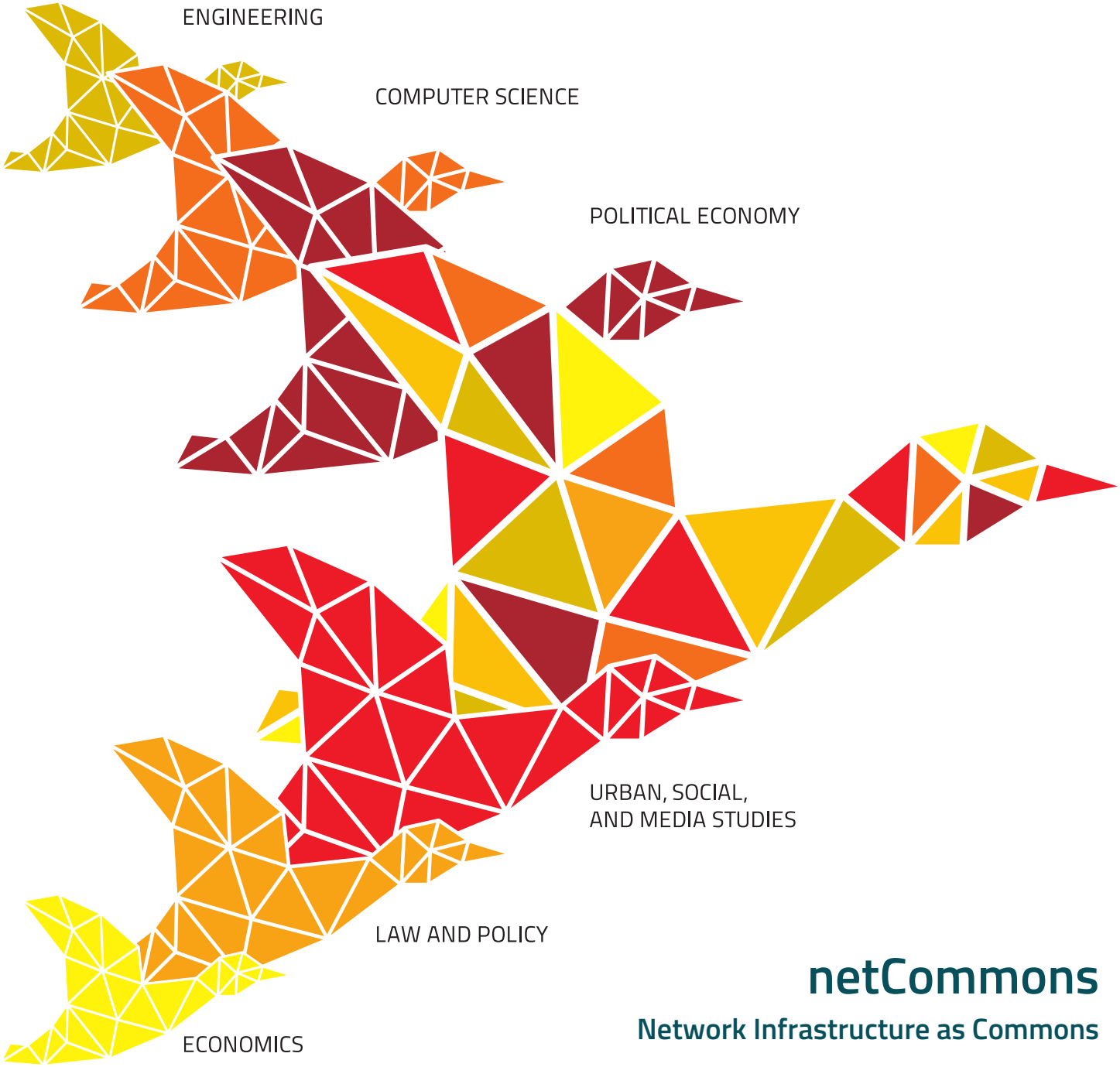

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Network Infrastructure as Commons

Report on the Governance Instruments and their Application to CNs

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Executive summary

This deliverable is part of Task 1.2: *"Improving governance: impact on Community Networks (CNs)"*. The ultimate expected outcome of the task is the improvement of the governance models of CNs. Task Leader: UPC; Task Contributor: CNRS

The outline of the deliverable is:

- An analysis from the social science perspective about the notion of community and community organization, with a particular attention to the most relevant contributions emerged in the field of organizational studies;
- An analysis and identification of good governance tools, as a result of collaborative research about several representative CNs: guifi.net and eXO (mainly Spain), ninux.org (Italy), FFDN and Tetaneutral (France) already covered in our previous research, and new CNs: Wireless For Communities (W4C) (India) and Rhizomatica (Mexico). We look at governance, from an outside view of the surrounding environment, and from an inside view of internal coordination, identifying governance bottlenecks and organizational developments.
- Synthesis: Recommendations and good practices (to improve the platform in D1.2) to take into account in any re-structuring in terms of organizational patterns and anti-patterns.
- Re-engineering: Plans for Work with selected CNs to incorporate such governance instruments within the routine management of CNs. The results will be reported in deliverable 1.4.

D1.4 is a related deliverable, due in M24 (December), that will refine and complete the work reported in this document. It will provide a more elaborate analysis of the re-engineering of organizational tools, including their evaluation and impact assessment.

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List of Acronyms

ANNGTS	Access networks to next-generation telecommunication services
APC	Association for Progressive Communications
B4RN	Broadband for the Rural North
CN	Community Network
CPR	Common-Pool Resource
DIY	Do-It-Yourself
eXO	Expansió de la Xarxa Oberta
FONNC	Compact license for a Free, Open & Neutral Network
GSM	Global System for Mobile Communications
IEEE	Institute of Electric and Electronic Engineers
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
ISOC	Internet Society
IoT	Internet of Things
ITU	International Telecommunications Union
IXP	Internet eXchange Point
NCL	Network Commons License
SME	Small and Medium Enterprise
TV	Television
UDHR	Universal Declaration of Human Rights
W4C	Wireless For Communities

1. Introduction

The objectives of this report are to analyze the multidimensional process of internal governance in community networks (CNs) and identify recommendations and "good" practices, in order to incorporate them as governance instruments in selected CNs to ehnance their internal coordination and organization.

From the netCommons proposal, the description of Task 1.2: *Improving governance: maximising the impact on CNs* is as follows:

> "*This task will identify what are the best governance tools (policies, agreements, decision making platforms etc.) for CNs to fine tune their internal organization, improve their resilience, optimize their sustainability, reduce gender divide. This analysis will be included in form of recommendations and best practices to improve the platform in Deliverable 1.2. Through active work within the CNs, meetings and participation to workshops co-organized by T6.1, the personnel involved in T1.2 will work to help selected CNs to incorporate such governance instruments within the routine management of CNs. A monitoring phase for the evaluation of the initial impact of the recommendations will also be carried out and will be reported in Deliverable 1.3.*"

Community networking infrastructures have been developed in many locations and communities to address the essential need of citizens to participate in the digital society and support communication in the artificial digital space as we can do in the natural acoustic space. CNs, described in Deliverable D1.2 [1] as global commons with a central artificial material commons component, are critical enabling infrastructures for the digital world. These infrastructures enable self-provisioned and self-organized ways to build and ensure social interconnection and access to knowledge, content, and communication.

As it has been argued in Deliverable D1.2 [1] about "*Existing CNs and their Organization (v2)*", CNs are bottom-up infrastructures characterized by a relatively distributed network architecture, and also by being built and self-managed by "communities" of citizens. Conceptually speaking, CNs represent an emerging kind of community organization engaged in producing a "commons-based" resource, based on the creative adoption of Information and Communications Technology (ICT) by collectives of citizens and organizations who pool their resources and coordinate their efforts (see Deliverable D1.1 [2]). Community networks combine the need to have infrastructures to support local socio-economic interaction, with experiences about the governance and management of common property, and with ideals related to the engagement of citizens, developed along the history of grassroots community organizations.

As reported in Deliverable D1.2 [1], under common principles, diversity makes a difference. Each CN has created diverse local institutions and organizational structures of varying sophistication, adapted to local conditions and needs . Each initiative adapts to its locality, with slightly different points of origin, values, strengths and weaknesses, and diverse levels of development and structuring.

We draw on the governance analysis in Deliverable D1.2 related to resilience and sustainability of network infrastructure commons. We have looked at representative examples of CNs. Several of them have already been covered in Deliverable D1.2 whereas others are new and are fitted in that previous analysis, so that they can benefit from organizational and governance improvements. Here we focus on how previously identified governance instruments can be adapted and applied to help these and other CNs evolve their governance and become more resilient, adaptable, sustainable, and scalable.

The report is organized along different sections that include:

a) *A social-science analysis of CNs* in Chapter 2. First, we look at CNs as an "inverse infrastructure", to emphasize the growing relevance of community organizations in shaping an alternative pattern to the dom-

inant business-oriented model of institutional infrastructures and commercial ISPs. Common to the latter is that public bodies, private organizations, or controlling governing bodies are central actors in the design, governance and management of large-scale technical systems.

Then we review the most relevant contributions that have emerged in the field of social science and organization studies concerning the notion of "community", with particular attention to the internal governance issues. Since the body of research on the internal governance of CNs is limited, this review allows us to frame the CN phenomenon as an emblematic case of community organization, which poses peculiar problems in terms of internal coordination, sustainability and management of the community's daily life. More specifically, we discuss the genealogy of the notion of "community" as it emerged in the social sciences, and then pay particular attention to the theme of community organizations in the context of internal governance. In this way, it is possible to define a conceptual tool box to analytically capture governance issues pertaining to the specific case of CNs. Under this lens, the CN is studied as an open-ended organizational process, which emerges by the assemblage of political visions, values and technical devices, and has to deal with continuous pressure from the surrounding environment, within which its action is articulated.

b) *An analysis and identification of good governance tools* in Chapter 3. We present the results of collaborative research directed at exploring practices and tools through which internal governance of CNs is performed in practice within several CNs: guifi.net and eXO (Spain), Ninux.org (Italy), FDN and Tetaneutral (France) already covered in our previous research, and new CNs: W4C (India) and Rhizomatica (Mexico). Such practices and tools include internal policies, formal and informal agreements, decision- making processes, internal communication processes and interactions, as well as the external view of the organization situated in its environment. The collaborative research outlines a specific methodological approach that allows professional researchers and community organizations' members to be actively engaged in the research process. That is, researchers and community organizations cooperate in order to: i) identify and frame relevant concerns to be tackled; ii) undertake the investigation, also interpreting the findings in terms of salience for organizational change. This methodological approach allows us to disclose and valorise the perspectives of the CNs' members who — through the stimuli offered by the interviewer -– are pushed to reflect on their experience as CNs activists. Thus, in this report the broader methodological framework is constituted by qualitative case studies. Within this frame, empirical data have been collected through qualitative interviews and documentary analysis on public and easily collectible documents produced by the CNs, as well as on the communications developed through the mailing list of the communities, in order to understand how internal governance, and some specific governance tools (such as internal information systems, decision making platforms, communication tools, internal agreement and policies) are used and translated into practices. In doing so, we also explored in depth the governance bottlenecks, in order to provide recommendations and good practices oriented to sustain CNs' management, resilience, and sustainability.

c) *Synthesis* in Chapter 4. The collaborative research aims to provide knowledge about the organization processes of the selected CNs. This can be applied to shaping recommendations about internal organisation and improving the sustainability of CNs. From that research we have identified the set of most common and relevant organizational patterns and anti-patterns in CNs and present it in an structured way.

d) *Reengineering* in Chapter 5. Interaction with several CNs has resulted in direct and indirect exchange of experiences and organizational instruments to handle similar issues with slightly different local nuances. Together with the CNs involved, we have identified several areas for further development (re-engineering). The aim is to assist selected CNs that have expressed interest to incorporate governance instruments or improve existing ones. These developments consist on restructuring for improvements, that can affect their outside view or inside view; or organizational developments, as the communities plan to transform to react to challenges or opportunities, such as scaling up or consolidation through professionalization.

2. A social-science perspective of community networks

2.1. Community of what? A genealogy of a concept

In general terms, the notion of "community" – in its different semantic articulations such as "sense of community", "community ties", "local communities", "national community" and so on – represents a pervasive term in the public sphere, apparently easily intelligible both by lay people and public policy stakeholders. At the same time, the concept of "community" has been traditionally at the core of social investigation through a variety of theoretical lenses, thus generating a complex and polysemous conceptual universe. In this sense, the academic debate around "community" constitutes a heterogeneous discursive arena deeply rooted in the fundamentals of social studies about societal organizational processes [3]. Notably, this large body of analysis now represents a multidisciplinary field commonly known as "community studies", gathering together mainly sociological and anthropological research work conducted through qualitative methodologies, such as ethnography and participant observation [4].

In this regard, one of the most relevant systematic reviews of research dedicated to the exploration of the social, organizational and cultural dimensions of communities identified 95 different definitions of the concept of "community" [5]. In light of this complexity, it is crucial to map the most significant contributions so that we can define a conceptual tool box to analytically capture governance issues pertaining to the specific case of CNs. In doing so, special attention will be paid to the topic of "local communities" as opposed to other declinations of the concept; for instance, the scholarship on "national community", as proposed by Benedict Anderson [6] in his seminal book Imagined Communities, where the nationalism culture in contemporary society is analysed.

Since its inception, community studies has been characterized by a strong theoretical assumption called the *loss of community theory*. This concerns the progressive loss of community ties, in terms of the erosion of solidarity and informal social support, due to the processes of industrialization, bureaucratization, urbanization and secularization that have occurred in modern society. In this regard, one of the foundational contributions of this theoretical approach come from the work of the German scholar Ferdinand Tönnies. Tönnies, in his book "Gemeinschaft und Gesellschaft" [Community and Society] [7], elaborate the enduring conceptual binarism between community and society. According to Tönnies, community organizations based on a spontaneous sense of collective belonging characterized the pre-industrial era. The main purpose of community was to maintain and reproduce its members' collective existence, on the basis of shared values and beliefs driven by mutual support and solidarity. In this sense, Tönnies considered the community to be a positive form of organization, to which people belonged, and which shaped collective identity and solidarity. On the contrary, modern societies – under the pressure of urbanization and industrialization processes – are characterized, on the one hand, by a constant erosion of community ties, and on the other hand, by the affirmation of a new paradigm of sociability based on individualism. Within this frame, societies are seen as a "cold contract" tacitly endorsed by free agents in order to pursue rationally their own individual objectives. Consequently, interactions among individuals are described as generative actions of a relational space in which people can achieve cynically their own self-interest. In this way, the element at the centre of modern society is individuals competing among themselves. In short, the work of Tönnies is characterized by an evaluative analytical posture that considers society to be an egoistic and degraded form of social organization, due to the changes in the economic system brought by capitalism.

In a similar vein, the French sociologist Emile Durkheim [8] proposes the notions of mechanical solidarity and organic solidarity to account for the transition from a basic, primitive division of labour, to a more structured and complex one. According to Durkheim, the first form of solidarity characterized the small-scale pre-modern

communities (clans and tribes of hunters and gatherers), and it was based on the recognition of a common origin and identity. In this sense, mechanical solidarity describes an apparatus of norms and values oriented to reproducing the collective mutualism within small-scale autonomous self-sufficient communities. In this communitarian context, the division of labour takes place along the lines of gender and age. In contrast, organic solidarity characterizes modern societies, with strong prevalent fragmentation and segmentation among individuals due to the increasing division of labour into specialized jobs. In his book entitled "De la division du travail social" (Of Division of Social Labour), Durkheim highlights how the processes of modernization and urbanization, together with the associated population growth, make an occupational specialization necessary to cope with the resulting social complexity, and the increasing competition for access to scarce economic resources. Differently from Tönnies, for Durkheim the erosion of community ties (and thus the shift from mechanical to organic solidarity) was generated by urbanization and the increasing division of labour, rather than by the advent of a market economy.

Along with Tönnies and Durkheim, the cultural analysis of the German sociologist Max Weber [9] has been very influential in questioning issues related to the loss of community. In his book "The Protestant Ethic and the Spirit of Capitalism", Weber highlights the transition from traditional sacred community organization, to modern society organized around rational social action aimed at pursuing individual self-interest. According to Weber, the loss of community is enacted through a bureaucratic division of labour, a process of secularization, and the undisputed triumph of market-oriented relationships. Weber's reflection on the loss of community ties is characterized by a marked ambivalence: on the one hand, he recognizes the organizational efficiency of modern capitalism, and on the other hand, he is deeply concerned about its consequences in terms of dehumanization and destruction of collective sentiments of community.

A further reflection on the loss of community is that proposed by Simmel in his two seminal essays "The Metropolis and Mental Life" [10] and "The Philosophy of Money" [10], where he analyses how the development of the modern metropolis loosened the reciprocity and solidarity in which communities were rooted. In particular, Simmel focuses on the consequences of the advent of modern capitalism and the market economy, emphasizing how social exchanges and face-to-face interactions are increasingly mediated by means of money.

The so-called loss of community theory, although already outlined within the aforementioned seminal works on the organizational forms of modern society, has been systematically formulated by Karl Polanyi [11] in his influential book "The Great Transformation". In this text, Polanyi argues that contemporary societies are characterized by an eclipse of the community. According to Polanyi, the quantity and intensity of community ties are reduced when a social context becomes more urbanized and industrialized. In other words, Polanyi highlights how the transition from agrarian and feudal societies to capitalist production, accompanied by the formation of nation-states, led to a reduction of the ties of solidarity, local community and cooperation on which communities should be based. As we will see in the next paragraph, this pessimistic view of the consequences of modernization processes has been challenged by some recent studies, which have highlighted the persistence and the centrality of community organizations within contemporary everyday life, in both urban and metropolitan environments.

2.2. Re-discovering community: communities of practice

A critical reading of the loss of community theory can be traced within organizational studies, which from the end of the 1980s have given rise to a flourishing field of investigation on the *community of practice*. The concept of community of practice first appeared within the investigation concerning the governance and management of organizational learning, or rather on how people learn to cooperate and work together within organizational settings [12]. In this body of research, particular emphasis has been put on the modalities through which expert knowledge is shaped, learned and shared through working practices performed by a community of practitioners.

Several authors [13] [14] identified the community of practice as an informal group circumscribed not only by its participants in themselves, but, above all, by the way they act and interpret the everyday events and

the common mission to be achieved. In this sense, a community of practice is a heterogeneous network of relationships between people, activities and the surrounding environment. Social relationships are enacted around a shared set of activities. At the same time, activities are performed through social interactions, so specific skills and experiences can become part of the practitioners' experience stabilizing the community itself. The notion of community of practice allows us to highlight how even apparently unqualified or routine tasks can generate a high density of interactions. These interactions, along with tacit and explicit norms on the division of labour, as well as modalities through which people learn to carry out a job, are exactly a community of practice. Thus a community of practice can be qualified as the relational space in which a "collective knowledgeable doing" [15] oriented to achieving specific goals takes place. As Gherardi and colleagues argue:

> Referring to a community of practice is not a way to postulate the existence of a new informal grouping or social system within the organisation, but is a way to emphasize that every practice is dependent on social processes through which it is sustained and perpetuated, and that learning takes place through the engagement in that practice [16] p. 279.

Conceptually speaking, communities of practice are generated around collective processes of learning and acting in a specific field, not necessarily attributable to a formal working environment. Some examples concern a group of hackers working to build a 3D printer; a group of computer scientists seeking to develop a new protocol or working on similar problems; or a concerned group of citizens building up a community network.

Here, the investigation around community of practice has provided a framework able to emphasize how there is no linear relationship between economic development, urbanization, technological innovation and erosion of community ties. On the contrary, communities represent organizational environments, which can take different shapes in relation to the broader social and cultural context within which they are located. More recently, this aspect has been highlighted within the broad debate about online communities, or those communities that are made possible by computer-mediated communication [17]. These kinds of communities are not space-bound, as social interactions occur mainly through computer networks, but at the same time they have a strong collective identity and specific goals widely shared by members. Nowadays, another relevant example is represented by formal and informal non-profit organizations, to which the next paragraph will be devoted, with the aim of introducing some of the main issues related to the internal governance of communities.

2.3. The shaping of community organizations: social interactions as non-profit action

As we have seen in the previous sections, community studies circumscribe a well consolidated field of inquiry. At the same time, investigations of the specific case of community organizations – such as formal or informal non-profit associations, "concerned groups" of citizens, civic organizations and so on – still represent an emerging field. In this regard, some authors have argued that community organizations identify the "dark matter of the non-profit universe" [18] [19]. However, it is important to emphasize that nowadays community organizations seem to be increasingly central in solving social problems that public institutions neglect [14], thus generating new forms of peer production of common pools of knowledge and services [20].

Organization scholars recognize that community organizations can provide an alternative to the business oriented and hierarchical models of production. More precisely, community organizations identify a group of people who – regardless of their background or employment status – voluntarily contribute to the production of goods and services for both public and private benefit [21]. With reference to this definition, community networks, as we will see later, represent an emblematic case of community organization.

In general terms, the involvement of community organizations in the public sphere is not driven mainly by a form of mere instrumental rationality, since their foundational values mostly concern social equality, universal access to social and civil rights, the improvement of the quality of life at local level, and in general the strengthening of direct citizen participation in democracy. Community organizations do not have substantial material and financial resources, but rather they depend on the voluntary willingness of people to contribute to the achievement of a shared set of social goals. Thus, their leaders may have no classical entrepreneurial

experience, but rather may be informally (or by acclamation) recognized as key members in the management of the everyday life of the community. These organizations can significantly change in their organizational pattern when new members arrive. At the same time, they can easily disappear, if the foundational purpose of their action is no longer central in the local context in which they act. In fact, community organizations are the emerging results of complex sets of values, tensions and social forces which characterize the surrounding environment in which they are located, and may influence members [19]. For this reason, each community differs according to its geographical location, type of action and intervention in the context concerned, and in relation to state and local government institutions, local history, and internal leadership styles. In order to theoretically capture the mutual entanglement between these different aspects within a specific community organization, some authors proposed the notion of "community organizing" [22]. More specifically, the use of the verb “organizing” draws attention to the processual dimension of the organizational action, which is interpreted as an "open-ended process", strictly entangled with the surrounding environment within which the voluntary activities of the community are performed. Within this frame, community organizations encompass the following distinctive dimensions [23] [24]: i) shared ecology; ii) social organization; iii) shared cultural and symbolic meanings.

i) Shared ecology: this dimension relates to the spatial context, and to the environment in which the community acts. The surrounding environment can characterize organizational identity and internal social dynamics. The social and institutional features of the local context are crucial in defining the processes of access to the material and financial resources that can ensure the long-term sustainability of the community. In addition, some communities may have a very high level of geographic specialization, where their action is made possible by some context peculiarities, as in the case of a community network offering Internet provision in a rural area strongly characterized by a digital divide;

ii) Social organization: this dimension mainly refers to the everyday social processes of community life, the modalities for identifying the objectives of the community, and how to deal with and accomplish them. In this regard, a central aspect of the internal governance of such communities concerns members’ interpersonal networks. Indeed, the social ties between community members and other territorial organizations (or government institutions) can be a crucial element in ensuring access to material, financial and symbolic resources useful in achieving the community’s mission. In this sense, the social ties of a community member can become a common resource for the community as a whole;

iii) Shared culture: this dimension regards values, beliefs and meanings that define the identity of the organization, and allow members to identify with it. It includes also the features of organizational commitment, as well as leadership styles and decision-making processes.

These three dimensions, here described separately for mere analytical purposes, are strongly related to each other in a relationship of mutual generation. At the same time, one of these dimensions may be more marked in one community, and extremely weak in another. For example, there are very large “neighbourhood communities” that can have strong territorial roots (shared ecology), but a poor collective identity (social organization) because some members may not know each other personally.

Regarding the governance of community organizations, it worth noting that there is little systematic research on the internal governance and management of community organizations. Contributions about management and internal governance have highlighted how every community, although working in the same domain, faces different challenges, and is characterized by peculiar strengths that may also change during its cycle of life. In this sense, it is not possible to identify a unique organizational management model. On the contrary, each community needs to be considered as a specific case, with its own identity and personality that requires us to identify strategies, challenges and development patterns appropriate to its peculiar characteristics.

In order to foster this report, in the next section, more attention will be paid to governance issues related to community management processes, with particular focus on community organizations which represent a concept that allows us to grasp some organizational issues in community networks.

2.4. Community Networks as "community organizations" in infrastructural landscape

Community organizations are articulated around voluntary collaboration between people and other diverse organizations, both public and private, which join their forces with the aim to pursue a shared interest in changing a situation, or to face a specific problem neglected by public institutions.

The voluntary nature of these organisations distinguishes them from other private and public bodies, primarily managed through a bureaucratic model. Given this state of affairs, community organizations aim to act in the public sphere, so as to foster democratic participation at the local scale. Within this frame, community networks (CNs) represent an emblematic case of community organizations. More specifically, as argued in the D1.2 "Existing CNs and their Organization (v2)" [1], CNs represent an emerging kind of community organization engaged in producing "common resources", based on the creative adoption of new technologies of communication by emerging collectives of citizens and organisations who pool their resources and coordinate their efforts. Even if community networks are a relatively new phenomenon, they reflect ideals and political beliefs about the engagement of citizens in the civil society developed in the course of a long history of grassroots community organizing in Europe and United States [25].

According to some studies, CNs can support the civic participation to the collective local life, thus strengthening social interaction among people [26] [27]. The potential of decentralized and distributed community networks in shaping new social interactions has been brought to the attention of social sciences since the first experiences with local computer networks during the '70s and the '80s predominantly in North America, often at the municipal level or in rural areas. As it has been demonstrated by Dulong de Rosnay et al. in the D5.1 on the history of Alternative Communications Networks, the origins of CNs are rooted in the pioneering experiments of societal applications of computer networks. The most well-known example of this kind is the Berkeley Community Memory, built in the early seventies by some activists in California, in order to share information and news among the counter-cultural community localized in San Francisco Bay [28].

As it has been highlighted in D2.1 [29] and D2.2 [30] about aspects of sustainability, CNs are distributed infrastructures usually built and self-managed by grassroots organizations of people, including hackers, geeks, engineering students, political activists and citizens. These networks are oriented to strengthen the access to a neutral network for digital communication, which is conceived by its developers as a political alternative to the global business-oriented governance of Internet.

For this ensemble of reasons, community networks may enable and support civic engagement through collective actions addressing the need to access networks more sustainably and respecting the rights of the users. These decentralized networks can be fully independent of the Internet, even though in a several countries they became popular as a less expensive alternative to commercial ISP connections [31].

Conceptually speaking, a CN can be considered to be an "inverse infrastructure" [32]. This notion put into light the increasing relevance of user-driven, decentralized, and self-managed infrastructures that emerge by an "inverse" trajectory. More precisely, the term "inverse" emphasizes the growing relevance of community organizations in shaping an alternative pattern to the dominant model of institutional infrastructures. The latter wants public bodies, private organizations, or controlled governing bodies to play central roles in the design and management of large-scale technical systems.

The notion of inverse infrastructure allows to clearly identify the following CNs' characteristics, which play a pivotal role in defining internal governance:

i) The user-driven dimension, which means that these infrastructures are designed and managed by the end-users themselves;

ii) The self-organization dimension, which means that internal governance is not handled by institutional actors or firms; everyday community management rather occurs through the cooperation of its users/members, often on a voluntary basis;

iii) The peer-to-peer dimension, or the adherence. In CNs the governance is distributed among a different

number of concerned actors, while internal coordination tends to be consistent with a participatory model [33].

