to changing conditions. Modification was a central task for SNET makers, as the video games that were played over the network had to be “modded” to function in Cuba without a software license and without connecting to the internet, and its hardware and software base constantly had to be refashioned (Figure 4). The concept of “modding” has its origins in gaming cultures and describes alterations by fan programmers that change one or more aspects of a video game (Postigo 2007). It is a communal practice that entails an ethos of collaboration our research participants frequently evoked. In the remainder of this article, we will use the rubric of modding as a prism to understand how SNET members not only manipulated their network’s software and physical infrastructure but also made and remade social connections and enacted agency in political processes.

[Fig. 4: List of modded games available through the RoG pillar]

As a practice that represents an almost infinite combinability of ideas, materials, and applications and demonstrates makers' ingenious aptitude for innovative responses (Jungnickel 2014, 93), modding is an indispensable part of the Cuban everyday practice of "resolver," a cultural ideology that denotes the inventive overcoming of great obstacles with minimal resources by repurposing what is available.[3] Resolver (literally "to resolve") became a necessity when the Soviet Union collapsed in 1991 and Cuba entered its euphemistically termed "Special Period in Times of Peace," which saw unprecedented shortages of everyday items. The practice continues to be essential in the island's still-prevailing economy of scarcity. It is part and parcel of "la lucha," the daily struggle for survival in an ongoing economic crisis. Powell (2008, 181) asserts that resolver is a collective effort because its ethos depends on community solidarity, relationships of trust, cooperation, and social obligations of reciprocity that sustain networks of relationships among family, neighborhood, and community members and that become particularly critical resources in times of need. She shows that part of the dialectic of resolver is that this communal solidarity is achieved at the cost of immense strain on the very social relations that constitute that solidarity, thus constantly threatening the strong bonds on which it is based. This burden, which also rested on the social relationships that formed the "back end" of SNET's material infrastructure, became clearly visible during our research. Admins often complained to us about how they were dependent on people with whom they did not share a common vision, whose way of doing things they disliked, or with whom they had conflicts over money, but with whom they still had to collaborate because of SNET's limited resources.

In theoretical terms, resolver can be understood as a form of "infrastructuring," as part of the infrastructural and articulation work (Star 1999) needed to keep networks like SNET alive. As Star describes, such work is being learned as part of the membership in a community of practice and constitutes a set of cultural competences. Challenging Star's argument about the invisibility of infrastructure and the work that keeps it running (which she argues only becomes apparent when it collapses), Larkin (2013) insists that infrastructures are often very present

3 In recent years, similar local practices of finding innovative and improvised solutions in response to a scarcity of resources, such as "gambiarra" in Brazil (Fonseca 2015) or "jugaad" in India (Rai 2019), have gained anthropological interest.

in people's lives, mobilizing affects and producing strong feelings of longing and pride, desire and frustration. Such conflicting emotions indeed were present among our research participants. During our interviews, we noted that whenever SNET makers spoke about their achievements in collectively reinventing, modding, and maintaining the network, they expressed both pride in their ingenuity and frustration about the large investments necessary in terms of work, time, and reciprocity. Instead of constantly being dependent on others, they often stated that they would prefer the supposedly smoothly running consumer internet access available in other countries. This serves as an important reminder that celebrating resolver and other sophisticated local forms of modding, resourcefulness, and invention (or even evoking them as alternatives to capitalist strategies of planned obsolescence) also entails the risk of fetishizing practices created out of pure necessity by those excluded from consumer capitalism (Dye et al. 2019).[4] In what follows, we will discuss how our research participants used various practices of modding to deal with the fragility of the material and social infrastructures on which SNET was based.

