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Expanding the Internet Commons: The Subversive Potential of Wireless Community Networks

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Abstract:

In this paper, we focus on an ongoing—though too often neglected—phenomenon of decentralization in telecommunications networks: we show how the current revival of grassroots community networks can counterbalance the erosion of autonomy of Internet users that results from current telecom policies. As opposed to more larger and centralized network infrastructures owned and managed by powerful third parties (such as the state or large, highly capitalized Internet Service Providers (ISPs)), grassroots community networks are deployed by the community and for the community at the local or regional level. Rather than being driven by profits, they focus on the actual needs of the needs of its participants. They also experiment with novel models of distributed governance relying on cooperation and sharing among a community of peers (from a dozen to tens of thousands participants), and that are reminiscent of commons-based peer production schemes (Benkler 2006). In our study, we focus on 'Wireless Community Networks' (WCN) (i.e those community networks providing connectivity through radio technologies, and Wi-Fi especially). While many community networks do not rely on radio technologies, those who do exhibit particular features that contrast more strongly from the dominant model found in traditional ISPs. In particular, to the extent that they rely solely and exclusively on free-to-use airwaves (or 'spectrum commons'), WCN are to some extent more independent from incumbent ISPs than landline community networks who necessarily have to enter into a contractual relationship with the owners of the 'last-mile' landline network infrastructure.

Keywords:

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'Freedom is fostered when the means of communication are dispersed, decentralized, and easily available, as are printing presses and microcomputers. Central control is more likely when the means of communication are concentrated, monopolized, and scarce, as are great networks.' (Sola Pool 1983, p. 5)

Ithiel de Sola Pool, an American political scientist and legal analyst of communications technologies, wrote these lines in 1984. But while acknowledging historical and technical tendencies, Sola Pool also understood that there was nothing deterministic about how technologies evolve. He knew that control over printing presses and microcomputers could become highly centralised, and he was aware of historical precedents—such as the grassroots telephone networks in the US at the turn of the twentieth century—where the deployment and management of telecommunication networks were emancipated from powerful corporations or States and underwent a process of radical decentralization (Starr 2004, p. 203). The politics of technology might be determined in the last instance by its political economy—how distributed the means for producing and using communications technologies are —but this actually depends on a combination of political, technical, economic, institutional or legal arrangements.

For all these contingencies, the baseline argument of Sola Pool and other acute political thinkers of media technologies is that the key to a free and more democratic society, then, comes down to a rather binary antagonism between decentralization/freedom and centralization/control in communications resources. Today, this antagonism plays a key role in understanding the politics of the Internet. We see it at play in the still-ongoing controversy regarding the massive information surveillance undertaken by the US National Security Agency (NSA) and its allied organizations. The privacy threats raised by centralized communications architectures is pushing a growing number of technology activists to respond by deploying decentralized and free software alternatives to the centralized online services known to collaborate with the NSA.

The same process has happened repeatedly in the Internet's short history. The quest for more democratic communications resources has in fact driven the development of the Internet. Forty years ago, the rise of the personal computer and the creation of early-Internet protocols came out of a need to democratize computing technologies by taking them out of the hands of technocracy—decentralizing both the use of computers and the control of communication technologies. Later, in the 1980s, the free software movement emerged as an attempt to alleviate the threat that proprietary software vendors created for the ecosystem of innovation. Likewise, in the early 2000s, the control exerted by a few large media conglomerates over the circulation of copyrighted works sparked a counter-reaction on the part of activists, lawyers and librarians to establish an alternative, more participative and democratic regulatory framework through the creation of the 'Creative Commons' licenses in order to encourage the dissemination and reuse of digital works.

The history of communication technologies is populated with such conflicts between centralization and decentralization. While many of these technologies started or have existed at some point of their development as a decentralized structure, often replacing older technological paradigms following a Schumpeterian process of 'creative-destruction', nearly all progressively evolved into concentrated clusters of power as a result of industrialization and the reaffirmation of state sovereignty (Wu 2010). However, as the examples above suggest, when the oppressive potential of centralized technologies becomes clear and when the needs of citizens turn out to be systematically overlooked in existing power dynamics, decentralized initiatives may emerge as an attempt to disrupt the dominant hegemony and allow for the democratic re-appropriation of technology—a process that the philosopher Andrew Feenberg calls 'subversive rationalization' (Feenberg 1995).

In this paper, we focus on an ongoing—though too often neglected—phenomenon of decentralization in telecommunications networks: we show how the current revival of grassroots community networks can counterbalance the erosion of autonomy of Internet users that results from current telecom policies. As opposed to more larger and centralized network infrastructures owned and managed by powerful third parties (such as the state or large, highly capitalized Internet Service Providers (ISPs)), grassroots community networks are deployed *by* the

community and *for* the community at the local or regional level. Rather than being driven by profits, they focus on the actual needs of the needs of its participants. They also experiment with novel models of distributed governance relying on cooperation and sharing among a community of peers (from a dozen to tens of thousands participants), and that are reminiscent of commons-based peer production schemes (Benkler 2006).

In our study, we focus on 'Wireless Community Networks' (WCN) (i.e those community networks providing connectivity through radio technologies, and Wi-Fi especially). While many community networks do not rely on radio technologies, those who do exhibit particular features that contrast more strongly from the dominant model found in traditional ISPs. In particular, to the extent that they rely solely and exclusively on free-to-use airwaves (or 'spectrum commons'), WCN are to some extent more independent from incumbent ISPs than landline community networks who necessarily have to enter into a contractual relationship with the owners of the 'last-mile' landline network infrastructure.

We also take a somewhat narrow geographical and jurisdictional scope, focusing on European community networks (though we also illustrate our developments with examples from other regions). Since the early days of the Internet, Europe has been a fertile ground for the development of community networks, and many (though not all) of the groups we surveyed are based in Europe. Given our goal to contextualize WCN in the history of telecom policy, we have also used the telecom regulatory framework of the European Union (EU) as a background picture on which to situate WCN and from which to draw various legal and policy analysis.

The paper begins by sketching out a short history of telecoms policy, pointing to the prejudicial consequences of centralisation from a political perspective by showing how incumbent ISPs turn into network gatekeepers and foster their commercial interests by exerting greater control over users' communications. Based on our fieldwork and qualitative interviews, our paper then moves on to describing WCN, presenting the main characteristics of these grassroots attempts at bringing about a 'subversive rationalization' of the last-mile network infrastructure. This second section outlines the motivations underlying the deployment of WCN, together with their technical features and innovative, commons-based models of governance, which all strongly contrast with the dominant, commercial model for Internet access provision. The third and last section assesses the impact of WCN on telecom regulation and the new power dynamics it entails, with regard to both the private sector and the public sector. The paper concludes that current telecoms regulation significantly overlooks the contribution of community networks to fostering political and socio-economic objectives associated with broadband policy and proposes a number of policy recommendations to overcome this gap.