Regarding the internal governance, these three dimensions highlight how the local context (large city, town, rural area, district) in which CNs operate, as well as the recognition of the problems associated with the implementation of the infrastructure, the formulation of solutions, and the related action plan in terms of human, financial and material resources represent crucial elements in the management of community life. In addition to these ensemble of elements, CNs should carefully develop doable strategies for the mobilization of resources to support the long-term sustainability of the network, and of the community itself.

Unlike the traditional models of internal governance used by business corporations, as in the case of a commercial ISP, CNs tend to adopt loose governance tools, mostly related on mechanisms of informal social control. For this reason, the forms of sanctions / rewards of members' activities act on the level of individual reputation, namely the collective acknowledgement of the degree of the centrality and authority of individual members within decision-making processes. This form of internal governance, based on the density of social interactions, seems appropriate to guarantee adherence and commitment to the common mission. In this regard, organization theories on collective action highlight how members' adherence to rules governing the management of common resources implies social control and informal conflict resolution strategies (accessible, low-cost means for dispute resolution, the 7th principle of Ostrom's commons-based governance principles) [34].

More in details, according to the D1.2 [1], network infrastructures can be considered as common-pool resource [34]. In this context, when members are not performing properly a specific task, the old-time members or the most influential one can "correct" the unfair or anomalous behavior, by encouraging the volunteers to adopt another style of conduct more consistent with the community mission. In this sense, volunteers can be "fired" from assignments when they are managing common resource as non-paid staff only as a last option (corresponding to the use of graduated sanctions for rule violators, the 6th principle in the Ostrom's typology. Even then, members very rarely are ejected from CNs for incompetence. Given this state of affairs, supervision by leaders is generally loose in CNs because most members are association volunteers. Thus, conformity to the community's rules relates on the modalities through which members are engaged in supervising each other (Ostrom principle 5: "Develop a system, carried out by community members, for monitoring members' behavior). Formal procedures to sanction are considered as remote option, in particular when supervision is performed not by external authorities, but by the members themselves [35]. Thus, the membership rules are mainly shaped through processes of socialization to the community life, via an active participation to the everyday activities (following principle 3, ensuring that those affected by the rules can participate in modifying the rules). Within this frame, the sharing of organizational values and mission among members play a crucial role in shaping a consistent internal governance, thus to pursue interests that are primarily collective and not related to personal fulfillment.

For the purposes of this report, it is worth to emphasize that each CN has peculiar and specific features, in terms of both founders and members' profiles, style of membership and leadership, constraints and opportunity in accessing resources, characteristics of the surrounding environment. In this sense, the level of material, symbolic and financial resources, the history of the community, the relationships with the local context and other concerned groups, as well as the distribution of member's reputation and prestige are elements in interplay in defining the internal coordination and governance. Therefore, any change in one of these variables requires the redefinition of internal governance processes and their related tools.

2.5. Internal governance of community organizations: an overview

Empirical research about the process of governance in community organizations still represents an emerging field of enquiry. According to O'Mahony and Ferraro [36], "relatively little is known about the process of organizing in communities" (p. 1079). In general terms, internal governance in community organizations concerns the process through which individuals with heterogeneous backgrounds and different personal biographies self-

coordinate their common actions to achieve significant outcomes, or to pursue specific social purposes. In this sense, within a community organization the internal governance concerns the ways of achieving the coordination and alignment of individuals with material and financial resources in order to develop a specific project. Considering some of the most relevant contributions developed within the field of organization studies [37] [38] [39], it would be possible to identify the following elements in which an effective internal governance is rooted: i) clearly define the mission of the community, as well as its articulation in accurate and discrete strategic goals; ii) clearly define membership rules to community life, also in terms of competencies and the learning process for new skills; iii) accurately identify how to acquire human, material, and financial resources, as well as how to manage them; iv) identify transparent measures for self-assessment of community activities. These elements, acting as general organizational principles, are required to be performed in practice through specific and multilevel management activities such as: supporting members' commitment within a common mission, articulated in shared specific goals; implementing shared mechanisms for coordinating and controlling members' activities; developing ways to encourage constructive conflict oriented to the sustainable development of the community, and discourage destructive conflict; mitigate the concentration and/or polarization of decision-making power. Starting from these synthetic considerations, in the next paragraphs we will detail some salient dimensions that need to be considered to support an effective internal governance in the context of community organizations.

2.5.1. Mission and goals

Community organizations are shaped to allow a wide range of social problems and public issues to be addressed by concerned groups of citizens and grassroots community activists. In this regard, a first central aspect for building an effective internal government concerns the elaboration of a specific and clearly articulated mission, usually in the form of a written charter of principles, that reflects the foundational values of the community. The process through which a community organization translates its mission into specific goals can vary considerably, depending on the leadership styles, forms of participation, power distribution, and surrounding environment. This process may follow a dynamic model of negotiations and bargaining both among the members of the community and with third parties that support the community. Moreover, both the specific goals and the general mission may be consistent and, to a certain extent, customised, with the characteristics and expectations of the participants. Shaping the mission and goals to encompass the expectations, values, and motivations of community members is crucial to enhance the likelihood that participants remain active and support the organization over time. This aspect seems to be extremely relevant to achieving a good degree of internal consensus, so as to facilitate the processes of coordination between the members [40]. In this sense, it is important that the objectives to be pursued, even if they change in order to meet the transformation occurring in the surrounding context, remain compatible with the main motivations that have driven individuals to participate actively in the community. Therefore, it is important to emphasize how the intensity of the memberships, the opportunity to feel active and integral members of the community, is closely linked to the process of building and formalizing a common vision concerning how to intervene in the public sphere to address a specific set of problems.

2.5.2. Community sustainability: resources and alliances

According to the conceptual framework developed by Christian Fuchs in the deliverable 2.1 about "The Multiple Aspects of Sustainability in Community Networks" the modalities through which community networks can be sustainable over time represent a crucial question regarding internal governance. This framework, by proposing jointly both elements of engagement and cooperation as drivers of economic and social sustainability, overcomes the traditional binarism between economic and social sustainability in which other approaches are rooted.

Taking into account this general framework, a key aspect in the internal governance relates to the determination

of the level of resources, both financial and material, necessary in order to implement community activities, and to foster its sustainability over time [41]. One of the primary sources of funding is represented by the same activists of the community, who can make financial contributions, or spend a portion of their free-time within community activities. Members can also influence policy makers, build partnerships to enhance the legitimacy of the community, and make available physical spaces for meetings and for other public initiatives. At the same time, community organizations can be supported by external stakeholders, private organizations, or public institutions interested in promoting their activities. The resources provided by external actors should be managed in coherence with the common vision, by means of horizontal negotiations among members in order to avoid organizational disagreements. In fact, the access to external sources of financing may create new constraints, or open new opportunities for organizational growth, thus pushing for change in the specific objectives, or the nature of the general mission. In this sense, the transparent management of resources, backed by written agreements or internal regulations, can hinder divisions and fragmentations among members, by supporting them to attain through collaboration the goals of the community.

On the level of sustainability, alliances with other organizations, as well as endorsement on the part of public institutions, are crucial for strengthening legitimacy. In this regard, some studies have suggested that strong links with other organizations active in the surrounding environment could provide greater opportunities for funding, assuring long-term community sustainability [42].

2.5.3. Coordinating members' action

The coordination of members' activities – in terms of division of tasks, actions to effectively promote the acquisition of new skills, implementation of internal communication tools – is a crucial concern for organizational communities, since their activists vary in their specific biographies, interests, motivations, competencies, and degree of involvement [19]. The coordination of the members depends on the complexity of the goals to be achieved, the level of the available resources, the fluidity of the internal communication process, and the specificities of the local context. In this regard, old-time members, as well as charismatic ones, can help newcomers to identify mutually valued tasks and to learn new skills. The development of effective coordination mechanisms for managing conflict requires negotiations and compromises. The definition of rules, by means of community licenses and collaboration agreements, can help to determine and delimit conflicting situations. The literature suggests that frequent face-to-face meetings, or the implementation of efficient online communication tools for internal communication, can be valid organisational arrangements to reduce misunderstandings, alleviate conflict and strengthen the consensus around controversial issues [41]. In this sense, the coordination of the collective action benefits from participatory decision-making models.

2.5.4. Accountability of community organizing

Accountability in community organizations circumscribes an ensemble of processes consecrated to justifying performance, the use of resources, the achievement of objectives, and the means of coordination of members' activities [43]. These processes, which may involve different procedures and accountability self-assessment tools, represent a central aspect of the long term sustainability of the community. In general terms, the activities of accountability must offer the members the possibility to know in depth the way in which the mission and objectives are pursued.

However, it is recognised that many activities of the community organization are not easy to assess, due to the difficulty in quantifying in a synthetic way the social impact of its achievements [44]. In fact, the community organization cannot be considered as a business-oriented institution. As a result, the measurement of its organizational efficiency, in terms of cost/benefits, does not produce suitable accountability parameters. In this regard, Sawhill and Williamson[44] suggested focusing accountability processes in three different areas, which are more pertinent with the constituent features of community organisations: i) impact, concerning the accountability of the mission success; ii) activity, concerning the accountability of the goals; iii) capacity, concerning

the degree to which the community mobilized the resources to achieve the objectives. The assessment of these three areas should be done in a participatory way, aimed at the production of open-text that can be discussed and amended by the members.

2.6. Assembling an effective internal governance

From this introductory review, it is possible to describe three main dimensions involved in the definition of an effective internal governance model for community organizations (see Fig. 2.1). The first one concerns the role played by the context of action, or the surrounding environment, which identifies the external stakeholders and institutions, along with the challenges addressed by the community. Each of the elements needs to be analysed and taken into account by those members governing and funding the community, thus to determine the most adequate governance tools, measures and actions for operating effectively.

Figure 2.1: Concepts related to the definition of an effective internal governance model for CNs.

A second central aspect concerns the members coordination, which should follow a horizontal and participatory model. The processes of coordination should actively involve the members, so as to ensure a consistent division of the tasks according to their skills and experience. In this regard, it can be crucial to have a team of members who works as a "knowledge brokers", so as to facilitate the interaction between old-time members and newcomers, or between members who have collaborated together few times. Finally, the third aspect concerns the definition of the mission, its declination in specific goals, and the capacity of the community to mobilize resources to accomplish them. In order to avoid internal conflicts, it is necessary that mission and objectives are perceived as relevant by the members of the community, along with a transparent management of the resources through a dedicated tool of accountability.

3. Governance in the making: analysis and identification of governance tools in CNs

According to the task 1.2 titled "Improving governance: maximizing the impact on CN", we have worked with several CNs to better understand their internal and external governance, and identify governance bottlenecks and needs that could be addressed with known governance tools. Some of these were already studied in Deliverable D1.2 [1] while some other are new. These are:

- guifi.net a community network that includes many local initiatives, as a kind of federation of local CNs, already described in Deliverable D1.2.
- The local guifi.net community in Barcelona (Expansió de la Xarxa Oberta (eXO) – Expansion of the Open Network) that exemplifies an urban community that manages a local network infrastructure in a sustainable way with the participation of volunteers and professionals, already described in Deliverable D1.2.
- FDN and tetaneutral.net, two of the most relevant French CNs which are also co-founder of the FDN Federation (already described in Deliverable D1.2), a federation of 28 non-Profit Internet Service Providers sharing common values, such as volunteer-based, solidarity-driven, democratic and non-profit working, defense and promotion of Net neutrality.
- ninux.org in Italy, already described in Deliverable D1.2.
- Wireless for Communities (W4C) in several rural areas in India, new to this report and a well known reference project.
- Rhizomatica and several community mobile networks in several rural areas in Mexico, new to this report and a well known reference project.

3.1. Shaping collaborative research: aims and methodology

With the aim to identify, analyse and strengthen governance tools operating in community networks, we developed a collaborative research involving the CNs mentioned above. According to the Report on Existing Community Networks and their Organization (Deliverable D1.2), which relies on Ostrom's framework [34] about commons, governance tools represent heterogeneous devices developed by CNs to keep the infrastructure and the community itself operational.

The research goals concerning the identification and analysis of governance tools operating in community networks have been reached by developing a qualitative research protocol [45]. As a result of the qualitative interviews, the social business model canvas [46] (see Sec. 3.4 of this report) has been used to better capture the specificities of the concerned CNs, thus summarizing and comparing their missions and environments.

Collaborative research outlines a specific methodological posture that allows professional researcher and community organizations' members to be actively engaged in the research process. In more details, this implies that researchers and community organizations cooperate in order to: i) identify and frame relevant concerns to be tackled; ii) undertake the investigation, also interpreting the findings in terms of salience for organizational change. This methodological approach allowed us to disclose and valorise the "indigenous perspectives" of the CNs' members who – through the stimuli offered by the interviewer – have been pushed to reflect on their experience as CNs activists.

As mentioned in the previous paragraph, CNs represent complex socio-technical aggregations oriented to solve local problems related to the need of a neutral network to be accessed freely. A pivotal principle of this collaborative research concerns the fact that community members are best situated to understand, identify, and cope with peculiar challenge when experiencing it. However, in complex community organizations, and more particularly in CNs, members may require external support or additional resources in order to develop strategies oriented to fine tune their internal organization and governance. In such cases, CNs take advantage from involving "outsider individuals" with special expertise on the governance of community organization.

In this report, the broader methodological framework is constituted by qualitative case studies. Within this frame, empirical data have been collected through seven qualitative interviews, informal talks with several CNs key members, and documentary analysis on public documents produced by the CNs, as well as on the communications developed through the mailing list of the communities, in order to understand how internal governance, and some specific governance tools (such as internal information systems, decision making platforms, communication tools, internal agreement and policies) are used and performed in practice. In doing so, we also explored in depth the governance bottlenecks, in order to provide recommendations and good practices oriented to sustain CNs' management, resilience, and sustainability.

Under the aegis of this framework, and on the basis of a preliminary documentary analysis, qualitative interviews were conducted with several key members of the CNs mentioned above in order to gather relevant information about internal governance processes. This methodology was not merely aimed at collecting data, but it had a proactive attitude that stimulated the reflection of respondents on their experience (see the interview guide in the appendix section). In particular, our collaborative research was characterized by the following elements:

- Interactions, in the form of interviews, between researchers and community members oriented to critically scrutinize problems, as well as virtuous practices, related to the daily management and internal governance of the community. In this sense, the priorities, viewpoints, and perceptions of the CNs' members are paramount throughout, rather than pre-conceptions of the researchers arising from the literature;
- Focus on the everyday life of the communities: this collaborative research implies a special attention on practical issues and problems related to the internal governance. In particular, the researcher encouraged the interviewee to reflect on: i) individual trajectory of participation in the CN; ii) organizational culture, internal governance and "everyday life" in CN; iii) perspectives on the future of the CN. In this way, knowledge about internal governance - shaped by the interviewee in cooperation with the researcher - can be practically applicable by the community;
- Interaction framed within a common attitude oriented to achieve change, or develop innovative strategies to face specific problems and concerns about internal governance. Although there can be many challenges for both CNs' members and researchers when they attempt to work together, during discursive interactions we tried to develop a common understanding of the problems' causes, thus drafting solutions to face them.

Overall, we tested a typology of collaborative research in order to generate a shared knowledge able to face specific issues of internal governance peculiar to each CN. During this process, information and knowledge generated by researchers, as well as the testimonies provided CNs members have been considered at the same level. Notably, this typology of participatory research is underpinned by values that stress epistemic equality between CNs' members and external researchers. This approach ensures that the concerned CNs obtain potential benefits from the discursive interaction with the professional researchers without sacrificing the strength and skills inherent in the do-it-yourself and self-organizing principles operating in everyday community life. This collaborative research privileged the peculiar internal governance agenda of the concerned community networks taking at the same time a proactive and reflexive approach to organisational change. In this way, collaborative research allows CNs' members to identify and meditate on their own views and on the challenges they must cope with. Reflexivity helps them to shape self responses which are inherently considered suitable to their own needs and circumstances; hence CNs are invited to take control of their own issues about inter-

nal governance. Rather than responding to a specific research question which is merely relevant for academic scholars, collaborative research entails the production of benefits for the community and its members.

3.2. Qualitative Case Studies

With the aim to perform this collaborative research we selected several different CNs localized in different national contexts, accordingly to their degree of development, and also to the possibility to easily negotiate a series of qualitative interviews. This methodological technique was based on a discursive interaction between researchers and CNs' members. Firstly, we made available the interview guide to all members of the netCommons project in order to get useful feedbacks and comments. The interviews were arranged in advance (and not spontaneously), thanks to the pre-existing link between some members of the netCommons project and some actors of the selected CNs. We conducted interviews with a pre-edited set of questions to be covered during the conversation. While the interviewer followed the prepared questions trying to cover all topics, she/he was also ready and able to stray from the path when she/he felt it was necessary and appropriate to explore more in depth an emergent issue on internal governance. Almost all the interviews were recorded. In a second phase, a focused transcription of the interviews was conducted, accordingly to the purposes of this deliverable. Informed consent has been asked to all interviewees, also providing them information about the research and on the following data anonymization process. The relevant consent form templates have been included in Appendix A and the interview guidelines in Appendix B. In all cases, personal data of the interviewees (telephone number, email and similar) have been kept private and have been used only by researcher to communicate with them. In the next sections we provide the description of each case, paying a special attention to the process of internal governance and its concerned tools.

3.3. Different networks, different models

Different CNs find ways to adapt to local conditions. They have many commonalities but also some differences in terms of economic, social, cultural motivation to develop participatory networking infrastructures to the benefit of the community (connectivity: local and Internet), derived services (web, voice, content, sensing, even electricity, computing, storage).

The model of the CN is based on the concept that the physical and active equipment are used as a Common Pool Resource (CPR). Its participants must accept the rules to join the network and must contribute the required infrastructure to do it (routers, links, and servers in terms of physical infrastructure), while keeping the ownership of hardware they have contributed and the right to withdraw. As a result, the infrastructure is shared and managed collectively, as a commons. Equally, skills are pooled to ensure good communication and governance, corresponding to the social and knowledge infrastructure necessary to develop and maintain the physical infrastructure.

The infrastructure commons is a crowdsourced investment among the participants that cooperate to invest, volunteer and trade to fulfill their mission, which is nurturing and preserving the commons. For this to happen volunteers, professionals, and other organizations should obtain benefits from contribution to the commons resource (infrastructure) and consumption of extractable resource (connectivity). Furthermore, they are expected to reinvest the majority of their surplus in the sustainability and resilience of the commons.

There are different ways in which CN organize themselves in achieving these goals. We focus on CN that are open for participation and oriented to serve the whole community (people, area) clearly beyond the initial core group. Therefore, technology is an enabler and has an influence, but the defining traits of a CN come from its **outside view** –what it does and with whom, the network infrastructure commons– and its **inside view** –how it does it, its governance. For the outside view, we are inspired by the social business model canvas [46] to summarize the mission and environment of CNs and be able to compare. For the inside view we are looking at an evolution of the organizational framework from Deliverable D1.2 [1].

3.4. The outside view

Network infrastructure commons can be supported by a formal or an informal organization, and its definition may vary according to its maturity level. A business model clearly articulates *"The rationale of how an organization creates, delivers and captures value"* [47]. This allows to understand how CNs organize to generate and distributed socio-economic value in a sustainable, adaptable, resilient, participatory way.

Social enterprises can be seen as formal or informal organizations that focus on creating value with social impact while maintaining sustainable operation. They are often started by people who are passionate about local solutions to local problems. CNs focus in connectivity. This leads to develop a Common-Pool Resource (CPR) networking infrastructure commons that can satisfy the local needs in a local way. The local socio-economic impact is the main motivation, typically provide abundant local and global connectivity that directly meets a social need or achieves a social impact, but also support, train or employ people that are experiencing some form of disadvantage or exclusion due to limited or no connectivity, or generate resources for social purposes (for example, excess electricity from solar panels powering network nodes, in developing areas, or infrastructures for inexpensive Internet of Things (IoT) sensing in developed areas)

A business model helps to design, understand and articulate how an organization or a business works or could work, how it creates, delivers and captures value, how it generates social value (production of connectivity) and how it generates financial value (investment and expenditure to achieve financial sustainability) and how we can innovate or adapt to local conditions. For a commons, "business" can be understood as the activity that results in the provision of connectivity obtained from a commons network infrastructure to its participants, and alternatively it can be called "sustainability model".

The business or sustainability model for a commons, should be able to be articulated in one page, and its substance focuses on how the community contributes to develop and maintain the core resource (the network infrastructure), how that infrastructure generates value and revenue from the consumption of the extractable resource (connectivity). It can help to understand why and how the commons works, and help redesign, innovate or optimize its operation and governance.

3.4.1. Community Networks depicted in a canvas

Community Networks develop and manage a commons (like traditional communal grasslands or irrigation systems), and they produce an extractable resource thanks to the commons, which is connectivity (regional or global). Participants develop and manage the network infrastructure commons to achieve social objectives, but when considering sustainability, business objectives or just sustainability objectives have to be considered to preserve the commons. This may be different depending on the stakeholders considered: volunteers may be motivated by interest or social impact, but professionals may also be motivated by economic return (money) and connectivity users (customers), may also be motivated not only by the benefits from connectivity but also by cost (money, in absolute terms or relative to the cost-benefit balance of alternatives).

Therefore the outside view shows how a commons is structured to achieve or maximize its social impact in the socio-economic local environment, the direct and indirect benefits brought by the production and consumption of connectivity (what we typically call business impact) by leveraging the commons, while preserving and nurturing it.

Typically the timeline for new community developments goes from an analysis of the needs (requirements), to the organizational design, and its implementation of the operational structures to ensure the impacts while preserving the commons for the future. Existing communities need to adapt as they learn from their experience, or as they adapt to environmental changes or challenges.

For that reason, the Canvas model takes into account the dimensions of a) usage, commerce (exchanges), compensations which can be accounted in economic terms, and b) the social impact, which can be accounted in quantitative or qualitative metrics, and c) the nurturing and preservation of infrastructure. Furthermore

the canvas can also show to what measure the CN and each of the key roles can be all feasible, fruitful and sustainable.

The main sections of a canvas model are the following:

Key partnerships: The network of surrounding organizations (suppliers, authorities, partners, supporters) that enable and make the commons work.

Key activities: The most important things that need to be done to make the commons work and deliver value. Can be:

- *Complementary:* expanding or operating the network brings more participants, and contributes to the sustainability of the commons.
- *Opposing:* Participation and coordination with others in the commons infrastructure can be based on cooperation or competition,

Questions to ask about activities:

- What are the key activities to undertake that deliver economic or social value to our participants/customers?
- What are the key activities to deliver our impact value proposition?
- What oppositional activities are there? How we can address these so that they are more balanced?

Key Resources: The assets, tangible and intangible, that make your business model work. What drives your economic or social model, and what drives your impacts: The infrastructure commons is a resource aggregate (subject to contribution and consumption).

Value propositions: The products and services that create value for specific participant segments – what keeps participants returning to your "enterprise".

Customer/participants relationships: The types of relationships a commons establishes with specific customer/participant segments.

Channels: How an CN communicates with and reaches its customer/participant segments to deliver its value proposition.

Customer Segments: The different groups of people or organizations an enterprise aims to reach and serve (and become participants, with full rights, not mere consumers).

Cost structure: The costs of the services, the cost in delivering an impact, the costs in contributing to the infrastructure commons, and its compensation to reach a balance.

Social and environmental cost: (optional) externalities not included in the cost structure. In the following canvases these are included in the Cost section.

Revenue streams: What enables to operate (exchanges, consumption, services) and generate the impact.

Social and environmental benefits: (optional) externalities not included in the revenue streams. In the following canvases these are included in the Revenue section.

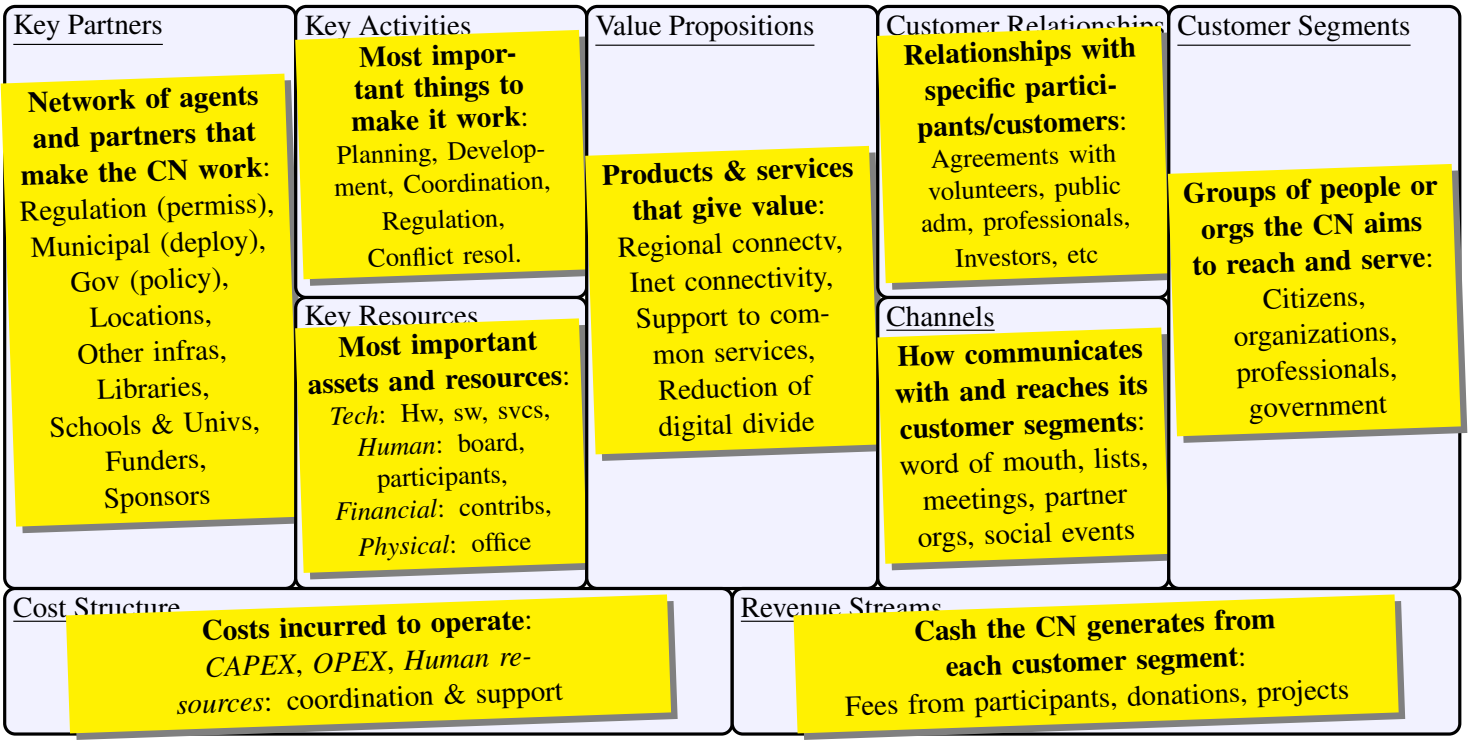


Figure 3.1: A template for the canvas of the outside view of a community network

3.5. The inside view

In contrast to the outside view, that shows an overview of how a CN interacts with its environment as, metaphorically, a living organism in a given locality, the inside view provides an anatomy, the structure of body parts, and physiology, the functions and relationships of these body parts.

