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Tselal and Zapoteco Shared Networks: The Paths Towards a Pluriversal Internet

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It is my great pleasure to introduce CARGC Paper 18, “Tseltal and Zapoteco Shared Networks: The Paths Towards a Pluriversal Internet,” by Dr. Fernanda R. Rosa, Assistant Professor in the department of Science, Technology, and Society at Virginia Tech. Her work focuses on internet governance and brings together technical discussions of internet infrastructure, design and social justice from the standpoint of the Global South. Before joining Virginia Tech, Rosa was a Postdoctoral Fellow (2019-2021) at CARGC in the Annenberg School for Communication at the University of Pennsylvania. She has a Ph.D. in Communication (American University, 2019, with distinction), a Masters in Public Policy and Management (Fundação Getulio Vargas, with honors), and a BA in Social Sciences (University of São Paulo). Her dissertation received an Honorable Mention for the Association of Internet Researchers’ Best Dissertation Award in 2020. She is the co-author of *Mobile Learning in Brazil* (2015, Zinnerama), and has recently published STS accounts on digital inequalities and platform studies in *Internet Policy Review*, *Policy & Internet*, *Preludios*, *Social Media + Society*.

Rosa’s study of the Latin-centric indigenous networks and their infrastructuring processes offers a compelling narrative to imagine our shared futures differently. In CARGC Paper 18, Rosa explores the Indigenous networks, principles, and practices of internet infrastructure building and sharing in Tseltal and Zapoteco sovereign territories in Chiapas and Oaxaca, Mexico. More specifically, she uses the concept of *shared networks* to examine “the first mile signal-

sharing practices” (p.8) among these underserved Indigenous communities . Exploring the Internet as a process, her research illuminates how local Tseltal and Zapoteco communities actively participate in designing their own first mile infrastructure as “internet codesigners” (p.8).

CARGC Paper 18 draws on extensive fieldwork among different institutions and actors in Chiapas and Oaxaca in Mexico in the year of 2017. Rosa conducted participatory observation at the International Forum on Indigenous and Communitarian Media in Oaxaca and subsequently visited two sites - a Tseltal pueblo in San Martín Abasolo, Ocosingo, in Chiapas, and a Zapoteco *pueblo* in Guelatao de Juárez, in Oaxaca. These two states, as the official data shows, have the lowest Internet connectivity rates in Mexico. Yet, through her grounded observation of and conversation with local community members, Rosa deftly shows it is the local community members, rather than the big internet service providers (ISP), that truly drive the first mile internet connection. By using the ethnography of infrastructure, CARGC Paper 18 highlights how indigenous values and infrastructuring processes are intricately interwoven together.

Inviting us to think about hybridity and multilayered cultural differences, CARGC Paper 18 makes several important contributions to the study of media infrastructure and indigenous politics from the perspective of the Global South. By highlighting the indigenous experiences, this paper addresses the local internet ecosystem with a bottom-up rather than top-

down approach. For instance, as Rosa's ethnography shows, after the Mexican telecommunications incumbent Telmex and the Federal Electricity Commission (CFE) failed to improve service and provide infrastructural support, the Guelatao community mobilized to design an Internet network through their own personal networks, bought routers, radio and sectorial antennas, and utilized passive infrastructure such as towers and posts. Through these *shared networks* built by indigenous people, this paper further illustrates how *comunalidad* (communality) is key to shaping our contemporary discussion of internet infrastructure and governance. Inspired by the Zapoteco anthropologist Jaime Martínez Luna and others, Rosa sees *comunalidad* as a Latin-centric indigenous framework that "define[s] who *we are* in relation to *others* and vice-versa" (20). This framework enables us to see beyond the Western-centric world system and to understand indigenous people, despite the long histories of colonialism and imperialism, always strive to achieve their own values of autonomy and coexistence.

Inspired by the spirit of *comunalidad* and *shared networks*, CARGC Paper 18 invites us all to re-imagine a more equitable, autonomous, and interdependent pluriversal internet. Latin-centric indigenous networks provide invaluable

resources for rethinking global Internet ecosystem and governance from a bottom-up approach without foregoing the insight that infrastructuring is always messy, hybrid, and historically situated. As Rosa concludes beautifully and forcefully in her paper, "Tseltal and Zapoteco participation in internet co-design enriches the public understanding of internet governance in practice, which includes a vivid struggle for a pluriversal internet."

I want to take this chance to thank Anastasiya Miazhevich, CARGC Administrative Coordinator, for all the tireless work she has put into the production of CARGC Press. I also want to thank Emma Fleming, Graphic Designer at Annenberg School for Communication, for her professional design of all the texts and images in this paper. Mariela Morales Suárez, CARGC doctoral fellow and doctoral candidate at Annenberg School for Communication, worked with Dr. Rosa to produce the Spanish edition. Last but not the least, CARGC Paper 18 comes out at a time when CARGC is embracing a new chapter under the leadership of Dr. Aswin Punathambekar. We are looking forward to re-imagining CARGC Press through interdisciplinary and multimodal scholarship in the upcoming years!



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TSELAL AND ZAPOTECO SHARED NETWORKS: THE PATHS TOWARDS A PLURIVERSAL INTERNET¹

This research paper examines the emergence of *shared networks* in Tselal and Zapoteco communities in Chiapas and Oaxaca (Mexico): internet first mile signal-sharing practices that articulate interconnection infrastructure and coexistence values to extend the internet to areas where the services of existing larger internet service providers are unsatisfactory or unavailable. In the case studies analyzed, indigenous people become internet codesigners by infrastructuring for their own local networks and interconnecting to the global internet. The paper argues that a hybrid materializes at the level of network interconnection when *comunalidad*, or the way of these communities—supported by unlicensed frequencies of the electromagnetic spectrum, towers, radio antennas, houses rooftops, routers, and cables—meet the values of the internet service providers and their policies. Shared networks are a result of what these arrangements both enact and constrain, and the evidence of vivid struggles of Latin-centric indigenous networks towards a pluriversal internet.