4. MODDING THE SOFTWARE INFRASTRUCTURE

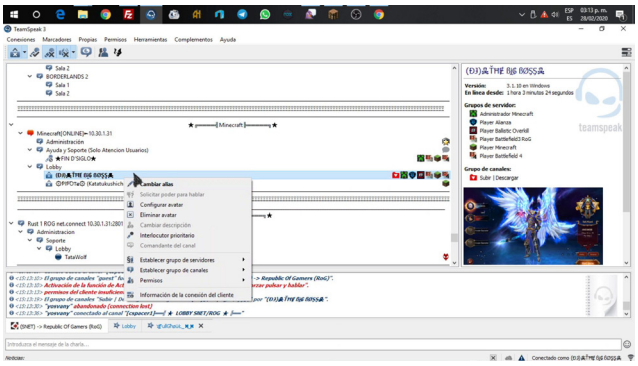
In its heyday, SNET hosted hundreds of websites, among them discussion forums on every imaginable topic, Craigslist-style classified advertisements platforms, several Facebook alternatives (such as Sígueme, or "Follow Me"), mirrors of internet websites (such as Wikipedia), and even various search engines to locate content. Most of these services relied on modified software that had been appropriated for use within SNET. The discussion boards, for example, were based on phpBB, a free, open-source flat-forum bulletin board software. Video games were provided via pirated versions of digital distribution platforms, such as Valve's Steam and Blizzard's BattleNet, that had been heavily modded so that all games ran free of charge and never went online.5 They were also regularly patched manually to ensure that they always ran on the latest versions. As Knorr (2009) describes in his ethnography of a global community of game modders, modding is a highly transnational collective practice that hinges on an ethos of participatory culture. This is of course also true for Cuba, where most active game modders were members of the pillar Republic of Gamers (RoG). Despite the limited internet access on the island, RoG's developer team had managed to sustain relations with the global modding scene. RoG's central administrator, DaVinci, through personal contacts even was able to convince Blizzard, the company behind *World of Warcraft*, to give the software to the Cuban community, allowing them to adapt the game to the specific needs of their network.

4 However, since the integration of SNET into the government intranet, we have seen many former SNET administrators and users succeed in the emerging Cuban private sector, where they are now applying the cultural capital and technical skills they acquired in creating and maintaining the network. Among them are, for example, the members of Cuba's most successful independent video game studio, ConWiro (with whom we developed a documentary video game about El Paquete Semanal (available at www.paketown.net) or the webmasters of many small advertising or online promotion agencies. Some of them expressed the hope that in this way SNET could be the blueprint for the development of native Cuban platforms that in the future could offer local alternatives to the services of the big US tech companies.

5 Even with better internet access, Cuban gamers would still be excluded from using these global online game distribution platforms as the US embargo prohibits US companies to do business in Cuba and also makes online payments from Cuba impossible.

The central interface that users utilized to navigate SNET also was a repurposed piece of software. TeamSpeak (TS), a voice-conferencing software that allows users to communicate with each other via voice and text over the internet or a LAN, had developed into the preferred platform for the users of Cuba's community networks to connect to other users, but also to forge their digital identities. While TeamSpeak is firmly rooted in gaming culture (being designed for gamers who can use the software to communicate with other players in the same team in a multiplayer video game), it was employed in SNET as a central organizational tool for its many features, customizability, and low system requirements. For most users we interviewed, TS was the first page they opened when they entered SNET. It was organized into a slew of channels and subchannels. Each pillar had its own TS server that functioned as the main communication platform within SNET, but with the growth of the network, pillars allowed nodes and subnodes to also host their own TS servers. The entry channel of each TS is the lobby in which all users are listed with their nicknames. Admins used the lobby as a directory that provided links to the various websites and services of a node or pillar.[6] They also employed it to transmit messages by moving all connected users to this channel when they needed to make a public announcement. Users could use TS to contact all the other network members via voice chat, send private or public messages, and send and receive data files. They could also create their own temporary channels on various topics with the approval of their admin. Admins and users made apt use of the software's high customizability and appropriated some of its features in order to make it work more like a social media network or a content-streaming platform. They, for example, delighted in using custom skins and themes and created channels for the broadcast of live DJ sets or self-made radio shows. As the TS lobby served as a central user database for each node or pillar, users invested a lot of care in their profiles (which were their prime digital representations within the network) by uploading an avatar image and choosing a nickname that was often designed in the aesthetics of ASCII art (for example #!MαĴαÐεřΘ, ⚡★⚡ŦŁ₳$Ħ⚡★⚡, or N3PH3L1M). Each profile provided additional information about the user through icons that the admin and technical team of each TS individually created (Figure 5). These icons appeared behind the user's nickname and let them self-identify, for example, as a fan of a particular game or football team, but also provided information about their standing in the network's hierarchy (e.g., as being part of a technical or developer team or a forum moderator). Admins could also attach icons to user nicknames to publicly flag them if they broke any rules.

