Enmeshed lives? Examining the limits of autonomy and ideology in the provision of wireless infrastructure. An ethnographic study of the Réseau Libre mesh network

Introduction

Over the past two years, documents leaked by Edward Snowden[1] have revealed long-term systematic government abuse of personal privacy through automated mass surveillance, this enabled through hacking wizardry (York, 2013), legal strong-arming (Tsukayama, 2013) and corporate complicity (Timberg & Gellman, 2013). While projects for reconceptualizing internet communications predate the Snowden revelations, the new knowledge that we have concerning mass surveillance provides a new context and a new urgency to this work. Examples of such projects include mesh network systems like Commotion Wireless[2], and Project Byzantium[3], peer-to-peer networking efforts like the FreedomBox[4] and autonomous networks like the PirateBox (Anderson, 2011)[5]. All of this leads us to ask the question: what might the networks of tomorrow look like, emerging from the ooze of the primordial surveillance state that we become more aware of everyday? Are these efforts to reinvent networked communication up to the challenge of both providing communications infrastructure and safeguarding our personal privacy?

Mesh networking is a method for creating self-organizing clusters of computers or wireless routers that communicate between and through one another wirelessly. In 2003, Microsoft predicted that mesh networking would become mainstream in five years; Intel's prediction was three years (O'brien, 2003). Mesh networks have been touted as a "solution for democratizing networked solutions" (Sinnreich, Graham, & Trammell, 2011), a solution for humanitarian disaster situations (Simonite, 2013) and a method for simultaneously avoiding state and corporate mass surveillance and countering the high prices of internet access from monopoly internet providers (Thompson, 2013). All said, though, mesh networks remain far from mainstream.

In this article, we examine a Montreal-based mesh network, Réseau Libre, which emerged in 2012 during Quebec's "Maple Spring"[6] and the Montreal offshoot of the Occupy Wall Street movement, Occupy Montreal[7]. Given its historical pedigree, we were eager to examine Réseau Libre's politics and goals. We also aim to learn about the technical practices of the individuals involved, to analyze the extent to which their project-oriented politics extend into their personal uses of technology and vice-versa. Studying Réseau Libre mesh network allows us to examine personal and organizational

1 Snowden Digital Surveillance Archive. https://snowdenarchive.cjfe.org
2 https://commotionwireless.net
3 http://project-byzantium.org/
4 Started in 2011. http://freedomboxfoundation.org
5 http://www.piratebox.cc Started in 2011.
6 The Maple Spring was a 7.5 month long student strike in Quebec that morphed into broader protests over freedom of expression and government corruption. The student strike lasted from February 13, 2012 - September 7, 2012.
7 http://www.occupons-montreal.org/

limitations, controversies and tensions related to access, primary mission, connectivity, and the autonomy of mesh networks and local hacker communities in the current context of growing internet monopoly. Thus, we examine the ideals and practices at work within the bounds of the mesh and its members, as well as the personal relationships of these individuals with technology and the internet outside the mesh. We explore, more indirectly, the contemporary issues of autonomy and utility, ideological and political consistency, operational security and social infrastructure.

Mesh networking projects are a global phenomenon and today many densely-developed cities such as Berlin[8], New York (Cohen, 2014) and Barcelona[9] have active mesh networking communities. Often built by hardware hackers who have an interest in community networks and the distribution of power and control within the internet, mesh networks can be seen as a step in the evolution of the idea of community wireless access as established by the widespread community wireless network (CWN) model. Whereas the CWN model focused on the fundamental issue of free internet access using consumer-grade hardware and mainstream internet providers (often in exchange for a coffee at the participating cafe), today's mesh networking projects introduce significant changes in approach, perspective, and – possibly – organizational and personal politics. By relying on mesh networking technology that is predicated on the concept of interconnectedness (computer to computer, small network to small network, neighbour to neighbour) and proximity, these projects call into question the nature of internet service provision. *If I want to access a database at my university library or a file at city hall or on my friend's computer, why should I have to pay an intermediary to do so?* Further, mesh networks such as Réseau Libre tend to be composed of nodes maintained by individuals who know one another in the real physical world, potentially offering a means of existing, working, and collaborating electronically outside the scope of mass surveillance.

This article is organized into five sections plus the introduction. **Section one** delves into the existing literature on mesh networks. Our work here seeks to fill a significant gap in the existing literature which is overwhelmingly technical (Ali, Ahmed, Piran, & Suh, 2014; Sattari-Naeini, 2014; Yu, 2014). When it is not, research on mesh networks tends to be anthropological in approach, conducted by social scientists for whom learning how to use new technologies is part of their personal ethnographic journey (Jungnickel, 2013). While we are indeed social scientists, we also have solid technical backgrounds in networking, security, and telecommunications policy and have been users of free and open-source software for close to two decades. **Section two** presents our research methodology and research questions, and briefly examines our roles as technically-minded activist-oriented academic researchers within this particular context. **Section three** presents the social, political and economic contexts from which Réseau Libre emerged and within which it operates. In particular, we discuss recent social uprisings in Québec, the state of Canada's telecommunications system, and state surveillance practices and laws. **Section four** presents a “state of the mesh”, looking at the history of Réseau Libre and what it is today both organizationally and physically. Finally, **section five** examines some of the conflicting visions of mesh networking in Montreal.