Keywords: Digital Inequalities; Infrastructuring; Internet Interconnection; Comunalidad; Pluriversal Design; Ethnography of Infrastructure; Values in Design; Community Networks; Indigenous Networks; Internet Governance.

INTRODUCTION

The sun had already set when we were leaving the community of San Martín. The internet was now finally working in one of the houses of that Tselal *pueblo*, for the first time. The area was densely green, in a hill with sparse houses, some of them not that distant from each other, denoting the sharing of land by family members. The state of Chiapas, Mexico, where that village is located, is ranked in the lowest level of internet connectivity in the country. In the role of a student and researcher, I was joining a group of activists, part of the not-for-profit Colective Ik' Ta K'op (Word of the Wind Collective) in the town of Abasolo in Ocosingo, whose goal is to expand internet access in their community. After an affectionate goodbye marked by gratitude and satisfaction, we walked toward the blue Volkswagen that brought us there, when someone noticed that our right back tire was flat. Santiago Gómez's,² the brother of one of the Collective's founders, Mariano Gómez, proposed a quick solution: go downhill in the dirt road and stop every five minutes to get out of the car, and wait for someone to fill

1 The author would like to thank all interviewees for their time, knowledge shared, and exchanges along the years. She is also grateful for the comments received from Zuleika Arashiro and CARGC's Infrastructures Reading Group, especially Clovis Bergère, Padma Chirumamilla and Celeste Wagner. This work was supported by Columbia University's School of International and Public Affairs and Carnegie Corporation of New York: [Grant: Tech & Policy Fellowship]; Red en Defensa de los Derechos Digitales: [Grant: Google Policy Fellowship]. A revised version of this manuscript was published as an article in *Information, Communication, and Society* in 2022 available at: <http://www.tandfonline.com/10.1080/1369118X.2022.2085614>.

2 The amount of effort that they have put into such projects, and the current recognition of their achievements by government agencies and international organizations, led the interviewees to demonstrate interest in being named when featured in my work. Some of them are also featured in media outlets. I have not changed people's names within the article for this reason.

the tire with an air bomb, repeatedly until we arrive at their family's house. In the car, beyond Mariano, his brother, and Fabíola López, Mariano's fiancée, there were also Maria Malvido, working for *Redes por la Diversidad, Equidad y Sustentabilidad A.C.*, an organization that supports communitarian communication initiatives,³ and me. We followed the plan and arrived safely. It was a solution designed using available resources, and it worked pretty well.

This paper is an invitation to understand the global internet and its interconnection dynamics, focusing on the strategies of Tseltal and Zapoteco communities to become part of the internet. Deciding to improve their connectivity conditions marked by poor or absent internet services in their territories, they have autonomously engaged in processes of “infrastructuring,” by building their own internet networks and interconnection arrangements to physically connect to the larger internet.

I borrow the term “infrastructuring” from participatory design scholarship, where “information infrastructure is viewed as constantly ‘becoming’” (Karasti 2014, 3), in that design is a continuous activity, a “*process* of inscribing knowledge and activities in new material forms” (Karasti 2014, 3, emphasis added). Focusing on Tseltal and Zapoteco internet design experiences, this paper aims to address the internet ecosystem with a bottom-up approach, seeking to shed light on the role of infrastructure in this scenario and raising three points. First, it calls attention to the existence of *shared networks*, built by indigenous people,⁴ but non-discernible when seen from above. From an internet routing system standpoint, networks are owned by autonomous systems and identified with autonomous system numbers (ASNs). That is not the case for the indigenous networks studied here. As noted elsewhere, “the question is perhaps not just what is a network but what it means to treat something as one” (Dourish 2017, 172). To recognize Tseltal and Zapoteco networks as internet networks, and their infrastructuring process as part of the design of the global internet, is to expand the drivers of internet governance—traditionally, governments, corporations and technical bodies—to include indigenous communities. This opens up the space of infrastructure to more closely examine the power struggles that constitute it.

Second, these shared networks illuminate processes of hybridization and *ch'ixi*⁵ which are only possible to see when adding the insights and the values of these communities to the broader discussion on internet infrastructure and governance. When indigenous communities decide to be part of the internet, they ally with technologies and create interconnection arrangements that mark the instance when their local networks become part of the global internet. At the moment of interconnection, when the local becomes global, the values embedded in their actions and technology allies, here discussed in terms of *comunalidad* (communality),⁶ meet the values of the internet service providers regulated by their policy terms, materializing a hybrid, an articulation of intentions and negotiations that make that internet possible. Framing this moment of interconnection as the materialization of a hybrid allows us to think in terms of both the “technopolitics” of interconnection, and the specific materialization of hybridization

3 For more information on these projects, see Baca-Feldman et al. (2018); Bloom (2015); Huerta (2018) and Parra, (2015).

4 I use this term as interviewees and authors refer to themselves and their communities in this way, resignifying its colonial origins and the subaltern meanings that it originally alludes to.

5 Silvia Rivera Cusicanqui informs that the word *ch'ixi* “has many connotations: it is a color that is the product of juxtaposition, in small points or spots, of opposed or contrasting colors: black and white, red and green, and so on.” (Cusicanqui 2012, 105).