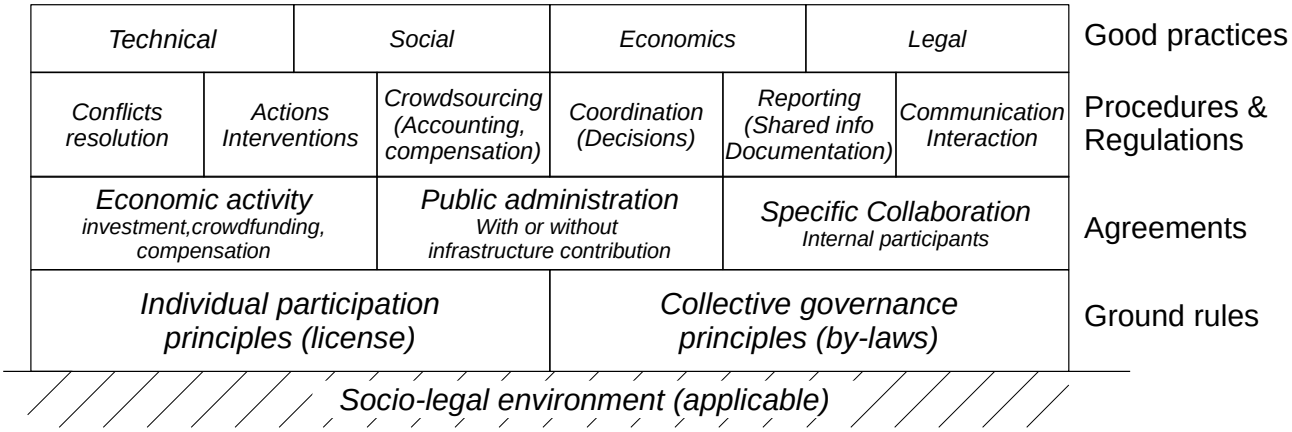


Figure 3.2: The inside view: a generic organizational block model generalized from the guifi.net model.

Community Networks exist in a given **socio-legal environment**. This is defined by a large set of practices and rules that apply in that given locality, that can facilitate or restrict the aim of the specific CN. Local choices will be required to build over that environment. The most relevant in our case are the regulations and legislation regarding network infrastructures, spectrum, telecom operators, telecom services, legal entities. Whatever done in a given locality has to be shaped by these applicable environmental conditions.

A CN has to define its **ground rules**. Either formal or informal, there are two elements that define the commit-

ments, rights and obligations, and therefore the limits, that shape up participation in the community:

- The *individual participation principles*, typically expressed in an concise individual participation license, that defines how a participant relates to the community and the commons, the participation principles that usually come from a few shared values. These principles (or license) has to be formally or informally accepted and assumed by all participants to be able to be part of a collective organization and avoid the CN is just a chaotic combination of individuals (a crowdsourced network).
- The *collective governance principles*, typically expressed by the by-laws of the community, define the general principles and rules established by the community to regulate itself, governing its internal affairs. This can be more or less unstructured depending on the needs and characteristics of the participants and the environment.

In some cases, the ground rules may suffice, while in some others, additional or specific **agreements** may be required. From the experience of guifi.net this is typically required by certain types of participants like schools, universities, companies, public administrations, professionals. We have identified three main categories:

- *Specific collaboration:* (for participants that have already accepted the individual participation principles): For instance a university (e.g. UPC) has signed an agreement between the guifi.net Foundation and UPC to regulate the collaboration in the areas of research and experimentation, student involvement, collaboration in funded projects, and expansion of guifi.net in the UPC campuses and the interconnection between the guifi.net network and the UPC network.
- *Public administration:* Public or governmental organizations have special attributions and resources that may require a clear and public agreement, beyond the default ground rules, to define the specific aspects of the relationship. This is the case when a public administration takes a neutral or a promotional position to allow or facilitate the deployment of a commons network in its domain of regulation and regulate the usage of public space or spectrum. This is also the case when a public administration contributes a public infrastructure to the infrastructure commons.
- *Economic activity:* Any type of economic activity requires also an agreement beyond the default ground rules. Examples of that are investment in fiat money (such as community shares for individuals, or community loans taken by the collective), or funding part of the infrastructure (e.g. contribution of nodes and links to the commons), or economic compensation in collective economic models with multiple contributors and consumers of constitutional or extractable resources.

The set of ground rules and agreements define a framework where specific **procedures and regulations** can be established. Again these can be more or less formal or rigid as needed. We have identified six main categories:

- *Communication and interaction*: procedures about how participants communicate and interact (e.g. structured or unstructured, synchronously or asynchronously, face-to-face or remotely, regularly or not, exploratory, issue driven, outcome oriented).
- *Reporting*: procedures about what information and how to share it (this is mainly related to transparency and manageability, such as a common monitoring system, a network state or status repository, a repository of related data), and what documentation and how to produce it (knowledge expressed in structured or unstructured documents, instructions, recommendations).
- *Coordination*: procedures for decision making to make different types of choices.
- *Crowdsourcing*: procedures to perform accounting and compensation of contributions in terms of human, material or economic resources.
- Actions, interventions: procedures to act, such as installations, repairs, maintenance.
- *Conflict resolution*: procedures to handle and resolve conflicts, including the outcomes (eventual sanctions).

On top of the procedures and regulations we find the practice, the daily life of the organization, that combine and implement the different procedures and regulations, according to the conditions defined by the agreements, ground rules and the socio-legal environment. From that practice we can identify good practices that represent

learning outcomes of an organization, and therefore should be encouraged to be repeated given the good experience. Obviously good practices define, by exclusion, "bad practices" that are worth to avoid repeating. These good practices can be very specific, dependent on specific details to the internal or external organizational models (local ways), or can be generalizable or adaptable to other environments (generic or adaptable patterns). We have identified four main categories:

- Legal: effective ways a CN found to relate to legislation and regulation: the relation can either be as adaptation to the environment or as influence to transform it to accommodate CNs.
- Economics: effective ways a CN found to manage economic aspects in areas such as funding for CAPEX, OPEX, services, community development, local reinvestment, scaling up economic development, cost sharing, etc.
- Social: effective ways to maximize social impact.
- Technical: effective ways to develop, adapt or apply technology in specific scenarios.

Examples of the above generic building blocks appear in the descriptions of each CN in the following sections of this chapter, and in the next Chapter 4 that lists a set of patterns and anti-patterns common in many CNs.

3.6. The intersection between the outside and inside views

The two diagrams are complementary. In fact, while the outside view describes the "business" model of the community, the inside view describes the organization of the community. These are two facets of the same collective. The agreements of the inside view (license, by-laws and specific agreements) provide a frame that stipulates the limits, rights and obligations on several categories of the outside view. The procedures in the inside view regulate and prescribe how certain tasks have been agreed to be done in the outside view. The good practices of the inside view describe reference examples of technical, social, economic and legal practices. Fig. 3.3 presents an outline of the intersections between the two views.

Understanding the organizational models of CN from these perspectives can have multiple benefits:

- It can provide a representation to help us to understand and reason about the strengths, weaknesses, opportunities and threats of our organization.
- It can help us to design, test and develop pilots or prototypes to test our ideas.
- It can help us to design, redesign, articulate the mechanisms of our community by comparison to details or structures from other initiatives.

Over the world there are experiences of CN that collapsed due to tension, conflict, abuse, ineffectiveness in delivering value to the community. It is sad to see CN close down or fail – not only the infrastructure CPR is lost, but the social impact disappears and the community spirit is eroded or destroyed. Understanding organizational models and their potential to design the internal coordination of a CN could help to highlight and therefore avoid some of the pitfalls and increase the likelihood that more CN become viable and sustainable in financial terms, in the social impact of their services, and in the direct and indirect socio-economic development that it creates (such as social participation, interaction, jobs, low cost connectivity, better infrastructures, local investment). In that direction, the rest of this chapter collects useful information about each CN interviewed that represents how it is situated and interacts with its environment, how it is organized internally, and what areas for further development are foreseen.

External \ Internal	License	By-laws	Agreements	Procedures	Technical	Social	Economic	Legal
Key Partners	Adopt	External Stakeholders	For specific effect	Regulation	weak	strong	weak	strong
Key Activities	Delimit	Aims, Limits	Influence, Determine	Prescription	weak		weak	weak
Resources				Prescription	strong		weak	strong
Value Proposition	*Influence*			Prescription	strong	strong	weak	weak
Relationships	Framing	Framing		Communication, documentation, intervention, conflicts			weak	
Channels				Coordination, Communication, Documentation		weak		
Customer Segments	Reference	By stakeholders if involved	Framing, if match	Prescription		strong	weak	
Costs			Framing,if match	Economic	weak		strong	strong
Revenue			Framing, if match	Economic	weak	weak	strong	strong
	Framing (limits, rights, obligations)			*Prescription of how-to do*	*Describe practices*			

Figure 3.3: The intersection between the inside and outside views

3.7. guifi.net (ES)

Guifi.net is managed as a commons, or more precisely as a *common-pool resource* (CPR) [34], being a network infrastructure core resource. Holding the infrastructure as a commons has some immediate positive effects, such as the avoidance of the multiplicity of infrastructure because all participants operate on the same infrastructure and the increase of efficiency of the infrastructure in terms of cost savings and ease of participation. The CPR (i.e., the guifi.net infrastructure) grows by each new network segment that the participants deploy to expand the network or to improve it, and the reward for the contributors is the network connectivity that participants acquire[48].

For commercial services, guifi.net as a CPR translates into a reduced entry barrier for starting business ventures since the network infrastructure is available for usage to everyone in the community, both individual and professional users. Participants can benefit from pooling with lower individual investments since resources are shared. The knowledge about the network is open, and the network is neutral; no barriers artificially limit the scope of contributions, such as expansion, content, or service creations.

We interviewed three members of the guifi.net Foundation. What follows represents the outside and inside view of the collective, the conglomerate of local guifi.net communities, from a perspective of the overall umbrella organization.

3.7.1. The outside view

The overall outside view of guifi.net considering what is common for most if not all local guifi.net communities is as follows, based on interviews with several key participants, and outlined in Fig. 3.4.

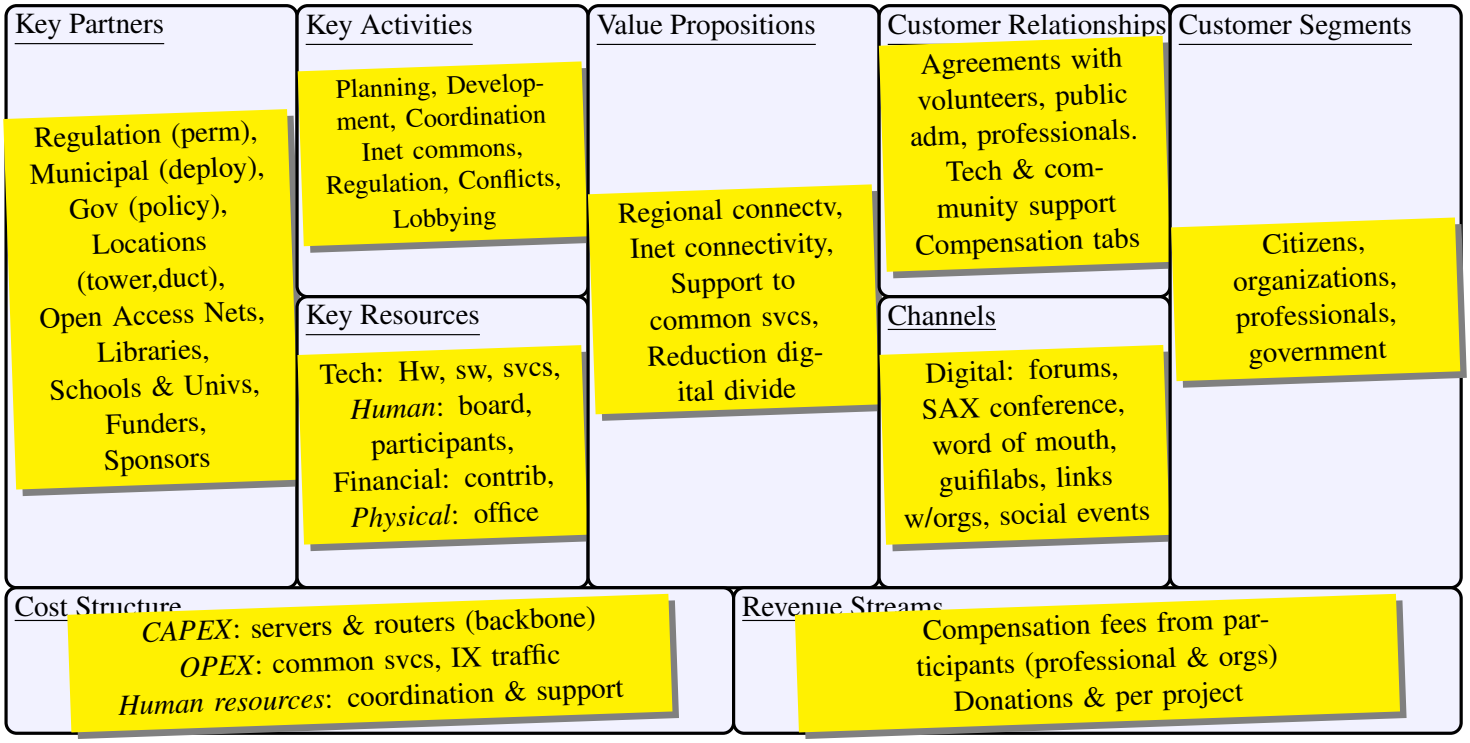


Figure 3.4: The canvas outline of the guifi.net (Foundation) outside view

The details about the outside view of the guifi.net umbrella organization outlined in Fig. 3.4 are described as follows. Sec. 3.8 describes the organizational structure of the eXO community (Metropolitan area of Barcelona), one of the specific local communities involved in guifi.net.

The key **partners** are external entities with key roles as the guifi.net Foundation acts as a default or collective interface to the external environment. These are the *regulatory bodies* for handling with the permissions, and present or future (policy work) on policy and regulation issues the community needs to perform its activity; the *municipalities* and *regional authorities* as they can regulate deployment in their role of managing the public space; the country *government* as it defines policies and regulations, including the authority for the regulation of (market) competition; the owners of *towers*, that can be in public or private locations, and can be managed by public or private organizations; the public and private owners of *fibre* ducts, dark fibre or active fibre (open access networks or traditional telecom providers); other external interested organizations such as libraries that are interested in promoting public access; diverse funders, sponsors and partner organizations willing to contribute to the aim of guifi.net (such as Internet Society (ISOC), European Commission, Institute of Electric and Electronic Engineers (IEEE), International Telecommunications Union (ITU), Association for Progressive Communications (APC)).

The key **activities** are the high level planning, and coordination of the deployment and operation of the network infrastructure, with a umbrella or default role that typically is delegated to and handled by local groups; the management and institutional support to help overcome obstacles and resolve conflicts before they damage local communities or the overall meta-community.

The key **resources** in the community are the hardware elements (typically routers, links and servers) that can be overseen but not owned by the Foundation, except the core routers in a few key locations that are directly owned and managed by the Foundation (in the regional backbone and the Internet carrier house, including the contracts with the Internet carriers); the supervision of the development of the key guifi.net software, such as the web site, the node database, the network monitoring system (other components managed by community members); the common information in maps or user databases; the coordination of key network installations, the coordination of the network maintenance, and support for network planning, particularly the backbone regional network and the Internet connectivity in commons, done in the details by each local community.

The main **value proposition** for the overall community is the coordination and supervision of "product" offerings directly to community participants and indirectly through professional service providers. The foundation has also a role in ensuring the sustainability of the overall infrastructure, promoting good practices to ensure each local group can have the resources to maintain, improve or even expand its guifi.net infrastructure. The Foundation oversees the main product that is connectivity, either regional or to the Internet (managed as two separate but interrelated commons. It also provides support for the development (but not the provision) of any other common services of interest for the community (for instance collecting offers for telephony, TV or other content). Finally it provides a very valuable service in promoting the reduction of the digital divide in different forums, and internationally, as a long-term value to the meta-community. All this is done in contact with the key partners identified previously.

The **member and customer segments** are the normal citizens, with more success among the technology savvy population, diverse public and private organizations that want to "buy" (join) the value proposition, and also with professionals that want to participate in the guifi.net commons, providing and consuming services and performing economic activity.

The **member and customer relationships** are managed by the Foundation at scale, and therefore following formal procedures supported by formal agreements with volunteers (generic like the NCL license or specific), the public administration, professionals. The Foundation also provides a last-resort technical and community support to its members, and uses the compensation tables as a mechanisms for economic interaction.

The main **channels** are digital such as diverse email forums (email or web based); the SAX yearly conference or assembly; word of mouth in different social media; eventual participation in guifilab meetings to present or discuss some topics of general interest; links with local and international organisations; diverse social events of general interests to the overall guifi.net community.

The **cost structure** is defined by the *CAPEX*: servers & routers in the backbone and the carrier house in Barcelona, and the *OPEX*, with the management and maintenance of common services (such as the common

web, monitoring, databases), the management and maintenance of the Internet eXchange traffic, and the *Human resources*, the Foundation employees that handle the coordination and support of the community, the international relations and the research and development projects the Foundation is involved, like the NetCommons project. The **social and environmental cost** includes deployed cables, and power consumption but this is not yet clearly accounted.

The **revenue & contribution streams** come to the Foundation as compensation fees from the compensation tables where participants (professional or not with a significant investment and consumption), donations, that have very significant tax incentives, and per specific projects. There are also non-economic contributions (in kind) that the Foundation is accounting. The **social and environmental benefits** come from having more people connected; lower cost and widespread connectivity; CO_2 savings due to less travel and more efficient meetings; and the side effect in some cases of excess electric power generation from solar panels.

3.7.2. The inside view

Community networks, as any other CPR, are fragile. More precisely, being non-excludable, they are congestion prone because connectivity is subtractable and therefore subject to exhaustion. This has been a driving principle to a scalable and effective community network. The internal organizational design has developed an organizational architecture and structures for an efficient and effective governance. The aim is to protect the core resource from depletion [34] and the community from collapse as the network grows and diversifies. Figure 3.5 presents the architecture of the body of normative instruments developed by the guifi.net community. The instruments were already presented in detail in deliverable 1.2. This is a classification and summary represented as a diagram.

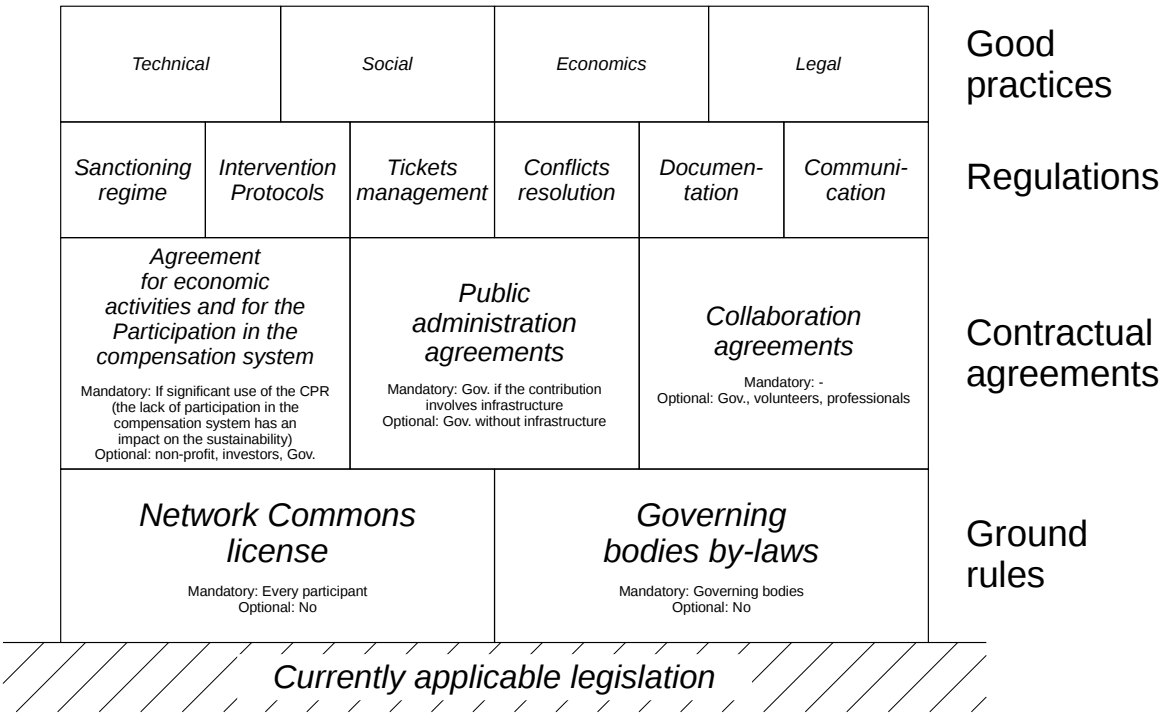


Figure 3.5: Body of normative instruments.

The main categories, following the generic architectural principles in Sec. 3.5, are the following:

- **Good practices:** technical, social, economic, legal practices.
- **Regulations:** for handling sanctions (as a result of conflicts and violation of boundaries, that can result in exclusion, economic sanctions, among other); follow-up of interventions (such as planning, deploy-

ments, maintenance); tickets (to handle formally reported issues or complaints predictably and timely); conflict resolution (to handle conflicts in an efficient and effective way); documentation (to collect more structured data about the network structure, traffic, activity and incidents, and less structured data in the form of documentation); communication (tools to help remote communication and coordination).

- **Contractual agreements:** development of templates, negotiation of the drafting and signature of: agreements with diverse local commercial or social organizations willing to participate in the commons as providers or consumers, compensation table agreements, agreements with public administrations, collaboration agreements with universities and international organizations.
- **Ground rules:** development, coordination, approval and support to the enforcement of the network commons license, and the bylaws of the governing body.
- **Legislation:** the last resort role of the guifi.net Foundation for the guifi.net community as registered telecom provider, as electronic communication service provider, the management of rights of pass, and the effect of the European cost reduction directive.

Many of these elements are reported elsewhere in detail, particularly in [1] and some of these summarized as pattern or anti-patterns in Chapter 4.

3.7.3. Organizational developments

One area to explore in guifi.net for further organizational development is community investment: mainly *community shares*, but also *community loans*, and the expansion and generalization of *economic compensation* as a mechanism to ensure the sustainability of the infrastructure commons. This relates to the corresponding organizational patters identified in Chapter 4.

3.8. The EXO Association in Barcelona

The Association for the Expansion of Open Network (eXO) corresponds to a large part of the local guifi.net community in Barcelona that has created its own organizational ecosystem adapted to the local people and conditions in the metropolitan area of Barcelona. It is part of and coordinated by the guifi.net Foundation as its umbrella organization. It exemplifies how a local community can organize, specialize and localize the guifi.net principles to manage a local network infrastructure with specific characteristics, in a large urban area, in a sustainable way with the participation and economic contributions of volunteers and professionals. The eXO association was described in detail in Section 3.3 of deliverable 1.2 [1]. We interviewed four members of the eXO association: one organizational member, and three individual members.

3.8.1. The outside view

The overall outside view of the eXO association is as follows, based on interviews with several key participants, is outlined in Fig. 3.6 and described in more detail as follows.

Key partners:

- The key partners are existing local community organizations that can support the association, mainly the guifi.net Foundation, the city council of the municipalities in the metropolitan area (Ajuntament), the regional governments (Diputació, Generalitat), universities (UPC, UPF, UOC, UB).

Key activities:

- Construction of a local network commons fully operated and managed by the community with the advice of key organizations, through a cooperative association to which the Communities belong.
- Internet access through tunneling of carrier Internet capacity shared through cost compensation with the guifi.net Foundation.

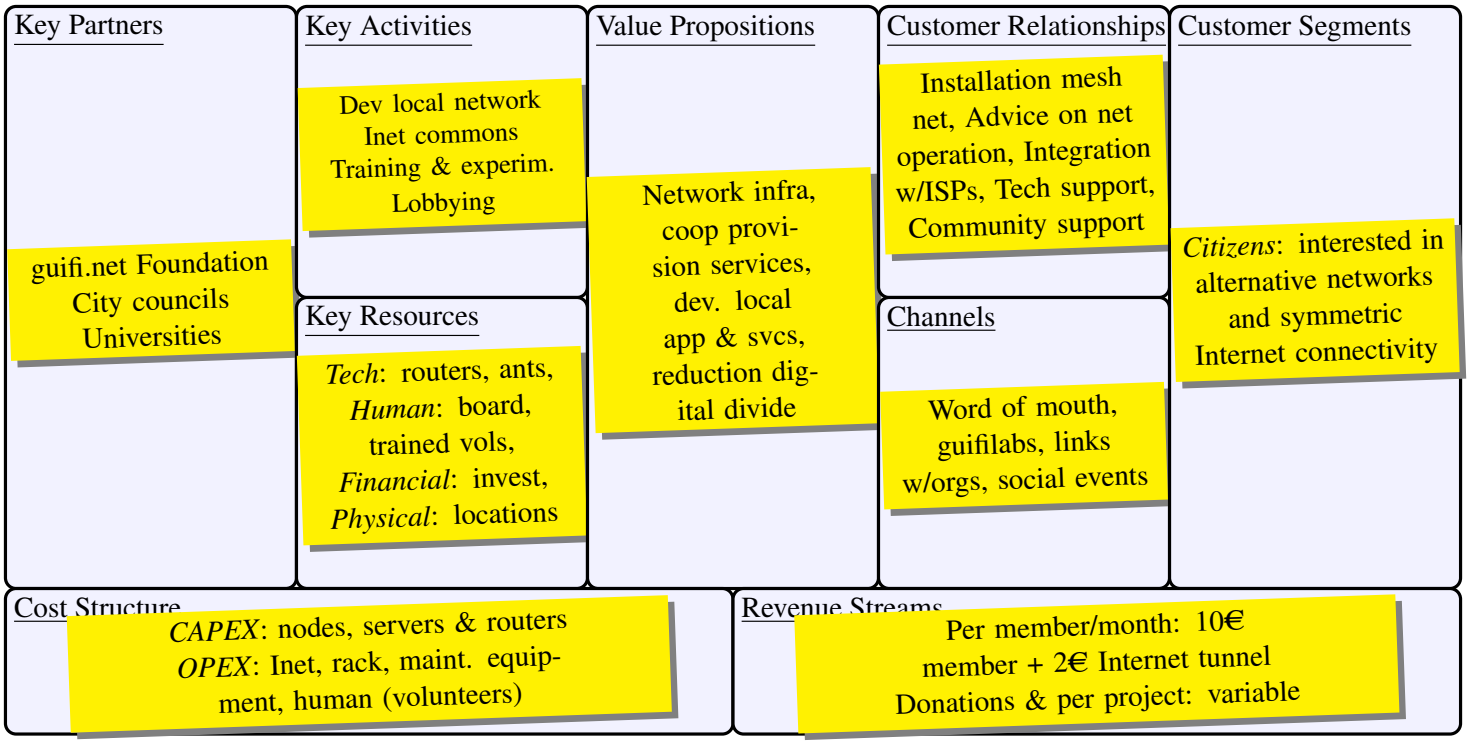


Figure 3.6: The canvas outline of the eXO outside view

- Training and experimentation about community networking technology.
- Self-provision of services of interest for the community of members.
- Research and development of technological, legal and economic innovation to improve the operation of the project.
- Lobbying for political and legislative influence to ensure that legal and institutional frameworks allow and facilitate the operation of community networks.