6 Such linking was more important in SNET than on the internet as SNET did not consistently use DNS (Domain Name System) which means that users couldn't just access any page by typing its domain name in their browser but had to know its IP address.



[Fig. 5: A user profile on TeamSpeak]

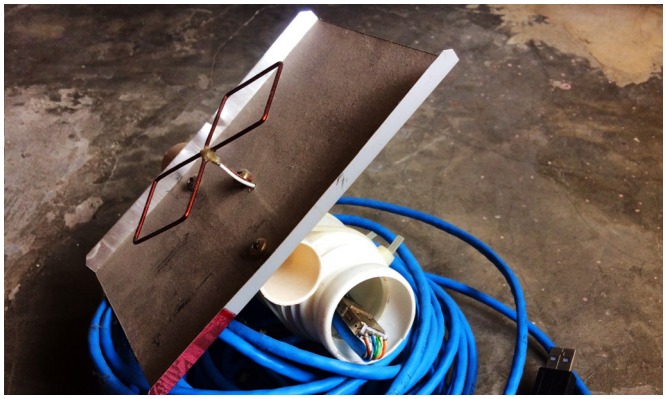
Richard Rogers (2019) has periodized the history of the global internet as a succession of three distinct logics of navigating it: first, the open web that was traversed by surfing and organized by web directories (such as DMOZ or Yahoo); second, the amateur Web 2.0 internet accessed by search engines (like AltaVista or Google); and third, our current centralized, capitalist net of closed platforms and its logics of the feed in which we passively scroll through content that has been tailored to our algorithmically determined interests. Instead of the online directory, the search engine, or the feed, SNET and other community networks around the country made TeamSpeak their central interface and were therefore organized by a logic of the social that prioritized communication and interaction between all users of the network. As we will now see, such a system, which promotes direct contact between all its members, was a prerequisite for maintaining the network infrastructure.

5.
MODDING THE PHYSICAL INFRASTRUCTURE

The physical limitations of Wi-Fi, the tropical climate, and a complex political context (with the state banning the import of wireless antennas and the US embargo raising the cost of networking and computing equipment) all put a lot of strain on the physical infrastructure of Cuba's community networks. These factors contributed to the networks' inherent fragility, which required constant acts of resolver. Wi-Fi is constrained by the use of the 2.4GHz and 5GHz spectrum, waves that by nature don't travel very far and are easily absorbed by trees, weather, or the built environment. Wi-Fi antennas therefore need line-of-sight links, which means that they often have to be mounted on poles on top of buildings to ensure that there is no interference. They also have to be protected from the extreme tropical climate because technological devices placed outside can easily suffer from sunburn or become fried by a lightning storm during the rainy season. SNET creators therefore had to mod found objects such as plastic containers to create housings for gear, find suitable poles, and construct elaborate antitheft structures (such as spikes or even electrified covers) to secure their costly equipment (Figure 6).

[Fig. 6: Anti-theft and weather protection cases for the network's WiFi antennas]

Alvaro (51), a law graduate who now works as a private taxi driver and used to administer a node in Alamar, remembered that at the beginning, some nodes, due to the impossibility of finding manufactured antennas, even relied on self-made directional Wi-Fi antennas that were built from cheap wireless network interface controllers, some copper wire, and scrap metal. Even though they were fully functional, users replaced them whenever a professional antenna became available on the black market as the DIY models (locally called biquads) just weren't fast enough and created latency during gaming (Figure 7).[7]



[Fig. 7: A Biquads WiFi antenna made from a USB WiFi and recycled materials]

The network was therefore shaped by what members could contribute in terms of materials, resources, and skills. It was designed so that it remained functional and rerouted traffic if particular nodes or connections failed because of disruptive nonhuman elements (such as rainstorms) or human elements (such as thieves). Camilo (22), a medical student from Centro Habana, described how in his subnode, users always temporarily disconnected their equipment and brought Ethernet cables (which are not meant for outdoor use) inside during a storm because once a lightning

7 Technological equipment not offered in state-run shops, such as computers, or forbidden to import, such as (until 2019) Wi-Fi antennas, typically are brought into the country by so-called *mulas* who mobilize vast transnational networks to provide their clients with material goods that are otherwise impossible to access (see Cearns 2020).

bolt had killed their local nano, it took them months to be able to replace it. Hence, users had learned to interact with such agents and forces outside of their control to make their network more resilient. TeamSpeak, the communication platform that connected all participants in the network, ensured that users could immediately report all problems with the physical infrastructure so admins (depending on the importance of the connection point that broke down) could determine how to react. However, as we will now see, continuous breakdown did not only affect SNET's physical infrastructure. It was also the social relationships that made up the network that carried the risk of collapse.