1. A short history of the Internet access market

Since its early days, the Internet has followed a trend of emancipation. As early as the immediate post-World War II years, key American scientists envisioned how computers, originally built for military and technocratic command-and-control applications, could be used by individuals as communications devices (Licklider & Taylor 1968). In the 1960s and 70s, the use of computers as a tool for emancipation went a step further when the counter-cultural youth began using these machines against the ruling technocracy to decentralize power, bring it down to the local level, and allow for the emergence of autonomous communities (Kirk 2002; Turner 2006).

Already during the 1970s and 80s, engineers and early hackers were experimenting with and exploring the potential of these new machines. But it is only in the following years, as personal computing boomed and the computer networks spread, that efforts from civil society to democratize the use of these revolutionary technologies went viral. Non-Governmental Organizations (NGOs) and activist groups started developing their own computer networks to coordinate and share information (Willetts 2010), the first online communities settled on cyberspace, and the creation of the World Wide Web in 1989 finally opened the door to widespread Internet use.

The time was ripe for the launch of countless initiatives bringing social movements, activists and general citizens into this new world of global, seamless and instantaneous communications. Stefania Milan, a social researcher working on media activism, describes the mid 1990s as an era of 'renaissance' for what she calls 'emancipatory communication practices'. Echoing the pirate radio movement of the late 1970s and 80s, the Internet sparked a political movement of tech activists whose aim was 'to bypass the politics of enclosure and control enacted by states and corporations' on the public sphere. They wanted to achieve a 'structural reform at the grassroots level through the creation of autonomous spaces of communication'. They saw the Internet as an un-owned space and, as many early Internet users, shared the 'assumption that commercialism and an honest, democratic public sphere do not mix' (McChesney 2013, p.102). By building technologies emancipated 'from commercial communication services, they aimed to empower civil society groups to articulate, voice and convey their own messages without filters' (Milan 2013, p.10). To do so, these 'radical techies' implemented secure emailing and free hosting services, as well as innovative web-publishing tools. They sought to promote unhindered information flows as a guarantee for political autonomy—a philosophy that has been described as 'informational liberalism' (Loveluck 2012)—and to subvert communications law (e.g. press law, copyright) to challenge the hegemony of political, media and business elites, engaging in practices of 'insurgent citizenship' in the public sphere (Tréguer 2013). Finally, they assimilated the Internet's original ethos and governance model: a network of equal peers communicating freely on a decentralized, end-to-end architecture, exerting bottom-up control on the tools used for communicating, in particular through free software (Coleman 2005).

At the infrastructure level, this bottom-up governance was achieved through the deployment of the first grassroots Internet access providers, as tech activists organized to make use of the incumbent telephone carriers' network in order to provide access to the Internet. In France, a small group of Internet hobbyists set up the French Data Network (FDN) as early as 1992. Though it was among the most active groups, this grassroots community network was only one of several small companies or nonprofit entities working to grant access to the Internet to a specific community. FDN members paid a fee of about 120 francs (around €18) a month plus the cost of telephony to call into the FDN modem, which in turn connected them to the global Internet. To carry its traffic to the global network, FDN contracted one of France Telecom's business offerings that had been developed to provide bandwidth to a variety of closed computer networks, such as Minitel for instance. FDN was thus able to acquire large batches of IP addresses and to obtain an uplink to the Internet at the speed of 32 kilobits per seconds with one of the few 'transit operators (transit operators manage backbones networks in the business-to-business market to provide Internet upstream connections to other organizations). As opposed to many mainstream ISPs that operated 'walled-gardens' (such as AOL or CompuServe, for instance), FDN provided users with their own IP addresses and configurable email services. It also ran a file-sharing server from which members could download free software to manage their modem and configure their connection. The FDN community contributed to that software by writing bits of code, and translated English technical documentation and tutorials to make them more accessible to a French audience. In other European countries, similar endeavors were developed, although most of them vanished when the commercial ISP market boomed in the late 1990s (unlike FDN).

In spite of its influence on the evolution of the Internet, this founding spirit of emancipation has since been heavily contested. By the early 2000s, not only had it become clear that states have indeed the means to enforce social control online, it also became obvious that rather than crushing

down multinational corporations, the Internet could actually become their new battlefield. Along with the growing concentration and increasingly oligopolistic outlook of the online service sector—with giants such as Apple, Microsoft or Google, which all rank among the five largest global corporations in terms of market valuation—, the telecoms market has also gone through a rapid process of expansion and concentration, as regulatory failures resulted in the corporate capture of telecom infrastructures.

This growing centralization explains why EU policy targets for broadband penetration and quality of service remain a distant reality: more than a third of European households still have no broadband access (39%) and, in a country such as Greece, broadband penetration is as low a 56% (EU Commission 2013). A fifth of EU citizens with no Internet access say they are deterred by the sheer cost of it (EU Commission 2013): the cheapest available broadband offer can be as high as €46.20 in Cyprus, €38.70 in Spain or €31.40 in Ireland (EU Commission 2014). Meanwhile, users are not provided with the service they paid for: on average, they only get 75% of the broadband speed they signed up for; 63% when they get it through ADSL rather than cable or fiber lines (SamKnows 2013) – and the numbers are even worse in rural areas.

More importantly perhaps, concentration has led to a loss of political autonomy for Internet users, where autonomy refers to the ability for an individual to make choices and determine the course of her life, free of external manipulative forces (Christman 2011). As Yochai Benkler (2006) explains in his seminal book, *The Wealth of Networks*, autonomy is adversely affected by concentration and increased top-down control over communications resources:

All of the components of decision making prior to action, and those actions that are themselves communicative moves or require communication as a precondition to efficacy, are constituted by the information and communications environment we, as agents, occupy. Conditions that cause failures at any of these junctures, which place bottlenecks, failures of communication, or provide opportunities for manipulation by a gatekeeper in the information environment, create threats to the democratic autonomy of individuals in that environment. The shape of the information environment, and the distribution of power within it to control information flows to and from individuals, are, as we have seen, the contingent product of a combination of technology, economic behavior, social patterns, and institutional structure or law (2006, p. 159).

Centralisation in Internet architectures has given a few Internet actors immense power over the governance of Internet communication, thereby undermining the very democratic values that the Internet was to foster. For online services—a.k.a. the 'cloud'—as well as the devices we use to access these services, many scholars have warned against the fast-paced process of centralization currently taking place under the influence of profit-seeking corporations (Zittrain 2008; Zhang et al. 2010; McChesney 2013). Devices and applications are becoming less and less generative as the ecosystem shifts away from general-purpose personal computers to laptops, tablets, smart-phones and other 'tethered' terminals whose sole function is to access preselected cloud applications provided by a handful of service providers. As a result of this trend, one of the founding principles of the Internet—the end-to-end principle —is gradually jeopardized as most of the network intelligence is moving away from the end-points towards dominant manufacturers and service providers.