Key Resources:

Technical Resources:

- Community mesh equipment and antennas
- Open Source Software
- Internet connectivity through tunneling and optical or wireless access to carrier house (Zona Franca)

Human resources:

- Executive board (volunteers)
- Trained staff in the community

Financial resources:

- Capital investment of the association (through membership quotas)
- Investment to deploy the network in each community
- Operational and maintenance costs

Physical resources:

- Office eXO (in a civic centre)
- Equipment eXO (routers in carrier house, servers)

Value proposition:

- Provide a mechanism for citizens to manage and operate their own local community network, and shared symmetric Internet access.
- Cooperative provision of network and Internet services ensuring that profits remain in an association to which they belong and invest in operation, expansion, innovation and training.
- Enabling the development of local telecommunication applications to serve the real needs of each community.
- Reduction of the digital divide, by training citizens, working with underserved and excluded groups, work in marginalized neighborhoods, with the corresponding beneficial impacts.

Community and Customer relations:

- Installation of mesh nodes in several Barcelona neighborhoods following a commons model.
- Advice on the operation and maintenance of networks.
- Integration of the network with Internet service providers.
- Technical support to membership/subscribers.
- Strengthening of community autonomy to reach their development objectives through the use of the local guifi.net mesh network.

Channels:

- Advertising by word of mouth.
- guifi-lab meetings in several locations in Barcelona.
- Linkage with communities, civil associations and NGOs.
- Participation in social events in city and neighborhood fairs, and media coverage.

Community and Customer Segments:

- Citizens in general, particularly those interested in alternative networks and guifi.net.

Cost structure:

Capital Expenses (CAPEX):

- Initial investment of EUR 80-300 for the purchase of equipment per node (about 65 nodes).
- Installation of equipment EUR 0-300 (per node).

Operational Expenses (OPEX) per month:

- Internet access in guifi carrier house and Internet eXchange: EUR 150.
- Rack space in guifi carrier house: EUR 50.
- Depreciation and maintenance of equipment.
- Human resources (Installer, technical support, community management, administrative assistant) – volunteer contribution (value: unknown) .

Sources of income and contributions:

Revenue per member:

- 10 EUR per month per member of the association.
- 2 EUR per month per Internet tunnel.
- Donations and per project funding (e.g. training courses).

3.8.2. The inside view

The following shows the specifics of eXO with respect to the architecture of the body of normative instruments developed by the guifi.net community. The post-it notes in Fig. 3.7 represent the specific aspects.

- **Good technical practices:** Mesh routing organized by neighborhoods. Internet tunnels to provide symmetric Internet connectivity to members. Instant messaging application for quick and immediate interaction. Network monitoring web sites to see connectivity in a map or in a circular graph.
- **Good social practices:** GuifiLabs at different neighborhoods every Thursday, a different one every week of the month. Volunteers assisting new members in planning and setting up new nodes. Training events for capacity building. Work with other city organizations in setting up neighborhood plans.
- **Good economics practices:** Limited Internet access contributed by eXO to help people with economic difficulties. Affordable symmetric Internet access (10+2 € per month) for members.
- **Good legal practices:** Support building and housing associations in obtaining shared common connectivity for the building (instead of per apartment).
- **Regulations in communication and documentation:** development of own communication channels (instant and lists, document repository).
- **Contractual agreements:** economic activity, participation in the Barcelona compensation table pilot (declarations).
- **Contractual agreements:** public administrations, participation in neighborhood development plans ("plans de barris").
- **Contractual agreements:** with public administrations, agreement with universities (UPC, UOC, UPF) for collaborative research and experimentation.
- **Contractual agreements:** collaboration with professionals (affiliated to guifi.net).
- **Ground rules:** governing bodies; establishment and governance of the eXO association (complementary to the umbrella guifi.net Foundation).

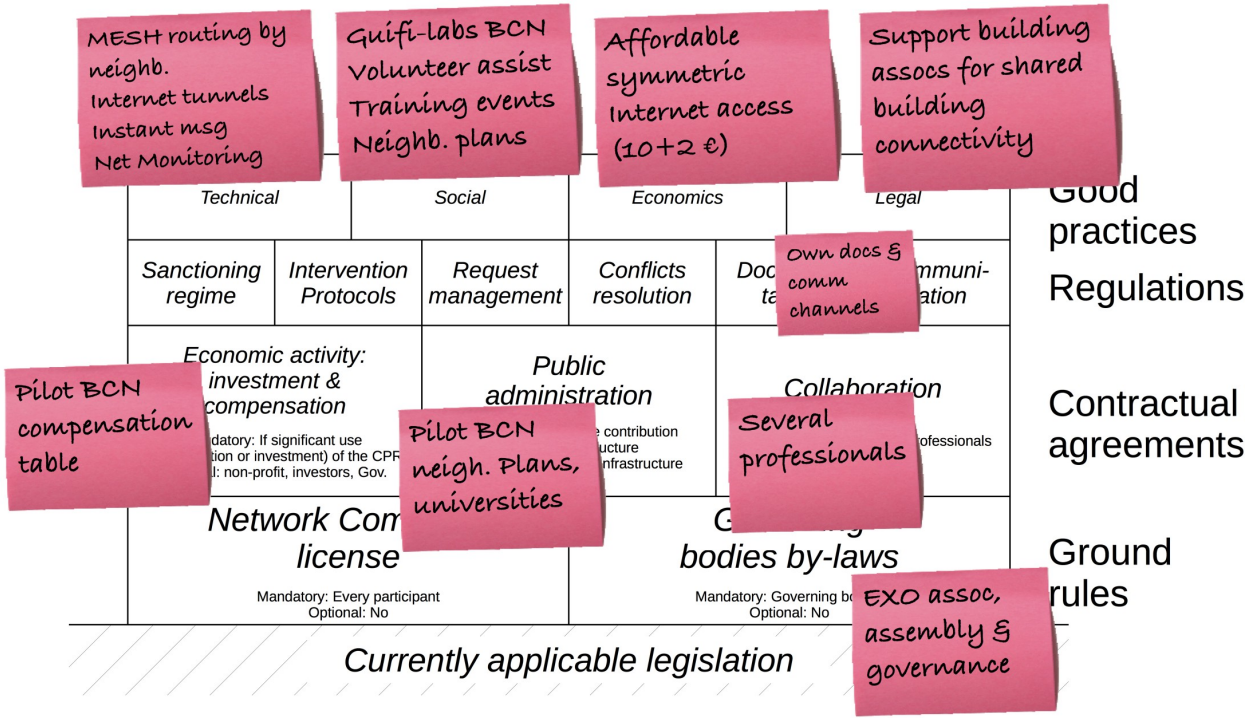


Figure 3.7: The inside view of eXO with respect to the common guifi.net model.

3.8.3. Organizational developments

One area to explore in eXO.cat for further organizational development is the bootstrapping of the compensation system, and the development of a crowdfunding model to fund occasional larger investments in specific projects, like inter-connecting neighborhoods, additional services, pilots, software development. This relates to the corresponding organizational patterns identified in Chapter 4.

3.9. Wireless for Communities (IN)

The W4C Programme is about connecting the remotest communities of India through unlicensed wireless spectrum. In India, even with mobile penetration, the tele-density in rural areas is still less than 40 percent, and Internet connectivity is a far cry. The reason has mostly been the issues around last mile connectivity. On the other hand, last mile wireless connectivity has the potential to offer a solution for the prohibitive costs of deploying conventional wired infrastructure in the remotest areas of the country.

With an objective to address the issues of Internet accessibility and connect remote and under-served regions of the country, in late 2010, Digital Empowerment Foundation (DEF) and Internet Society (ISOC) initiated a joint called "Wireless for Communities" (W4C) which utilizes low-cost Wi-Fi based equipment and unlicensed spectrum (free spectrum) to connect and empower rural and under-served communities. The motivation behind ideating the project is twofold – firstly to democratize the availability of connectivity and enable Internet accessibility to information in rural parts of the country, secondly to address the issue of lack of content product and services originating from rural areas which affects the economy from percolating to the bottom of the pyramid.

The first pilot project was launched in late 2011 in Chanderi cluster, highly populated with marginalized handloom weavers, located in Madhya Pradesh [49].

We interviewed one representative of the DEF India organization, a project manager, and access to public documentation sites[1]. What follows represents the outside and inside view of the initiative, focused on the overall umbrella organization, with some details about a few representative CNs.

3.9.1. The outside view

The overall outside view of the W4C programme, from a high level perspective considering the coordination of several communities involved (withouth detailing the organization of each) is outlined in Fig. 3.8 and described in more detail as follows.

Key partners:

- Local, regional, and national government.
- Local institutions: schools, public healthcare centers, banks, bridges, and they provide support as well. Water tanks, offices (e.g. location for routers in exchange of access). Contributions such as locations, electricity.
- Communities (in general) take care of sustainability.
- International organizations (e.g. ISOC, APC)

Key Activities:

The project has three components:

- 1) Training of Trainers programme: development of local capacities in the communities to contribute to the autonomy, resilience and sustainability of the local infrastructures,

[1] Main source: http://wforc.in/

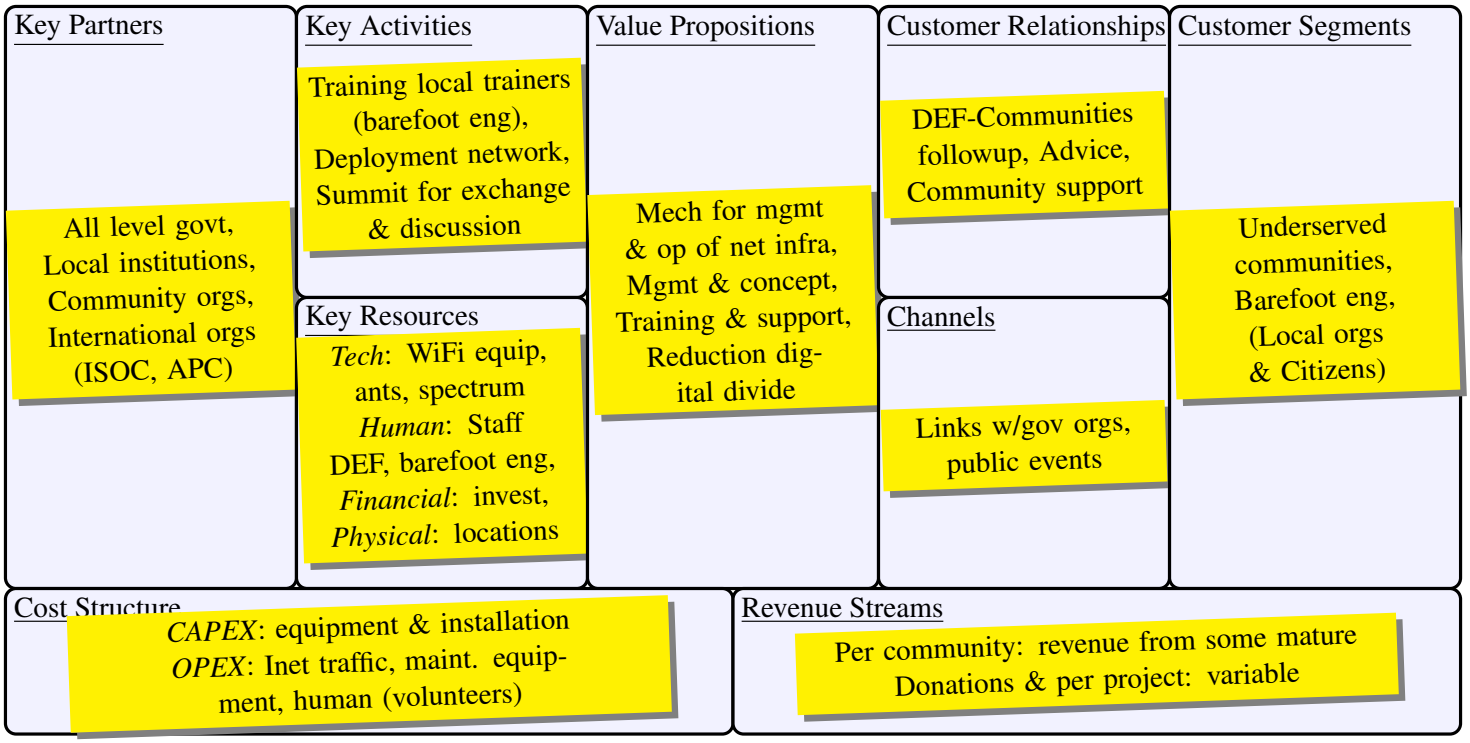


Figure 3.8: The canvas outline of the W4C (from central DEF) outside view

- 2) Deployment of Wireless Networks in rural locations; including initial deployment, macro (external and remote high level coordination), micro-management (detailed management done by DEF staff, before handled to locally trained personnel),
- 3) Conclave/Summit to discuss best practices, lessons learnt, and discussing issues from both a technical and policy perspective.

Key Resources:

Technical Resources:

- Community WiFi Equipment and Antennas.
- Open Source and closed source Software.
- Concession of radio-electric spectrum license to operate, even using unlicensed spectrum.
- Internet connection in each location.

Human resources:

- Staff of DEF India
- Trained staff in the communities (so called barefoot engineers).

Financial resources:

- Capital investment for national office of DEF India.
- Investment to deploy the network in each community.
- Operational and maintenance costs.

Physical resources:

- Office of DEF India, and community centres in each community (shared).
- Equipment DEF India, and equipment owned by communities.

Customer segments:

- The coverage of W4C is in 18 India states, with more than 20 community networks: the biggest has 40Km diameter, with 7 community centers in a cluster of 10-12 villages. The widest has 80Km between the most distant villages. The smallest has a 3-5 Km of diameter.
- The amount of citizens involved is around 4,000 (directly connected) people in total. Some CN can have only 20-30 people. There is an emphasis in supporting students and women, some of them employed and also unemployed. The demographics are important as the project aims at focusing and addressing the needs of the more marginalized.

Customer relationships:

- W4C works with communities. Sometimes these communities own their network, in these W4C participates sporadically, only when local communities experience problems.
- For other newer communities DEF also does micro-management: all the local planning, deployment, training. This is because trust, training and capacity is not developed yet, but the aim is transferring the management to the communities as soon as they are ready and committed.
- Engagement of W4C happens at multiple levels, depending what the government policy people require, or the needs of the local communities.

Value proposition:

- Provide a mechanism for rural, marginalized and indigenous communities to manage and operate their own WiFi telecommunications network.
- Management and conceptualization of the local network infrastructure.
- Training, motivation, financial and technical support to communities. W4C contributes in economic terms (setting up infrastructure) and social terms (keep on motivating and training locals).
- Reduction of the digital divide with the corresponding beneficial impacts.

Channels: When the network is being planned and during the initial deployment:

- W4C does a needss assessment of each community. They perform activities to plan the deployment and engage the community. It usually starts at at community center where the network is initially deployed there, and a few locals are employed and work from there to bootstrap the service.
- Local people that provide the training (that are literate) become very good influencers to engage other people, since they know the local language, local customs, needs, and people.
- As part of the deployment of the infrastructure, the community is mobilized in face-to-face meetings where people come, and they talk about their needs and what the network can provide.
- Meetings with citizens in places where they usually meet.
- Identification of young people for promotion, as they understand better and can realize the potential of knowing about the network and its use as a key resource to get an employment.
- Sometimes interviews, and continuous interaction with locals.

Cost structure:

Capital Expenses (CAPEX):

- The initial investment for the purchase of equipment is provided by W4C. (Costs: unknown)
- Installation of equipment for the expansion, improvement, sometimes contributed by W4C, others by communities, or jointly.

Operational Expenses (OPEX) per month:

- Internet access.
- Depreciation and maintenance of equipment.
- Human resources: barefoot engineers, community management, administrative management.

Sources of income and contributions:

Revenue:

- For telecom services, per member: specific for each community.
- W4C gets some revenue from some CN, to reinvest or help other communities. Mature and self-sufficient networks (Barren, Telonia, Chanderi) do not need external micro-management from DEF-W4C so they don't generate any revenue to the central project (W4C).
- Donations from very diverse sources.

3.9.2. The inside view

The W4C is a programme, a project centrally managed by DEF India. More mature communities are managed locally, while young community networks are managed partly or fully by DEF as part of the maturing process.

How communities make decisions? In one case, with 7 centers, they have periodic face-to-face meetings, and they make decisions on their own, sometimes also by video-conf (predominant), by email, and the meetings are performed in an informal way. Decisions typically made by consensus, while sometimes W4C helps in high-level decisions, while the detailed decisions are handled by the community themselves.

Regarding the equivalent to a license or manifesto, there are a few informal principles, not a formal license:

- Focus on serving marginalized society: the unconnected;
- Open-source software preferred but not mandatory;
- Women participation: try to engage them, but not mandatory;
- Preference also for involving children, youth;
- The network is open for everyone, 24x7;
- Promoted to provide feedback about quality of the service;
- Anyone allowed to participate in the management of the network;
- Routers managed either by the location owner or someone else.

A key human resource are the network engineers. They are inspired by the movement of the so called "barefoot engineers" [2] based on the philosophy of "Learning by doing", breaking the barriers of caste, literacy, gender. They learn about how to setup and operate networks, and they learn as they go. Surprisingly some of the training materials have little or no text but just images and colors as many of these network engineers can be illiterate [50].

A key social organization are the local communities, exhibiting very diverse levels of involvement. Local networks are defined with the community: so they can manage the network on their own, only with short term central support to bootstrap the infrastructure; with governmental support, understanding their needs; with the citizens that provide locations and skills. Regarding sustainability, communities sometimes invest but they may not want to learn. The objective of W4C is that local communities consolidate and become self-sufficient: "*It's your infrastructure, you need to learn about it and how to maintain it.*"

The motivation to start a new infrastructure comes from policy objectives to connect and empower rural underserved communities. The goal is implementing the network with community members, local people engaging in, with support from W4C. Sometimes W4C take these "barefoot engineers" as employees to deploy networks in remote areas. As a result of their training and experience, about 8 of them got jobs in Telecom operators and governmental offices. That is also a positive outcome as these people get better included in society, and the public and private organizations incorporate people with this training, experience and perspective.

[2] The inspiration comes from the Barefoot movement and approach: https://www.barefootcollege.org/approach/

Figure 3.9: A training session for children in a W4C community, with training materials in the background.

3.9.3. Organizational developments

One area to explore in W4C for further organizational development is improving the support for the transformation of community networks into social enterprises, for which there are both success and failure stories. This can help in the sustainability of the networks but also in the consolidation of the teams and the stability of employment [51]. The long term aim is to develop more structured governance instruments to be able to scale up to 250 centers in rural areas covering 6000 blocks to provide connectivity, where a block is an administrative unit composed by 5-6 villages. This relates to several organizational patters identified in Chapter 4 such as the compensation system, or the identification and development of stakeholder groups. Finally, based on the experience of W4C, another aim is at defining metrics and criteria for the feasibility of community networks, although this is difficult to define as the deployment of a network may not be successful in economic terms but may be successful in social terms, and both aspects are equally important.

3.10. Rhizomatica: Community Mobile Telephony (MX)

In Mexico, many citizens who want to communicate and participate in the Internet, fixed or mobile, cannot because a few big telcos are not interested in investing in building infrastructure and providing service to them. So, the citizens have to create their own infrastructures and self-provide services.

Rhizomatica began in 2009 as a quest to make alternative telecommunications infrastructure possible for people around the world dealing with oppressive regimes, the threat of natural disasters, or the reality of living in a place deemed too poor or isolated to cover. Their mission is to increase access to and participation in telecommunications for the over 2 billion people without affordable mobile coverage and the 700 million with none at all by supporting communities to build and maintain self-governed and owned communication infrastructure.

Rhizomatica creates open-source technology that helps people and communities build their own networks. They advocate, agitate and organize to gain access to spectrum for these networks and those people that might want to build in the future. And they create organization and sustainability strategies so that these networks can thrive without exploiting users[3].

More than 20 communities in the Oaxaca region in Mexico have created networks that are owned and managed by each community. Each community has to raise about 10,000 USD to fund the cost of the initial deployment of the network that is based on an open source hardware and software for a GSM base station. They learn how to build and maintain their own network. They sign people up for voice call service, they collect the payments for the service, and they have community assemblies about how much cell service (voice calls so far) should cost. The coverage of these local networks is limited by environmental factors such as mountains, foliage, humidity. All the local networks participate in an umbrella organization through elected representatives. Communities elect members to be part of the organization (one local volunteer that is also a user, rotated periodically among the users, who does a simple local management of accounts, and is the local liaison and reports to the umbrella organization). It is a participatory organization, but which also creates a political base to defend their work. The economic model is cost oriented to ensure the sustainability, so villages can recover the investment, pay monthly costs like electricity, telephony and Internet backhaul.

Three aspects of success, related to openness and affordability, are critical: technological, policy and regulation, and social. Regarding *technology*, the Open-source software and hardware for GSM and WiFi access points has created affordable and simple ways to self-provide local access, combined with satellite ISPs for backhaul connectivity. In the *policy and regulation* front, 30 communities approached the Telecom regulator, exercising their right under UN treaties, with a legal claim related to a clause in the Mexican telecommunication law that mentioned unused spectrum. Large companies get national spectrum but then don't operate in many areas. They claim that spectrum is a territorial right, and they obtained a license in certain territories and have to be a noncommercial network. Regarding *social*, the infrastructure is a community resource funded, owned, managed sustainably by the community that not only provides affordable services, but also creates a surplus that is reinvested for the benefit of the community.

We interviewed one representative of the umbrella organization, with brief interactions with two more, and access to public documents in several web sites[4]. What follows represents the outside and inside view of the initiative, focused on the overall umbrella organization, with some additional details about typical local CNs in general.

3.10.1. The outside view

The social business model canvas for one community mobile telephony operator (a template that can represent most if not all of them) is the following. Fig. 3.10 shows an image from the training materials Rhizomatica has used with new communities (in Spanish). In fact, members of the Rhizomatica team worked in the past with the author of [46] to use the diagram as a tool to develop a common understanding of the outside view of their communities. We discovered that during the interviews. The diagram adapted to our framework and in English is summarized in Fig. 3.11.

Key partners: The key partners are existing local community organizations that can support the operator, technology providers (TIC), service providers (VOIP, ISP), umbrella organization (Rhizomatica, Redes por la Diversidad y Sustenibilidad) [5] and global organizations such as Shuttleworth.

Key activities:

- Construction of a local network fully operated and managed by the community with the advice of key

[3] https://www.rhizomatica.org/about/

[4] Main sources: TIC A.C. association https://www.tic-ac.org, Redes A.C. association https://www.redesac.org.mx, Rhizomatica https://www.rhizomatica.org

[5] https://www.rhizomatica.org/, https://www.tic-ac.org/, https://www.redesac.org.mx/

Figure 3.10: The original canvas block model used by Rhizomatica to train communities, in Spanish.

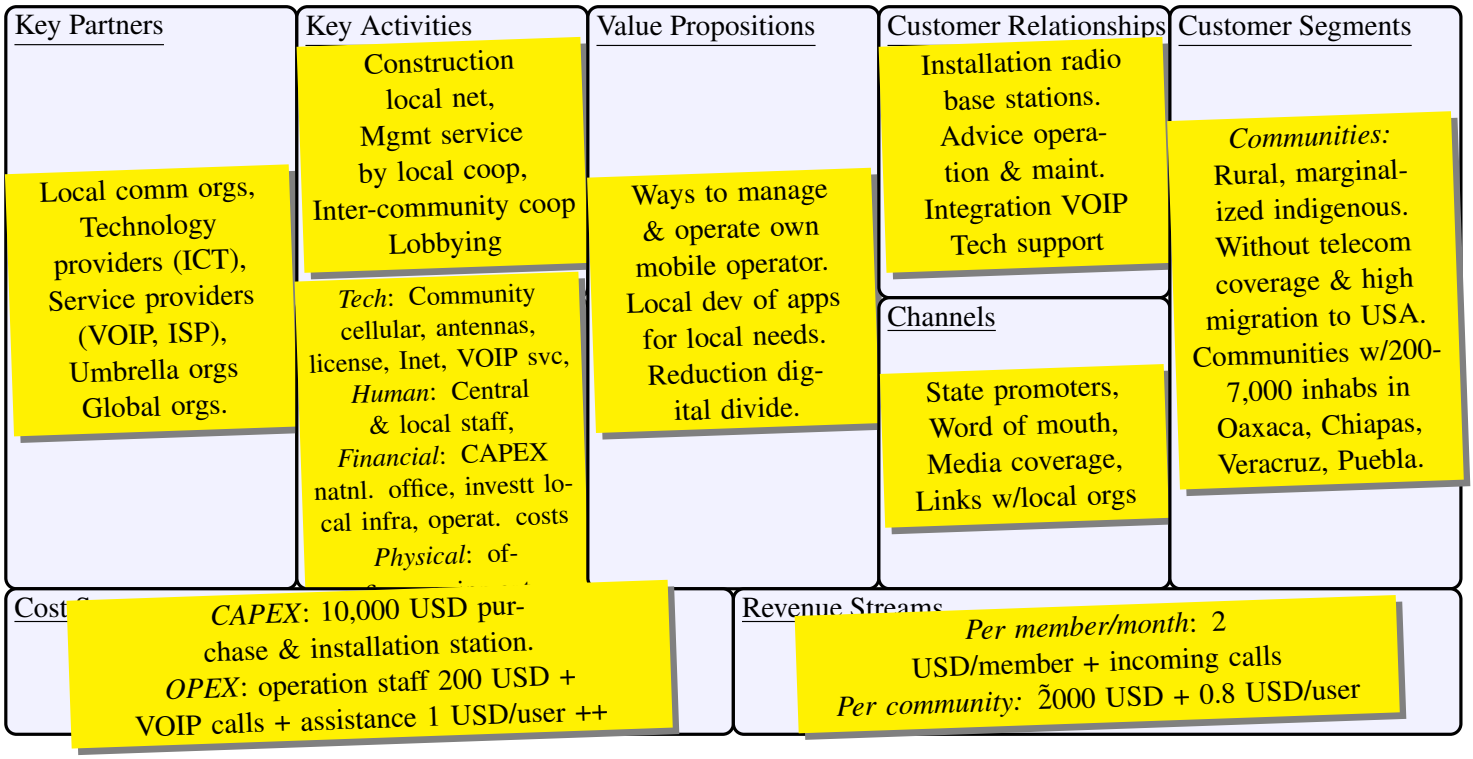


Figure 3.11: The canvas outline for the outside view of a typical local community involved in Rhizomatica.

organizations, through a cooperative association to which the Communities belong. Off-net calls are made via VoIP via a local ISP.

- Inter-community linkage to promote local-regional development based on the complementarity they provide each other.
- Lobbying as a management task and permanent political and legislative influence in order to ensure that

legal and institutional frameworks allow the operation of community networks.

- Identification and promotion of the development needs of each community through telephony.
- Training and guidance to communities to operate and maintain their network.
- Research and development of technological, legal and economic innovation to improve the operation of the project.

Key Resources:

Technical Resources:

- Community Cellular Equipment and Antennas.
- Open Source Software.
- Concession of radio-electric spectrum license.
- Internet connection in each location.
- Voice calls service over IP.

Human resources:

- Staff of Rhizomatica and the TIC A.C. association.
- Trained staff in the communities

Financial resources:

- Capital investment for each national office of Rhizomatica.
- Investment to deploy the network in each community.
- Operational and maintenance costs.