8 Freifunk. https://berlin.freifunk.net/
9 Guifi. http://guifi.net/en

Literature review

Mesh networks can be seen as a logical organizational and technological progression from community wireless networks. Social science research on community wireless networks began in the early 2000s and gained significant speed in 2003 with the formation of the Canadian Research Alliance for Community Innovation and Networking (CRACIN). Looking at a landscape where a significant segment of efforts to facilitate internet access had been funded by government yet the effects of these efforts on society had been unexamined, CRACIN sought to fill important research gaps (Clement et al., 2004, p. 10). Research issuing from this project tended to examine grassroots and municipal wireless networks that worked to provide free access to the internet by wireless means and in public spaces (Clement, 2012; Alison Powell & Shade, 2006). Powell's work, issuing from this immense research undertaking, has examined the question of whether community wireless networks are likely to produce more democratic communication spaces (Alison Powell, 2011) and the barriers between technical subcultures and other participatory cultures (A. Powell, 2012). In the context of the UK and Australia, Gaved's work has examined community wireless networks as a means of reducing the digital divide (Gaved, 2011) and has compared grassroots efforts with master-planned neighbourhoods that use top-down network provision (Gaved & Foth, 2006).

While there are numerous mesh network projects around the world (and indeed some have become large-scale internet providers), social scientists have given them very little attention. Mesh networking, it seems, has been approached as more of a technical innovation than a socio-technical one and few researchers have attempted to make the leap. It has, however, received an interesting amount of attention in the popular press with articles in the magazines *Mother Jones*, *New Scientist*, and *Scientific American* dating back to the early 2000s (Agustine, 2014; Dibbell, 2012; Hodson, 2013; O'brien, 2003; Thompson, 2013). In 2008 and 2009, European computer science, informatics, telematics and telecommunications researchers examined the issue of security and mesh networks. Rather than reducing the issue to one of digital code, they insist that issues of security and trust in mesh networking are ultimately issues of trust within a community of individuals (Antoniadis et al., 2008; Bury, Ishmael, Race, & Smith, 2010).

This focus on the human element in network provision and network security resonates further in one of the few academic articles that has wholely enaged with the mesh network as a technical, social and political project (Sinnreich et al., 2011). The authors propose an interesting set of ten "specifications for a democratized network": decentralized, universally accessible, censor-proof, surveillance-proof, secure, scalable, permanent, fast (enough), independent, evolvable" (Sinnreich et al., 2011, p. 339). They link the monopolized state of the telecommunications market with threats to freedom of speech and propose mesh networks as a way to work around these dangers. A seemingly serious proposal at its inception and accompanying TED Talk (*TEDxUSC - Aram Sinnreich - The Next Generation Internet*, 2011), the project's website has not been updated since 2012 and its instigators seem to have drifted elsewhere[10].

Similar to Gaved's work noted earlier, Schaffer has considered how mesh networking in the United States may be employed for reducing the digital divide (Shaffer, 2011). Shaffer's research examines

10 Mondonet. http://mondonet.org/

why people “steal” wireless signals from others and why people share their capacity with one another. Finally, Katrina Jungnickel's ethnographic study of an Australian mesh network (Jungnickel, 2013) goes deep inside the human inner workings of a mesh network. While obviously a talented and dedicated researcher, her work is fairly uncritical in its subjects and relies on ethnographic powers of observation. We learn about the individuals who compose the network, but much of the technical and political foundations of the project are taken at face value.

Research Questions and Methodology

We aim here to examine an emerging urban mesh network in order to better understand where this type of project is situated in the larger context of internet connectivity, network privacy, and communication infrastructure autonomy.

We seek answers to the following questions:

1. What are the main ideological or ethical motivations of the founders of Réseau Libre and how do they relate to the current context of a monopoly of internet providers?
2. What are the real and potential uses of a mesh network the size and scope of Réseau Libre and and what are the realistic benefits of using Réseau Libre for the participants in the mesh network?
3. What are the personal and organizational limitations, controversies and tensions related to access, primary mission, connectivity, autonomy of mesh networks and local hacker communities in the case or Réseau Libre and Montreal?

For the purposes of the current research, we have decided to rely on an ethnographic approach based on participatory observations and semi-directed interviews. Our goal is to understand and describe the values and positioning of mesh network participants based on our long-term engagement with the field and the community. As participant-observers, we aim to carefully listen to participants' experiences, give them meaning, and help to structure them, and bring their experiences into the processes of planning and acting. We are also looking for common features and patterns in relation to a bigger picture rather than examining each issue in isolation. The focus is placed on the actual processes within in the community with respect to external forces and contexts. One of the researchers has been involved with Réseau Libre from a very early phase, participating in local meetings and discussions, testing network connections and antennas, participating in installations, and hosting a node on her own roof. In this way, we have had access to up-to-date information and an opportunity to make our own observations, parallel to the information that is given on the website, tutorials, and via the interviews.