A similar trend is happening at the infrastructure level as well, in a context where much of the network infrastructure is now owned and controlled by a few centralized ISPs. Historically, Internet networks have been regarded as neutral pipes or 'mere conduits'. In line with the end-to-end principle, the role of network operators was merely to provide efficient data delivery in accordance with the 'network neutrality' principle (i.e. the homogeneous delivery of all data packet, without altering or discriminating one type of traffic over others). Today, however, network neutrality (sometimes summed up by the motto inspired by constitutional law that 'all bits are created equal') is being progressively undermined by incumbent ISPs. This is due not only to these actors' economic incentives (Asghari, et al. 2013; Belli & De Filippi 2014; Musiani et al. 2013), but also to regulatory incentives to filter online content under the pressure of public officials (Mueller 2010). The latter have led to a culture of 'privatised enforcement', with private actors arbitrarily determining the limits to freedom of expression and implementing them as they see fit (by blocking, for example, pornographic but nonetheless legal content). While there is generally little transparency regarding the websites and content blocked by ISPs, the risk of accidentally filtering or censoring legitimate material is technically inevitable and, in practice, fairly common (Bradwell et al. 2012).

Another example of how dominant telecom operators might undermine users autonomy is through their collaboration with intelligence agencies for surveillance purposes—privacy being a core component of autonomy (Bernal 2014). In the post-2001 geopolitical context, and as evidenced by the ongoing revelations on the practices of the NSA in the US, states are now engaging in massive and sometimes illegal surveillance of Internet communications by establishing private-public partnerships with telecom operators (Deibert 2013; Ball et al, 2013).

2. Governing the last-mile as a commons: the revival of community networks

The trend towards centralization, combined with economic incentives and regulations encouraging surveillance and control has led to the revival of more decentralized, citizen-centric network architectures. In this section, we focus on the deployment of Wireless Community Networks (WCN) as a possible alternative to the growing centralization of power and control over the Internet's physical network and describe the characteristics of decentralized and per-to-peer governance structures adopted by these groups.

2.1 The rise of Wireless Community Networks in Europe

WCN represent a means for civil society to regain control over the infrastructure of communication and acquire the technical know-how necessary to communicate freely without being dependent upon any third-party operator or large corporation. All across Europe, and beyond, there is a growing number of grassroots community networks seeking to provide a decentralized alternative and more commons-based approach to the current Internet infrastructure. While most of them are very limited in scope — and are therefore not widely heard of the most popular ones enjoy more than tens of thousands of users. For our study, we focused on a handful of groups, and in particular FreiFunk (Germany), Wlan Slovenija (Slovenia), Guifi.net (Spain) and Tetaneutral.net in Toulouse (France) —the latter is also a member of the FFDN, a federation of French grassroots networks initially spearheaded by the landline community network FDN. Other European WCN include Ninux (Italy), Funfeuer (Austria), the Athens Wireless Metropolitan Network (Greece), Djurslands.net (Denmark) and Czfree.net (Czech Republic). Several of these initiatives are currently collaborating to promote the deployment and long-term sustainability of community networks. For instance, the recently-launched 'DIY ISP initiative' seeks to create a forum for like-minded tech activists engaged in community networks to share ideas as well as technical and legal knowledge. They want to show that 'building an ISP from scratch is entirely within the range of motivated individuals.'

The common characteristic of all of these networks is that they are community-driven: they are deployed *by* the community *for* the community. Yet, the values and underlying justifications for their deployment might be difficult to delineate, since they can be fueled by a variety of motivations: from the need to support undeserved areas lacking broadband connectivity to the will to provide a more diversified (and often

cheaper) means to access the Internet; from the aspiration to preserve network neutrality and civil liberties online to an eagerness to counteract the growing concentration of power in the hands of a few large ISPs; from the desire to learn and experiment with telecommunication technologies, to the satisfaction of being part of a collective of like-minded individuals.

Most of the European groups we have interviewed for this study are driven by a combination of these motivations, although the two prime drivers are usually the lack of affordable or high-quality Internet access and the political drive to successfully roll-out and maintain a citizen-owned telecom infrastructure.

Tetaneutral.net is a wireless community network founded in 2011 and run by a non-profit organization based in Toulouse (France's fifth largest city) whose starting goal was to provide Internet access rivaling commercial ADSL offers that, in certain parts of the city, were limited to 512K. Its coverage soon expanded to half a dozen rural areas in the surroundings of Toulouse that previously did not have access to a decent broadband connection. After three years of existence, Tetaneutral.net now counts almost 500 members who contribute a small fee to the organization, 300 of which are subscribers who also pay about €20 a month (depending on their financial situation).

Similarly, Guifi.net is a community network that began in 2004 in a rural community in Central Catalonia (120 kilometers outside of Barcelona) where DSL connection provided by the incumbent carrier Telefónica was both expensive and unreliable. While it is possible to deploy ad-hoc routers within the network, most of the nodes are either clients or final nodes that do not provide routing capabilities for other nodes. Like Tetaneutral.net, Guifi.net's infrastructure is managed as a 'commons': it is legally owned and commercially run by a non-profit foundation (on behalf of its users). Guifi.net also enjoys long-term partnerships with local governments and city councils for the construction of a large-scale sustainable WCN. Several municipalities contribute resources to Guifi.net's network (i.e. by installing antennas on street lamps or rooftops) and share their Internet connection. Guifi.net rapidly spread and currently provides connectivity to over 45000 users, across various Spanish regions.

As opposed to the traditional, tree-like topography where network administration is centralized and routing follows a predetermined route, certain community networks have chosen to implement a more decentralized network architecture based on 'mesh' networking technologies. Community Mesh Networks (CMN) are a subcategory of WCN which adopt a radically distributed network topography, whereby every device can simultaneously be both a client and a relay node for other users (Akyildiz et al. 2005; Zhang et al. 2007). Mesh networks interconnect users' devices (routers, computers, mobile phones and other terminals) via WiFi directly to one another without following a predetermined hierarchical, tree-like topography, depending on the relay nodes located within the range of the WiFi signal at any given moment.

Freifunk and Wlan Slovenija are two community networks that operate through a mesh network topography. Interestingly, their deployment did not stem from a technical necessity, but rather than an ideological drive: deploying a mesh network infrastructure was a sensible and well-informed choice aimed at maximizing individual autonomy through a decentralized peer-to-peer communication network.