Physical resources:

- Office of Rhizomatica.
- Equipment Rhizomatica.

Value proposition:

- Provide a mechanism for rural, marginalized and indigenous communities to manage and operate their own mobile telecommunications network.
- With this, cellular penetration increases while reducing costs up to 97% ensuring that some of the profits remain in an association to which they belong and invest in innovation and training.
- Enabling the development of local telecommunication applications to serve the real needs of each community.
- Reduction of the digital divide with the corresponding beneficial impacts.

Community and Customer relations:

- Installation of radio base stations in communities.
- Advice on the operation and maintenance of networks.
- Integration of the network with Internet service providers and voice over IP.
- Technical support to communities.
- Strengthening of community autonomy to reach their development objectives through the use of the mobile network.

Channels:

- State Promoters.
- Advertising by word of mouth.
- Media Coverage.
- Linkage with communities, civil associations and NGOs.

Customer Segments:

- Rural, highly marginalized and indigenous communities.
- Communities without telecommunication coverage with high migration to the United States.
- Communities of 200 to 7,000 inhabitants of the states of: Oaxaca, Chiapas, Veracruz, Puebla.

Cost structure:

Costs per Community:

- Initial investment of USD 10,000 for the purchase and installation of equipment to operate the telecommunications network (CAPEX) which includes USD 2,000 of installation expenses plus equipment purchase.

Operational Expenses (OPEX):

- Salary operators USD 200 per month.
- Internet access USD 100 per month.
- Monthly cost of off net calls in VoIP = Total offnet calls x Price of calls.
- Quota of assistance and technical service USD1 per subscriber.
- Depreciation and maintenance of equipment.

Rhizomatica Costs:

Capital investment by state or national headquarters (CAPEX):

- Tools - USD 10,000
- Computers (4) - USD 2,700
- Office Furniture - USD 1,000
- Truck - USD 20,000

National operating expenditure based in Oaxaca per month (OPEX):

- Human resources (General coordination, operations, liaison, finance, legal, innovation, inter-institutional relations, technical support and R. R.H. H) - USD 12,800
- Employee Insurance - USD 175
- Fixed office expenses (rent, electricity, water, internet) - USD 400
- Truck expenses - USD 700

Operating expenditure per state per month (OPEX):

- Human resources (Installer, technical support, social liaison, administrative assistant) - USD 6,900
- Employee Insurance - USD 120
- Fixed office expenses (rent, electricity, water, internet) - USD 400
- Truck expenses - USD 700

Sources of income and contributions:

Revenue per Community

- Recovery fee of 40 pesos per subscriber in the community.
- Incoming calls off-net = Price per calls x Number of calls made by the community.
- Public budget and contributions of migrants from localities.

Income from Rhizomatica by State:

- Income per installation per community of USD 2,000

- Advisory fee and technical service of 15 pesos per subscriber in each community with service.
- Funding and contributions from national and international organizations.

3.10.2. The inside view

We are talking about a federation of communities (rural villages), and an organization with offices by states and a central national office (Rhizomatica), with support from two related organizations: TIC A.C. and Redes A.C.

The name references both the biological phenomena and the concept of the rhizome, in that if one is separated into pieces, each piece can give rise to a new plant. This reflect the attempt to strike a balance between the benefits of interconnectedness and autonomy – two ideas that are seemingly at odds.

Rhizomática initiated "Telecomunicaciones Indígenas Comunitarias" TIC A. C. (Community Indigenous Telecommunications) and continues being an important ally in the technological development. "Redes por la Diversidad, Equidad y Sustentabilidad A.C." (Networks for Diversity, Equity and Sustainability, Civil Association) was acting as tax endorsement for TIC A. C. initially, and currently carries a significant part of the financial administration of TIC A. C. in addition to supporting institutional relations and legal matters.

According to public documentation [6] TIC AC, as a civil association, responds to the mandate of the General Assembly of associates, made up of all communities. Under the mandate of the Assembly there is the coordination board and a team in the Oaxaca office that works to provide technical, legal and network linkage. The work is designed to facilitate the participation and direct representation of the communities that are members of the civil association, in order to promote autonomy in the management and sustainability of each network. Part of their mission has to do with the possibility of building a platform for collective action and organized political power.

The social base is the indigenous and rural communities. The way in which communities participate, makes this a social project that uses technology to strengthen the processes of autonomy and defense of the territory of communities.

In this sense the communities have three levels of participation:

1. Economic contribution for the acquisition of equipment to operate each network, which implies that community cellular telephone networks are a communal good.
2. The participation of the community in the physical installation of the radio base stations, which prepares the ground in which the installation will be done, which strengthens the sense of co-responsibility between TIC AC and the community.
3. The community assigns a management committee that performs the function of managing the network, which implies that the committee becomes the link between TIC AC and citizens, and between TIC AC and the municipal authority.

3.10.3. Organizational developments

One area of interest to Rhizomatica to explore for further organizational development is the implementation of a regional *backbone network* and *shared backhaul* Internet connectivity following the *economic compensation* model in guifi.net. This relates to the corresponding organizational patters identified in Chapter 4.

3.11. ninux.org

The ninux Community Network is one of the oldest and most widespread CN in Italy. ninux started originally in Rome, following other similar projects, such as the Seattle Wireless created in 2000 in the Northwest United

[6] TIC AC https://www.tic-ac.org/tequio/ (Spanish language)

States [52]. The name of the network, "ninux", means "No Internet, Network Under eXperiment". In recent years, ninux has expanded beyond Rome to other Italian cities, where other local grassroots networks have been launched under the same acronym. The network in Rome, which is the most consolidated one, got underway in 2001 as a technical experiment, thanks to the effort of about ten people, including informatics students, experts in network operating systems, home-grown hackers, and geeks, some of whom were also participating in the free and open software movement developed in Italy during the previous decade. The pioneer collective originally meet in a popular local café, called by ninux members "nerd pub", and subsequently in the spaces of formal non-profit associations Fusolab 2.0 engaged in promoting countercultural and artistic activities. More in details, Fusolab 2.0 is engaged in developing and disseminate a critical and alternative vision of the about the existing cultural and economic social model, by promoting sharing of knowledge in the following areas: cultural production (music and art); critical consumption, sustainability, degrowth and common goods, information and media, interculturalism, digital cultures and technological innovation.

In the early period, the ground-breaking group began to collectively test emerging wireless networking hardware and software, building up experimental connections between wireless antennas (also homemade) installed on their own home roofs. Year after year, thanks to the implementation on the network of services such as file sharing and tools for cooperative writing, the infrastructure attracted a growing number of participants, civic associations, thus turning into a relatively wide urban decentralized wireless network, which in 2017 numbers about 350 nodes. From a descriptive point of view, the ninux network presents all the major features of an inverse infrastructure, being bottom-up, self-organized, decentralized, and emerging as the result of a process of engagement where end-users and designers substantially overlap.

Nowadays, ninux represents an informal umbrella organization composed of several various local "islands". Despite the different degree in infrastructure development, in 2017 ninux is deeply-rooted in the following Italian cities: Bologna, Catanzaro, Cosenza, Firenze, Pisa, Roma, Torino, Verona. Accordingly to the "Report on Existing Community Networks and their Organization" (Deliverable number D1.2), ninux is not yet established in a form of "legally recognized association" under Italian law, and its initial motivations were mainly oriented at experimenting an innovative wireless mesh network. Although the general technical framework of the local "islands" is almost the same, their connectivity and organisation has developed independently, and their respective informal working groups are driven by distinctive mixes of political and technical needs, local constraints, and motivations. For example, while ninux at large is still informal and non-institutionalised, some "islands", such as Rome or Pisa, have established various kinds of indirect relationship with institutional actors, ISPs or universities. The primary motivation behind some of the "islands" is the political desire to challenge the perceived neoliberal governance of the Internet; other "islands" are also driven by strong political beliefs, but are not a priori against the inclusion of conventional web access services within the building of their networks.

Initially, the building of the infrastructure was almost entirely crafted, and for this reason it was necessary – besides a great passion and technical expertise – to purchase prototypes, and manually assemble the components necessary to make network infrastructure operative, such as the antennas. In this regard, a turning point for the technical development of the network happened in 2008, when a private company (Ubiquiti) started to market low-cost wireless devices and antennas, gradually adopted as "gold standard" by all members of ninux. The adoption of these devices has considerably facilitated the construction of the infrastructure, thus lowering the threshold of technical expertise required to be active part of the community. Starting from this moment, community participation has grown resulting in the need to develop governance tools that will be discussed in subsequent sections. In fact, even if the local networks remain technically separated from each other, they share the same name, a common political framework, and governance tools supporting a collective cooperative work for the development of software, hardware, and protocols.

3.11.1. The outside view

The overall outside view of ninux considering what is common for most if not all local communities is as follows, based on interviews with several key participants, and outlined in Fig. 3.12.

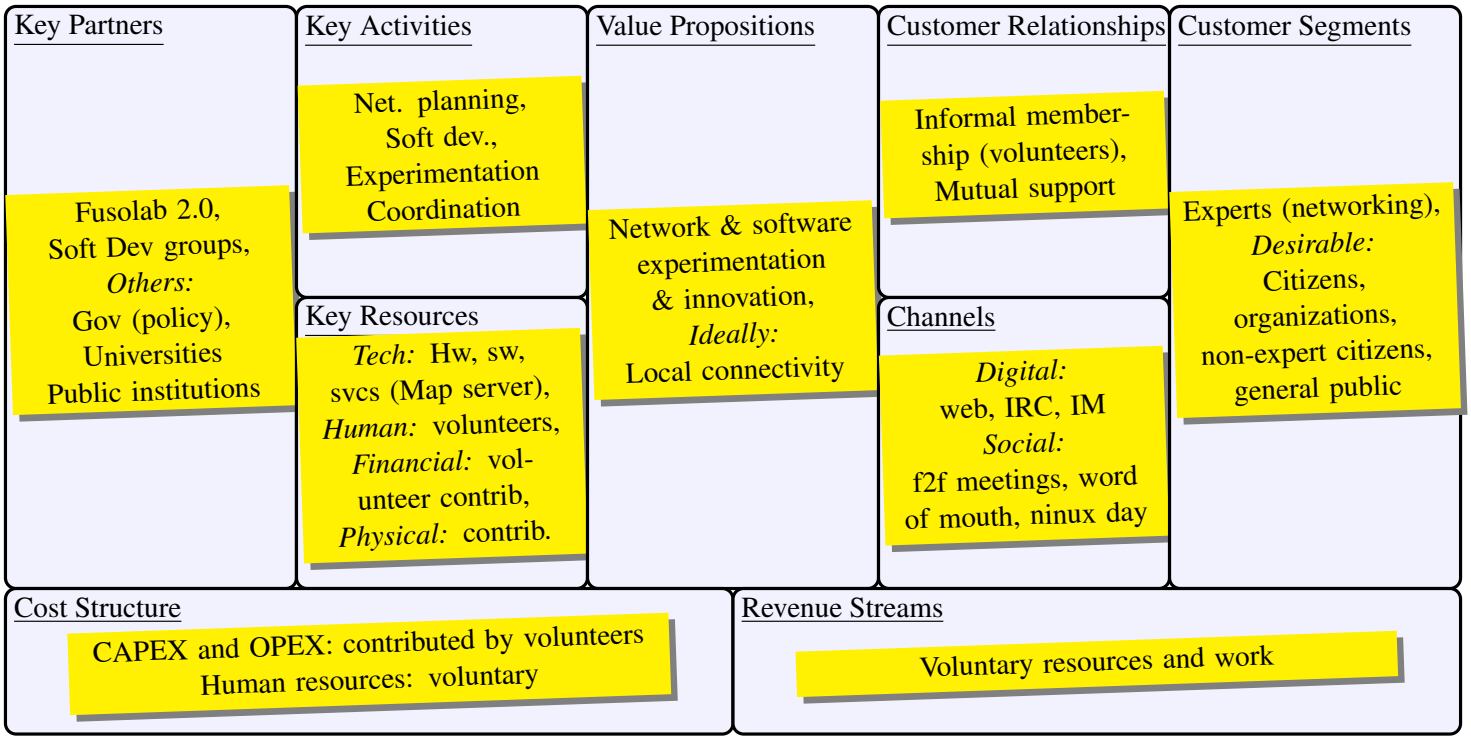


Figure 3.12: The canvas outside view outline of the ninux umbrella structure

3.11.2. Organizational Model and internal governance tools

3.11.2.1. Mission and statement of intent: the Commons Wireless Manifesto

> ninux.org is a wireless community of people who are pursuing an open, decentralized, and citizen-owned alternative network project. There are several services available on this network, including an Internet access; but the value of the project mostly relies in the active participation, the sharing of knowledge, and the contribution that each of us can give in many form to the growth of the community (not limited to technological one). In this regard, ninux's goal is not to provide Internet access, but to build a network infrastructure that aspire to become an integral part of the Internet. This would not be possible without a group of affectionate and motivated people. For this reason, we are convinced that the Community is first and foremost the network in itself [7].

This brief but sharp quotation is extracted from the "Wireless Commons Manifesto", in which the community mission, strategic goals, as well as a set of common principles and visions have been summarized. Overall, the ninux "Wireless Commons Manifesto" – which is deeply rooted in the well-known Pico Peering Agreement[8] – represents an informal agreement, acting as foundational statement. The aforementioned manifesto emphasizes the political and social relevance of decentralized and mesh network architectures, framing their contribution to the empowerment and self-determination of citizens; their role as democratizing device and resources to fight digital divide; their support for freedom of speech over the Internet network; and their alternative vision to the influence of commercial firms in shaping policy and regulation of the web. These several instances reflect the set of political concerns sustaining the work of shaping CN as a common resource:

> Becoming part of a network managed as "common good" means being more than a mere consumer. By adhering, you may become an active participant in a network that is far more than the summation of its users. You will fight to solve social, political and technical problems.

[7] See the ninux Wireless Commons Manifesto – available online: http://wiki.ninux.org/Manifesto
[8] http://picopeer.net/

> You can give to your community the resources it consumes, by co-operating with other people to build the network we all dream of. [ninux Wireless Commons Manifesto – available online: http://wiki.ninux.org/Manifesto]

This shared framework is the result of an on-going collective effort of negotiation, which occurs through and mailing lists, and thanks to periodic meetings, such as an annual "ninux Day" happening. At the same time, the "Wireless Commons Manifesto" represents the main tool to communicate the visions and mission of the community to external people and stakeholder. During the start-up period of the project, the concerned Manifesto has been quite crucial in defining a common framework to be adopted by the different "islands". Nowadays, however, according to many participants, the Manifesto seems too generic and unfit for ensuring a sustainable growth of the community. As stated by ninux's members:

> Initially, we decided that Internet was not a suitable service to integrate in the network. We preferred to have an experimental network. But year after year, we realized that our community was not a citizens community, but a nerd one. And the nerds, within a specific site, are not too many to allow ninux to grow... So, now we can't grow staying as a nerd network. [Interview 1, ninux member].
>
> After the initial period of starting the network, we experienced difficulties in transforming the infrastructures in something more than an experiment... and many people have gone away. [Interview 3, ninux member]

More in details, in the last years with the spread of the network to different cities other than Rome, many ninux's members claim to redefine the nature of the project, as well as its purposes, thus to shape new strategies oriented to face a sustainable development of the network in the long-term. In this regard, it is worth noting that the Manifesto puts the emphasis on the social dimension of the network, rather than on the technical one. However, this aspect relates to an "organizational dilemma" that, in the last few years, pervaded the internal governance of the community, namely the fracture between the "founding group" (more linked to the hacker culture of technical experimentation), and the emerging group of newcomers more concerned with building a stable, "scalable", and user-friendly infrastructure, in which web services may be part of the network. This aspect will be addressed in the next paragraph.

3.11.2.2. The Organizational Model Dilemma

As previously argued, ninux community does not have any formal legal status, officially recognized under the Italian law. Even if this condition implies fewer constraints in terms of public accountability it also prevents the elaboration of a shared internal governance framework in terms of the definition of internal regulations, formal agreements, membership rules and division of roles, which represent crucial elements in shaping a sustainable community organization. From a conceptual point of view, ninux's internal governance can be described as an informal "do-it-yourself-ocracy". The so-called "do-it-yourself-ocracy" strongly relies on the hackers cultures which inspired grassroots organizations, such as the open source software, and free software movement. This approach in managing communities' life implies a strong decentralized, cooperative and horizontal model of organizing [53]. Thus, members can acquire a specific role in relation to their expertise, competencies, and kind of task in which they are involved, rather than through formal process of nomination.

According to this organizational approach, ninux community is enlivened through a completely free work performed by voluntary members. Usually, community members organize technical task forces engaged (mainly during the weekends) in installing antennas on the roofs of the buildings where citizens interested in joining the community lived-in. At the same time, other expert members are involved in developing protocols, or in the network configuration activities.

"Sure, there is a strong technical component. Therefore, members who are good at technological activities, good at computer developing, good at solving network problems are the most appreciated ones. It's hard,

for me, to find central, visible members in the community that are not nerds or geeks. [Interview 1, ninux member]."

This quotation highlights the relevance of technical skills as element of legitimization of the active membership. However, in recent years, an emerging group of members is engaged in promoting a radical organizational change oriented to implement a more stable and user-friendly network, thus to shape a more inclusive community for non geek people. Conceptually speaking, this group aims to develop a new organizational strategy oriented to support and strengthen a non-expert participation in the community; thus to overcome the supposed necessity of the continuous need for having an experimental network. In other terms, this group has triggered a tension between the "implementation" of reliable technical devices to develop a dependable network, and the experimentation activities as constitutive practices of the community. This peculiar tension engenders a "conflicting pluralisation" of visions in ninux about the ways in which the infrastructure project requires to be carried out:

> We are a community network that initially decided not to offer Internet as a main service. But now, with this attitude, it's difficult to catch up new members, or concerned citizens in general. Currently, if you are not interested in the technical dimension of the network, or in its technical development, probably you can not find something interesting in ninux, in terms of public utility." [Interview 1, ninux member].

This quotation reveals how the development of the network is stratified around different conceptions, sometimes conflicting with each other, regarding the options about the infrastructure development. Alongside a vision of the infrastructure as a place of continuous experimentation and innovation, the community can however develop attitudes that hinder the construction of new knowledge, privileging instead the network stability and its technical sustainability. Concerning the internal governance, during the last year, there has been an increasing attention about the possibility to embark ninux in an organizational transition from a nerd-based experimental community, to a more pluralistic community network able to embrace new non-expert members. In this sense, the changes in organizational values, beliefs and vision of the mission that drive internal coordination are a cornerstone of internal governance processes. This aspect clearly emerges from recent claims concerning the need to establish a formal association operating under the Italian law:

> The possibility of formalizing ninux as a legal association is a matter of concern. In ninux, there are people who have proposed many times to build a formal association, but there has been a strong resistance. Some relevant members conceive a distributed and decentralized community as something you can not put in a "black box". At the same time, it's important to affirm that there are many people who have spent so much time and energy in ninux... and thus they left the community because there is no structured way to assign responsibilities, duties and so on. Now, people decide to do things autonomously. But with our internal organization people get tired and go away. By the way, an association can be the right tool of trying to build an effective internal coordination, in terms of a formal system of delegations. I think we need it. Every island should have its own association. [Interview 1, ninux member]

> ninux is totally self-organized. There is no formal hierarchical line to take decision. In my opinion, in this situation the network does not scale well. In this way, the decision making process engender always an high level of conflictuality, and finally we never take any decision. It's so frustrating. I'm also part of another community organization engaged in open source software development, where there are democratic organs, thus we have regulations which can act as conflict resolution tool. Decisions are always taken collectively. [Interview 2, ninux member]

These quotations highlight how the constitution of an association can open the possibility to provide to the concerned community network an effective internal governance framework, transparent regulations and procedures for the daily management of community life.

3.11.2.3. The valorization of the voluntary work: incentives and social digital currency

Furthermore, a central aspect arising by the high degree of informality which characterizes ninux relates to the difficulty of recognizing and giving value to the free work performed by voluntary members.

> The fact that we are not well-structured make everyday management quite complicated. Without a formal association, or clear organizational structures, it is impossible to give roles to the people. You are not in a condition to encourage them. All this informality does not help. For example, there are people who have worked so hard, but then they disappeared. You do not see them anymore. They have lost their interest, and since they are not obliged to do something specific because there are no clear responsibilities, these people are volatile. [Interview 2, ninux member].

The relevant issue emerging from these two quotes concerns the necessity to recognize and give value to the free work done by community members. This aspect is closely related to what has been described in the introductory section of this report about the vulnerability of community organizations, whose integrity can be jeopardised in case of systematic non-recognition of the member's contributions. This problem becomes particularly relevant in our case study, as we are dealing with a decentralised community network which has not implemented a system of incentives, or a mechanism to recognize and account for the free work and contributions offered by members. In this respect, the establishment of a formal association could facilitate the introduction of a system of accountability aimed at recognizing and add value to the voluntary work.

A first form of valorisation of voluntary work involves the development and strengthening of a clear and effective system of incentives. Conceptually speaking, the incentive system represents a set of rewards that is self-managed by community members so as to attain common goals.

Concerning the implementation of a system of incentives, as it has been argued in the deliverable 2.3 [54] about the "*Incentives for Participation and Active Collaboration in CNs (v2)*", it is crucial to consider three different and interdependent dimensions that characterize CNs. The first one is the political dimension which concerns the way that the community network is governed; the second one is the socio-cultural dimension which relies on the activities of creation of services and applications, as well as on the distribution of content; the last one is the economic dimension, or the way that the economic benefits are generated. Following these considerations and according to Smith [55], the tasks and actions that are most valuable and relevant for members to be performed are those that are most rewarded by the incentive system. In this regard, it is possible to identify seven different levels of incentives that can be successfully implemented in community organizations: sociability incentives; purposive incentives; service incentives; informational incentives; lobbying incentives; utilitarian incentives. The following table presents an analytical description of the incentives and their relevance with regard to ninux's internal governance.

Name of incentive	Description	Relevance to ninux's internal governance
Sociability Incentives (actionable on the political dimension)	These social incentives imply rewards that offer satisfaction, gratification and pleasure to members via the sociable presence of, and interaction with, other CNs members. In this sense, it is important to encourage social relationships that can activate long term acquaintanceship and friendship relationships among CNs members	Yes: promoting face-to-face meetings that are not merely related to the discussion of technical issues related to the community. Running public seminars, conferences, and workshops.

Purposive Incentives (actionable on the political dimension)	These kinds of incentives are ideological and political rewards that CNs may offer to members involved in collaborating for the achievement of commons purposes. Active participants can gain satisfaction from adhering to CNs ideological and political framework about what these goals should be and how they should be achieved.	Yes: Incentive already active.
Service Incentives (actionable on the socio-cultural dimension)	CNs can have strong service incentives. The emphasis is put on offer altruistic satisfaction to members from direct helping of the citizens through services developed by the community, such as access to neutral networks, online services relevant for the local community, sharing of information and so on.	Yes: It is necessary to strengthen the implementation of services within the network.
Educational Incentives (actionable on the socio-cultural dimension)	These are CNs participation rewards from learning new knowledge and skills while participating in community life.	Yes: Incentive already active.
Lobbying Incentives (actionable on the political dimension)	This type of incentive focuses on how CNs attempts to have alliances with relevant stakeholders, as well as political influence on the general public, policy makers and local public bodies. This kinds of activities can offer an high degree of gratification to members engaged in promoting collective actions about digital rights.	Yes: In order to strengthen this type of incentives, it is necessary to build an association legally recognized by Italian law.
Developmental Incentives (actionable on the socio-cultural dimension)	These are rewards which rely on human, intellectual and personal growth arising from experiences in a community volunteer role	Yes: promoting face-to-face meetings that are not merely related to the discussion of technical issues but related to the community; running seminars, conferences, and workshops
Utilitarian Incentives (actionable on the economic dimension)	These incentives are indirect economic rewards, as the community can open new professional or business contact opportunities.	Yes: Incentive already active. Some members, thanks to the technical skills learned in ninux, have found a well-paid work in ICT field.

Following this classification, the incentives to community members can be managed (i.e. strengthened, enhanced, weakened or suspended) in relation to the formal and informal rules upon which the community is governed (political dimension), the services and content distributed (socio-cultural dimension), and the economic benefits generated (economic dimension).

Along with the system of incentives described above, as it has been underlined in the deliverable 2.4 [56] on the "*Economic Sustainability of CNs (v1)*", a more complex strategy that goes in the direction to recognize voluntary work may rely in the development of a "social wallet", operating as internal "community currency". In addition, a community currency may have the potential to support the economic sustainability of CNs, by providing opportunities for CNs activities and services to access to local markets and local customers. In this way, a social currency can empower the long-term sustainability of the infrastructure on which community

activities and services are grounded.

Within this context, a social wallet can be considered as a complex toolkit for a "community currency" as a device to sustain and formalise a bottom-up engagement in CNs via the institution of an ad-hoc social remuneration system. Thus, community currency can be useful to foster democratic processes, to encourage active participation, and collective decision-making on division of task matters affecting CNs. The social digital currency can be composed by a set of tools designed to manage a reward mechanism in a transparent and audible way. This device can enact a form of "exposure" of the voluntary work that reflects social relations in which the shaping of members' rules is deeply rooted. In this sense, a digital social currency can be a viable solution for effectively reframing the structure of the community and potential economies around which a local distributed network is articulated. Following these lines of thought, an important issue is that the social digital currency not only can be a useful tool to reward voluntary work, but it can be used as a social currency to access to potential infrastructure services developed by the community; thus linking infrastructure resources with correspondent unmet needs and, consequently, foster local relevance of the infrastructures and its services. Under this perspective, collaborative relationships can be reconsidered in a new way, by valorising the voluntary work, which can better meet the need of the community, and could allow CNs to increase the long-term investments sustainability.

Finally, another central aspect of "positive externalities" that may emerge from the constitution of a formal association concerns the level of formal alliances with external organizations, stakeholders and public institutions, as well as the access to financial resources: two crucial aspects for defining a framework for sustainable community development:

> If you are an association, you can go to a school in order to propose to connect the building to the network. Same thing with other public bodies. But if you are an informal group, you can't do it. [Interview 3, ninux member]
>
> There are many opportunities of financing both at national and European level. In this regard, if you act as formal association you may apply to these public calls. Now, we can't, as we are an informal group of people. [Interview 2, ninux member]

As clearly emerged, the public agency and legitimization of the community at large can largely benefit by acting within the framework of a formal association. Thus certain alliances, or the possibility to access to financial resources, can be practicable only assuming a legal status recognized by the public law.