6 The literature in *comunalidad* is mostly in Spanish and citations used along the text are author's own translations.

and *ch'ixi* in the context of Latin America (Canclini 1989; Cusicanqui 2012). And while the understanding of indigenous media as a hybrid is by no means new (Ginsburg 1991), and the meanings of hybridity vary, including being considered an expression of hegemony and preservation of the world order (Kraidy, 2002), in taking internet infrastructure and the way of being of indigenous people into consideration, I argue that these processes of hybridization are the efforts to build a pluriversal internet. In decolonial terms, pluriversal actions challenge universal understandings of the world, accounting for multiple knowledges and epistemologies (Escobar 2018; Grosfoguel 2011). I argue that a pluriversal internet is being built in Tseltal and Zapoteco internet initiatives, as they embed *comunalidad* and coexistence values into internet infrastructure, visible at the moment of interconnection.

Finally, this paper joins an increasing debate within digital inclusion scholarship that embraces the materiality of internet infrastructure as a crucial vantage point to understand the limited access to the internet in contexts marked by diverse scenarios of vulnerabilities. This debate proposes a rethinking of visibilities and invisibilities, breakdowns and their intrinsic relation to normalcy among marginalized people. It brings to the forefront underlying layers of digital inequalities that require swaths of internet users to engage in constant infrastructure monitoring, handling and maintenance (Gonzales 2016; Nemer and Chirumamilla 2019). Tseltal and Zapoteco experiences are about building new infrastructure to access the internet, but also maintaining its functionality despites risks of shutdowns by internet service providers.

The following sections are organized as follows. They explain the basis of shared networks, the methodology and methods of this research, and then analyze two complementary experiences of infrastructuring shared networks.

WHY SHARED NETWORKS

In one of the first interviews I conducted in Mexico City, Erick Huerta, a lawyer working on indigenous connectivity issues⁷ in the regions I would later visit, explained to me that what telecommunications companies call “last mile,” they call “first mile,” referring to that last piece of infrastructure that connects telco networks to end users. From the communities’ standpoint, that is clearly not the end of an infrastructure path, but the beginning. Beyond the logical and objective reasons for this semantic shift, there was also a political meaning embedded into the term. I would later understand it as a call for action based on indigenous communities’ own values: if that is their first mile to a desirable communication infrastructure, indigenous people can build it.

First mile experiences have been extensively analyzed in the context of communication development, community informatics, emancipatory communication practices, and community networks, to name a few (Crawford 2013; De Filippi and Tréguer 2016; McMahon 2014; McMahon et al. 2014; Milan 2013; Paisley and Richardson 1998; Philpot et al. 2014).

Importantly, “community networks,” along with grassroots movements leading emancipatory communication practices (Milan 2013), have emerged in conflict with telecommunication companies—as a kind of “a counter-power to currently established power structures or incumbents” (De Filippi and

⁷ For more information on these projects, see Baca-Feldman et al. (2018); Bloom (2015); Huerta (2018) and Parra, (2015).

Tréguer 2015, 4). Nevertheless, they have been increasingly recognized in the policy realm as useful do-it-yourself (DIY) efforts that actually enhances market competition. As the director of the Alliance for Affordable Internet (A4AI) puts it: “While it is important to continue supporting competition at all levels of the sector, the reality is that public access and community networks are an important aspect of broadband *market health and resilience*” (Jorge 2019, 9, emphasis added). This discourse dialogues with evidence from the US that when charging for their services, the prices of community internet service providers (CISP) and fiber-to-the-home (FTTH) services offered by municipalities tend to be lower than commercial internet service providers (ISP) (Crawford 2013; Talbot et al. 2017). In the policy spheres, affordability values emerge with the goal of reaching the “internet for all.”

Furthermore, “community networks,” along with “wireless community networks” and “grassroots community networks,” have been associated with the redemption of values from the beginning of the internet, on the one side, and as alternative solutions to areas where investments from the private sector are considered not viable or the prices and services are unsatisfactory, on the other (Crawford 2013; De Filippi and Tréguer 2015; O’Flaherty 2018). A representative of Internet Society, an organization that works in many fronts to expand connectivity policies worldwide, illustrates that: “At the Internet Society we are interested in promoting community initiatives in these unprofitable places. We can think of it as a return to the academic origins of the Internet, where everyone makes the effort to ‘reach’ the Internet instead of waiting for the Internet to reach us.” (O’Flaherty 2018, 238, own translation).

However, the cases that follow are not a mere result of affordability or a revival of an arguable imaginary of the origins of the internet. Instead, Tselal and Zapoteco people are exercising their right to coexist, embedding infrastructures in values and traditions that are *not* rooted in the mainstream history of the beginning of the larger internet and should not, as the analyses above founded in global North projections imply, be coopted in this direction. In fact, it is worth remembering the lack of information on the participation of indigenous people in mainstream cybernetics and internet history that we know so far (e.g. Abbate 1999; Braman 2012a, 2012b; Medina 2011).

Altogether, these perspectives reconcile conflicts of interest under the term community networks, and with few exceptions (e.g. De Filippi and Tréguer 2015; McMahon et al. 2014), they overlook inherent contradictions and power relations at stake. In the context of indigenous communities, regulatory efforts, on the one side, and emancipatory efforts on the other, even if leading to effective results (e.g. internet access), may still disregard the protagonism of indigenous sovereign territories, in which natural resources necessary for wireless internet to work are constitutive of their lands (Duarte 2017). For instance, in Abasolo, I would hear from Mariano Gómez⁸ that: “There are things we already knew about the internet, but we did not know the name. The spectrum, we call air (own translation).”