However, as in other peer-to-peer architectures, while the political values attached to decentralization might have driven the launch of this initiative, such motives are not in and of themselves sufficient for the network to scale up beyond a restrained community of highly engaged individuals with strong ideological values. To grow, these community networks must also provide a service that is considered at least as good and preferably better than that of mainstream ISPs. In Ljubljana, for instance, where cheap fiber connections were already available to many households, there was no immediate practical need to build an alternative network, and the ideological drive to participate in a Do-It-Yourself network or the desire to experiment with mesh networking technologies did not scale to more than a few tech-savvy individuals. The rapid growth of Wlan Slovenija—which started in 2009 and now counts almost a thousand nodes—is due to the fact that the network actually turned out to be very useful to its users. Indeed, by sharing their Internet connection with the community, and by encouraging others to do the same, participants could get free Internet access from potentially anywhere in the city. As the network grew, Wlan Slovenija gained both recognition and even more traction. To be sure, some new users were ideologically appealed by the project, while others joined because they could not afford commercial Internet access. But the critical mass attained by the community mainly resulted from its competitive advantage over mainstream ISPs.

2.2 Technological features: greater flexibility, resiliency, autonomy

At the technical level, the main benefits of WCN come from their flexibility and resiliency, but also from their grassroots community-driven and decentralized design, in order to foster user autonomy.

a) Network flexibility and resiliency: Given the considerable investments required to set up an independent network infrastructure, and the costs of purchasing wholesale access to last-mile landline networks from commercial operators, many grassroots community networks have decided to operate via wireless technologies, setting up network of peers sharing radio signals. Most of their network infrastructure consists of wireless radio equipment: Wi-Fi routers and antennas strategically distributed at different locations so as to maximize coverage. As a result, they can often provide a service of better quality than that which is generally available from commercial alternatives.

With regard to mesh networks, given their low-cost and highly flexible infrastructure taking advantage of users' terminal equipment, they have historically been deployed in areas with little or no pre-existing network infrastructure, mostly in Africa. But mesh networks have also been deployed in countries where telecommunications infrastructure does exist, but is simply not affordable for lower-income households. In the American city of Detroit, where a mesh network is currently being deployed, the inhabitants could not afford to pay for an Internet connection. The mesh network—which relies on the Commotion open source software kit—builds upon existing human and hardware resources to deploy and maintain a community network with almost no upfront investments. In a European context, CMN are even known to provide better service than commercial alternatives, especially when used with high-speed landline infrastructure. For instance, Guifi.net, which began as a Do-It-Yourself wireless network intended to provide local radio connectivity to undeserved areas devoid of decent broadband Internet access, is now expanding its infrastructure by rolling out physical fibred optic cables so as to beef up the speeds delivered to rural areas in Catalonia, which so far had not been considered sufficiently profitable by mainstream ISPs.

In terms of flexibility, the main technical advantage of mesh networks are their dynamic routing protocols (e.g B.A.T.M.A.N., OLSR, Cjdns, Babel or BMX), which define the rules for transmitting and circulating packets throughout the network: as the network evolves—with new relay nodes appearing, others disappearing, and some merely changing their location—it automatically reconfigures itself according to the availability and proximity of bandwidth or storage.

This feature allows mesh networks to grow organically with minimal coordination and give them maximum resiliency: with mesh topology, there is theoretically no sensitive points (or single points of failure) to jeopardize the functioning of the local network. In practice, mesh networks are very resistant to network failure or interference since they constantly reconfigure themselves by establishing ad-hoc connections between any device at range. Even if a particular node is down, dynamic connections between nodes enable packets to travel through multiple routes, relayed from one node to another until the final destination is reached. Hence, to the extent that the network is dense enough and that many users operate as

relay nodes, the only way to shut down the network is to shut down every single node it is made of.

This resiliency explains why a variety of mesh networks have been deployed in areas affected by natural disasters and impoverished communities where the basic communication infrastructure has been severely damaged or degraded. For instance, in the face of the damages caused to Haiti's communication infrastructure by the 2010 earthquake, the Serval project was launched in Australia with the objective to create a disaster-proof wireless network that relies exclusively on the connectivity of mobile devices. Similarly, in the US, the Red Hook wireless network had formerly been deployed in Brooklyn (NY) for the purposes of providing greater resiliency and community outreach. In the midst of recovery from Hurricane Sandy, the network became extremely useful: thanks to mesh network technologies, rescue teams and local inhabitants could quickly expand the mesh network in spite of the damages incurred by the conventional infrastructure of communication (New America Foundation 2013).

Yet, despite these advantageous features, the deployment of CMN is not devoid of problems. Common issues range from the lack of infrastructure, to excessive packet loss resulting from transmission errors and slow bandwidth rate. These difficulties (many of which might eventually be overcome with the progressive refinement of mesh networking technologies) explain why some communities prefer to achieve similar goals by deploying self-managed communications networks through a more manageable and more centralized network structure, such as the one deployed by Tetaneutral.net.

b) User autonomy: Another distinctive feature of WCN—both mesh and non-mesh—relates to the commitment of grassroots community networks to promote users' autonomy and fundamental rights to communication and privacy. As opposed to commercial ISPs blocking certain ports and censoring websites or content, most community networks are intended to protect net neutrality. In several countries, small community networks are usually not affected by censorship orders issued by courts against illegal online content. In France for instance, the state has to compensate ISPs financially for the cost incurred for blocking websites. As a result, prosecutors make the choice of focusing on the few large commercial ISPs with the biggest market share. WCNs' commitment to fostering human rights is also reflected by the light-touch approach to logging users' communications and sometimes their refusal to abide to legally mandated data-retention requirements imposed on traditional ISPs.

User autonomy and self-reliance is maximal when WCN are apprehended not just as part of the wider Internet but as autonomous local networks (or Intranets), allowing users to share information with other users connected to the same community network. In this regard, to the extent that they do not require centralized administration to operate, mesh networks' flexible topography make them especially fit for deploying flexible and autonomous peer-to-peer radio networks. In the town of Sayada in Tunisia, an experimental mesh network has recently been deployed to operate locally, separate from the open Internet. The aim is to provide residents with an improved communication infrastructure, enabling them to freely and more securely communicate with each other, without having to rely on any third party ISPs. Local mesh networks also enable users to escape from the ubiquitous and pervasive surveillance that is occurring on the global Internet, as a result of privacy-intrusive practices undertaken by traditional online operators. In particular, given the lack of a central authority regulating access to the network, it is difficult for anyone to assess the real identity of users connected to these networks.