Participants in the study are members or founders of Réseau Libre living in Montreal. We contacted all members through the Réseau Libre open email list inviting the respondents to participate. First, they could participate in an on-line survey with about twenty questions related to their personal participation in the mesh network, including the technical specifications of their nodes, personal motivations, expectations, and ethical visions. Willing participants were then invited to participate in a 45-90 minute semi-guided interview. Ultimately, we were able to interact with eight participants (out of about 42), who answered the on-line survey and/or met with us for a face-to-face interview. The methodology of

this research has been kept relatively flexible, providing space for the participants to draw attention to issues of their choosing.

Social disruption, politics and telecoms

Consumer choice, when it comes to telecommunications providers in Canada, is quite limited. According to the Canadian Radio-Television and Telecommunications Commission (CRTC), Canada's communications regulator, the “top five incumbent telecommunications service providers” earned 62% of telecommunications revenues in 2013. In addition, the top five incumbent internet service providers (ISPs) (including affiliates) control 75% of the internet access market (Government of Canada, 2014). Internationally, Canada's high-speed internet access has been documented as being one of the most expensive markets. Internet metrics company Ookla ranks Canada 20th in terms of relative cost of broadband, just above Japan among the G7 nations (Ookla, 2015). Finally, the Organization for Economic Co-operation and Development (OECD) also ranks Canada among the most expensive countries in the world in terms of internet access (Nowak, 2015; OECD, 2013). While the country boasts a number of independent ISPs, the majority of them rent wholesale infrastructure from the dominant incumbent providers.

Chris Patterson, a postdoctoral fellow at the University of Toronto's CitizenLab, has shown how the Canadian government has incredible sway over the incumbent providers. The majority of these providers offer not only internet access but are also active in mobile telephony and television and need regulatory permits to offer these services. Thus, according to Patterson, who has conducted extensive interviews with industry insiders, the country's telecommunications providers are hesitant to oppose governmental demands for personal information, preferring to “play nice” (Brown, n.d.). This has resulted in what the federal privacy commissioner has documented as 1.2 million requests, by the federal government to telecommunications providers, for private customer information. This has largely been done without court-issued warrants (Canadian Wireless Telecomunications Association, 2014; Clement & Obar, 2015). Since the Snowden leaks, there has been both increasing media scrutiny of state surveillance practices in Canada (Freeze, 2013; Hildebrandt, Seglins, & Pereira, 2015; Weston, Greenwald, & Gallagher, 2013) and an effort by the Canadian state to expand surveillance powers through the imposition of *“An Act to enact the Security of Canada Information Sharing Act and the Secure Air Travel Act, to amend the Criminal Code, the Canadian Security Intelligence Service Act and the Immigration and Refugee Protection Act and to make related and consequential amendments to other Acts”,* also known as Bill C-51 or the Anti-terrorism Act (Parliament of Canada, 2015). Academic researchers have also increasingly turned their gaze to state surveillance, including a number of studies funded by the federal Office of the Privacy Commissioner (OPC)[11]. One such project, IXmaps, “is a mapping tool that allows you to see how your personal data travels across the internet”.[12] The same researchers published a 2015 report on the data privacy transparency of Canadian telecommunications providers detailing the almost universally poor state of privacy safeguards among internet providers as well as transit providers (the corporations who makeup the backbone of the internet) (Clement & Obar, 2015). This series of factors – poor consumer choice, monopolized telecommunications providers, pervasive surveillance and poor privacy protection – provide us with the

11 Research funded by the OPC. https://www.priv.gc.ca/information/research-recherche/index_e.asp

12 IXmaps. https://www.ixmaps.com

technical and economic backdrop from which Réseau Libre has emerged.

In analyzing the emergence of Réseau Libre, it is just as important to understand the unique social context of Quebec in 2012 as it is to understand as state of telecommunications in Canada. The Quebec government's relationship with its student population has been quite tumultuous over the past ten years and the province experienced widespread student strikes in 2005 and 2012, numerous university-focused student strikes and numerous university labour strikes[13]. In February 2012, students went on strike in protest of massive governmental divestment in the education system. On 17 May 2012, the provincial legislature passed “Loi 78”, a special law that aimed to introduce severe controls on public protests (Lessard, Chouinard, & Journet, 2012).