6.
MODDING SOCIAL RELATIONS

SNET's human infrastructure relied on enduring social ties between its members. Because almost every aspect of network configuration required direct contact between users and administrators, communal construction and maintenance necessitated a lot of voluntary work, and members often organized meetings and events, SNET generated a tight-knit community with a strong sense of belonging. Yet SNET users depended not only on people inside but also outside the network to make connection. Getting permission to mount an antenna on a spot with good reception or running cable over a balcony frequently depended on the goodwill of neighbors, parents, or partners. When equipment needed to be repaired or replaced, this often led to lengthy renegotiations as a neighbor's property needed to be accessed again or household savings had to be invested in new cables or antennas. The supporting relationships necessary to maintain this local network oftentimes transgressed national borders, as friends or relatives outside of Cuba frequently provided access to Wi-Fi equipment, the resources to acquire it, or vital information on how to set up or mod hardware or software.

Echoing Larkin's (2013, 333) observation that collectively constructing infrastructure is often experienced as deeply emotional and fulfilling by its makers, our research participants univocally described how SNET had enriched their lives, how online acquaintance often seamlessly translated to friendship, or how the continuous exchange in forums or during meetings had taught them invaluable technical skills and created a strong community spirit. Admins, who all stated that their engagement with the network constituted a full-time job, as they constantly had to assist users with technical problems, explain configurations, or maintain equipment, expressed pride in what they had communally created. Anand, Gupta, and Appel's (2018, 26) remarks that infrastructures often excite affects and sentiment and produce a sense of belonging and accomplishment certainly apply to the case of SNET. However, we will now show how the strong emotions that the joint work on the network generated among its admins and users also resulted in rivalries and exclusions. These rivalries sometimes even led to serious conflicts over the organization and goals of the network, the use of limited technical and material resources, and over how to deal with external pressures arising from the complex Cuban political context.

A constant source of dispute was, for example, the use of the funds generated by the obligatory membership fee that was introduced in 2015 to allow investments into infrastructure and repair. Each user had to pay 25 CUP (around US$1) per month that was shared between a fund at node level and a fund at pillar level.

The introduction of this fee in many instances created conflicts between node admins and pillar admins as well as between node admins and users. Because the contribution was first introduced on the node level, it took long and tough negotiations between pillars and nodes to agree on how these funds should be split between the different levels of the network hierarchy (and, therefore, on who could decide how they would be invested). Users, in contrast, often complained about the lack of transparency about what happened with their money. There were nodes that were very open with their internal accounting and kept public lists that proved to the penny how the collected contributions were used. Other admins, however, began to see them as a monthly salary paid by users for being connected to them. Jaime (23), an informatics student from Habana Vieja, for example, recalled that the admin of his node used to spend the money as he pleased, and when something urgently had to be repaired, users frequently had to pay extra to regain connection. In some cases, this membership fee generated substantial revenues for admins who made investments into network technology to be able to connect as many users as possible (often several hundred) and have a steady stream of income.

Over time, the ongoing tensions around these funds brought to the fore differences in values, motivations, and managing styles and led to mistrust, unresolved hostilities, and unsettled scores. These tensions finally erupted when DaVinci, the admin of the Republic of Gamers pillar, revealed that he and his developer team had created a virtual shop inside their modded *World of Warcraft* in which players could invest real money for virtual items (such as weapons or equipment) inside the game world. The shop functioned in a way that users could contact someone from the technical support and pay either personally in cash or by transferring credit to a mobile phone or national internet account. In addition, they laid out plans for implementing a virtual currency. The earnings generated from this were meant to be invested in more servers to enhance the overall gaming experience. The shop was debated fiercely on TeamSpeak and various SNET forums, and many members felt that this innovation de facto turned their beloved communitarian project into a business. Other pillar administrators felt threatened by DaVinci's plan because they expected that further investments into RoG's infrastructure would make the main game-hosting pillar even more popular, making it more attractive for nodes to connect to it and, eventually, tilting the delicate power balance between pillars even more in its favor.