That being said, the resistance of mesh networks to surveillance and repression should not be over-hyped, as it is sometimes the case in media reports. 'Devices operating in any wireless network—including mesh networks—use a radio transmitter that can always be located by triangulation', notes a member of Freifunk (Mr. Juergen Neumann, pers.comm., 26 March, 2014). Besides, even with highly distributed networks, traffic can always be monitored. As Professor Edward Felten (2014) writes, 'as soon as an adversary connects to your network, or your network links up to the Internet, you're dealing with the same security and privacy problems you would have had with an ordinary connection.' Thus, in spite of their benefits, in no way can local community networks replace proper encryption techniques. Their primary advantage in times of crisis is the fact that they provide community with the means to communicate independently from the central command of governments and traditional operators. They enable citizen to organize (politically or otherwise) even in the eventuality that the established powers activate the so-called 'kill-switch' and shut down communications networks in a given area (Hasan et al.), as has occurred in Egypt and Libya during the 2011 Arab spring, and as has even been considered in the US (Ackerman 2011), among other instances.

2.3 Governing Internet networks as a commons

WCN constitute, essentially, a political choice: by establishing a mix of social and relational ties between participants involved in the provision of the network infrastructure, they promote a more democratic and cooperative political system, with a more symmetrical and participatory governance structure (Bauwens 2005).

Historically, such a participatory, consensus-driven governance model has only been applied to a limited number of layers of the Internet (Lessig 1999). Early on, it had been the founding ethos of Internet governance and soon became a norm for the development of Internet protocols and standards (e.g. IETF for Internet networking standards; W3C for web standards) where decision-making is decentralized—or, in the words of David C. Clark: 'We reject kings, presidents and voting. We believe in rough consensus and running code' (Clark 1992). At the application and content layers, commons-based governance can also be found in the context of the Free Software and Creative Commons movements, with projects such as Linux and Wikipedia. The revival of community networks has shown that the model of open governance characteristic of many 'common pool resources' (Ostrom 1990) can also be applied to the physical, last-mile infrastructure of the network, with important consequences on the following key features:

a) Transparency: Transparency is an important precondition to open governance. Most WCNs adopted transparent accounting: whether related to expenses or equipment costs, fees or other revenue streams, all items are typically made publicly available.. On a more technical front, many centralized WCNs have made the logical interface for administrating the network available to all members who wish to access it, whereas in the context of more decentralized mesh networks, the community is in charge of maintaining a public database of active relay nodes.

b) Inclusiveness: in the context of many WCN, it is for the community itself to decide the manner in which the network should effectively be designed and managed. This goal is achieved via flat organizations and a peer-to-peer approach to decision-making, based on deliberation and consensus. While most of the communication is done via mailing lists, many WCNs try to organize weekly or monthly meetings where all willing participants and the most active volunteers can get together to socialize and discuss important management issues. 'Day-to-day decisions are often proposed and debated on mailing lists and social networks, while most important decisions are usually presented and discussed in meetings,' says one member of Guifi.net (Mr. Pablo Boronat Pérez, pers.comm., 28 March, 2014).

Yet, as is often the case in Internet governance fora, community networks tend to favor the most active members. Some define themselves as a 'do-ocracy':

We are organized in a non-hierarchical community where common decisions are made consensually through constructive debate and arguments, but where in the case of equivalent arguments, we favor

arguments of those who are more actively participating in the network," writes a member of the Slovenian network Wlan Slovenija (Mitar, pers.comm., 23 March, 2014).

Yet, the network requires at a complete consensus, because the dissatisfied can in any moment decide not to participate anymore. That way, the whole network would be at loss." Thus, as with Internet standard-setting bodies and free software projects, the governance of grassroots community networks ultimately mandates consensus to alleviate the risk of 'forking'. The network's technical properties and, in particular, the possibility for dissatisfied users to leave the original network and create a new one reinforce the group's commitment to consensus-driven governance.

c) Social goals: Most WCNs are committed to serving the wider community to which they belong. As outlined before, many provide connectivity to places that traditional, commercial ISPs neglect. These are often undeserved areas or poor neighborhoods, whether in rural or urban settings.

In order to take into account the socio-economic situation of some of their members, several of the organizations we surveyed give preferential subscription fees to unemployed people and students, and some even consider their subscriber's fee a 'suggested donation'. Often, WCN even configure their networks to provide free Internet access to cultural centers, public parks, squats, or even schools, city halls and healthcare centers.

d) Education: For community networks, users' lack of technical skills is sometimes one of the most challenging problems, and can lead projects to fail (Albert 2013). Educating users to the use of technical tools and network management is therefore an important task for community networks to thrive and meet their goal of creating inclusive and citizen-centric networks. This objective is sought, for instance, by the Digital Stewards program, a technology training designed by the OTI. Started in the US, but also replicated in countries such as Tunisia and India, the curriculum aims to impart to community members the basic knowledge and skills required to design and deploy a communications network, such as wireless mesh networks. More generally, in all the WCNs we have interviewed, active and skilled volunteers are in charge of training new-comers and neophytes, helping them, for instance, to set up and manage their routers and Wi-Fi antennas.

In addition to sharing knowledge about how the network functions, WCNs also encourage users to adopt a more pro-active approach to securing network connectivity and their online communications. Accordingly, community networks often promote the use of free software, decentralized online services and end-to-end encryption techniques. 'We are educating users how they can protect themselves on our and any other network,' says one of our interviewees (Mr. Pablo Boronat Pérez, pers.comm., 28 March, 2014). Surveillance is also an important concern: 'We are teaching people that even through they do not have to give their identity to log into our mesh network, they are not anonymous toward the authorities or other entities due to hardware and software profiles of their devices and other metadata', explains another participant (Mr. Juergen Neumann, pers.comm., 26 March 2014).

e) Incentives for participation: The flip-side to a commons-based governance for WCNs, however, is that they only subsist insofar as there is someone willing to contribute to the network. As opposed to software, which, once produced, remains operational and available to all, WCNs cannot operate without a constant provision of bandwidth resources to sustain the infrastructure and to pass traffic on to relay nodes across the network. Members have an incentive to provide resources to the network and to work together to address any network failure that might occur (say, a displaced radio antenna) so as to maximize the benefits they can derive from it, both individually and collectively.

While free riding cannot be completely avoided, WCNs have to provide enough incentives for the community to contribute a sufficient amount of resources so as to ensure the long-term sustainability of the network. This is especially true in the context of mesh networks: given that they use a dynamic routing method where relay nodes and routes are not predetermined, the efficiency of the network depends on the number of users who accept at any given moment to operate as relay nodes. This way, although specific routing protocols might allow for the establishment of supernodes (which have priority over the other nodes by virtue of their greater bandwidth, for instance), all users can potentially contribute to increasing the network bandwidth.