> By the end of May, the movement could loosely be divided into three phases, each punctuated by a massive march on the 22nd of each month, each of which gathering 200, 000 to 400,000 thousand or more protesters. The first, oriented primarily toward defending accessible education and fighting privatization models of education and other social services; the second, toward defending the commons more generally, wherein stronger links were made with environmental groups; and the third, in defense of freedom of expression and public assembly. Each of these phases was articulated by distinct social dramaturgies. At all three phases of the movement, attacks of a performative order have been launched against protest tactics: either they were too ‘festive’ or too ‘violent’. In both cases the attacks occlude the actual socio-political transformation that is being enacted in the streets. (Spiegel, 2012)

The strike continued until September 2012. Alongside it was the Occupy Montreal movement. Inspired by the Occupy Wall Street movement, it initiated a protest camp in Montreal's Victoria Square in October 2011 (Dalton, 2011). While protesters were eventually evicted from the camp close to a month later, on November 25, 2011 (CBC News, 2011) they continued to organize general assemblies for some time after. According to one of our interview subjects, the Occupy Montreal camp was outfitted with an antenna similar to those used by Réseau Libre. Although the camp may be long gone, he claimed the antenna remains there, hidden (bgm, 2015). While the Occupy Montreal movement may have not grown to immense proportions, its existence provides us with a link between disruptions to the social order in Quebec and networked social movements and disruptions on a global scale.

Réseau Libre is not the first Quebecois project that aimed to bring Wi-Fi connectivity to the masses. Our participants described a number of local rural projects, such as Un Quebec branché sur le monde[14], Communautel[15], and Villages branchés du Québec – alternative internet providers in locations where big telecommunications providers refuse to operate due to the labour and investment required to extend their networks. Île Sans Fil[16] (ISF), a Montreal community wireless network, has helped these projects by installing antennas and providing conceptual direction. (Lussier, 2015)

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13 For instance, in 2009, professors at the Université du Québec à Montréal (UQAM) were on strike for for six weeks and the local student unions went on strike in solidarity with them. Author Evan Light was a graduate student at UQAM during the 2005 and 2012 student strikes and the 2009 professors' strike.

14 UQBM, http://uqbm.**qc**.ca/

15 Communautel – L'internet des hautes Laurentides, http://www.communautel.org/

16 Île sans fil, www.**ilesansfil**.org/

Current state of mesh

"Réseau Libre is an informal group of volunteers, community and university organizations, as well as enterprises, interested in Wi-Fi and networking technologies and free software."[17] This is how the group defines itself to the world. Their website describes the community as an "independent, decentralized mesh" with open infrastructure, collaborative space, and willing to offer an alternative to telecommunications monopolies[18]. As per July 2015, Réseau Libre consists of 47 active nodes and about 120 nodes planned or being built[19]. As the map shows, some nodes are connected to each other, and others are completely isolated. The majority use omni-directional antennas with Wi-Fi modems (such as Ubiquity Bullets[20]), costing between $100-$200 and resistant to all kinds of outdoor conditions and capable of providing basic connectivity to a limited territory. For software, Réseau Libre members largely use Commotion[21] to configure their networks.

Many of the Réseau Libre members we interviewed have been involved since its beginning in late 2011 and early 2012. Most have a basic antenna, but some have invested in more sophisticated installations. Some have created local clusters of nodes while others are completely isolated from other nodes, except through virtual private network (VPN)[22]. Some members are "in-between" antennas due to technical or other reasons (moving, floods, landlord disputes around roof access, etc.).

Personal paths for creating Réseau Libre

The idea to start a mesh network originated with a few groups of individuals, working separately, and evolved into a common project, quite diverse in its motivations and aspirations. With mostly experimental goals, a small group of local techno-activists and practitioners began to test connections between private homes in close proximity to one another. At the end of 2011, they began to publish the results of their tests on a public wiki. [23]

> *I had a neighbour 500 meters from my place, and we talked: let's put antennas on the roof and connect. So [...] we found these antennas with Ubiquity stations, which are outdoor antennas, fairly cheap, around 100$. We thought we have nothing to lose, we were taking photos, publishing them on the Koumbit wiki. [...] Later on, tahini found our documentation and invited us to meet at l'Escalier with other Wi-Fi geeks that had similar interests. On our side, it was really connecting houses together to see what happens. We had no idea what we were doing. (bgm, 2015)*

Meanwhile, Wi-Fi and networking professionals, some of whom were former volunteers with Île Sans

17 http://reseaulibre.ca
18 Ibid.
19 Réseau Libre Map of Nodes. http://wiki.reseaulibre.ca/ikiwiki.cgi?map=map&do=osm&zoom=12&lat=45.5227&lon=-73.59554&layers=0B0TT
20 For example, Ubiquity Bullet M2; for more information: https://www.ubnt.com/airmax/bulletm/
21 Commotion Wireless. https://commotionwireless.net/
22 A VPN creates an encrypted private network across a public network, like a mesh network or the internet.
23 https://wiki.koumbit.net/NanoStation/OpenWrt

Fil (ISF), began looking at less corporate and more autonomous Wi-Fi projects to experiment with (Lussier, 2015; tahini, 2015). Inspired by the idea of free or very low cost Internet distribution and a number of projects in other parts of the world, such as Barcelona's Guifi or the Athens mesh network, they started launching such a project in Montreal in order to experiment, learn more about the technology, and test possibilities.