To resolve the conflict, a meeting of SNET's main admins was organized in a café near the Malecón. Attendees with whom we spoke described the atmosphere as tense and poisoned by the insurmountable differences that had built up between the leaders of various pillars. At the end of the night a vote was held in which four pillars backed RoG's advance and four, led by the pillar GNTK (pronounced "Genética"), voted against it, with the pillar Playa abstaining. The trench between both factions deepened when, shortly after this meeting, a subnode belonging to the Cerro Cerrado pillar asked to switch to Wifinet in hope of better connection speeds due to the geographical proximity. When the Wifinet pillar accepted the node (and thus also took over its collected membership fees), the fragile balance of power between the pillars finally broke down. Cerro Cerrado allied itself with the other pillars with whom it voted against the online shop and blocked all IP addresses of the rival pillars. After two weeks of unsuccessful negotiations, the faction around

RoG and Wifinet also disconnected from the other bloc. SNET had thus broken into two halves. From November 12, 2017, users who entered the network could no longer connect to services or people on the other side. Pedro (24), a freelance software developer from Centro Habana, explained that many popular services, like the programmer forum Netlab, which had contributed immensely to SNET's technological development and to the identification of its users with the network, disappeared soon after the split: "Once we fully realized that our members were left on different sides of the border, it didn't make sense to continue. The day that Netlab died, we all cried."

After the separation, several subnodes switched pillars because of advantages offered by the rival side. Many of the more idealistic users and admins (such as Pedro and Ernesto), for whom SNET was all about community and horizontal relationships and for whom Netlab was the central meeting point, frustratedly sold their network equipment and turned their backs on the project. "Those who stayed in SNET were the gamers," Ernesto commented. For him, the spirit of collaboration that defined the SNET community had all but disappeared. SNET continued to exist in this partitioned form until summer 2019, when the Cuban government released new legislation on the operation of private Wi-Fi networks, forcing SNET makers to once again adjust to changing circumstances.

7.
MODDING POLITICS

While until summer 2019 it was illegal to import Wi-Fi equipment, the operation of a private network was not really prosecuted. Alvaro recalled that sometimes local authorities confiscated antennas, but this seemed to happen more because of a lack of understanding of what SNET was than because of an organized crackdown. To avoid the shutdown of their network, SNET makers therefore had been taking pains to not get into conflict with the government, proactively banned political debate and the distribution of pornography, and prohibited nodes connected to the internet. Contrary to the idea of community networks as refuges of autonomy and strongholds against surveillance and repression (as, for example, elaborated in De Filippi and Tréguer 2015), SNET chose to actively self-censor members' freedom of expression in order to be able to survive in Cuba's authoritarian system. As a network primarily committed to gaming, its makers and users were not seeking any form of social change, but merely wanted to make up for the specific lack of connectivity they experienced, a motivation also connoted in the concept of resolver, which does not imply radical reform or the challenging of power structures but rather the fixing of what is given with what is currently at hand. Being aware of the state's long-standing strategy of dealing with new cultural forms of expression and social movements by incorporating them into the institutional frames of revolutionary national culture, some pillar admins had early on sought informal meetings with state officials to improve SNET's standing with the government.8 In particular, RoG's central administrator, DaVinci, had continued to explore ways to fully legalize the network. RoG developers, for example, frequently

8 This politics of integrating alternative areas of expression is embodied in Fidel Castro's famous dictum "Within the Revolution, everything; against the Revolution, nothing". For a case study of state attempts to incorporate Cuba's emergent hip hop scene within the state's institutional structures (see Perry 2015, 172–197).

collaborated with the Joven Clubs de Computación by organizing workshops or making public presentations at these state institutions when they were releasing new *World of Warcraft* updates (Figure 8).

[Fig. 8: A presentation by the admins of the RoG pillar at a local Joven Club]

The government resolutions 98 and 99 from May 2019 changed the legal and political framework in which SNET was operating. With this new legislation, the Cuban state finally authorized the domestic use of Wi-Fi antennas (which many Cubans were already using to capture the signal from the public hotspots from their homes or their small private businesses like restaurants and vacation rentals, if these were located close enough to a Wi-Fi park). Yet, at the same time, authorities now regulated outdoor cabling, the use of the Wi-Fi frequency bands, and radio transmitter power, supposedly to reduce interference with the state-provided mobile phone network. And this was where SNET finally hit a brick wall, as the new rules restricted many of the frequencies the network relied on and limited transmission power to a degree that made the long-directional Wi-Fi connections between pillars impossible.