A limited number of WMNs are experimenting with innovative mechanisms to incentivize participation and to encourage users contributions to the network. For instance, Guifi.net elaborated the idea of deploying a 'CommunityCoin'—a cryptocurrency based on Bitcoin's block-chain technology whose objective is to reward the contribution of community members so as encourage and facilitate the assessment of internal community participation. While these coins do not have any real monetary value, they can be spent by community members to purchase a variety of goods or services from other community members. Here, again, the political goal of encouraging the establishment of strong and cohesive communities capable of self-organising in order to fulfill their own needs by their own means is reinforced by technical necessities.

As we have seen in this overview of European community networks, grassroots organizations are a citizen response to the growing centralization and corporate enclosure of network infrastructures operated by commercial ISPs. Given the motivations underlying these initiatives, as well as the technical and governance features they implement, WCN have the potential of shifting the power dynamics in the telecom sector, by addressing many of the concerns raised by the growing concentration of power in last-miles networks, and potentially at the backbone level as well.

3. Community networks and new power dynamics in telecom infrastructures

If telecoms policy sets the goal of promoting individual and collective autonomy, what is to be done is the face of growing concentration threats? According to Benkler (2006), law should respond by 'implementing policies that predictably diversify the set of options that all individuals are able to see as open to them' (Benkler 2006, p. 152). In the field of communications, this is precisely what community networks can achieve, and the reason why they might subvert the political economy of Internet access.

3.1 The interplay between WCNs and telecom operators

From a political standpoint, following the typology of social movements drawn by Stefania Milan in her analysis of 'emancipatory communication practices', we can infer three ways by which community networks can act to counteract existing power dynamics in the telecoms sector.

One way is to address the issue from within the political system, as 'insiders', formally interacting with the power holders in order to make them support the deployment of community networks. Another solution is to fight the problem as '*outsiders'*, pressuring both regulators and incumbents from outside the political system, by means of protests, demonstrations and other campaigning tactics aimed at voicing dissent against the practices of commercial ISPs and against the lack of appropriate regulation for community networks.

Yet, most of the community networks we surveyed do not properly qualify as what social movement scholars define as 'insiders' (although they sometimes do interact with policy-makers), and much less as 'outsiders'. Mostly, they fall within the third category—what Milan identifies as 'beyonders'. They acknowledge that law and regulation will always be

late compared to practice and private ordering, and purport to influence the networked ecosystem by remaining beyond the political system. This objective is achieved by building self-organized, decentralized and citizen-owned communications networks and setting up alternative socio-political and technical arrangements as a substitute for the traditional top-down power dynamics typical of traditional institutions. As one member of Guifi.net puts it, 'our community can show that we can do things in another way, more participative, ethical and transparent, without the extortion of big companies nor the corruption of politicians and opaque public administrations' (Mr. Pablo Boronat Pérez, pers.comm., 28 March, 2014). In this sense, these networks are 'prefigurative realities' that challenge the status quo and ultimately contribute to a new political order (Milan, 2013, pp.126-38): these networks – built 'for the people, by the people' – fundamentally embody a form of political action.

WCNs can also be regarded as a distributed counter-power to traditional telecoms operators since they have the potential of being a source of competition to mainstream commercial ISPs. As we have seen, WCN often provide better services than commercial alternatives. What is more, they adhere to specific ethical commitments and governance structures. As opposed to commercial providers, which are sometimes prohibitive cost-wise to the poorest households, and often engage in anti-competitive behavior against the interest of consumers, WCNs promote open and democratic values in governance, network neutrality and consumer protection. They aim for social inclusion and thrive to protect civil liberties. Hence, while they do not directly wage competition against traditional ISP, these nonprofit, community networks serve to increase diversity in the market for Internet access—thereby opening up the range of options available to citizens. This, in turn, affects the operations of commercial ISPs.

WCN also exemplify the process of disintermediation that is characteristic of many other social arrangements brought about by the Internet network. They show that people dissatisfied with commercial offerings can get together and cooperate to create independent grassroots network infrastructures, or simply join those that already exist. From locally-grown food to locally-grown networks, WCNs form part of a wider movement focused on empowering local communities to directly produce and manage the resources that matters the most to them.

At this point in time, however, and although they can be completely autonomous when they operate as closed local networks, WCN eventually rely on third-party intermediaries to connect with the global Internet network. Uplink Internet access is achieved by linking the local network to one or several 'Internet gateways' in charge of routing the traffic from and to global backbones. Here, potential bottlenecks resurface.

To obtain such an uplink to the Internet, community networks currently choose from a number of strategies. The first is to use upstream through traditional mainstream last-mile ISPs. Some WCN, like Freifunk in Berlin, prefers not to build any formal relationship with third party ISPs, and simply rely on the goodwill of community members (who are also subscribers of commercial ISPs) to share their commercial Internet connection so as to provide bandwidth and connectivity to the rest of the network. The same is true for Wlan Slovenija.

When relying exclusively on the uplink connections of mainstream ISPs to provide a gateway to the Internet is not possible, or perhaps simply not reliable enough, WCN must act as a legal entity to establish a commercial relationship with transit ISPs. The transit market is generally much more competitive than the mainstream last-mile Internet access markets. Lesser concentration creates a more diverse ecosystem where multinational firms, such as Cogent or Level 3, compete with smaller, local companies. Some of these smaller telecom companies grew out of tech activist circles as community networks, and are keen to offer support (to the extent that it is commercially viable). Diversity therefore drives both competition and cooperation, and allows grassroots community networks to escape the risk of abusive behaviors on the part of incumbent operators.

That being said, one cannot rule out the possibility of a transit operator exerting control over, and even disconnecting, a community network. To the extent that (in both urban and rural areas) a few large telecom operators retain the ability to filter, censor, monitor, and discriminate in online communications, or simply refuse to interconnect, the need for uplink leads to the emergence of new bottlenecks that replicate the problems that community networks aimed to address in the first place. To meet these challenges, some activists have begun to organize: the goal is for community networks to collectively acquire more independence and more bargaining power in the various markets in which they operate, and promote their philosophy in the face of the conflicting value systems of commercial telecom operators who might engage in predatory practices. Indeed, if a given grassroots community network strongly believes in the principles of freedom, openness and individual autonomy, how can it ensures that these principles are being endorsed by the network with which it interconnects to pass on Internet traffic? Or, in other words, how can a free (free as in 'free' speech) network remain such when it starts reaching beyond the local community that initiated it?