3.11.2.4. Internal coordination tools

As pointed out in the Report on Existing Community Networks and their Organization (Deliverable 1.2), ninux members have developed several governance tools oriented to manage internal governance, as well as external communication:

- *Mailing Lists:* every island set up and manage its own mailing list, created on request by the participants. In addition to local mailing lists, there are two others national mailing list ("wireless@ml.ninux.org" and "not-wireless@ml.ninux.org") in which generic issue related to ninux can be discussed, such as the organization of national meetings and other relevant public events. Concerning online communication, a subgroup of members are engaged in replying e-mails sent to the address "contatti@ninux.org". This e-mail represents one possible main "entry point" to the community, thus to provide information to interested people in more mediated way compared to the general mailing lists, where every members may answer to a potential the newcomers.
- *Website & Blog:* the website of ninux is a wiki, collaboratively realized by the community. Some of the pages are translated in English, but the language is primarily Italian. The community has also develop a Wordpress blog, where members can write on issues of common interest. The website hosts general information about the community; a frequently asked questions section; several online handbooks devoted

to give more technical information. These technical guidelines are organized according to five levels of complexity: i) starting members; ii) novice; iii) intermediate; iv) student; v) advanced. According to some testimonies collected during the interviews, the website – in the form of wiki – does not seem to be particularly effective as external communication tool:

> For a non-expert person who is approaching ninux for the first time, it is difficult to understand what a community network is. For example, today someone sent a message to our Telegram public group asking information for installing ninux in its smartphone. It sounds quite incredible, but it happened because the first approach that a person has with the ninux website is not positive. You do not understand what ninux is. So, a person approaching ninux needs clear information to figure out what a community network is. If you go to the guifi website you can easily understand what guifi is right now. If you go to the ninux website you do not understand nothing. [Interview 3, ninux member]

This testimony emphasizes the low communicative effectiveness of the ninux website for communication with external people, or potential newcomers. In this sense, the website should be readjusted in such a way as to ensure a broad dissemination of the community's mission, as well as its objectives and modalities to reach them. In addition, the website may host periodical reports on community activities, thus to facilitate internal accountability processes, while making them more transparent.

- *Face-to-face meetings:* each island organizes periodic meeting (weekly or fortnightly), in form of horizontal assembly, with the local community. From time to time a national meeting – called ninux Day – is organized. The last one was organized in Florence on November 26th and 27th 2016 with the participation of about thirty people belonging to the main Italian ninux islands[9].
- Local meetings are conceived as skill-sharing happening, where members perform an informal pedagogical arena to share and learn relevant technical skills useful to network management. In this regard, one of the most problematic issues raised during both interviews and mailing list discussions relates to the fact that local meetings are not perceived by starting members and newcomers as inclusive discussion spaces, due to the hegemony played by the nerds and geeks which are mainly interested in discussing network engineering issues.
- *The Mapserver [10]:* this online tool is a key instrument in the ninux community because it acts both as technical entry point in the community and monitoring device of the network. As documented in the Report on Existing Community Networks and their Organization (Deliverable 1.2), the mapserver hosts a geo-located map of the current state of the network. The mapserver is updated periodically by a software that is configured to load all the topologies from the various ninux islands: each island publishes a topology file at a public URL using one of the supported formats, and the active nodes and links can be visualized in the map. It is not only a public mirror of the state of the network, but it is also a fundamental instrument for new users that want to enter the network, that can use it to find other nodes nearby, compute an approximated distance and contact the owner of existent or potential nodes in order to set-up a new link. The mapserver was developed by the ninux community, it is powered by an open source platform named "nodeshot" available on github.
- *Internet Relay Chat meeting:* recently the community start to organise national online meeting using IRC protocol in order to take collective decisions about specific technical or organization issues. These meeting are organized every two weeks, with the participation of about ten / fifteen members. After every online meeting a summary report is automatically produce by a BOT, with a summary of the main points discussed by the participants. Thus this report is send to the national mailing list: wireless@ml.ninux.org. However, the format of the meeting summary is extremely concise. In this sense, it would be advantageous to produce a more narrative report of the discussions occurred via IRC protocol, thus to solicit

[9] A report about the last ninux Day is online available at the following address: http://netcommons.eu/?q=content/netcommons-ninuxday-meeting-ninux-community-network

[10] http://map.ninux.org/

two-way feedback from members who did not take part in the discussion.

- *Telegram group* [11]*:* each island has its own local telegram group to coordinate face to face local meetings, or specific activities both technical and organizational. In addition, a national Telegram group has been set up, where there are about one hundred people. Apparently, the telegram group is now the most used communication tool. The management of this group is quite crucial, as by now it represents the main entry point for newcomers. The centrality assumed by Telegram groups resulted in a noticeable reduction in online discussions within mailing lists, both nationals and locals. It is worth noting that interactions occurring in Telegram groups are much more ephemeral if compared to other communication tools (e.g. mailing list; video conference etc.); this is due to the high amount of daily messages which doesn't entail an easy overview of the conversation log.
- *ninux Experimental (NNXX):* starting from February 2017, a subgroup of ninux members launched the "NNXX" experimentation initiative. This initiative is handled through the following tools: i) telegram channel for real-time support ; ii) "Trello board NNXX" [12] to plan and monitor experimentation activities; a mailing list called "ninux-dev" [13] for non real-time support. This initiative has the following main objectives: sustain the generation and growth of new ninux islands; simplify connections between different network nodes, thus to increase overall infrastructure resilience; simplify the configuration and updating of the infrastructure; sharing new knowledge in the field of mesh network. Within this initiative, "OpenWisp 2" is under development:

  > OpenWisp 2 allows you to manage your routers in a very lean way. With this software, a person launches a script that can configure the router automatically and securely. The goal is to simplify the configuration and use of the network more and more. [Interview 2, ninux member]
  >
  > Now we are experimenting with OpenWisp 2, which greatly helps in managing and configuring the network. In this way, the team of technicians will be less central. Configuration becomes easier. The idea is that you get a package for people: an antenna, a router, and simple instructions to connect to the network. In addition, technical issues can be managed remotely. [Interview 3, ninux member]

In ninux, the development and implementation activities of openwisp2 appear now to be quite crucial, as it would make infrastructure configuration and expansion much easier, thus making the network more inclusive for non expert people which have low technical skills.

3.11.2.5. The dilemma of inclusiveness

As described above, the management of the tension between the group of members who want to keep ninux as a "life-long" experimental network and those who, on the contrary, want to activate an organizational change in order to implement a more inclusive network is crucial in the definition of a sustainable internal governance framework. Based on the data collected during the interviews, some main elements need to be taken into account for helping the process oriented to shape a more inclusive community network, in which both expert and non-expert members can cohabit.

The first one concerns the implementation of web services within the network, as well as and other online resources perceived relevant to the local community in which the network is integrated. As some ninux participants argue:

> Nowadays, we can no longer distinguish a community network that offers an Internet access, from a community network that refuses to integrate web services. With this dichotomy in mind, we risk to disappear. We have defended this idea for so many years, but honestly it did not work. The

[11] http://www.ninux.org/telegram
[12] https://trello.com/b/YTyT16e9/nnxx-ninux-experimental
[13] http://ml.ninux.org/mailman/listinfo/ninux-dev

> constitution of a formal association, in the sense of a collaborative ISP, could help to revive the community. [Interview 1, ninux member]
>
> Definitely, we have to recognize that if you want to involve people who are not experts, citizens, general public you can not offer nerd services. The 90% of what a person wants to do is on the Internet. [Interview 3, ninux member]

Alongside the possibility of formalizing ninux as a legal association, a second crucial aspect concerns the organization of more inclusive discussion meetings, which address not only technical issues, such as external communication, the political nature of the project, modalities to perform alliances with external stakeholders, and so on.

3.11.2.6. Facing the gender bias

With regard to the issue of building a more inclusive community network, the so-called gender bias appears to be a crucial issue. In fact, the ninux community is composed almost exclusively of men:

> There is a basic problem, here at ninux, about the fact that the basic skills you need to get into the project are distributed in a very uneven way. Most of the people you meet with technical skills are men. Then, the scant of women is a problem that I have heard discussing in ninux, as well as in other European community networks. [Interview 1, ninux member]

In general terms, within CNs in which legitimate participation is primarily considered as an experience in learning and sharing technical skills, gender bias can be particularly pervasive. In this regard, the low presence of woman in ICT training programs and jobs represents a phenomenon that has been documented over the last years. A growing body of research has pointed out that nowadays ICT field is largely populated by men, and it defines a techno-scientific domain in which women are excluded (Lagesen, 2007; Hill, Corbett and Rose, 2010). At the same time, gender bias in ICT is not simply a matter of formal educational trajectories, as it is pervasive also in grassroots organizations, affecting voluntary work such as that required by community networks.

Many recent studies have stressed that ICT is publicly perceived as an emblematic male field, towards which women manifest disaffection, or disinterest [57] (Cozza 2011). These investigations highlighted that disaffection and disinterest are not contingent or attributable to biological features, but are rooted on several external factors such as the concrete experience with a techno-scientific culture that women feel distant from them, as well as negative experiences with teachers, peers and educational programs. Accordingly, within CNs it may be crucial to promote happenings and events in order to foster the relationships between women and ICT, thus to reinforce their active participation. In this sense, it is crucial to provide resources and support for participation for women in male-dominated spaces. At the same time, these events can be relevant also for male members in order to unveil and critically deconstruct the hegemonic masculinity, so as to shape relational spaces within which gender differences can be considered as relevant aspects of inclusion. A virtuous example of active intervention to attack gender bias in the ICT and computing fields is represented by "Django Girls"[14], a grassroots non-profit organization which is engaged in empowers and helps women to organize programming workshops by providing tools, resources designed with empathy.

3.11.3. Lesson learned: elements to project ninux into the future

Based on what has been argued in the previous sections, it is possible to distill and present point-by-point the most relevant elements that should be actively taken into account in order to empower and enhance in sustainable way ninux internal governance.

- Building a formal association and a clear accountability system, such as the submission of semi-annual reports to be discussed within the community at large. In doing so, it is crucial to start a participatory

[14] https://djangogirls.org/

process, animated by all the various components active in ninux, so as to define an organizational backbone that respects the plurality of voices which compose ninux (more details in sections 7.2.1; 7.2.2 of this report);

- Introduce a system of valorisation of voluntary work and support an inclusive participation in the network that not only recognize technical skills, but all the activities that are collateral to the development of the community, such as the organization of public events; public communication and public relations with the external stakeholders. Introduce self-assessment questionnaire to assess community for both mission compliance issues and achievement of the goals. (more details in sections 7.2.3);
- Development and strengthening of a clear and effective system of incentives (more details in sections 7.2.3 of this report);
- Organize more inclusive face to face discussion groups. Promote happening and events in order to foster the relationships between women and ICT, thus to reinforce their active participation (more details in sections 7.2.5; 7.2.6 of this report);
- Improve external communication by enhancing the website (more details in sections 7.2.4 of this report)

3.12. FFDN: the case of FDN and Teutraneutral

In this section we focus the attention on the FFDN (French Data Network Federation), a federation of 28 CNs operating across France (plus one in Belgium), with about 3000 adherents. FFDN was founded in 2011, and following some global events affecting the digital rights debate (e.g., WikiLeaks Cablegate, of the Arab Spring, important debates on copyright enforcement like ACTA or SOPA), many volunteers actively engaged in French CNs started to motivate people to build their own local networks, or a do-it-yourself ISPs. In this sense, rather than building a single centralised organization, CNs French activists decided to coordinate their common action in a very loosely centralized way, by creating a federation of many local non-profit do-it-yourself ISPs. All FFDN members are formal organizations operating under the French 1901 law on the freedom of association. All the associations gathered within the federation are non-profit ISP sharing common values: volunteer-based, solidarity-driven, democratic and non-profit working, defense and promotion of net neutrality. In this sense, the FFDN is oriented to coordinate its members within the public debate about Internet democracy, freedom of expression and net neutrality, by providing resources and tools to grow and address issues surrounding their missions as collaborative ISP.

In general terms, members of the FFDN differ between one another with respect to the provided services. Some CNs offer ADSL access, others implement their own local loop by providing Wifi access in areas where ADSL or cable access is lacking, others still target a specific population to deliver local services. In addition, some charismatic spokesmen of the board of the Federation are actively engaged in the public sphere to defend freedom of expression on the network, neutrality of the network, involvement of users in management of the network, spreading of knowledge about the inner workings of the Internet: an ensemble of activities aimed to support the development of a more democratic and pluralistic Internet network. In this sense, FFDN members are actively involved in different activities, both on regulatory and political level. Concerning the regulatory level, FFDN members monitor the work of French regulators (Autorité de Régulation des Communications Electroniques et des Postes - ARCEP) in order to assure the protection of Internet users against any abusive or overbearing position, thus to assure the neutrality of the network at large. On the political side FFDN interacts with the sphere of political representation, and in particular with political parties (both at national and European level) in order to orient policy-making processes in a consistent way with the foundational values of the federation itself. Finally, FFDN support public engagement of citizens with the aim to develop a critical views of Internet, putting into light the power relationships embedded in our “network society”.

Concerning the internal governance, as it has been highlighted in deliverable number D1.2 (Report on Existing Community Networks and their Organization), FFDN’s principles rely on three different texts that provide a general framework for internal governance:

- by-laws, in which the organizational pillars of the federation are formalized;
- internal agreement (reglement interieur), where operating rules are formalized;
- charter of good practices.

People sitting on the boards of FFDN's CNs must be unpaid volunteers. For the proposes of this report, we selected two of the most representative CNs which have co-founded FFDN: French Data Network and Tetaneutral.net.

3.12.1. The outside view

The overall outside view of FFDN considering what is common for most if not all local communities is as follows, based on interviews with several key participants, and outlined in Fig. 3.13.

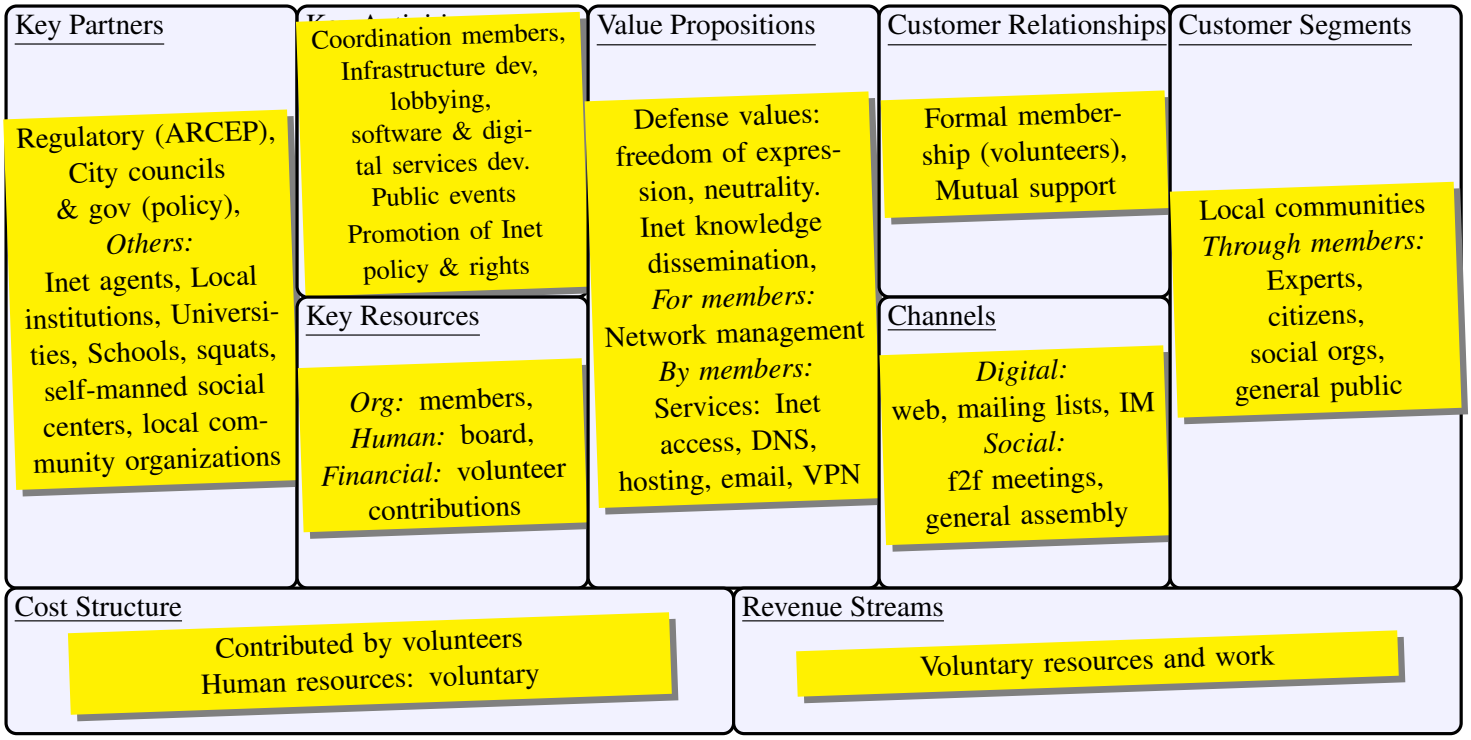


Figure 3.13: The canvas outside view outline of the FFDN umbrella structure

The next subsections describe the organizational model and internal governance tools of two member organizations: FDN and Tetaneutral.

3.12.2. Organizational Model and internal governance tools: How to be a member of a deterritorialized community?

French Data Network (FDN) has been founded in 1992, and it represents the oldest French CN. At present, FDN provides ADSL connectivity with a static IP address at a national scale on last-mile landline infrastructures leased from Orange and SFR, two of the major French telco operators. In this sense, FDN does not have a strong rooting in a specific local context or city, as it offers its services across all national territory. In this regard, FDN can be considered a deterritorialized CN with peculiar internal governance process oriented to ensure the coordination of its geographically dispersed members. Along with Internet access, FDN offers also an ensemble of services embedded in the network, such as domain names (fdn.fr, fdn.org); public DNS servers; e-mail services; hosting of mailing lists; VPN encrypted tunnels. During the first years of activity, FDN

was mainly involved in offering a low cost Internet access service. However, few years after its foundation, FDN started to frame its principal activity related to offer a low-cost Internet access within a wider political framework concerning civic engagement about digital rights. In this way, FDN has been recognized as one of the main French public political actors within the debate about net-neutrality and democratization of digital communication technologies:

> In France, in the early 1990s, FDN was one of the few organizations that offered an Internet access. Obviously, there were other commercial ISPs, but they were much more expensive than FDN. However, at the beginning there was no clear political vision behind the project. Therefore, the political visions, the values, the principles that now you can find also in FFDN have matured over time. This has happened as a form of collective response to the first attempts finalized to regulate Internet access by the French authorities. Since 1996 our politicians started to regulate Internet access, without realizing what the Internet was... anyway, their Internet model was not our model. Thus, we felt the need to intervene in order to prevent the implementation of unfair regulations and laws. [Interview 4, FDN member]

As it clearly emerges from this quotation, FDN has gradually enacted a process of politicization of the community. Therefore, the community's activities have been gradually articulated within a political frame inspired by the global debate on net-neutrality, digital rights and, more generally, the freedom of expression. The political positioning of FDN is also clearly set out by means of some "highlights" put in evidence in the home page of the web site.

> We are aware of the political consequences, as well as social implications, induced by the introduction of Internet in our lives, in our societies, in our political systems. FDN supports and participates in a number of citizen initiatives related to the defense of fundamental human rights, especially in the digital domain [FDN web site - https://www.fdn.fr/]

This process of gradual elaboration of a common political identity has allowed expanding the membership base to over 500 members until now. In more detail, through the development of a shared and persuasive political backbone – in which the community project has been deeply rooted – it has been possible to recruit people who are not only interested in the Internet in itself, such as lay people and concerned citizens engaged in the protection of freedom of expression. In addition, it is important to highlight that several key members of FDN are not using any service provided by the community, as they joined the association as a form of political activism in the field of digital rights. Thus, most of the FDN adherents have become aware about community activities through a word-of-mouth: a kind of "snowball" recruiting technique occurred in geek milieu, and in others socio-political circles and associations related to the protection of human rights and ecologist activism. Potential adherents may follow the instructions on the FDN website in order to join the community formally. In this respect, joining the association is not a mere formal procedure of signing an agreement; on the contrary it represents a crucial step through which people embrace a larger political covenant of engagement within the community. As it has been declared in the FDN website:

> When you join our community, you may actively support it, thus to give more weight to its actions. Above all, it is crucial to be interested in its functioning, receiving and reading the minutes of the various meetings, voting in the annual General Assembly. In this way, you can be more and more actively involved [FDN web site - https://www.fdn.fr/asso/adherer/]

This citation highlights how adherents have to translate their initial motivations that have pushed them to join the community in a daily engagement within it, thus enabling an active commitment with the broader political project. Given this state of affairs, one of the foundational value of the FDN relates to the centrality of shaping a community with a widely shared longing for sociability, also mediated by various communication tools. Here, members are conceived as part of a social and political community (or a "militant structure" as argued by some FDN members) and not as a mere users / consumers of a service:

> For our community subscribers are not users, are not numbers. They are part of the community:

> they are the community. For instance, the letter of convocation of the annual General Assembly is sent by the president of the association by postal service. It's not simply a standardised e-mail. The president always tries to customize the letters for each member with a specific message, or a simple greeting. We must always remind to ourselves that the community is composed by real people. [Interview 5, FDN member]

Despite the geographical dispersion of the FDN members, this latter testimony highlights the continuous efforts in building an inclusive community of proximity – founded on a common political aspiration – in which it seeks to support social interactions and commitment. In this sense, FDN's political values and visions represent a sort of "ubiquitous context", an "imagined political land" that replaces the local physical context that CNs members traditionally recognize as their environment of action. More in details, FDN gathers a "concerned group of people" pooled on a common set of technical and political motivations. The boundaries existing between "members", "end-users," as well as between "political activists" in the field of digital rights and "geeks" fade. In this sense, FDN represents a CN in which political visions and values, the technical development of the network, as well as the members commitment, are tied in a dynamic of mutual configuration. Thus, the concerned community can be considered as the emerging outcome of a set of heterogeneous activities performed on the political level, on the level of the daily management of the association (i.e. financial management, public communication and so on), but also on the technical level, thus to make the network actionable and reliable. The wide heterogeneity of community-led activities reflects the characteristics of the FDN members. As one participant argues:

> Within the FDN, there are different kinds of members. There are those who are in the community to benefit from the Internet access. These people have chosen FDN, and not another commercial ISPs, not only for economic reasons, but also mainly because they share our political values on which the community network is built, such as the net-neutrality. There is also a technophile population because we offer peculiar services that other operators do not offer. Then, geeks have also adhered because they just want to pay for an Internet access. They are not interested in the proposals of the other commercial ISPs who, in addition to the Internet, offer you a subscription to TV, cell phone and so on. So, with the commercial ISPs you risk to pay for something that you will not use, like a TV [...]. Then, there is a population that is not geek: graphic designer, professors, concerned citizens, and so on. Ordinary people. We offer the Internet in a way that matches their values. They are people who support our values. [Interview 6, FDN member]

As it clearly emerges from this quotation, FDN represents a plural community in which the active participation of different types of members is recognized and encouraged. This aspect is made possible thanks to a political and organizational work aimed at building a clear mission, articulated in objectives broadly shared by the members base. At the same time, as stated above, the high geographical dispersion of the community constitute one of the main challenge for the definition of an effective internal coordination:

> In FDN, one of the biggest problems is that we are all scattered now over France. Therefore, it is necessary to coordinate the action of the most active members via phone meetings, thus to work together. But this kind of coordination is possible only with people who know each other well. But if people do not know each other well, it's very complicated to have clear, precise speeches by phone. Therefore, one of the most important challenges is to find ways for people to meet more often, regularly. We are trying to do this because it is very difficult to work for the community without regularly face to face meeting. [Interview 4, FDN member]

Over time, FDN has defined a set of governance tools aimed at shaping an effective internal coordination, this to address the challenges posed by the territorial dispersal that characterizes the community. These tools, which will be analysed in the next sections of this report are: a by-law, internal regulation, the association board and the working groups.

3.12.3. Internal Coordination

3.12.3.1. By-law and internal regulation in FDN

As pointed out in the Report on Existing Community Networks and their Organization (Deliverable 1.2) [1], all CNs affiliated to FFDN have to be act as "formal association" formally recognize by the French 1901 law on the freedom of association. In this regard, the FDN has two internal governance tools that serve primarily as internal conflict resolution devices:

- *The by-law*[15]: it is a formal document, online available in the website of the association. The statute dates back to 1998. Minor changes have been made recently. It is composed by 16 articles devoted to formalizing aspects related to the goals of the association, how to become members, the conditions under which a member can be excluded from the CN, the functioning of the general assembly, the internal functioning of the boards of the association, and so on. The by-law is the first document to be submitted to those who want to adhere to the FDN. However, as argued by some members, the by-law is not considered a relevant governance tool for the daily management of the association, since the informal agreements negotiations occurring among the most active members seem to be much more cogent. The lack of cogency of the by-law may also related to the fact its fundamental sections have remained unchanged since 1998, while FDN being gradually transformed both in terms of services offered, as well as in terms of internal organization and general mission. As it has been argued by an FDN member:

  > In the by-law you can read: "The aim of the association is to promote, use and develop the Internet and Usenet networks in a ethical way, particularly by favouring research or educational purposes without commercial goals." Today, all people know Internet, so our goal is no longer to divulgate Internet for research or educational purposes. For example, our political engagement for the net net-neutrality does not appear in any way among the goals of the association. [Interview 5, FDN member]

  As it emerges from this quotation, in FDN there is a gap between what is formally stated in the by-law and what is pursued in practice by the association in terms of mission and objectives. This aspect is not particularly problematic, as in community organizations like CNs the informal agreements tend to go far beyond what is stated in formal documents. At the same time, a better definition of community goals could be helpful, thus to render the public communication to external actors and stakeholders more transparent and consistent with the community life.

- *Internal regulation:* it is a formal document (online available in the website of the association) [16] dating back to 2015. It is organised around 13 articles devoted to formalise a set of fundamental organizational rules. Conceptually speaking, the internal regulation represents an operationalization of some of the general principles contained in the by-law. Thus, this document details the terms of membership in FDN, membership fees, the terms of service delivery and technical support, member responsibilities, and so on. As it has been argued by:

  > The internal regulation, as well as the by-law, may be useful in case of stronf conflicts. In general, they are not important. When there is a conflict, these two documents may offer the possibility to figure out how to move forward, how to act. In everyday life these texts are not important. The important thing is to be able to find consensus on general decisions. That's all. The important thing is to avoid conflicts. However, these two texts can help us if we are to handle a complex situation. They can be an escape route in case of complex situations. [Interview 5, FDN member]

  As in the case of the by-law, the internal regulation is not particularly central in the management of the daily life of the association. On the contrary, it represents, together with the statue, a document that is

[15] https://www.fdn.fr/statuts.pdf
[16] https://www.fdn.fr/reglement.pdf

used as the last resort in case of conflict resolution.