Reinier (18), an engineering student from Vedado, remembered how the day after the publication of the new laws, his whole node was on TeamSpeak. After the administrators declared that with the new rules SNET would basically become illegal and opened the discussion channel, emotions ran high. A few days later, on June 1, the bloc composed of the RoG, Wifinet, Imperivm, and Habana-Este pillars published a communiqué on the official SNET Facebook page and on Twitter in which they asked the authorities to create a special license for SNET that would allow it to connect to the national intranet linking the network of the state-run Joven Clubs de Computación. They also asked their users to stay calm and not engage in the heated debates that had already flared up in the commentary section of the online state news outlet *Cubadebate*. In a second notification ten days later, they announced that they had already begun negotiating with representatives of the Ministry of Communication (MINCOM). With the future of SNET hanging in the air, many users were looking for ways to advocate for the survival of their network. Some of them staged a series of demonstrations inside different game worlds with the slogan “YO SOY SNET” (I am SNET) as their rallying cry. Images of these virtual gatherings were then posted on social media (Figure 9).

[Fig. 9: A virtual YO SOY SNET demonstration inside Black Desert Online]

Yet, soon after, the network split again over the question of how to react to the new regulations. While most users did not want to get into trouble with the government and the administrators on the pillar level tried to negotiate ways of integrating SNET into the state intranet, a small group of users decided to fight for the network's independence and autonomy. They took their disagreement with the new law to Twitter and later to the streets. Despite the explicit calls from pillar admins to refrain from public protests, these idealists organized a small demonstration in front of the Ministry of Communication which was attended by about a hundred people, something that rarely happens in Cuba. These online and offline protests were short-lived and quickly suppressed by state security (who visited and threatened their most vocal leader). The protests were also not backed by the silent majority of SNET users, who were too afraid or too politically apathetic and gladly willing to trade in their network's independence for an official and more smoothly running alternative. The manifestations did, however, generate considerable international media attention. Their hashtag, #YoSoySNET, was quickly picked up by dissident bloggers and activists and instrumentalized by Miami-based Cuban exile influencers such as Alexander Otaola for their anticommunist propaganda. Hence, at the end of its existence, this network, born out of pure practical necessities and never encouraged political debate, ultimately inspired a moment of political action – which, ironically, was exactly what the government always feared and what led to the decision to ban it in the first place.

While the protest movement gave up shortly after the demonstration under pressure from the state (and its initiator publicly complained online that he felt abandoned by the pillar administrators), negotiations between pillar representatives and government officials continued. By mid-August, the pillar admins announced that they had reached an agreement with the Ministry of Communication and that SNET's nodes would be connected to Joven Club's network of 644 nationwide branch offices. For this, SNET's node operators would have to apply for a private network license and declare their equipment, while users would have to log in to the network with a registered account. This secured the survival of many of SNET's services (particularly its highly customized video games) but effectively ended its autonomy, anonymity, and decentralized structure. At the time of writing, the process of fusing both networks is still underway, and only a fraction of SNET's users is already connected to Joven Club's so-called Tinored. Many admins have sold their equipment and left, while some users who were linked to their subnodes through now-prohibited outdoor cabling cannot afford to switch to wireless technology. Gamers whose nodes are already linked to Tinored told

us they now enjoy better connection speeds (260 of the 644 Joven Clubs are connected by fiberoptic cables) and can play over the network with users from all over the island. They now also have home access to all the other services within the national intranet, such as Ecured (Cuba's politically sanitized version of Wikipedia), the blog platform Reflejos, and the national email service, or Mochila, the official alternative to El Paquete Semanal. Some trademark SNET offerings, like particular games, forums, and TeamSpeak servers, have already been migrated successfully. Greta, from of RoG's developer team, revealed that her pillar is still negotiating with Joven Club officials about several questions, such as some sort of authorship recognition for the software they developed, or Joven Club's requirement that every post on a public forum must be approved by a moderator before being published. It is planned that RoG's administrative and development teams will be hired as Joven Club employees.