I adopt the term *shared networks*, instead of community networks, to denote the first mile signal-sharing practices that articulate interconnection infrastructure and coexistence values to extend basic services to underserved areas—here in particular, the internet to areas where the services of existing larger internet service providers are unsatisfactory or unavailable. Shared networks both acknowledge the sharing-

⁸ The amount of effort that they have put into such projects, and the current recognition of their achievements by government agencies and international organizations, led the interviewees to demonstrate interest in being named when featured in my work. Some of them are also featured in media outlets. I have not changed people’s names within the article for this reason.

oriented principles characteristic of these networks, independent of the actor responsible for it (a municipality, a collective, a business, etc.), while also critically illuminating interconnection infrastructure that affords and materializes such principles. It takes into consideration that artifacts are actively constitutive of societies' morality (Latour 2008), implying a delegation of their values to infrastructure as we shall see.

METHODOLOGY AND METHODS

This work presupposes that technology and society mutually shape and embed each other in a process that has been framed as co-production (Jasanoff 2004). Significant contributions from this approach are attention to contextualization and how knowledge is situated; consideration of silences and not only explicit discourses; equal concern with stability and instability; and the integration between knowledge and technology production with power (Jasanoff 2004). Additionally, using the ethnography of infrastructure (Star 1999) as a method, a focus on infrastructure deployment, design and governance oriented the *in loco* research.

I was conducting participatory observation at the International Forum on Indigenous and Communitarian Media, in Oaxaca, Mexico, in August 2017, when I had the opportunity to meet numerous people who were developing internet infrastructure projects in non-urban communities. In that event, co-sponsored by the telecommunication regulator *Instituto Federal de Telecomunicaciones* (IFT), they were openly showing their solutions to the telcos' and government's absence in their indigenous territories, and receiving recognition for their achievements. The IFT's president, one of the most important telecommunications authorities, was even present at the event.

I asked some of the presenters if I could see in person the infrastructure that they had built to have access to the internet. In the present paper, I examine two of the sites that I visited following the forum—a Tselal *pueblo* in San Martín Abasolo, Ocosingo, in Chiapas, and a Zapoteco *pueblo* in Guelatao de Juárez, in Oaxaca. In the communities, my interlocutors took me to see devices already in place, and also to see firsthand the set-up of the internet for the first time in a new locality. They would not only guide me through their communities and infrastructures, but would also explain how those apparatuses were built, the challenges and the motivations to do so.⁹ Our conversations occurred in Spanish, and the possibility of understanding how the values that they shared in their public presentations were visible in the infrastructures they were building guided this research. My previous research on digital literacy and technology and education—including in indigenous schools (Rosa and Azenha 2015)—also shaped my interest, considering broader contexts of internet access in the global South.

According to official data from 2005, these two indigenous territories have a population of 2,884 and 544, respectively (SEDESOL 2005b, 2005a). In the index created by the *Consejo Nacional de Población* (CONAPO) to measure “a set of social disadvantages of a community or locality” (Vega Estrada, Téllez Vázquez, and López Ramírez 2012, 11), San Martín Abasolo has a high and Guelatao has a very low social disadvantage levels. Regarding access to the internet, both states—Chiapas and Oaxaca—are

⁹ The amount of effort that they have put into such projects, and the current recognition of their achievements by government agencies and international organizations, led the interviewees to demonstrate interest in being named when featured in my work. Some of them are also featured in media outlets. I have not changed people's names within the article for this reason.

considered areas with the lowest connectivity rates in Mexico: between 0-20 out of 100 inhabitants have access to the internet at home. As a comparison, in Mexico City, this number corresponds to 76 out of 100, and in the country, to 43 out of 100 (IFT, 2017, p. 29). It is in this scenario that these experiences take place.

TSELTAL'S AND ZAPOTECO'S FIGHTS FOR COEXISTENCE

The history of indigenous populations in Mexico, and more visibly in Chiapas and Oaxaca where the present fieldwork took place, is marked by tensions against cultural assimilation processes (Muñoz 2005). Particularly, the history of Abasolo includes land conflicts between indigenous people and squirearchy, and as more recently documented, organized peasant movements in the 1980s (Gómez Méndez 2016; Gómez Ramírez 1999). Importantly, the municipality of Ocosingo, where Abasolo is located, is also known as one of the bases of the Zapatistas uprising in 1994 against constitutional neoliberal reforms (Schmal 2004). Furthermore, colonizing methods are still visible in the region through the centrality of Catholicism in the community—the church dates from 1570 (Gómez Ramírez 1999)—and the Maya's ruins in the region (e.g. Toniná) that illustrate, not subtly, the long-term effects of the Western imperialism. In a telling coexistence, stunning mountains are named in Tseltal language; corn and water have feast days; and most of the population lives off sowing, especially coffee, motivated also by price and demand outside the community (Gómez Méndez 2016).

The written history of Guelatao also dates back to the sixteenth century, similarly including conflicts, violence, and in the 1980s a historical movement against the concession of the state for a company to continue exploiting the woods in the region (Martínez Luna 2006). Today, the *pueblo* is marked by dirt roads in the margins of paved ones, and residencies with apparent blocks contrasting with other constructions, all surrounded by astonishing green mountains. Sources of pride for its residents, Guelatao has a cinema, a museum, a music band, and from the perspective of the Mexican government, remarkably low levels of social disadvantage (Vega Estrada, Téllez Vázquez, and López Ramírez 2012, 11). Despite that, concerns with the effects of development policies in the territory, particularly in regard to food sovereignty appear in critical local circles (Martínez Luna, 2006).