Such questions are being addressed by the Free Network Foundation (FNF)—a nonprofit organization created to support 'free networks'—defined as any network that equitably grants the following freedoms to all: 'Freedom to communicate for any purpose, without discrimination, interference, or interception; freedom to grow, improve, communicate across, and connect to the whole network; freedom to study, use, remix, and share any network communication mechanisms, in their most reusable forms.' In conjunction with this definition and labeling effort, the FNF seeks to create a license for interconnection agreements—whereby the administrators of independent Internet networks make an agreement for the purpose of exchanging traffic—replicating the 'share-alike' provision characteristic of many copyleft licenses and free software licenses. Building on previous reflections, such as the "Pico Peering Agreement" or the "Commons for Open Free & Neutral Network" elaborated by Guifi.net, the idea is to transpose this concept to the realm of network 'peering agreements' (referring to settlement-free interconnection agreements), through the establishment of a 'peer-alike' provision that would favor free networks over non-free networks. By offering free transit only in exchange of reciprocal values, such a provision could act either as an incentive for non-free networks to convert into free networks, or (at least) as a way for community networks to build bargaining power and better defend themselves from predatory behaviors. This way, community networks could eventually provide a new model for interconnection, one that blurs the distinction between the backbone and the last-mile and federates networks in a decentralized manner, extending in every direction and potentially spawning over whole countries and even across borders. A first experiment of this kind was carried on in 2012, when community networks FunkFeuer from Austria, NEDWirelles from Croatia, and Wlan Slovenija established a wireless backbone spanning across geographical borders to create a direct link between them. As the number of WCNs deployed over the world grow, the potential for establishing a global and independent network infrastructure that abides to the founding principles of the Internet will also increase.

3.2. How regulation favors commercial players and creates hurdles for WCN

Despite their potential in fostering public interest goals in telecom policy, regulators have so far failed to support the efforts of community networks. More often than not, public policy actually puts important hurdles in their way.

The most striking example is that several community networks have been precluded from using public broadband networks funded with taxpayers money. In France for instance, many local governments have invested in rolling-out fiber networks in both urban and rural areas. These public networks are built and managed by a private contractor, which then leases access to Internet access providers that, in turn, sell Internet access offers to subscribers. Yet, the fee charged by the contractor to access the public

network is designed for large commercial ISPs, and is often much too prohibitive for nonprofit community networks.

Another other major problem of current telecom policies for WCNs is the issue of spectrum management. Here, again, regulatory capture by commercial interests leads to regulatory choices that systematically overlook the potential of more flexible and citizen-centric policies. The recent allocations of the so-called 'digital dividend' (i.e. the frequencies left vacant by the switch from analog to digital television) is a textbook case. In France for instance, it was proposed to use part of the spectrum dividend to create new digital TV channels and develop mobile television as well as digital radio (neither of these two technologies has taken off thus far). The remaining half of these 'golden frequencies' of the lower UHF bands (sought-after for their long-range propagation) was then auctioned off to telecom operators for their 4G mobile Internet access offers (the lucrative license auctioning took place between October 2011 and January 2012 and brought €3.5bn to the French state). Similar policies have been devised in other European countries.

In the process, one option has, however, never been considered: extending 'unlicensed' access to some of these frequencies—that is, effectively turning them into a commons open for all to use. Long thought to be unreasonable because of the risk of radio interferences, opening up the spectrum to multiple, non-coordinated radio users has actually been experimented on a worldwide basis more than a decade ago for Wi-Fi frequencies. Needless to say, it has proved to be a very wise policy choice. At the time, those frequencies were referred to as 'junk bands', because few actually thought they could have valuable applications. Now, experts predict that Wi-Fi will power 55 per cent of Internet traffic by 2017 (Cisco 2013). It is widely recognized as a flexible and efficient technology, enabling large-scale innovation, allowing laptops, mobile phones, tablets, game consoles, cameras, e-book readers and countless other devices to connect seamlessly to the Internet. As our case-studies have shown, it also plays a key role in fostering the development of citizen-centric last-mile networks. Even exclusive licensees in the telecom sector providing Internet access over 3G and 4G increasingly resort to Wi-Fi's open spectrum to offload their Internet traffic (Juniper Research 2013).

The success of Wi-Fi has proven the defense of a market-based approach as the sole alternative to exclusive licensing to be overly simplistic. Against the backdrop of traditional economic theory, open spectrum policies have shown that commons-based approach to many-to-many communication infrastructure can actually work in practice. Through packet switching, best-effort delivery, as well as innovative radio transmission and bandwidth managements techniques, Wi-Fi has successfully verified Ostrom's (1990, p. 88) claim that users themselves and ad hoc technical standards can create and enforce rules that mitigate the over-exploitation of the commons, confirming the point that orthodox economists usually overlook the practical failures of privatization and government regulation. In many regards, though property-based allocations of spectrum and exclusive licensing still have the upper hand, they have often come short of fostering public interest goals, for instance by causing a very significant underutilization of this public resource (Forge et al., 2012). Moreover, not only does the regulatory focus on exclusive licensing create an enormous opportunity cost by favoring established players over innovative new-entrants (such as community networks), it has even been argued by human rights NGOs that it may actually breach the international law on freedom of expression (Article 19 2005).

Meanwhile, despite the successes of Wi-Fi, unlicensed access to spectrum remains marginal, and WCN's spectrum needs are largely ignored by regulators—which is all the more worrying considering that these are increasingly victims of the rapid growth of Wi-Fi traffic. Guifi.net and Freifunk, for instance, report having a hard time maintaining the quality of their network because of the saturation of the 5GHz frequency bands. Another issue for WCNs is linked to the topography of their environment: Wi-Fi bands have some important technical limitations, in particular in terms of propagation, and signals are easily blocked by buildings or trees. WCNs are thus faced with the choice of either refraining from creating a new radio link in a given location, or pushing the emission power levels beyond the legal limits to overcome these obstacles.

3.3. Towards a public policy for the network commons

Much can be done at the regulatory level not only to lift the technical, legal and policy hurdles that community networks run into, but also to actively support them. Several elements presented in the course of this paper—from regulatory capture to the impressive results achieved by these small nonprofit citizen groups—show that this is both an urgent and sound policy move. Considering the increasingly concentrated outlook of telecom markets across Europe, a policy overhaul focused on community networks can indeed help create effective counter-powers to the dominance of commercial operators in the communications infrastructure. Various policy considerations follow from our fieldwork.

First, there are a range of regulations making WCNs' work and very existence significantly and often unnecessarily difficult. In Belgium for instance, the registration fee telecom operators must pay to the NRA is relatively high, whereas in France, Spain or Germany, it is free—which may explain why the movement is much more dynamic in these countries. It is, therefore, all the more important that registration processes be harmonized at the EU level, and, in particular, that they remain free for nonprofit networks.