Until the integration is completed, some nodes and pillars still operate independently. Several node and subnode admins, however, have decided to go underground by not applying for the now obligatory license and providing clearly illegal services, such as internet connection (something for which they would have been banned from SNET). These local networks are mostly run for profit and usually offer TeamSpeak, an FTP server with pirated media content, peer-to-peer sharing via the BitTorrent protocol, and access to the weekly media collection El Paquete Semanal for a price cheaper than on the street. Home internet access through these nodes usually costs 250 CUP (around US$10) a month and is established by capturing the signal from a Wi-Fi park and then sharing the administrator's official internet account between all users or by using a MikroTik router with level 4 license that can bridge the signal from the park to the computer of a user who can then log in with their own credentials. With this final modification, independent Cuban community networks have turned into illicit businesses, where admins risk hefty fines for providing services that continue to be in high demand.

8. CONCLUSION

In this article, we have analyzed SNET as a human infrastructure in which connectivity is based not only on technological devices but fundamentally on social relations. Drawing on Howe et al.'s (2016) observations on the paradoxical qualities of infrastructure that oscillate between aspiration and failure, we unfolded the network's innate tensions between generative and entropic energies. While SNET fostered new connections between people and created a tight-knit community, these productive qualities always entailed the risk of breakdown. SNET's intrinsic fragility stemmed from insufficient resources, from rivalling imaginaries of a participatory and community-oriented versus a commercialized and more vertically structured network, and from government pressure and intervention, all of which required constant acts of modding. Intervening in the anthropological theorization of material breakdown as a constitutive element that shapes both people's relationship to and imaginaries of infrastructure, we have highlighted how the possibility of breakdown inherent in social relations fundamentally affects the experience and form of human infrastructures. The network's "people-embeddedness" produced not only emotions of belonging and solidarity in its creators but also constant stress, conflict, and frustration. The resulting instability first led to partial disconnection when unresolved disputes among administrators resulted in SNET's separation and, eventually, to its dissolution into the official state intranet.

The SNET story also marks the beginning of the progressively eroding state media monopoly resulting from the recent introduction of mobile internet in Cuba that finally allows for always-on connectivity and has given the government political headaches (Henken 2021, 6). Today, the articulation of dissent and political organizing takes place not in domestic networks (which the government can easily shut down, as the case of SNET has made clear), but on global social media platforms (mainly in the hands of US tech giants) such as Facebook, Twitter, WhatsApp, or Telegram, which are beyond the reach of the Cuban state. Increased access to such services has de facto diminished government control over the day-to-day media narrative. The activists who protested against SNET's shutdown used Twitter and Facebook (and to a much lesser extent, the network itself) to publicly voice their dissent because these platforms reach a much wider national and international audience. Even though most of its users defined themselves as apolitical and the network never promoted societal change, SNET's sheer existence implied some powerful ideas about successful independent self-organization that ultimately encouraged an (albeit tiny) fraction of its users to stand up against the government. Their demonstration in front of the Ministry of Communication preempted similar protests, such as 27N, a movement that emerged when more than three hundred intellectuals, artists, and journalists gathered on November 27, 2020, in front of the Ministry of Culture to protest state violence and demand the recognition of their rights and freedoms as citizens in the aftermath of the arrest of dissident rapper Denis Solís González. Their ongoing protest, organized collectively and decentralized via WhatsApp, is one of many examples of how Cubans have begun to use new media technologies to change their society from within. Although the emergence of networked public spheres in which citizens dare to voice their discontent and overcome their isolation certainly poses a challenge to closed societies, many authoritarian governments, as Tufekci (2017) shows, have quickly learned to adapt their propaganda strategies to the logics of digital communication. The Cuban state has recently begun to mobilize an army of supporters and paid employees (so-called *ciberclarias*) to intervene in online debates, spread misinformation, and post in favor of the government in order to split public opinion. Therefore, while in the case of SNET the government has once again succeeded with its established strategy of incorporating a civil society initiative into its institutional framework, it remains to be seen whether it can also curb growing citizen engagement and horizontal information sharing on the dominant social media platforms. Cuba's struggle over the meaning, consequences, extent, and course of its digital revolution only has begun.

Acknowledgments

The research for this article was supported by a grant from the German Research Foundation (DFG). We wish to thank all the members of the SNET community who were willing to share their stories with us. We further are indebted to Elizabeth Chin and the three anonymous reviewers for their critical reading of our manuscript, helping us refine our arguments and suggesting substantial improvements.

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