The history of Guelatao also includes the singular fact of being the land of Benito Juárez, Mexico's president in the nineteenth century with Zapoteco origins. His bicentennial birth inspired a book about the community and its territory sponsored by the senate and written by the prominent Zapoteco anthropologist Jaime Martínez Luna, also born in the *pueblo*. Along with Mixe Floriberto Díaz Gómez, Jaime Martínez is considered a reference theoretician of the term “comunalidad,” defined as the way of being of indigenous people, which is central for the present analysis. In contrast to an essentialization, I understand *comunalidad* in relation to the concept of hybridity, in Latin American thought, which refers to the existence of elements that inherently clash—the traditional and the modern, the liberal institutions and the authoritarianism, handicraft and new technologies. This creates a heterogeneous reality full of “impure genres” that expand and characterize the region to different extents (Canclini 1989).

In her critique of hybridity with the concept of *ch'ixi*, Silvia Rivera Cusicanqui (2012) understands that the result of these meetings is “the parallel coexistence of multiple cultural differences that do not extinguish but instead antagonize and complement each other” (105). In Tseltal's and Zapoteco's efforts

to coexist, hybrids and *ch'ixi*, form all the time. This can be seen within the contentious relations with Mexican government policies, which coexist with local political systems founded on *usos y costumbres* (“uses and customs”), and as we shall see, in the consolidation of their communication rights when interconnecting their local networks to the global internet.

The shared network in Guelatao will be presented focusing on the formation and design of their first mile infrastructure, followed by the case in Abasolo, which will be presented complementarily with a focus on the sharing principles that they expand inside the community. Joining literature focused on actors whose participation still need to be told and emphasized (Costanza-Chock 2020; McIlwain 2019), in considering the internet design as a process, the present research enable to see Tselal’s and Zapoteco’s participation clearly, as internet codesigners.

Case 1 - Internet Infrastructuring by a Municipality

Humberto Morales is a network technician at a university in the region, and the municipality coordinator of the internet project deployment. His service to the municipality is known as *tequio*, a non-paid work that people are expected to do voluntarily for the community in territories that follow the political system of uses and customs (*usos y costumbres*) and one of the *comunalidad* pillars (Mendoza Bautista 2017).

In a room of his house, Humberto explains that before developing their own wireless network to bring internet service to the community from another city, they tried at least two other alternatives. First, they requested, unsuccessfully, service improvements from Telmex, the Mexican telecommunications incumbent, and the only internet service provider (ISP) available in town until 2014. The internet service offered was slow and unsatisfactory, delivering 100 Kbps (kilobits per second) of download and 10 Kbps of upload, he remembered. According to him, in response to the request, the company indicated that there was no financial incentive to improve their service. Alternatively, the Guelatao community representatives sought to negotiate the use of Federal Electricity Commission (CFE) infrastructure and optical fiber network, also unsuccessfully.

As an incumbent, Telmex was responsible for 57.7% of the internet provision in the country, together with Telnor, both sister companies under América Móvil’s control (IFT 2017, 27). Its market power to define commercial relations is an important factor of interconnection politics and of commercial standards in the provision of services.

With these requests unfulfilled, Humberto, along with Saúl Hernández Marcial, Héctor Juan Miguel, and Julio García Márquez at the University of Sierra Juárez, decided to deploy a public wireless network, under the municipality’s responsibility, which would allow them to contract a better service in the capital Oaxaca, and then bring the signal to Guelatao and its population. The conditions under which this deployment happened are revealing of the role of infrastructure in shaping the contours of internet design.

The first step for the group to enable internet in their community was to identify the nearest internet service provider (ISP) already offering internet service, from where community representatives could bring the internet signal to the community. The plan was simple: to contract with that service as if they were a residential client, making agreements with acquaintances or friends who had houses in the

capital Oaxaca where the internet could be requested and installed, and from that house, deploying their own wireless network to transport the internet to Guelatao.

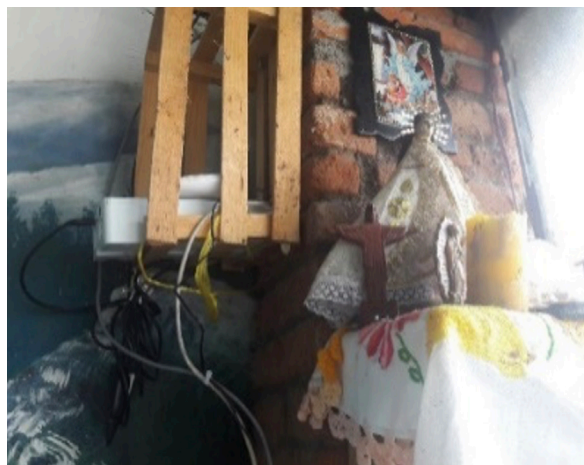
For that, the professionals bought routers, radio and sectorial antennas and initiated collaborations with parties who had the passive infrastructure—towers, posts, etc.—to install the devices in the highest and closest points possible to their own municipalities, ensuring good signal capacity, not uncommonly influenced by natural barriers, including ridges, trees, etc. The collaborations could involve local households that are well positioned, or companies, which sometimes have towers already installed for different purposes, such as television service. The agreements involved money and, sometimes, exchange of resources that benefitted both parties.