> *Technically, it's quite complex so the geeks have lots of fun playing with the technology. It's far of being standard, that's why it's challenging. The more complicated it is , the more it develops their interest. (Lussier, 2015)*

One of the participants founded a project called mesh-mtl.org[24], which did not fully develop (Lussier, 2015). Another was hoping to create a more "monopoly-independent ISP", but this project never materialized either (xSmurf, 2015). In the end, many of these individuals know each other from previous projects and through personal connections. Others have been inspired by international gathering of mesh network professionals. Others have been connecting to their neighbours and testing signals between them. Shortly after the wiki archives from the mesh experiments were put online, they were discovered by other groups of interested indviduals, one of whom proposed a meeting to discuss a possible independent project – the Réseau Libre. A meeting in a bar downtown Montreal, called L'Escalier (formerly Utopik) followed. Thus, the creation of Réseau Libre has started helping ideas to spread and be shared among like-minded individuals interested in mesh networking. *"It was hard to explain to people what mesh is, how it works, what's a node, what's an antenna, and no, it's not an alternative to your current Internet Service Provider."*(bgm, 2015) That was the start of Réseau Libre.

Usage and motivations of joining Réseau Libre

An notable aspect of Réseau Libre is the diversity of motivations users have for joining the network. As bgm put it, *"one interesting thing about this project is that every single person involved has a different view on the future and motivation for this project."(bgm, 2015)* The following is a summary of that spectrum of Réseau Libre members' uses and visions for the network:

1. **Experimenting, testing, exploring. And most importantly – it's fun!** All project participants are volunteers, and many have no particular motivation other than the possibility to experiment with software and hardware they have not "played" with before. Hacking Wi-Fi – and the will to learn more about "opening the black box of the router", together with affordable and weather-resistant equipment, creates the potential for such experiments to become real. In all interviews, words such as "fun" and "play" are used to describe personal enthusiasm and motivations around mesh hacking. *"I don't know what to do with Réseau Libre yet... for now it's a platform for experimentation for a bunch of a geeks."* Therefore, "i*f we can see each other through the network, that'd be fun. :)".* (tahini, 2015) Fun, in itself, is a reason enough for the hackers to do what they do.
2. **Aiming to extend the benefits of Wi-Fi connectivity in any way possible**. For those participants more experienced with mesh networking and Wi-Fi, experimentation is not the primary motivation. Instead, they want to add value to the new network, differentiating it from preexisting internet connections.

24 Unavailable at the moment.

> *So, I've done networking, wired, optical, city area, whatever, for about 20-ish years now. 25 even (I feel old!). I'm maybe less wildly interested in the nature of the tech, I'm more interested in what it can do. I played with a lot of tech over the years, and I just wanted to make it work. (Packman, 2015)*

Such added value could be connecting on a fast connection with a neighbour (for playing games together, for example), watching TV between the neighbors, or archiving large files on a remote server. This participant's experiments have attained wireless speeds of 60 megabits, ten times more than what a regular ISP can offer at any time.

3. **Local aspect of digital connectivity.** Many of the arguments for creating a mesh network revolve around the desire to connect locally rather than use paid bandwidth for a number of services around the house or in close proximity to it. *"I don't need to go to New York to speak to my neighbour! Maybe they have a blackout at NYC and all the shit stops, and I can't call my neighbour because there is a blackout in NYC. That's not an acceptable technical solution.."* (xSmurf, 2015)
4. ***"... nobody's recording your conversation!!!"*** *(xSmurf, 2015)* As we will see from the next section, along with the technical and local interests, participants have insisted on a decentralized, monopoly independent, surveillance-free network that offers services to the local community in a more ethical way.

5. Finally, one participant summarized the various motivations:

> *I wonder if we didn't use this pretext to find a common project. Often such projects that do not seem to have a great use allow people to get together, to try to work something out. This makes people overcome isolation, meaning that the project itself is not that important, but the reason, the motivation to work together is. In this way, we've encouraged the creation of a new community. (Lussier, 2015)*

In the end, it seems that Réseau Libre collects members of a common interest, mostly politically inclined, sharing-oriented people. Brought together, they can now work with like-minded individuals.

Guiding principles of Réseau Libre

Some participants declared that their motivation is purely technological. For others, aligning technical projects with political goals has been an important asset of the network. While there are a numer of competing statements regarding the motivations to join and ideas around the future of Réseau Libre, most current members seem to agree on a few core guiding principles. *"There are internet freedoms we support, we have principles for internet access, but people can use it for what they want" (xSmurf, 2015)*. Interview participants stated that they agree with the socially and politically-engaged vision of the project that is implicitly Free Software-oriented, independent, informal, and not-for profit. Stress is put on the lack of corporate interests and thus it is comprised solely of volunteers. Bringing paid people to coordinate the organization is considered to be a mistake that risks ruining the project. In part, this is because each members' motivations are very different. Consensus decision-making is another guiding principle of the Réseau Libre members. One research participant stated that many of the hackers and

activists that are currently part the Réseau Libre did not previously know how to work by consensus. After participating in the Occupy movement, they now understand consensus decision-making and the process runs smoothly.

