guifi.net, a crowdsourced network infrastructure held in common

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ABSTRACT

The expression "crowdsourced computer networks" refers to a network infrastructure built by citizens and organisations who pool their resources and coordinate their efforts to make these networks happen. "Community networks" are a subset of crowdsourced networks that are structured to be open, free, and neutral. In these communities the infrastructure is established by the participants and is managed as a common resource. Many crowdsourcing experiences have flourished in community networks. This paper discusses the case of guifi.net, a success case of a community network daily used by thousands of participants, focusing on its principles and the crowdsourcing processes and tools developed within the community, and the role they play in the ecosystem that is guifi.net; the current status of its implementation; its measurable local impact; and the lessons learned in more than a decade.

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1. Introduction

Crowdsourced computer networks are built by citizens and organisations who pool their resources and coordinate their efforts to build network infrastructures. The coverage of underserved areas and the fight against the digital divide are the most frequent driving factors, but motivations such as contributing to development of a new telecommunications model or just for pleasure are also often mentioned by their contributors. Technologies employed vary significantly, ranging from very-low-cost, off-the-shelf wireless (WiFi) routers to expensive optical fibre (OF) equipment [1].

Models of participation, organisation, and funding are very diverse. For example, some networks are freely accessible, others are cooperative based, some are run by federations of microISPs, etc. A few examples follow.[1] Broadband for Rural North (B4RN) in Lancashire, UK, and Nepal Wireless Networking Project (NWNP) are networks built in response to the lack of coverage of the conventional operators. B4RN deploys and operates optical fibre in a cooperative way. NWNP [2] is a social enterprise that provides Internet access, electronic commerce, education, telemedicine, environmental. and agricultural services to a number of remote villages, using wireless technologies. The French Data Network Federation (FFDN) is a federation of French Do-it-Yourself ISPs which comprises DSL resellers, WISPs, collocation centres, and the like. HSLnet is one of the many cooperative fibre-optic networks in the Netherlands.

Community networks (CNs) is a subset of crowdsourced networks that is characterised for being open, free, and neutral. They are open because everyone has the right to know how they are built. They are free because the network access is driven by the non-discriminatory principle; thus they are

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[1] BARN: http://b4rn.org.uk/, NWNP: http://www.nepalwireless.net/, FFDN: http://www.ffdn.org/en, HSLnet: http://www.hslnet.nl/.

universal. And they are neutral because any technical solution available may be used to extend the network, and because the network can be used to transmit data of any kind by any participant, including commercial purposes.

Representative examples[2] are Freifunk (FF) in Germany, the Athens Wireless Metropolitan Network (AWMN) in Attica, Greece, FunkFeuer (0xFF) in Austria, and Ninux.org in Italy, all of them with thousands of links, mostly wireless,[3] but gradually integrating also optical fibre and optical wireless links.

Although CNs have already been studied from several angles [3] [4], there is still insufficient understanding of the practises and methodologies which have given rise to such complex collaborative systems. This paper tackles this lack by analysing guifi.net[4] [5] [6], the largest CN worldwide.

In 2004, guifi.net began as a group of people who met regularly for network planning and deployment. The group was seeking ways to create amateur networking infrastructures in remote rural areas, ignored or underserved by conventional ISPs, taking advantage of open spectrum, open software, and inexpensive WiFi devices. Along with the expansion of the network, the participants also discussed ways to structure the fast-growing community. Bringing a network to new locations requires coordination for planning the links, configuring the hardware, aligning antennas, etc. In addition, new tasks such as network design, routing coordination, and address allocation become increasingly critical as the network and the community grow. These tasks have resulted in many tools that have been developed specifically for guifi.net and are used by the guifi.net community.

In this paper we describe the fundamental principles of guifi.net, and how their application results in a collective good, the network infrastructure, that is built collectively from contributions from many participants, and governed as a common-pool resource (CPR).

We identify and analyse the most relevant of these tools and discuss their impact on the expansion of guifi.net. As a result of our investigations, we firmly believe that guifi.net has made very significant contributions, not only to the formalisation of the CN concept itself, but also to the development and application of effective social and technical tools to make CNs sustainable and scalable. These tools are in constant evolution to better put the commons model into practice.

The remainder of this paper is structured as follows. Section 2 presents the underlying guifi.net principles that structure the participation and usage of the network, and discusses how these translate into a social production process that results in a collective good that is governed collectively as a common-pool resource. Section 3 surveys the stakeholders and presents the architecture of the governing mechanisms. Section 4 introduces the tools and strategies developed to implement these principles, such as software tools to share information, communicating among groups, coordinating contributions, overseeing and regulating the community, stipulating collaboration agreements, resolving conflicts, and compensating for imbalances. Section 5 presents the results achieved in terms of the commons infrastructure, interconnection with other networks, the community of participants, the organisational framework, and the measurable impact in areas with strong infrastructure development. In Section 6 we analyse and discuss the results. Section 7 discusses the correspondence with academic models of CPR. Section 8 presents lessons learned that can be generalised. In Section 9 some recommendations for future work are made. Finally, conclusions are presented in Section 10.

Computer networks are hereinafter referred to as *networks* and network infrastructure as *infrastructure*.

2. Principles

The fundamental principles of guifi.net, defined at the start to be fully inclusive, revolve around (i) the openness of access (usage) of the infrastructure, and (ii) the openness of participation (construction, operation, governance) in the development of the infrastructure and its community.

Non-discriminatory and open access. The access is non-discriminatory because the prices are determined using the cost-oriented methodology (vs. market-oriented) with the fair-trade principle for labour pricing. It is open because everybody has the right to join the infrastructure.

Open participation. Everybody has the right to join the community. According to roles and interests, four main groups can be identified: (i) volunteers, interested in aspects such as neutrality, independence, creativity, innovation, DIY, and protection of consumers' rights; (ii) professionals, interested in aspects such as demand, service supply, and stability of operation; (iii) customers, interested in network access and service consumption; and (iv) public administrations, interested in managing specific attributions and obligations to regulate the participation of society, usage of public space, and even in satisfying their own telecommunication needs. A balance among these four groups must be preserved, as every group has natural attributions that should not be delegated or undertaken by any other.

These fundamental principles applied to an infrastructure result in a network that is a *collective good*, *socially produced*, and governed as a *common-pool resource (CPR)*.

The network is a *collective good* or a peer property in which participants contribute their efforts and contribute goods (routers, links, and servers) that are shared to build a computer network, which combined by several Internet protocols results in a peer property, provided that the community rules, as a community license, are respected by all participants.

The development of a CN is a *social production* or a peer production because the participants work cooperatively, at local scale, to deploy an infrastructure to build network islands, and at global scale to share knowledge and coordinate actions to ensure the interoperability of the infrastructure deployed at local scale.

The *common-pool resource (CPR)* is the model chosen to hold and govern the network. The participants must accept the rules to join the network and must contribute the

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