Interdependency values are seen in the whole path of the local network, and the decisions about with whom to partner was constrained by the way that infrastructure works: who offers services and where, who can share towers and posts, where it should be set to be protected from natural accidents, etc. As researchers summarize, “users are able to transform the materiality and meaning of artifacts, but the affordances and features of these artifacts also affect their agency” (Siles and Boczkowski 2012, 231). For instance, high geographic points for radio antennas are beneficial for signal capacity, but are also highly vulnerable to electrical discharge, which causes damage to the equipment and requires a quick replacement. This is part of the cost of technology maintenance (Gonzales 2016), necessary to keep the internet functional in these territories.

Besides the towers and the cables, four main antennas were necessary for the ecosystem to work, one in Oaxaca to send the signal, two in a middle-point town in the path—one facing Oaxaca to receive it, and the other one facing Guelatao to resend it—and finally one in Guelatao, in a tower from where the signal is received and is distributed to reach households and public spaces such as the school, the health center, the movie theater, etc. Sectorial antennas are jointly used with radio antennas to allow the signal sharing.

As a result of the project, network access improved from the nominal speed of 1 Mbps of download promised by Telmex in Guelatao—only 100 Kbps as measured—to 60 Mbps. The devices and antennas work with the frequency of 5 MHz, an unlicensed frequency, which does not require any payment or authorization from the telecommunications regulator to be used, and is considered more stable than the frequency of 2.4 MHz, which is more popular in the communication of Wi-Fi devices and, consequently, more subject to interferences.

The improvement costs were worth it. The municipality charges approximately 9 dollars (150 pesos) per household for connectivity. The monthly cost for the infrastructure built from Oaxaca to Guelatao includes approximately 76 dollars (1.300 pesos) paid to the internet service provider contracted in the capital; 12 dollars (200 pesos) paid for the electricity and the rent of the rooftop on a house in Oaxaca; and 88 dollars (1.500 pesos) paid for the municipality that owns the middle-point land. The total is 176 dollars (3.000 pesos). As of 2020, there were 30 households connected, in addition to the public



Figures 1 and 2: A household with an external radio antenna and a router inside

primary school, the public health center, the public library and the city hall, where free internet is offered: One point five (1.5) Mbps is divided between the users.

Throughout the path from a household in Oaxaca to many households in Guelatao, in their contact with different devices, people have constantly “domesticated” internet first mile infrastructure as internet codesigners. Domestication in relation to media happens through means of appropriation and “meaning-making dynamics,” as well as processes of interpretation, negotiation and incorporation of content into the day-to-day routines, considering also “broader cultural and social relations” in which media users participate (Siles and Boczkowski 2012, 240). Media, of course, is not only formed by content, but also by its infrastructure, or materiality (Lievrouw 2014). In the cases studied, domestication is key and in *comunalidad* terms means that “Just as the cornfield is not the same everywhere, communication will not be the same in all spaces” (Martínez Luna 2015, 32-33).

In Figures 1 and 2, the radio antenna is affixed in a clothesline bar, and the router is placed close to the altar, a sacred space in the house, influenced by the orientation of the technician about the best place to receive the signal from the outdoor antenna. The role of infrastructure attributes, or affordances, in the resultant scenario of adaptations is once again evident.

Case 2 - Internet Infrastructuring by a Social Organization

During the International Forum of Indigenous Media, in the audience, we would hear the following explanation about the sharing principles embedded in an internet project in Abasolo de San Martín, in Ocosingo, Chiapas:

“From the daily practices there is what in Tselal is known as *mankumun*: *man* is to buy and *kumun* is together. During the Day of the Dead and other festivities, a cow or *wakax* is bought and skinned among all. [A] little part of the meat is eaten and the other part is divided. We do

it for two reasons: the first is unfortunately economic, as it is cheaper to do this because you get more pieces of meat than going to the butcher shop or elsewhere. The other is a matter of living together: while you are preparing the cow, you are talking and there is a relationship, a communication between us, a more spiritual way of living together, something that goes beyond just the act of making it.” (Álvarez Malvido 2017, own translation)

The speaker was Mariano Gómez, an elementary teacher of indigenous education, and one of the founders of the Colectivo Ik’ Ta K’op (Word of the Wind Collective) who built from scratch a wireless infrastructure where neither cellphone nor internet service was available. In 2013, the point-to-point internet was a solution to replace the unstable and low-speed internet previously available. There, the only option in the 2000s was a satellite to bring internet to that region. The signal now comes through a mobile network that they built from a municipality where there is already an ISP offering the service, similar to Guelatao.

The sharing values in the cow example can be seen in the design of this network, where each device installed in the households becomes also a hotspot. In this way, the more neighbors that have home internet access, the more people can have access to the internet outdoors on the street. That happens with the Wi-Fi password commercialized not only by the Mariano’s house, that also works as a cyber-café, but also provided by any person who requested from the Collective the installation of the antenna at home. In other words, this network design enables any household to become an internet service provider and charge for the service if wanted, creating a “distributed governance” (De Filippi and Tréguer 2015). The arrangements can vary, but commonly interested people provide and install the towers, while the Collective provides the radio antennas. The towers are commonly made of bamboo and provided by the home’s owner that will receive the antennas. Below, the figures show the first time



Figures 3 and 4. Bringing internet to the community of San Martín for the first time

that the internet was enabled in a more distant community known as San Martín, described in the beginning of this paper.

The Collective charged different amounts for the service, depending on the involvement that neighbors want to have with the project, from approximately 12 dollars (200 pesos) per month to the ones that want to be just users, to 5–6 dollars (80–100 pesos), for the ones who can support device maintenance and collaborate in other Collective projects. Also, families can have the service for free if they affirm they cannot pay for it.