Local aspects of the mesh

Apart from the social and political conditions that Réseau Libre has emerged from (see previous section), participants also mentioned a number of local aspects that make the network unique. Inspired by big mesh networks such as Guifi in Barcelona, Montreal mesh activists have realized that the infrastructure of the city, as well as internet users' needs are very different. These needs must be met if they are to be to build a network of the size of one in Barcelona. After a number of experiments, members of Réseau Libre noticed that Montreal is a difficult city to develop a mesh network in. The city is very spread out, with relatively short buildings and very few tall ones outside the city centre. This does not allow for small antennas to make a very long-distance connection. Wi-Fi connectivity is also interrupted by trees, which are numerous in the city. For these reasons, small clusters of mesh nodes have appeared in different neighborhoods but these clusters have difficulty connecting to one another. Many members are still isolated from other nodes, using the Internet to join the mesh. While the routers in the antennas are very resistant to the weather conditions, project participants admit that one of the biggest constraints on the mesh is the fact that majority of the inhabitants of the city live in rented buildings and cannot access rooftops to install antennas. Moreover, Montreal tenants tend to move often. This would result in a forever changing network infrastructure. Further one of the participants complained that it is impossible to even write standardized instructions for node installation because architectural aspects of the buildings, and wiring and electric power schemas in Montreal apartments are very different from one another.

> *“We haven't been installing tons of antennas either – there's been lots of interest, but a lot of problems also, such as roof access, landlord problems, hardware delivery, money problems, and a general will for wanting to learn.” (bgm, 2015)*

Participants' backgrounds

From our interviews and surveys, we learned that the majority of Réseau Libre members are highly technical - either hardware and radio amateurs, or software and networking professionals. Out of the eight participants, at least five are software developers, working in different spheres of computer science such as web development, information security, research and development. All have demonstrated a preference for Free and Open Source Software and a strong sense of self-learning. The majority of participants are involved in small cooperatives or tech NGO activist groups, either working full-time or actively participating as members and volunteers.

Although most of the participants report very good networking and programming skills, many admit their lower competence with hardware tools such as Wi-Fi antennas and cabling equipment. However, majority of the participants in the study indicated they had installed the antennas by themselves or with a little help from their peers. They also indicated that the Réseau Libre project is serving them as a platform and infrastructure to learn more about hardware and mesh networking in general.

Mesh limits and conflicting visions

In exploring some of the visions of Réseau Libre members regarding their involvement with mesh in Montreal, three conflicts (or limitations) seem most clearly emphasized:

1. There are two divergent visions regarding the values of members and their personal views on the existence of the network. First, Réseau Libre has the full potential to become an alternative internet provider for the city, based on principles of independence from monopoly, and a not-for-profit approach that limits the cost of internet access for individuals or small end-users group (such as housing cooperatives). The other vision - more idealistic perhaps - is linked to the idea that the network is not and will never be used for commercial purposes such as providing and selling internet access, but will be used as an alternative to the internet all together.
2. A similar debate emerges from the question of how to get more members. In order to do so, Réseau Libre must offer some more services, but in order to offer more services and better connectivity (and other conditions), there needs to be a critical mass, more nodes to connect to each other – and more people to communicate to and through their neighbors.
3. The third debate is on the security of the network. While there is a general concern about privacy issues among the Réseau Libre members, the mesh is for now fully open with no security mechanisms built-in. While the members' discourse turns around the responsibility of every single person who connects to the network, it appears that the Réseau Libre members, being technically adept and aware of security problems in general, are allowing non-technical and unaware users to connect, without protecting their privacy in any way, nor are they securing the network itself.

These conflicting visions are our conclusions as researchers and not necessarily representative of the perspectives of Réseau Libre members, although some of the research participants had come to similar conclusions. It was noted that if the mesh network continues to develop as it has, it may not attain a necessary critical mass and never become an important internet player in Montreal. The next few pages provide an overview of these debates.

Internet alternative or alternative to the Internet?

Many project participants were concerned with the monopoly practices of large telecoms and ISPs in Canada, practices that result in poor internet connectivity and the systematic invasion of customer privacy. Building an independent network based on fundamental principles of freedom and rights, the sharing of information, and communicating locally seems to be an alternative Réseau Libre members agree upon. The limitation of commercial projects is a condition supported by the members, however all consider that providing limited services (including internet access) to neighbours and friends (“with no particular profit”) makes good use of the network. For example, there was an internet outage at one members' house and another node provided an emergency connection for a few days until the network came back. However, members still maintain a shared vision of keeping the project from becoming an ISP in a competitive and commercialized way.

The ways in which debate and decision-making occurs within the organization could play a significant in Réseau Libre's future. If kept in its current state, the mesh network will maintain its low number of users and participants. It may achieve its local goals of testing and experimentation, but it will not have enough tools and services to offer that would make membership more attractive to more users, especially less technical ones. The debate itself risks pushing away some members who believe the mesh is the internet alternative they are looking for and want it to remain highly technical, strictly local and disconnected.