3.12.3.2. Decision making: the board of the FDN

The board is the central organ of the FDN. It is a formal working group composed by the president, the vice-president, the secretary and the treasurer. All these members are elected each year by the General Assembly of the FDN. Alongside the four elected members, there are about ten people in the board who collaborate in the day-to-day management of the association. The board is the main body of government and management of the FDN, and it is responsible of several duties, such as the ordinary administration of the association; the definition of new projects and strategies oriented to recruit new members, as well as facilitate the internal coordination among members. At present, the internal coordination of the FDN board is particularly complex:

> The board is composed by people that are dispersed throughout France. So, it is important to find a way to organize face to face meetings. There are members of the board who almost never meet. Now, we are trying to organize two, or three face to face meetings per year, thus to allow the members of the board to know each other better by working together during few days. [Interview 4, FDN member]

Until 2014, board members resided in Paris, and for this reason the internal coordination of this organ occurred mainly through face-to-face meetings. However, since 2015 board members live in diverse cities quite distant from each other. This aspect implied a transformation of the board internal coordination arrangements, forcing members to coordinate its action through telephone meetings. In a similar vein, –as we have shown before– the coordination among the different ninux "islands" has been characterized by the same problem related to the geographical dispersion; thus ninux members are now using IRC to discuss issues which are of potential interest for the national community at large, and not only at the local level. Regarding FDN, the board was oriented towards the organization of a telephone meeting once a month, in order to face the diverse issues that have been put on the agenda by the volunteers of the association. Therefore, the role of these meetings concerns the assessment of the community activities, in its organizational and technical dimensions, thus to ensure the sustainable functioning of the network. The minutes of the board meeting are then distributed by e-mail to all the members of the association. One of the main crucial duties in charge of the president concerns the writing and sending to the FDN members the reports about the functioning of the community:

> The most crucial report is done every 6 months, and it allows to share the prospects of the medium / long term regarding the evolution of the community. This report is the result of the president's reflections, and it is sent to all members by e-mail. This report seeks to assess the internal dynamics of the community, as well as its possible developments in terms of projects that need to be undertaking, or stopped. Usually, there is not a debate around these reports. [Interview 6, FDN member]

The reports drawn up by the president represent the main form of public accountability of the association's activities. However, as it emerges from the last testimony, the communication of the reports is rather unilateral. From this point of view, it would be convenient to stimulate members to discuss the contents of the report and, at the same time, shape ways for collaborative writing of the reports, so to empower the most active members of the community. In addition, implementing a collaborative accountability process could help to make the work of coordination performed by the board more visible, as well as less dependent on the role of the president. In fact, even if the board is composed of about 15 people, in FDN the decision-making process and responsibilities are traditionally centralized around the president. However, it is important to note that this aspect raises complex issues with regard to the sustainability of the community's internal governance. As one participant states:

> One of the most complex issues concerns the replacement of the president, or to find another person who is able to perform the role of president. For example, currently the new president starts to be

> very effective and, at the same time, it is much more difficult to replace him. For example, we have had tremendous difficulties in replacing the old president since there was no one who had the proper skills, both organizational and administrative. [Interview 4, FDN member]

This testimony puts into light that FDN has traditionally adopted an internal governance model characterised by a high degree of centrality of the president, whose authority derives from its organizational and managerial skills. In this regard, it seems appropriate to adopt an organizational model that can help to redistribute responsibilities within a management team, so as to activate a collective learning process and sharing of the most relevant skills required for an effective management of the association. More specifically, it is crucial to support an internal governance model characterized by a plural leadership, as an emerging outcome of a team's joint work. This approach can strengthen internal democracy, by improving participative decision making, supporting high turnover in leadership (i.e. less oligarchy), and favouring low hierarchy (i.e. fewer levels of leadership).

3.12.3.3. The working group in FDN

As it has been described in the previous section, the board represents a formal working group that has the main task of coordinating community activities and ensuring its sustainable development. As in the case of ninux, FDN's activities are based on the voluntary work performed by the members.

> If anyone wants to do something for the association, then we motivate him. We get him in touch with the working groups. The reference point is represented by the working groups: if you want to work on technical issues you have to go to the technical group. If you want to work on communication activities you have to go to the communication group. Finally, if you want to work with the treasury you have to go to that group. [Interview 5, FDN member]
>
> The working groups are self-organized. There are those who handle the technical dimension of the network. Those who run public relations: people who speak in public on behalf of the association, and so on. Each group is organized spontaneously. [Interview 6, FDN member]

FDN is articulated through three main working groups, each one covering a specific area of intervention: i) the management of the technical infrastructure; ii) the management of the external communication, i.e. website management, public relations, and so on; iii) the financial management of the community. In this respect, the overall approach regarding the management of the FDN community adheres to the so-called "do-it-yourself-ocracy". This approach in managing communities' life implies a cooperation among members, which can acquire a specific role in relation to their expertise, competencies, and kind of task in which they are involved, rather than through formal process of nomination (Dulong de Rosnay, 2016; see also section 3.10.1.2 of this report). The organization of the voluntary work within three different working groups represents a valuable strategy to foster the building of an inclusive community, as it allows valorising not only the technological skills; but especially the so-called "soft skills" required in the internal governance of the community life. The internal coordination of the working groups occurs mainly through face-to-face meetings, or via online communication tools. Overall, the three working groups gather about forty volunteers, which are the most active members of the community. As we have argued before, the most active members of the community are adherents that strongly share the political values of FDN. According to some key members, in FDN the technological dimension is strongly subordinated to the political and organizational level, thus favouring the inclusion of members who do not have strong technological skills:

> The technological dimension does not play a central role: it's just a tool we need. For example, for us it is very difficult to work with technophile people, which do not share our political vision. [...] During our meetings, or discussion in mailing list we never talk about technological questions in itself, but rather about political and organizational issues related to our community. In this way, all people can feel comfortable within the discussions. [Interview 6, FDN member]

However, although the structuration of the voluntary work within working groups seems to be a suitable strategy to coordinate the efforts of volunteers in a efficiently and virtuously way, the issue of how to recognize and make visible the free work performed by members represents a crucial issue:

"One of the biggest problems is the difficulty of making volunteers' work clear. You need to share more information. If you share the information well, then you can make a more active participation because the participants are aware of the community how it works. [Interview 6, FDN member]"

This testimony highlights how working groups can be perceived as narrow niches, which doesn't help to render publicly accountable and visible the voluntary work. As in the case of ninux, the integrity of the community can be jeopardised in case of non-recognition of the member's contributions. At the same time, this problem is less evident in FDN, because the set of informal incentives (sociability incentives; purposive incentives; service incentives; informational incentives; lobbying incentives; utilitarian incentives) described in the section 3.10.1.3 of this report is quite effective. In this regard, it may be useful to stimulate the working groups to produce semi-annual reports through which present and discuss their internal activities, problems, as well as the objectives that have been achieved, to the overall community.

3.12.3.4. Internal Governance tools

FDN members have developed several governance tools oriented to manage internal governance, as well as external communication:

- *The General Assembly:* it is one of the most important face-to-face meetings of the community, which takes place every year in Paris. During the General Assembly, which is attended approximately by seventy people, members discuss the general situation of the community, its projects, development lines, financial situation, and so on. During the assembly members of the community elect the board members of FDN.

  > Historically, the general assembly occurs in two days: a first day of formal debate, and a second day in which a collective discussion about specific topics takes place. However, this year we decided to change the organization of the first day. Previously, the board supervised the discussion, and answered the questions arising from the adherents. Instead, this year, we've asked to some persons expert in civic engagement techniques to help us to have a more horizontal discussion, thus to bring out member's expectations, criticalities and so on... [Interview 6, FDN member]

  As it clearly emerges from this last testimony, the general assembly can be considered as the most important accountability tool, during which the CN can be collectively assessed. Alongside the general assembly, internal online pools are sometimes used to gather the opinion of community members on specific issues that affect the life of the community. Overall, these two tools allow the board to maintain a bond not only symbolic, but constructive, with a geographically distributed CN. For this reason, it is quite crucial to support a broader participation of members in the General Assembly, as they can contribute to enact a participatory evaluation context by providing relevant information that is useful to program board since it is grounded in the situated everyday experience of the adherents. Rather than receiving an outside evaluation report (like that sent via e-mail by the president every six months) participating in the General Assembly can strengthen the sense of community and the members' commitment to the mission. Since the objective of CNs is to empower a responsible citizens participation in the digital society, structuring the General Assembly as a participatory evaluation momentum with the highest possible participation of members seems to be particularly appropriate.
- *Mailing Lists:* FDN has set up different mailing lists. The most important one is called "ag@". This list gathers all members of the association, who are automatically subscribed when they join the FDN. The subscription to this list is cancelled when a member leaves the community. The board use this mailing list to disseminate the reports, minutes of the meetings, relevant information, and so on. This

list does not include a moderation mechanism and all members are authorized to send messages. A second relevant mailing list is called "bistro@", within which discussions and debates on specific issues related to the community take place. The mailing list called "benevoles@" is open to all interested people, thus non-members of the community can participate in the discussions about the actions and development of the FDN occurring within this list. For this reason, the list benevoles@ represents one possible "entry point" to the community. Finally, each working group has set up its own mailing list (such as "tresorier@"; "support@"; "adminsys@") within which the discussions about communication activities, technical support and financial management take place.

- *Internet Relay Chat meeting (IRC):* it represents the tool used by the FDN's geeks to discuss technical issues, not necessarily related to FDN. At the same time, this chat is the main mode through which new technophile members are recruited;
- *FDN information system:* FDN has set up a complex information system that allows to manage provision of network services to members, to monitor the financial resources of the community, as well as to manage reimbursements to members who have incurred expenses for the community, and so on;
- *Network Monitor Tool:* The technical working group has set up a real-time monitor of the infrastructure and of the various services. The monitor is online available.[17]

3.12.3.5. Facing the gender bias

As we have seen in the previous paragraphs, over the last decades FDN has developed an interesting inclusive model of internal governance based on the coordination among different working groups, which allow the active participation of adherents with very heterogeneous skills. More in details, the administrative management of the CN, external the communication, as well as the financial management are considered as critical tasks for shaping a sustainable community. The legitimacy of these heterogeneous skills has undoubtedly favored a female presence within the community, as well as within the board. However, as in the case of ninux, the masculine culture in ICT is an issue that affects also FDN:

> FDN is a male environment, and it may be uncomfortable for women, due to sexist dynamics. [...] You know, there is a sexist culture in the ICT field. The prejudice concerns the idea that men are always good in technical activities, and women are never good enough. Obviously, this is not true. Women are competent. But often this is not recognized. [Interview 5, FDN member]
>
> Women, sometimes, are involved in managing internal conflicts, as well as suffering situations. They are the only ones that carry out a relational activity which is a sort of care activity. It is a fundamental emotional work, but at the same time invisible because it is mainly done in private. [Interview 6, FDN member]

These two testimonies highlight the need to promote actions, in the form of internal workshops, oriented to critically deconstruct the dominant masculine culture, which tends to marginalize the participation of women in CNs, by relegating them to "care activities" and other practices in which soft skills are required. As in the case of ninux, these events can be relevant both for male and female members in order to unveil the hegemonic masculinity, so as to shape relational spaces within which gender differences can be considered as relevant aspects of inclusion.

3.12.4. Lesson learned: elements to project FDN into the future

Based on what has been argued in the previous sections, it is possible to distill and present point-by-point the most relevant elements that should be actively taken into account in order to empower and enhance internal governance in FDN:

[17] https://isengard.fdn.fr/

- Introducing a more effective strategy of accountability in the form of participative writing of the reports. In more detail, this practice of accountability should be conducted through the active involvement of the working groups members, so as they can directly present their activities to the community at large. A positive consequence of this form of public accountability lies in the possibility to render the voluntary work performed within working groups much more visible to the community adherents;
- Redistribution of responsibilities and duties which are centralized in the hands of the president within a more larger team of members, thus to enact a process of learning of the organizational competencies required in the ordinary management of the community. More in detail, it would be appropriate to promote an organizational model based on distributed leadership. In this way, the activities related to the core work of the community oriented to influence the motivation of the adherents, support their active engagement, perform internal coordination, define strategies of accountability may be horizontally shared among a plural team of members. In this way, the most crucial skills required to sustain an effective internal governance can be learned by more individuals, thus to render the turn-over of the board's members more sustainable;
- Promote happenings and events in order to foster the relationships between women and ICT, thus to reinforce their active participation;

3.13. Tetaneutral.net: foundation, development and motivations

Tetaneutral.net (hereinafter TN) is a community network located in Toulouse, officially founded in 2011. The main founding drivers of TN concerned the promotion of the use and development of a neutral Internet network for scientific, social, scientific and cultural purposes. In addition, TN is actively engaged in promoting the public understanding of Internet – in its social and cultural implications – in order to defend the neutrality of the network. As it has been declared in the TN website:

> In order to promote the public understanding of the Internet, the association tetaneutral.net has decided to become a full member of Internet network by exercising the functions of Internet access provider and Internet hosting, in the form of not-for-profit organization. [...] Tetaneutral.net will explain and defend the neutrality of the internet network. [TN web site - https://tetaneutral.net/]

This quotation highlights how TN, from the very beginning, has oriented its action not only in providing an Internet services, but rather animating the political movement of CNs engaged in the defence of digital rights. More in detail, TN is emerged as a local spin-off of FDN, which together with "Toulouse sans fil", represented the historical CNs active in Toulouse:

> Tetanuetral is born thanks to the contribution of some FDN members, which pushed us to build a new local community network. Already in 2009, in Toulouse there were several FDN members. So, these people have founded tetaneutral. From the beginning, we had a lot of luck because we were looking for a place to install the first network machines and we met some activists engaged in the squat called Mix'art Myrys, who gave us the availability of their premises. Initially, we started adding an Internet access in all the squats of Toulouse. [...] However, currently among our adherent we have also some local private companies. These companies are TN members because we offer a better connection than that offered by Orange [the biggest French multinational telco corporation]. In Toulouse, TN community network works better than that of Orange. Finally, we have also extended the network to the countryside, in areas where Orange is not interested in offering Internet access because it is not economically profitable. [Interview 7, TN member]

As it has been already documented in the deliverable 1.2 about "Existing CNs and their Organization (v2)", TN started to provide an alternative Internet access to the citizens of Toulouse, thus competing whit commercial ISPs that offered Internet services limited to 512K in several parts of the city. Its coverage soon expanded in

many rural areas in the surroundings of Toulouse that previously did not have access to a quality Internet connection. Thanks to the initial technical and organizational support of TN, people residents of these rural areas have built their own local CNs. In this sense, TN has had a key role in motivating diverse local communities to shape new independents CNs, so as to face the digital divide that traditionally affected rural areas surrounding Toulouse. Therefore, it is important to point out that the need to tackle the digital divide problem has been a motivational element of utmost importance in supporting TN work oriented to spread CNs models outside urban boundaries of the city of Toulouse. In addition, TN is now also cooperating with some municipalities surrounding Toulouse in order to extend the network. For instance, recently the city council gave to TN the permission to access to a pole located in a public area in order to install an antenna. In exchange, TN brought a high speed Internet access to the local elementary school. Finally, TN started to work with a clinic specialized in providing healthcare to homeless people, many of which are migrants, thus they may have online interactions with their families residing their home countries. After 6 years of activities, TN now counts 615 members, including over 400 individual and collective subscribers, such as voluntary associations, squats, counter-cultural spaces and private companies. In general terms, TN can be interpreted as a successful CN, as it has been able to expand considerably its network within a relatively short time-span. More recently, a further element that allowed TN to enlarge the members base is related to the fact that the community is now offering an Internet access via optical fiber, thus gaining competitive advantage on the technological level with other commercial ISPs, such as Orange. With regard to community participation, it is possible to identify different elements that motivated people to join TN:

> Currently, there are members who are active because they have a lot of fun in doing technical activities. For example, we are able to offer services that commercial Internet operators do not offer. There are also the militants who joined TN for political reasons, and they may have less technical skills. They are people who want to be engaged in a project designed to provide the internet to people who really need it: migrants, poor people... [...] Thus, of course, there are people who joined the association because we are able to offer a good and low cost Internet connection. [...] Indeed, we have an indicative tariff plan, but people can pay what they want in relation to their economic condition. So, students or unemployed people can have a good Internet connection at a very low cost price. [Interview 7, TN member]

This testimony reveals three different level of motivations that may orient people to join TN community: the first one concerns the technical motivations, related to the possibility to benefit from particular network services developed by the community, such as the hosting of virtual machines; the second one concerns the political motivations, which relies to the desire to be engaged in a wide project oriented to ensure an universal access to digital communications; the last one regards the economic level, and more particularly the possibility to benefit from a low cost high speed Internet connection. Concerning the economic reasons behind the subscription to the community, TN has implemented an interesting fees management policy, which in the medium term has proven to be sustainable. More in details, TN has provided an indicative pricing tariff for the main services offered to both individual and collective entities, such as associations, squats and private companies. However, individual subjects have the freedom to independently decide the monetary contribution to be offered monthly to the community in relation to their specific economic situation. In this way, TN also provides Internet access to people with very low incomes, such as precarious workers. This aspect is closely related to an important organizational value, which characterized TN community. As it has been argued by a TN member:

> I believe that the fundamental value that drives people to collaborate in tetaneutral is the need to bring Internet where it is needed, to give Internet to those who need it. This is why we bring Internet to the countryside, or we connect squats, or we offer a low-cost connection to the poor. The poor are those who have more difficulty in building and maintaining social relationships. [Interview 7, TN member]

This specific approach in managing the financial aspects of the community renders TN a project with a strong social impact: a community organization articulated around voluntary collaboration between people, which

joined their forces with the aim to ensure the universal access to digital communication. Here, it is worth pointing out that a fee management policy that leaves great autonomy to members (such as implemented in TN) can generate free-riding behaviours. However, despite the financial resources of the community derive exclusively from members' donations and fees, the financial management strategy chosen by TN has proven to be sustainable until now.

3.13.1. Internal coordination and communication tools in tetaneutral.net

TN members have implemented several governance and communication tools oriented to manage internal coordination, as well as external communication:

- *Face-to-face meetings:* every week a social dinner takes place in a local restaurant during which TN members discuss about technical, organizational and political issues of the community. Social dinners represent the most relevant moment of horizontal discussion within the community. Currently, these meetings are attended by a low number of members;
- The General Assembly: it is one of the most import face-to-face meeting of the community, which takes place every year. The last General Assembly took place at the Mix'Art Myrys squat on May 2017 with the participation of 34 adherents. This last assembly was organized around two different parts. The first one, more formal, devoted to approve the financial balance of the association, and to elect the board members of TN. The second part of the assembly was consecrated to discuss in more informal way - via collaborative workshop - around general situation of the community, its projects, development lines, and so on;
- *Mailing Lists:* TN has set up two main mailing lists, whose participation is completely open to all interested people. All discussions occurring in the mailing lists are stored online, thus to allow all interested people to retrieve information about a particular topic which has been questioned by the community. More precisely, a first mailing list is dedicated to host general discussions about organizational and political issues. A second mailing list is dedicated to host discussions about the technical development of the community, as well as to cope with technical problems affecting the network;
- *E-mail address:* concerning online communication, a subgroup of members is engaged in replying e-mails sent to the address "question@tetaneutral.net". This e-mail represents one possible main "entry point" to the community – both for potential members and general stakeholders (public authorities, journalists, others volunteer associations and so) – thus to provide information to interested people in more mediated way compared to the general mailing lists, where every members may answer to a potential the newcomers;
- *Internet Relay Chat meeting (IRC):* it represents the tool used by the TN's geeks to discuss technical issues FDN. At the same time, this chat is the main mode through which new technophile members may be recruited.
- *Website and social network:* the website of tetaneutral.net is collaboratively realized by the community. The community has also developed a social network page based on "Mastodon", a free, decentralized and open-source social network alternative to business platforms. The content of the website is presented around several sections consecrated to give information about: how to communicate with and join the community; public events organized by the TN members; kinds of services offered by the community and the related fees; political values; financial accountability; key events of the TN history.

3.13.2. Internal governance tools and decision making process in tetaneutral.net

All CNs affiliated to FFDN are formally recognized by the French 1901 law on the freedom of association. In this regard, TN has two internal governance tools:

- *The by-law*[18]: it is a formal document, online available in the website of the association. It is composed by 5 chapters and 19 articles devoted to formalizing aspects related to the goals of the association; how to become members; the conditions under which a member can be excluded from the CN; the functioning of the general assembly; the functioning of the boards of the association. The by-law is the first document to be submitted to those who want to adhere to the TN. In accordance with a testimony released by a key member of the community, the by-law is not considered as relevant governance tool for the daily life management of the association, since the informal agreements negotiations occurring among the most active adherents seem to be much more cogent;
- *Internal regulation*[19]: it is a formal document (online available in the website of the association) dating back to 2012. It is organised around 5 articles devoted to formalise a set of fundamental organizational rules. Conceptually speaking, the internal regulation represents an operationalization of some of the general principles contained in the by-law. Thus, this document details how the community services are offered; the adherence of the community to national laws and regulations; fees; network maintenance and technical services.

  As in the case of the by-law, the internal regulation is not particularly central in the management of the daily life of the association. On the contrary, it represents, together with the statue, a document that is used as the last resort in case of conflict resolution.
- *The board:* The board is the central organ of the TN, which can be considered as a formal working group composed by maximum 18 members. Within the board the main formal roles are: the president, the vice-president, the secretary and the treasurer. All the members of the board are elected each year by the General Assembly of the TN. Formally, the board is in charge of implementing the guidelines and decisions proposed by the general assembly, as well as to manage the balance sheet and the ordinary administration of the association. However, according to a testimony released by a key member of the association, the board seems to have a mere symbolic role:

  > Formally... in theory we have a board. However, the board has never done anything real. There are about ten active members who do things in everyday life of the associations. Currently, the problem is that the founder, which formally has been the president of the association for a long time, has decided to leave the association. He really did an extraordinary job until now, both organizational and technical. Now, we are trying to reintroduce a more formal board, thus to work in more collective way redistributing tasks and responsibilities. Tasks and responsibilities that so far were almost exclusively in the hands of the president. [Interview 7, TN member].

  This quotation highlights how the association's board has concentrated the decision-making process and management responsibilities of the association in the hands of the founder, thus discouraging the enactment of a horizontal division of tasks, duties, and responsibilities. At the same time, TN has been until now characterized by a low degree of active participation of its members base, as well as for a low level of internal coordination:

  > At the moment, me... but I can say all members.... I'm not able to say exactly who does what. It is difficult to recognize and quantify the work, and its content, performed by volunteers. We have never implemented an accounting system to quantify the voluntary work. It must be said that the historical president of TN has done a lot of things without any assistance for many, many years. He has extraordinary skills... so, for a long time he has consecrated himself to the association. Now, he has reduced the time he dedicates to the association... and for tetaneutral it's a huge problem. We need to find a way to replace it collectively. But, first of all, we are to learn from him how to do things.... [Interview 7, TN member]

[18] http://tetaneutral.net/doc/Statuts-tetaneutral-net.pdf
[19] https://chiliproject.tetaneutral.net/projects/tetaneutral/wiki/RI

As in the case of FDN, the figure of the president has been particularly central in ensuring the continuity and efficacy of the organizational and management processes of the association. However, this centralization of responsibilities in the hands of one member may prevents the implementation of distributed learning processes among an ensemble of members of the skills needed to manage and coordinate the everyday life of the association. Within TN the president / founder has performed most of the core activities without the support of other members. Therefore, it has been not possible to enact a learning process of core organizational skills, as well as an horizontal sharing of duties and responsibilities. From this point of view, it is seems crucial to implement a more structured and transparent division of roles and skills, alongside with the adoption of a model in which the voluntary work can be performed in collectively way. In this sense, following the organizational model adopted in FDN, the introduction of specific working groups involved in dealing a specific and circumscribe set of activities (i.e. technological activities, public relations, financial management) can be a useful strategy in ensuring a sustainable internal governance in the long term.

> Managing the change of president... the fact that the founder leaves the association represents complex issues. In tetaneutral there are people who have to work together, but they have never met. For example, there are many people who do not take part in the weekly social dinners, so they do not know each other. [Interview 7, TN member]

This quotation highlights the complexity to manage the transition from an internal governance model characterised by a high degree of centrality of the president, to a more distributed governance and decision-making process. In this regard, it seems appropriate to adopt an organizational model that can help to redistribute responsibilities within working groups, so as to sustain a distributed learning process and sharing of the core skills required for an effective management of the association. As we have already argued in the case of FDN, it is crucial to support an internal governance model characterized by a plural leadership. This approach can strengthen internal democracy, by improving participative decision making process and supporting a distributed leadership, thus to prevent the emergence of oligarchic dynamics or the concentration of the decision making process within restricted niches of members. Finally, another aspect to be considered with great attention in order to ensure a more effective internal coordination of volunteer activities concerns the implementation of a mechanism of public accountability of the free work performed by the TN members:

> Tetaneutral provides the infrastructure. The activities performed by people using the infrastructure are not a matter of concern for us. For example, there are people who develop and implement infrastructure services in total autonomy, and the most active members may be not aware of this new service. A person can implement a specific service, even without making a collective decision about it. At the present, tetaneutral deals exclusively with the infrastructure.[Interview 7, TN member]

Until now, TN has adopted an internal coordination model that offers great autonomy to the members of the association. At the same time, in order to ensure a sustainable and coherent development of the community in respect to its objectives and mission, it seems appropriate to introduce internal procedures, in the form of periodic public reports, oriented to strengthen the accountability of the activities of volunteers. In this way, it may be possible to recognize and valorize the plurality of activities that are being carried out on the infrastructure.

3.13.3. Facing the gender bias

Concerning the gender bias, during the research within tetaneutral.net we gathered some critical elements that are recurrent both in ninux and FDN, or rather the fact that the features and attributes of the community are biased due to the fact that a dominant majority of active members are male:

> In tetaneutral we have many problems in supporting women's active participation. People who do things, or which are interested in being active members, are mostly men. I think, it's a common problem in the whole IT field. Computer science is a context domintaed by men. It is a relevant political problem for us. But, it is difficult for us to deal with it. For example, when I organized public meetings, there were only men. [Interview 7, TN member]

As in the case of ninux and FDN, the masculine culture in ICT is an issue that strongly affects TN. As we have already argued, it seems to be crucial the promotion of positive actions, in the form of internal workshops, oriented to critically deconstruct the dominant masculine culture, which tends to marginalize the participation of women in CNs.

3.13.4. Lesson learned: elements to project tetaneutral.net into the future

Based on what has been argued in the previous sections, it is possible to distill and present point-by-point the most relevant elements that should be considered in order to empower and enhance internal governance in TN:

- Redistribute responsibilities and duties which were centralized in the hands of the president / founder within a more large team of members, thus to enact a process of learning of the core competencies required in the management of the everyday life of the community. More in detail, it would be appropriate to boost the effective functioning of the board, which it has been until now a mere symbolic organ. A possible strategy for achieving this goal may be the promotion of an organizational model based on distributed leadership, by introducing a system of division of task and responsibilities among the members of the board;
- Strengthen internal coordination and horizontal cooperation among the most active members. A possible positive action for achieving this goal may be the introduction of specific working groups (following the model adopted in FDN) involved in dealing a specific and circumscribe set of activities (i.e. technological activities, public relations, financial management). In this way, it will be possible to enact an horizontal process of learning of the core skills required in the management of the community network;
- Introducing a more effective strategy of accountability in the form of participative writing of the reports. More in details, this practices of accountability should be conducted through the active involvement of the most active members, so as they can directly present their activities to the community at large. A positive consequence of this form of public accountability lies in the possibility to give value to the voluntary work;
- Strengthen the active participation in face-to-face meetings. In particular, it may be useful, in addition to the social dinner, to plan a more structured monthly assembly, whose agenda must be established horizontally and inclusively through a mailing-list discussions;
- Promote happening and events in order to foster the relationships between women and ICT, thus to reinforce their active participation;

4. Synthesis

After the analysis in the previous section, including the identification of areas for organizational improvement, and the organizational framework in Deliverable D1.2 [1], here we identify several key **organizational patterns** that apply to CNs. These emerge from specific experiences and, after generalization, can be applied in re-engineering CN practices. We discuss this further in Chapter 5 and report on it in Deliverable D1.4 (December 2017).

The idea of defining organizational patterns for CNs originates from the idea of a *design pattern*, the re-usable form of a solution to a design problem [58]. Patterns can be expressed in a pattern language, a method of describing good design or organization practices or patterns of useful organization within a field of expertise. Organizational patterns [59] and pattern languages can help people think about, design, develop, manage and use information and communication systems that more fully meet human needs. An *anti-pattern* is a common response to a recurring problem that is usually ineffective and risks being highly counterproductive. This idea is well known and used in software design but also applicable to organizational patterns.