Importantly, beyond the internet first mile infrastructure, the project also maintains an intranet with locally-curated content. This initiative, first developed by a teacher for his own students, can be available to all in the community with the design of the network. The intranet has a range of educational content, including a library of books from Latin America and other parts of the world, movies and documentaries, an offline version of Wikipedia, courses such as Khan Academy in Spanish, and materials in the Tseltal language (EFE 2019), among others, cached in the community's server.

Abasolo's connectivity project is one more example of domestication that may be not easy to understand from the outside. A skeptical Facebook public post about the project and its focus on keeping the content curated local and not on the internet says "I follow without understanding why it is good that there is an intranet and no open resource on the internet" (own translation), to which Erick Huerta responded: "Well, you should have some understanding of the priorities of indigenous peoples and the strengthening of their identities" (Pisanty 2019, own translation). The example shows that the question about with whom people from this Tseltal community want to connect should not be taken for granted. Beyond sharing values, the connection with other local communities that would be distant otherwise, as the one in which the internet was brought for the first time, is key. The *comunalidad* literature also helps to interpret this phenomenon: "The communal is the integration of diversity, it is the unity of natural diversity. ... It is to communicate from a work shared in reciprocity, not between individuals and nations, but between communities and regions" (Martínez Luna 2015, 30-31). Nevertheless, it is worth mentioning that the internet capacity available in the community also plays a role in the intranet design. To have more people able to use the internet, it is not expected that everything goes online, which would require a better speed. Using just what is necessary also stands out as an important value under sharing principles. This is more important than being connected to the global internet.

In this direction, Mariano envisions each indigenous community having a server in the future to build its own intranet and its own cloud service, enabling anyone to share material with others locally. Within an internet governance framework, I interpret this as local content delivery networks (CDNs)—as opposed to global CDNs owned by global content providers such as the big techs. Such initiative dialogues with strengthening the community autonomy. In this project, one can see the conception of a local ecosystem, and the rise of a sense of internet governance founded in values of sharing, self-sustainability and collaboration. As Mariano notes:

"If we want to do internet governance, we do not just have to have infrastructure, our antennas, our towers and links. We have to have the logical part, software design. And not only. We also have to produce our own content, our own videos. The Collective, dedicated to the deployment of networks, is not going to start making videos. We do not know how to make videos. But there are other organizations that do. In an organization, I cannot rule the internet by myself. I need several arms and supports to make real internet governance." (own translation)

It is also useful to mention that in the context of communication and *comunalidad*: “Resorting to autonomy has been a strategy to live together with the rest of the world, to stop their aggressions, to strengthen our concrete unity” (Martínez Luna 2015, 38, own translation). In is about reaffirming who *we are*.

UNDERSTANDING SHARED NETWORKS WITH *COMUNALIDAD*

Comunalidad, as these two cases elucidate, defines primarily “the way of living and thinking” (Martínez Luna 2015, 44) of the *pueblos*, encompassing the territory—the Earth; the authority of assemblies to take decisions; the voluntary services and the collective work in the communities; and the parties and rituals (Díaz Gómez 2004, 368). As explained in the International Indigenous Forum through presentations and dialogues with participants, it does not end in formal institutions. Instead, it involves a “horizon and utopia” and works differently in different communities as occurs with democracy in western societies (Aquino Moreschi 2013, 12). In this sense, it is useful to think of it in terms of “a structure, a form of social organization and a mentality” (Maldonado Alvarado 2013, 22), all being negotiated as societies are transformed in contact with neoliberalism, gender, generational, and migration issues, to name a few (Aquino Moreschi 2013; Guerrero Osorio 2013; Vásquez Vásquez 2013).

As a framework for the present research, *comunalidad* synthesizes values that define who *we are* in relation to *others* and vice-versa, a tool for “mutual recognition” (Guerrero Osorio 2013), where “community” is meant to be “geometrical,” involving territory, collective history, language, and types of community systems and organizations, as opposed to the “arithmetic” western communities: “a simple aggregate of individuals out of their egocentric isolation” (Díaz Gómez 2004, 367). This is telling as Tseltal and Zapoteco networks would never be well framed as a “community network.” They convey types of Latin-centric indigenous networks, if a name to communicate to others, me included, is necessary, which as a reminder, enforce and exercise the *comunalidad*, rooted in their territories’ history. They call attention to similar patterns of colonialism and colonality rooted in Latin American history and entangling these sovereign territories (as seen in Canclini 1989; Cusicanqui 2012; Galeano 2004; Pinto 2018; Quijano 2007; Ricaurte 2019), without disregarding differences, here marked by the protagonist role of Tseltal and Zapoteco people.

Similarly, in their work of codesigning technologies with Herero indigenous people in Namibia, scholars call for a move to an afro-centric human-computer interaction (HCI) research and design, one that is local and “driven by indigenous people” (Winschiers-Theophilus and Bidwell 2013, 253). Tseltal and Zapoteco shared networks, while not HCI *per se*, exemplify experiences of such ideal at the level of first mile internet infrastructure design, where the seeds for “dialogical forms for the construction of knowledges” (Cusicanqui 2012, 106), can be seen. Latin-centric indigenous networks call attention to the role of indigenous people, who know deeply the effects of colonialism and colonality in the region, as internet codesigners towards a pluriversal internet. A pluriverse—as opposed to a universe (Escobar 2018; Grosfoguel 2009)—, founded on values of autonomy and coexistence.