Réseau Libre members often spoke to us about ways to use the mesh for local distribution of Internet to neighbours and small communities of users. They discussed covering the “last mile” – providing connectivity for people who not served by large providers because, for instance, operating in rural communities is not profitable enough. Also, because Réseau Libre is a political project in that it promotes the rights of freedom and privacy, Internet users could align with those principles and rely on a provider they trust. Another possible future for the mesh is to provide free (or very in expensive) internet access to low-income communities and individuals. One problem mentioned with the Internet provision is the centralization of authority that stems from this process. How is trust being built between users and providers? The liability for using the internet for illegal purposes has to be taken by the provider, who, on their side, cannot guarantee that users will engage only in legal activity. Another risk is non-encrypted traffic passing from the users to the provider, and the latter being able to track the usage. Wi-Fi connections are open by default on the mesh at the moment, therefore free to be seen by “sniffers”. Mesh internet tends also to be slower the further you are from the antenna. Therefore, there are number of current limitations to the project. However, with careful planning and a local focus on a limited number of nodes and users, there are possibilities for success.

There may be a middle-ground where different nodes and neighborhoods invest in different projects (as is the case at the moment); allowing certain members to use the mesh to provide “last mile” connectivity. Meanwhile, other users could keep it low investment, and continue to experiment with the technology, individually or in smaller groups. Others may invest their time and money in developing a faster and far-reaching connection, allowing more services to be developed and shared among the nodes. The development of these services seems to be the motivation of the members in developing towards a more advanced form of the project.

In both cases, it seems that members will have to invest in better equipment and strategies for offering more services to their neighbours in order to maintain interest and attract more members. Ultimately, the future of Réseau Libre hinges on how it approaches the dominant commercial nature of internet provision.

A critical mass of users or more services offered?

A common dilemma mentioned by research participants was the need to attain a critical mass of users in order for the project to grow and thrive. Currently, there are few real benefits for the users, especially for those who are not directly interested in experimenting with mesh technology themselves. Due to low-quality equipment, the network is still unreliable and quite slow. For technically proficient users, there is still an option to experiment with, improve and learn from the technology, but this is not an attractive option for non-technical users. *“We have to build a network that works, we have to create the*

reason for people to use it." (Packman, 2015)

We asked our research participants what services could possibly be useful to a mass of users. Some responses were: geo-localization services, chat services, file-sharing, backup exchange, local communication between neigbours (that does not pass through general internet routing, as would be the case with a number of internet applications). Speed and unlimited traffic are two interesting assets of the mesh, potentially offering nodes a connection several times faster than any Internet service currently offered in Canada. Moreover, end-users often have limits on the amunt of data they can transmit through their ISP in a given month. One of the research participants says:

> *So, in my discussions with the rest of the RL, there's been a lot of agreement on that it'd be nice to find a reason for the network to be used for something, but not a lot of agreement on how to make the network to be fast. Someone suggested: who cares about speed, I just want to learn about mesh! [laugh] Well, it's a very dull thing to say. (Packman, 2015)*

This same user explained:

> *My idea for a killer application is a public version of Dropbox, where we have anonymous space on each other's servers, a lot of us, the guys that have antennas on the roofs. My house burned down 15 years ago. It's great to have off-site backups. The stuff that is existentially irreplaceable. Now we can do it - but everyone's DSL upstream sucks. And Bell Canada is only happy to keep it that way. There's no market for it. (Packman, 2015)*[25]

Recreating a mini-network around the house for automation of electronic appliances and creating a mini file/media server for local needs are also ways to use a mesh network while producing limited internet traffic.

Providing limited Internet to neighbours and local connectivity through the mesh is also possible and serves as a backup plan for emergencies. An equal number of participants believe and refute that *"projects like Réseau Libre can create alternative ways of distributing the "last mile", and connect more people for less money."* (Lussier, 2015) Those who believe that there is a strong potential for Réseau Libre to develop into an ISP believe it will maintain its political, internet freedom-oriented, alternative, independent, and ad hoc (local) characteristics. Others believe it is very important to start offering services, once used over the Internet, to local connectivities.

> *It's still interesting that even if we are all interconnected to the internet, many of our communications and needs for connection and services are local (they are all talking on Facebook, but they are all talking locally, even in the same room). It would be interesting to reappropriate those services.* (bgm, 2015)

In the current phase, Réseau Libre members are not ready to say where it will head next. The multiplicity of projects help to develop individual capacities, dialogues, and ideas. Experimentation with internet and other types of connectivities and services is on-going and it is not clear how and whether those diversified ideas will become more synchronized in the future or not.

As one participant says, for the past three years of meetings, most of the discussions have been related to the technical aspects of mesh development. There has been no discussion on its future or social

25 This killer app does exist. Please see Tahoe-LAFS. https://tahoe-lafs.org

aspects such as building a critical mass of users.