Second, several laws seek to prevent the sharing of Internet connections amongst several users by making people responsible (and potentially liable) for all communications made through their Wi-Fi connection. This is the case in France, for instance, where the 2009 three-strikes copyright law against peer-to-peer file-sharing also introduced a tort for improperly securing one's Internet connection against unlawful activity on the part of a third party. As a result, many community networks who would like to establish open Wi-Fi networks in public spaces, such as parks and streets, refrain from doing so out of legal insecurity. In our view, even though connection sharing might sometimes make law enforcement more difficult by allowing many unrelated users to share the same IP address, this drawback is more than compensated by the benefits brought about by the deployment of open wireless networks.

Third, it is not just Internet wireless access points that can be shared, but also the intangible infrastructure on which radio signals travel. As we have seen, unlicensed spectrum is a key asset for community networks to set up affordable and flexible last-mile infrastructure, but it is currently very limited. In the US, the Federal Communications Commission has initiated promising policies in that field (Farivar 2014). But for the moment, the EU has shied away from similar moves. In 2012, the EU adopted its first Radio Spectrum Policy Programme (RSPP). During the legislative process, the EU Parliament voted in favor of ambitious amendments aimed at opening more spectrum to unlicensed uses (LQDN 2011). Even if some of these amendments were later scrapped by national governments, the final text still calls for member states and the European Commission to 'assess' the 'need for and feasibility of extending the allocations of unlicensed spectrum' in the Wi-Fi bands, while also voicing tepid support for mesh networks by stressing their potential to foster access to the global Internet. As EU lawmakers were working on the RSPP, a study commissioned by the EU Commission also called for a new 100 MHz of license-exempt bands as well as for higher power output limits in rural areas to reduce the cost of broadband Internet access deployment. Since then, however, EU work on unlicensed spectrum and on flexible authorization schemes which would be more accessible to community networks has stalled. In a communication released in September 2012, the EU Commission failed to announce any concrete action to expand unlicensed use of the spectrum (European Commission 2012). At the national level too, there is unfortunately no policy change in sight.

Fourth, networks built with taxpayers' money could also be treated as a

commons, and as such should remain free from corporate capture. Regulators should ensure that nonprofit community networks can access publicly-funded and subsidized physical infrastructures without unnecessary financial or administrative hurdles. Accordingly, they should review existing policies and current practices in this field, providing transparent information to map publicly funded networks, and mandate rules to allow community networks to use these on a preferential basis.[3]

Of course, countless other policy initiatives can help support grassroots networks, such as small grants and subsidies to help these groups buy servers and radio equipment, communicate around their initiative, but also support their research on radio transmission, routing methods, software or encryption (Shaffer 2013). Like Guifi.net, the most successful of these groups suggest that even little governmental support—either local or national—can make a big difference in their ability to successfully accomplish the ambitious objectives they set for themselves.

But all of these policies point to an overarching issue, namely the need to democratize telecom policy and establish procedures that can institutionalize 'subversive rationalization' in this field. In many countries, such as Spain or Italy, even though city councils may occasionally actively support these organizations to the extent that they provide better Internet access to their citizens, regional governments and national regulators have so far largely neglected them. An Italian group, Ninux, feels that 'the government simply does not understand who or what we are.' At the EU level, where much of telecom regulation applicable in Europe is ultimately crafted, community networks are virtually absent of policy debates.

Given the revival of community networks in the past years, it is not enough for regulatory authorities to treat citizens as mere consumers by occasionally inviting consumer organizations at the table. Regulators and policy-makers need to recognize that the Internet architecture is a contested site, and that citizen groups across Europe and beyond are showing that for the provision of Internet access, commons-based forms of governance are not only possible but that they also represent effective and viable alternatives to the most powerful telecom operators. Their participants have both the expertise and legitimacy to take an integral part in technical and legal debates over broadband policy in which traditional, commercial ISPs are over-represented. They can bring informed and dissenting views to these debates, and eventually help alleviate regulatory capture. In the very few instances where regulators reached out in good faith to community networks, it led to significant achievements. On one occasion, Wlan Slovenija was invited to actively contribute to a policy debate on a piece of telecom legislation, which translated in the adoption of a Net neutrality provision in Slovenian law in late 2012.

But democratising telecoms policy is not the sole responsibility of institutional actors. If regulators are not ready to listen, community networks must organize politically and pressure them to do so. In Germany, Freifunk's members claim that it might be paying off: 'Recently, we have been doing a lot of policy work on the level of the municipality, the districts and the local regulatory bodies,' reports one member, 'and we are having some success' (Mr. Juergen Neumann, pers.comm., 16 May, 2014). For instance, the group has been allowed to conduct a limited experiment in Berlin in the so-called 'white space' (white spaces refer to the frequencies in the UHF band left unused by TV and radio broadcasters). Radio signals in the lower UHF bands can go through walls and other similar obstacles, allowing for long distance radio links—potentially across several dozen kilometres—without the need to have the receiver antenna in sight, as it is the case for traditional Wi-Fi bands. The goal, explains that Freifunk member, is therefore 'to show that we can build inexpensive mesh nodes operating in white space bands with off-the-shelf equipment and demonstrate that the power of mesh multiplies once we are able to use radio frequencies with greater propagation than Wi-Fi.'

To go back to the typology of political action, these examples show that 'insider' strategies, i.e. direct engagement with policy-makers, are worth pursuing. In a sign that community networks might increasingly be moving in this direction, many of them are working to form a more cohesive and powerful group to discuss legislative issues and advocate regulatory reforms, for instance within the DIY ISP initiative mentioned above. Of course, a potential problem for sustaining political engagement is the fact that community networks are often run by volunteers whose lack of time and resources may preclude them to participate as actively as the full-time and well-resourced lobbyists of incumbent actors. But overtime, as the movement grows, it may be able sustain its engagement with public authorities, especially if the latter adapts and establish ad hoc contact channels and remote participation mechanisms.

Twenty years after the privatization of national networks in Europe, there is certainly a long way to go for telecom policy to balance the interests of all various stakeholders—including citizens—so as to live up to the social, economic and democratic stakes of Internet governance, of which it is a crucial part. In this process, community networks will undoubtedly have an important role to play. These burgeoning initiatives should invite policy-makers to break away from the narrow focus of past regulatory logics, overly driven by industrial economics and prone to regulatory capture. Bringing the impetus for reform, however, will undoubtedly require on the part of community networks and their allies in civil society to further organize for collective action and make these issues a visible part of the public debate, where they belong.

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[3] On very-fast broadband roll-out, our interviewees also pointed to the need to reorient both public and private investments in fiber-optic last-mile networks where they are most needed, that is in rural communities where decent broadband is crucially lacking, rather than in already well-connected urban areas where there is usually less demand for higher speeds. They also called on regulators to better coordinate so that any public work being carried to roll-out fiber-optic cables that can then be used to expand and improve Internet access.