INTERNET INTERCONNECTION, HYBRIDS AND *CH'IXI*

Communicating through the internet in Mexico, where access to broadband internet is a constitutional right, paradoxically requires from Tseltal and Zapoteco communities a long infrastructuring process. To have such a right fulfilled, they have to actively denote their existence, shaping contradictory encounters that are analyzed here as the materialization of a hybridization process. In the context of internet design, Tseltal and Zapoteco communities materialize a hybrid when building their interconnection strategies to become part of the larger internet. In doing that, values of autonomy and self-sustainability, along with the commercial and neoliberal values of internet service providers, altogether instantiate means of communication between *us*, and between *us* and the *others*. Values here are assumed to be “hypotheses” (JafariNaimi et al. 2015), that emerge in context, in face of situations that require actions.

In the studies of *comunalidad*, Arturo Guerrero Osorio (2013) brings a meaningful image of a river and a whirlpool to represent the contentious but inevitable relations that make *comunalidad* exist: “The flow of the river and the accidents of the riverbank generate the whirlpool. But the whirlpool achieves its own internal dynamic, different from that of the river in general. It has its own existence, an order ‘inside,’ relatively stable although shaped by the current from ‘outside.’ However, we cannot separate the whirlpool from the river. We see *comunalidad* as a spiral in the flow of capitalism, a localized way of building modernity.” (42)

For the author, the result of that “conflict” is “resistance” and “adequation” by means of communal values. Using this perspective, Tseltal and Zapoteco infrastructuring is a collective practice that not only materializes the hybrid, but is also a result of it. In other words, there is resistance in their actions to bring internet to their territories despite formal rejected requests to ISPs, and there is adequation as well, once they are still subjected to the policies of these ISPs, as will be further discussed next. That is to say, these projects are innovative and effective, to use modern capitalist words, at the same time that they express a Latin-centric fight for coexistence based on values of autonomy and self-sustainability.

The second way of thinking of hybridization in the context of internet interconnection of Tseltal and Zapoteco networks consists of including infrastructure in the debate and, specifically, its “technopolitics”—the “hybrid forms of power embedded in technological artifacts, systems, and practices” (Hecht 2011, 3). In the cases examined above, the Guelatao municipality and the Collective in Abasolo take action mobilizing many resources and responding to the limitations imposed by technologies’ affordances and interoperability to enable connectivity, despite ISP positions in ignoring their requests. Moreover, they establish shared networks by design that disregard the restrictions imposed by ISPs’ policies on signal sharing. For instance, Telmex’s terms and conditions explicitly state that “THE CONSUMER acknowledges and accepts that the SERVICE is of a residential character for use in the household, so that THE CONSUMER cannot commercialize, sell or resell the internet service” (Telmex 2016, 4, emphases in the original, own translation).

These facts show the efforts of Tseltal and Zapoteco communities who, with the goal of establishing communication with the internet, signify the commercial ISP services and the internet infrastructuring as a means to get there. However, the question of power and control remains open, as “Infrastructure does not grow de novo” (Star and Ruhleder 2015, 381), and infrastructuring is always constrained by previous paths.

Looking at the materiality of the infrastructure built, these shared networks do not have substantial control of their internet communication. Instead, they are susceptible to the ISPs’ economic power and

legal prerogatives materialized in their terms of services, as the companies can shut down the internet at any time. Additionally, in the position of ISP consumers, Tseltal and Zapoteco communities are directly subject to the companies' policies and possible deep packet inspection, a procedure that ISPs in general have taken, arguing the need for network management that leads to decisions over users' traffic for commercial purposes. Monitoring, slowing down, and blocking the sharing of content through peer-to-peer file-sharing platforms are some examples of existing practices (Bendrath and Mueller 2011). As Jane Summerton (1999) synthesizes, "In actor-networks, control by the dominant actor is accompanied by the loss of autonomy by all others" (96). It is a constant negotiation in favor of a pragmatic need for internet communication.

Interestingly, in the current development of the internet, in which a plethora of objects have connectivity, authors have described changes driven by the market in the realm of interoperability. Basically, in the era of the internet of things, artifacts are manufactured without interoperability properties as the result of the rise of standards fragmentation, where each company produces its own proprietary standards (DeNardis 2020). This has positive and negative consequences, but most importantly, is not a neutral design characteristic. In the context studied here, this works as an evidence, from the current commercial internet trajectory, of the technical feasibility of Tseltal, Zapoteco and other communities to create technologies founded on their own values, mitigating path dependencies embedded in infrastructure. As the intranet arrangement in Abasolo exemplifies, sometimes local and regional connectivity are more important and can be prioritized, a design option that already demonstrates the exercise of their autonomy in place. As Arturo Escobar (2018) puts it, autonomy, or "*autonomía is a theory and practice of interexistence and interbeing, a design for the pluriverse*" (173, emphasis in the original). Technology design in the context of indigenous communication needs to take that into account.

FINAL CONSIDERATIONS

Interconnection arrangements that allow the local to become global, and local to stay local, are key places of hybridization where tensions are explicit. Also, hybridization is inevitable and constitutive of what Tseltal and Zapoteco communities both produce and are, so also is their communication infrastructure. Thus, there are reasons to not think separately of humans and their values on the one side, and infrastructure on the other, as if the first ones were independently driven. Hybridization processes are what allow shared networks to be interoperable—the way that Tseltal and Zapoteco people can coexist on the internet, and the fundamental characteristic of Latin-Centric indigenous networks and their infrastructure.

The history of the internet is multiple and diverse, and includes groups following different paths in the past and in the present. Latin-centric indigenous networks founded on sharing-oriented principles call attention to just few examples of internet infrastructuring underway. More generally, Tseltal and Zapoteco participation in internet co-design enriches the public understanding of internet governance in practice, which includes a vivid struggle for a pluriversal internet.

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MISSION STATEMENT

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