> *We have to first make the network function, and once it works, other folks will want to join. I think we can find some unique applications - thus causing it to grow; and once it grows enough, the potential is there.* (Lussier, 2015)

There are certainly problems, such as speed, reliability of the connection, and lack of policy decisions regarding privacy and security. To solve these issues will take time and strategic planning. For now, as Lussier mentiones, "(w)*e are not there yet. We have not paid even one bill in the name of Réseau Libre. We do not exist yet. We do not know how to share the responsibility."* (2015)

Network (in)security

All Réseau Libre members interviewed for this case study spoke out against the state of monopolized telecommunications infrastructure and many addressed the issue of mass surveillance which has been facilitated by these infrastructure providers. To a certain extent, these individuals have also attempted to put their discourse into action and all use so-called[26] independent internet service providers. Further, those who are cellphone subscribers (two are not) claim to be critical of their use of cellphones by using Fido, a formerly independent cellular provider that has since become a brand of Rogers (Shmuel, 2013). However, according to a recent report on data privacy transparency among Canadian telecommunications providers, "the'fighting brands' of major mobile carriers, Virgin Mobile, Fido and Koodo, all score below average and are significantly less transparent than their corporate owners, Bell, Rogers and Telus respectively" (Clement & Obar, 2015, p. 26). This leads us to believe that while Réseau Libre core members may be technologically advanced and self-identify as critical users of technology, they are willing to advance their personal security practices only to the point that it is convenient. For the sake of argument, however, there are no cellphone choices (other than abstinence) that one can adopt on a personal level in terms of the use of Canadian telecommunications providers that would make a substantial difference in terms of safeguarding one's privacy. Indeed, the individuals we interviewed tended to address this concern by minimizing the ways they access the internet. Two of five did not have cellphones, one had a FirefoxOS phone used exclusively to access servers in the case of emergencies (bgm, 2015), and one had a phone to use exclusively with Wi-Fi networks, including his own experimental high-speed wireless network (Packman, 2015).

The concept of network security, while it may be seen as a positive by-product of mesh networking, is not necessarily integrated into the core functionality of network design in the context of Réseau Libre. This is not because it has been overlooked, rather network security appears to have been quite consciously put aside. Instead, it has been framed in terms of responsiblity on the part of end users. Indeed, one core member offers free internet access through a Wi-Fi hotspot and then re-routes users through an encrypted portal. Users assume the same risks as they would in a cafe with an open hotspot (bgm, 2015). Another core member stated that Réseau Libre took "no security approach" and that it entirely the responsibilty of users to protect themselves (xSmurf, 2015). Is there anything, then, that differentiates this mesh network in terms of security from the non-transparent corporate networks they

26 We say "so-called" because incumbent telecommunications providers in Canada almost universally own the physical infrastructure that brings cables into peoples' homes. Independent ISPs rent this infrastructure and provide their own services over-top. It is unclear the extent to which this data may analyzed/surveilled by the incumbent providers.

claim to contest?

Réseau Libre's security-inspired origins appear to have been set out as ideals, preconditions that have perhaps proven to be unrealistic for a network of small scale. In fact, it appears that, according to the core members we have interviewed, a lack of security on the mesh has been rationalized as no worse than the internet-at-large. *“The mesh is not very sercure, no matter who can “sniff” it and see information on the mesh. It's in fact as insecure as the internet itself.”* (Lussier, 2015). There is, however, a significant difference between Réseau Libre and internet access that one purchases from a corporation. ISPs generally employ security professionals who police their networks, assuring some level of network security. A mix of specialized hardware, software and staff then are charged with ensuring the trustworthiness of the network. (Bury et al., 2010) have described how mesh networks generally suffer from security issues due to their “open” nature and their desire to engage with large non-specialized populations (2010, p. 229). Through our interviews with core members of Réseau Libre, it has become evident that network security is conceived of in two somewhat conflicting ways. First, on Réseau Libre there is no such thing as network security in terms of your information being safe – it is up to users to protect themselves accordingly. Second, the security of the network infrastructure in and of itself relies on human relationships and it is these trust relations that are then grafted onto the network links. These two approaches may be feasible on a small scale, but both begin to have serious difficulties when one thinks of their application to a network that may include hundreds or thousands of nodes and thus hundreds or thousands of individual users.

Conclusion

In today's post-Snowden era, citizens organize around ideas of alternative connectivity, private digital communications, and autonomous networks. Our internet communications have become increasingly “polluted” by the smoke of surveillance, our data continuously collected by governments and private corporations. Further, when technically savvy populations are provided with limited and over-priced access to telecommunications resources, they are pushed to think in alternative ways. Mesh networks such as Réseau Libre are examples of local communities organizing against monopolized infrastructure by using consumer-grade technology to build distributed networks.

The example of Montreal-based mesh network, Réseau Libre, however problematic the project may seem, demonstrates the potential for, the actual use of, and the collective practices that stem from such a mesh laboratory, a space for experimenting and implementing localized personal ideas, all based on principles of internet freedom. Ultimately, as we can see, the Réseau Libre project itself appears to be fairly disjointed. It has, however, become a starting point for other projects that are just as intriguing and as disruptive as the original proposition of a massive decentralized and secure wireless network. The rich diversity of projects and ideas for further development proves the need of such networks to develop and grow, providing citizens place for truly independent non-corporate space.

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