Here we apply the idea to describe a few of the most common and relevant organizational patterns and anti-patterns in CNs. This is work in progress that will be further developed in future Deliverable D1.4.

In fact, the patterns and anti-patterns identified cover most of the relevant elements of the generic internal view identified before, as Fig. 4.1 shows.

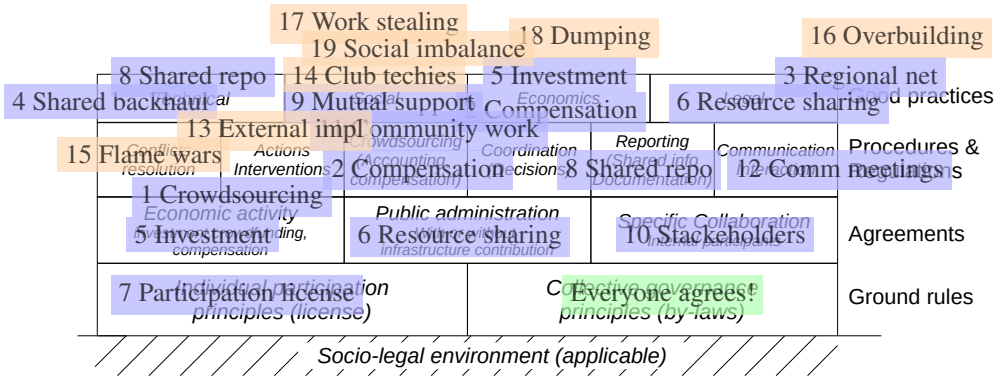


Figure 4.1: The mapping of patterns to the generic internal view.

4.1. Crowdsourcing/sponsorships (Pattern)

Problem: Solving an identified bottleneck in a network infrastructure that affects one group of participants.

Context: Community networks as they grow in an unplanned manner face bottlenecks that may be easily solved but depend on collective solutions that require contributions from several parties, particularly for solutions that benefit multiple participants (e.g. a village, region).

Discussion: Before crowdfunding became popular, many CNs implemented crowdsourcing efforts to expand networks. This is particularly relevant for backbone nodes, that are more complex and expensive to deploy, requiring more economic contributions but also expertise from different people. These network segments can bring benefits to a wider range of people that may be interested in contributing to the funding and deployment of improved nodes and links.

Solution: Once the bottleneck is identified and a solution agreed, a campaign is launched to collect contributions of economic, human and hardware resources with a soft or hard deadline. Once the objective is met, the contributions are collected and the solution implemented, and celebrated.

Example: guifi.net "apadrinaments" (sponsorships) in date, status, priority, contact, description, items, payment instructions (January, 2006). See Fig. 4.2.

References: [48]

Figure 4.2: Web summary of one of the oldest calls for crowdfunding in guifi.net for supernodes to cover key nodes in a village of the Osona county.

4.2. Economic compensation (Pattern)

Problem: Cost sharing, coordination of contribution and consumption, to achieve overall sustainability.

Context: In remote or less populated areas, the demand and its growth may not be enough for small communities and ISPs to have access to long distance links, and therefore be competitive with larger operators.

Discussion: Long distance links, particularly optical, have a high cost and may not be economically competitive for small or slowly growing demands. Pooling and compensation by sharing costs and expenditures across many participants may allow to bootstrap and promote the investment and consumption of network infrastructure among a larger number of participants. However transparency and auditability is required in the declaration and stipulation of costs, investments, consumption, and an authority to settle the required compensations oriented to cost, not to profit, considering return of investment, and quickly resolve conflicts.

The overall aim is to ensure the sustainability of the commons infrastructure, as all critical costs, investments and consumptions are declared, auditable and balanced.

Solution: Declaration of investments and consumptions with periodic settlement (compensation tables). See Fig. 4.3.

Example: The guifi.net Foundation compensation tables.

References: [60]

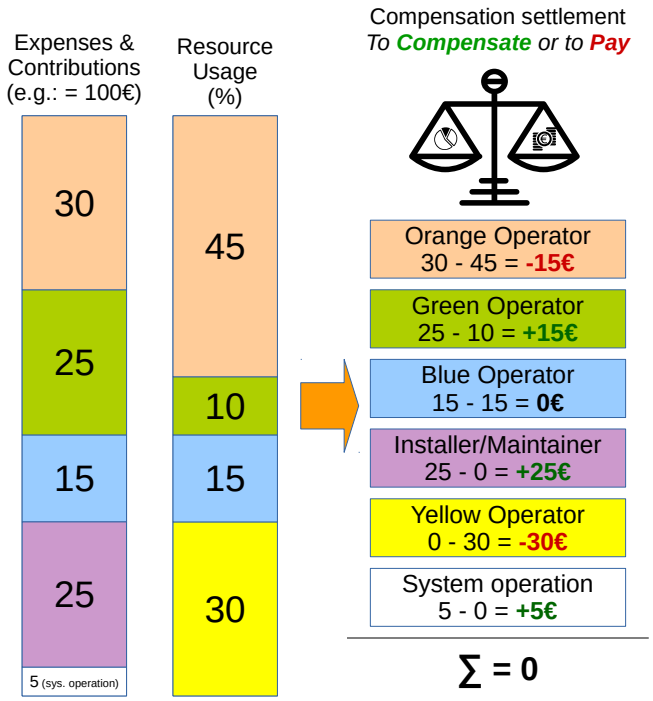


Figure 4.3: guifi.net: Declaration of expenses & contributions, resource usage, and compensation settlements.

4.3. Regional network (Pattern)

Problem: Regional backbone network connectivity across several islands of CN connectivity, avoiding higher costs of open Internet transit.

Context: Remote, rural, under-serviced regions can benefit from larger and more resilient connectivity when islands of connectivity are interconnected. This is a critical attribute for long-term sustainability.

Discussion: The concept of the Internet eXchange Point (IXP), an Ethernet fabric central to the structure of the global Internet, is largely absent from the development of community-driven collaborative network infrastructure. The reasons for this are two-fold. IXPs exist in central, typically urban, environments where strong network infrastructure ensures high levels of connectivity. Between rural and remote regions, where networks are separated by distance and terrain, no such infrastructure exists. A distributed IXPs architecture designed for the community network environment can help to scale up, and benefit from economies of scale and economies of larger population (the Metcalfe effect). This regional network can be used to bring the benefits of good interconnection across several separate densely connected areas. The interconnection can reduce the network diameter, increase the average performance and the reliability of the overall network. For the case of guifi.net shown in Fig. 4.4, it has brought huge improvements in performance, reliability, latency, as before the optical interconnection traffic had to go through many wireless links to get to distant nodes. Aside pure regional traffic, a typical use of a regional network backbone is sharing a backhaul Internet access, which is the next pattern. That regional interconnection can be obtained in different ways, ranging from wired or wireless long distance community links, or using public fibres in roads, or renting a leased optical link from a telecom provider or an open-access network provider.

Solution: Sharing the costs of backhaul connectivity in a regional network to remote and underserved locations. This is an organizational vehicle that combines networks to generate economies of scale and a supporting network infrastructure. For example, a remote port into RemIX [61] could be housed in a small cabinet atop a hill, or in space that is donated by a property owner for this purpose. Equipment is therefore restricted to the small and power-efficient. RemIX has four main components, consisting of a switching fabric, member autonomous systems (ASes), exchange transit and auxiliary services.

Example: the Remix (HUBS) regional network, PoPIX in guifi.net.

References: [61] [48]

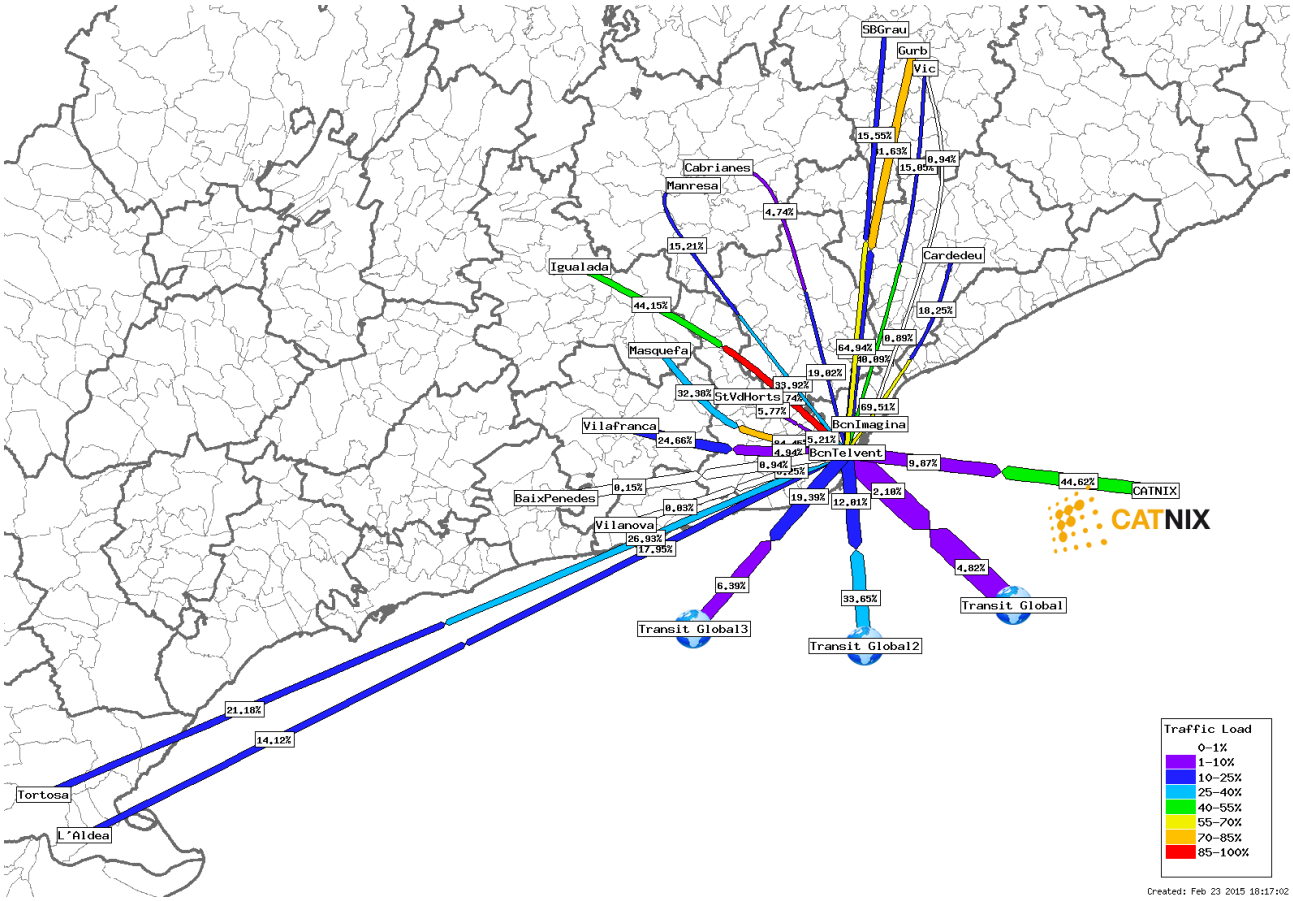


Figure 4.4: The guifi.net PoPIX regional backbone, interconnecting several islands of connectivity.

4.4. Shared backhaul Internet (Pattern)

Problem: Internet backhaul connectivity for a group of several islands of CN connectivity.

Context: Remote, rural, under-serviced regions, can share the cost of good Internet connectivity across a regional network interconnecting small communities. This is a necessary attribute for long-term sustainability.

Discussion: RemIX by the HUBS organization and the guifi.net Foundation use the regional interconnection to share the cost of Internet access. In both cases several small CNs can share the cost and benefit from the economies of scale in contracting Internet carriers to reach the global Internet. For instance, in the case of guifi.net, this arrangement allows to share among many guifi.net participants 22 Gbps across four optical connections with at least three separate Internet carriers. This pattern depends on the previous two patterns: *economic compensation*, and *regional network*.

Solution: Sharing the costs of Internet access, relying on a regional network that allows to efficiently share the cost and the benefits of good Internet connectivity and benefit from economies of scale in Internet carriers, both in terms of higher speed at lower cost, and the possibility to have several separate connections that increase the reliability of the Internet connectivity.

Example: Remix reference implementation in HUBS in Fig. 4.5, guifi.net carrier house cost sharing.

References: [61], [62], [60].

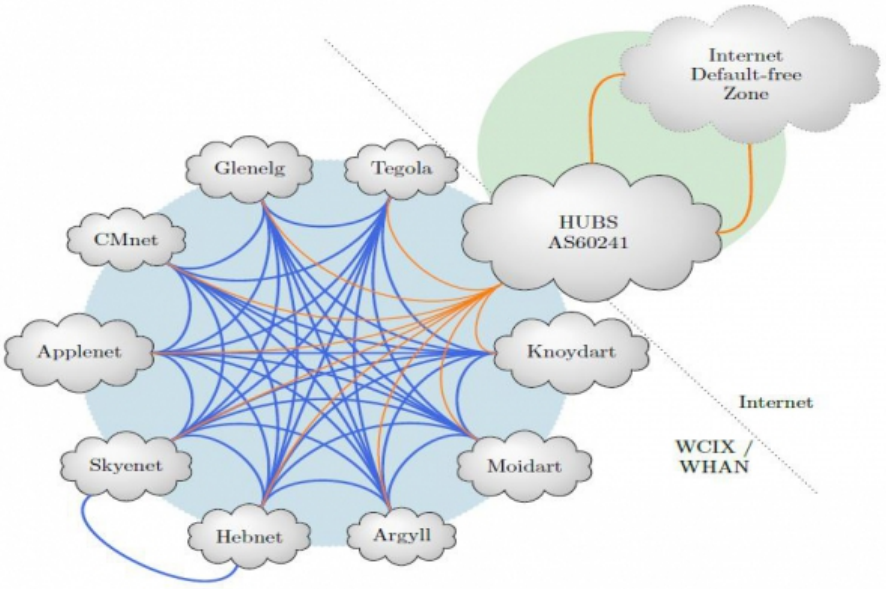


Figure 4.5: The Remix HUBS implementation

4.5. Community Investment – Shares and Loans (Pattern)

Problem: Investment in a CN infrastructure.

Context: Planning, initial deployment, expansion of networking infrastructure.

Discussion: Funding sufficiently a network infrastructure allows its deployment to advance quickly and provide connectivity asap. A quick deployment not only benefits citizens but also leaves less room for overcapacity provisioning by competitors, typically incumbents that play strategies to deter competitors or reduce the coverage or feasibility of alternative operators when they emerge. Furthermore, a local networking infrastructure is a good way for citizens to invest in a resource that can provide good financial returns (interest) and contribute to add value to their houses and the region. Investments can also have good tax returns. At least for the case of Broadband for the Rural North (B4RN) in the UK and guifi.net in Spain, investment in infrastructures or organizations (such as foundations) of public interest, has important tax incentives, with deductions of up to 30% of the investment in B4RN. In the case of donations to the guifi.net commons network under Law 49/2002 (rev.2015) for patronage, with the limit of 10% of the total incomes every year, individuals can recover up to 35-75% and organizations can recover up to 40% of their investment in CAPEX.

Solution: Community shares, as a contribution/investment by citizens to fund the deployment of a network infrastructure. Returns in quicker access to connectivity, financial (interest) return, and tax return.

Community loans, subscribed by communities (collectively) from a common fund to be invested in the deployment of a network infrastructure in exchange of a return.

Example: Broadband for the Rural North Limited was registered as a Community Benefit Society. It was formed to raise funds from the sale of shares to own and operate the network. However, much of the labour to dig trenches was supplied by local volunteers, who were rewarded with the chance to get a connection for their families or businesses, and some work is also rewarded in shares. Farmers and other landowners allowed free access for duct and the fibre within to cross their land.

Because B4RN is non-profit they only extend the network into communities where they're wanted. Each new area that invites B4RN in needs to raise the investment to cover the work and materials required for their area's installation.

Shares: Every community's core investment is made up of shares, the value of which can be ring-fenced for

supporting the build-out in their area. The shares are an investment, not only do they support the project in that community, but they have tax advantages and will pay a good return.

In a nutshell (See Fig. 4.6 and Fig. 4.7 and a sample share request form[1]):

- Minimum shareholding £100 / maximum £100,000.
- All shareholders are members of B4RN. One member one vote.
- Shares must be held for a minimum of 3 years.
- Individual investors can claim 30% tax relief (HMRC Enterprise Investment Scheme).
- After year 3, interest of 5% can be paid out or reinvested.
- Some shareholders choose to invest £1,500 and claim free connection worth £150.
- Shares can only ever be sold back to B4RN at £1 each.

Loans: B4RN also currently accept a limited number of 5 year loans from the community, paying 4% interest. The minimum shareholding will be £100 and anyone purchasing this will become a member of B4RN and entitled to vote at meetings and become involved in the strategy of the society. The B4RN Investment Policy Statement rules investors may hold a maximum of £100,000 worth of shares in the B4RN. As a community benefit society a member is entitled to one vote irrespective of the number of shares they own. All shares are "withdrawable shares" and can only be sold back to B4RN. They have no potential for capital gains and will only be redeemed at face value. For the first three years the investment cannot be withdrawn nor will any interest be paid. From year 4 and onwards annual interest will be paid at a rate which will be determined by the board after taking into account the financial position of the society and Financial Conduct Authority rules. At present our target rate is 5% which will be paid in the form of additional shares credited to the investor's account. From year 4 onwards investors may apply to withdraw their investment. We intend to put aside an amount each year to fund these withdrawals. However the amount available will be subject to the company's trading position and will be at the discretion of the board so there is no guarantee that it will be sufficient to meet all demands.

The shares issue is designed to be compatible with the tax office Enterprise Initiative Scheme which gives a 30% tax relief against the value of the shares purchased.

References: B4RN Resources for investors[2] and videos explaining the project and investment plans[3].

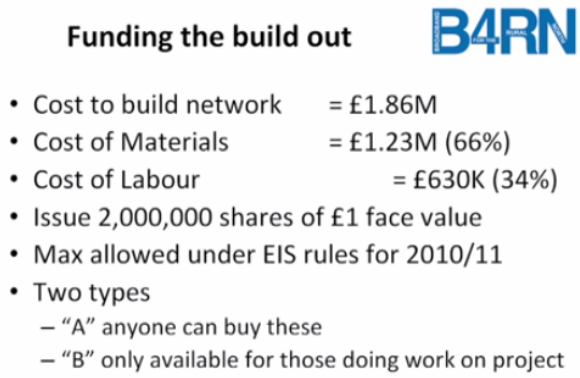
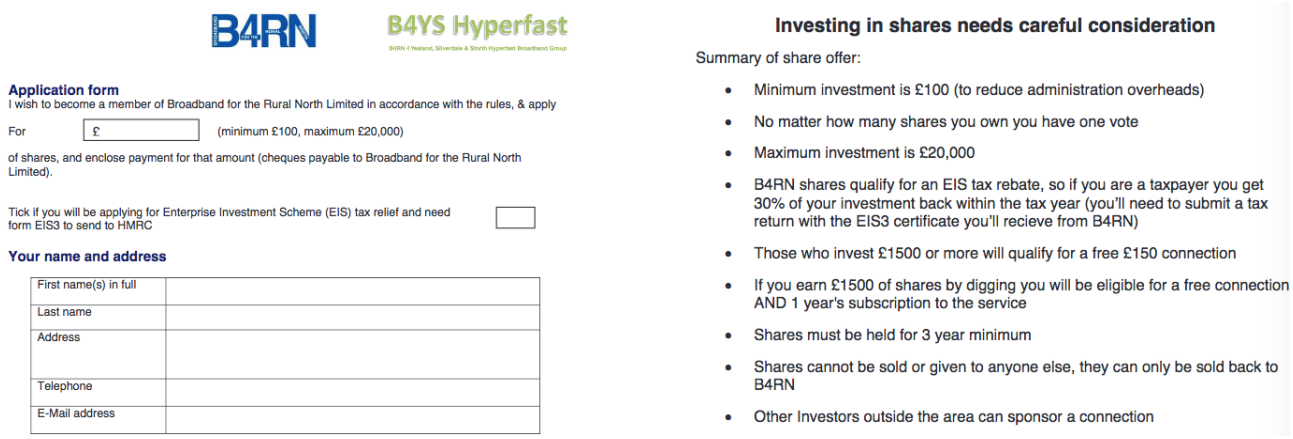


Figure 4.6: The B4RN summary of community shares.

[1] http://www.b4ys.org.uk/how-do-i-get-it/invest-shares/
[2] https://b4rn.org.uk/resources/
[3] https://b4rn.org.uk/b4rn-launch-video-courtesy-of-lunar-creative-video/



B4RN B4YS Hyperfast

Application form
I wish to become a member of Broadband for the Rural North Limited in accordance with the rules, & apply

For £ (minimum £100, maximum £20,000)

of shares, and enclose payment for that amount (cheques payable to Broadband for the Rural North Limited).

Tick if you will be applying for Enterprise Investment Scheme (EIS) tax relief and need form EIS3 to send to HMRC ☐

Your name and address

First name(s) in full	
Last name	
Address	
Telephone	
E-Mail address	

Investing in shares needs careful consideration

Summary of share offer:

- Minimum investment is £100 (to reduce administration overheads)
- No matter how many shares you own you have one vote
- Maximum investment is £20,000
- B4RN shares qualify for an EIS tax rebate, so if you are a taxpayer you get 30% of your investment back within the tax year (you'll need to submit a tax return with the EIS3 certificate you'll recieve from B4RN)
- Those who invest £1500 or more will qualify for a free £150 connection
- If you earn £1500 of shares by digging you will be eligible for a free connection AND 1 year's subscription to the service
- Shares must be held for 3 year minimum
- Shares cannot be sold or given to anyone else, they can only be sold back to B4RN
- Other Investors outside the area can sponsor a connection

Figure 4.7: Extract from a B4RN community share request form.

4.6. Legal/regulatory mechanism for cooperative resource sharing (Pattern)

Problem: A reliable way to access and share critical resources for communication under a cooperative scheme, which includes cost sharing and infrastructure sharing schemes.

Context: Community networks need ways to establish communication links. That implies right of pass to access to public space (like streets, roads, pipes, poles, towers, water channels, other cables) for the deployment of cables, or the right to use electromagnetic spectrum for wireless communication (unlicensed spectrum such as WiFi frequencies, or licensed spectrum such as Global System for Mobile Communications (GSM) or Television (TV) frequencies). That access can be used for long distance links (backhaul) or access to end-users (also know as "the last" or "first mile").

Discussion: Rights to setup communication links, either as passing through public space with cable, or using wireless spectrum is a critical resource for communications. Governments can privatize the public space (either underground, or over ground used for different types of infrastructures) or the electromagnetic spectrum, in exchange of huge amounts of money in licensing fees. However once privatized, it can be exploited to provide cost effective services covering most of the population (in terms of geographic coverage and price), or only a few (for different reasons) but at the same preventing others to try. The Universal Declaration of Human Rights (UDHR) declares the right to information and communication, to implement that right citizens should have a way to access public space to communicate digitally as well as it can be done over other means. That implies defining ways to ensure access to public spectrum and public space. Different regulations and works look at that, but there are different solutions in different contexts, but all look at different degrees and forms of sharing, as ITU described in its report [63], and global organizations for a free and open network have promoted [64].

According to [65] Mexico in 2015,

> "*the Mexican communications regulator, Instituto Federal de Telecomunicaciones (IFETEL), published its new frequency plan (IFETEL 2015). IFETEL has set aside mobile spectrum in the 800MHz band to serve social good. The criteria for using this spectrum is that the population of communities being served must be less than 2,500 or the community must be designated as an indigenous region or priority zone.*"

Rhizomatica is a non-profit organization that has been providing GSM services to indigenous communities around Oaxaca since 2012. Until 2015, it operated under a special dispensation from IFETEL, but the allocation of spectrum to this purpose is now official and any organization may apply for access to this spectrum under the conditions specified. This access gap is identified by studies from ITU in [66] and there is ongoing work with ITU to promote that type of regulation for spectrum sharing with underserved communities. The specific

instrument is Recommendation D.19 (approved in March 2010) [67], that provides guidance on a number of issues concerning telecommunications/ICTs in rural and remote areas considering

> "*that provision of ICT services and applications by small entrepreneurs in rural and remote areas have the potential of creating employment. These ventures can be supported by financial institutions and receive support from various government schemes*"

and

> "*that the accumulation of experiences world-wide on community access institutions (telekiosks, multi-purpose community telecentres, multi-media centres), points to the need for pro-active and supportive government policies to simulate demand of the services available.*"

Examples of support instruments are

> "*These facilities, where necessary, should also be supported by Universal Service Funds as an essential component of rural communications.*"

According to the model of universal deployment for Access networks to next-generation telecommunication services (ANNGTS) by the guifi.net Foundation [68]:

> "*Since the authorities already manage spaces and public domains in order to host various services and, to the extent possible, plan for these infrastructures to support the deployment of ANNGTS not only in a private manner but also on a shared basis, providing any type of service in any mode of operation or business model is not mutually exclusive. It is an opportunity to improve efficiency and diversity and consequently develop the existing regulatory framework at the municipal level in a consistent and orderly manner.*
> *Consequences of not adopting it*
> *a) Perpetuation of old practices and conflicting interpretations of the law*
> *It is important to note that, prior to the regulatory changes, the framework was very different; therefore, procedures that are appropriate for a state monopoly for the use of the infrastructures that are currently capable of supporting ANNGTS were set. For example, in the previous situation, when a public operator occupied an infrastructure, it occupied the domain in its entirety. Currently operators are private. In those cases where sharing is technically feasible, if they have a chance, they could aim for occupations to be interpreted according to the existing practices to hinder the presence of new competitors. New entrants would then be forced to attend an exception proceeding, such as having to appeal through the regulator, so that they are forced to share or to present a conflict, when this obviously proves much less effective from the perspective of compliance of the law than having a well-established form of sharing from an applicable rule. All this results in a slowdown and discourages new deployments.*
> *b) Increased costs and the digital divide*
> *The necessary infrastructures to effectively provide these new generation services have a significant cost. If not shared effectively, this entails several dangers: that the availability of the infrastructure will result in a lack of real diversity in supply, that the deployment will become uneven or slow following strict speculative or economic efficiency-based criteria, that some operators will try to hinder the entry of others, over-investment, or that the performance of the administration will affect certain business models, excluding or hindering new ones.*
> *All these dangers can ultimately materialise, cause discrimination when it comes to access, and unnecessarily increase the cost of services.*"

This practice is linked with the different initiatives around the world to promote sharing, that can be defined in terms of facilitating sharing the cost of building infrastructures (e.g. including fibre when building roads), but that typically do not define the details of the sharing, either at cost (cooperatively) or at market prices

(competitively), or the obligations to use the resources effectively, prevention of obstacles, etc. Different studies worldwide support this [69], [64], [65].

Solution: Regulation and policy measures that promote infrastructure sharing, both for construction and usage, both for wired and wireless scenarios. Given the social role of CN, and the strength of the competitors, particularly in underserved or "market-failure" areas, additional support is needed, such as default mechanisms to allow communities to operate under clear terms that do not create uncertainty, that facilitate deployment, both for the "first mile" deployments and for regional connectivity. This is related to the patterns of *regional network* and the anti-pattern of *overbuilding*.

Example: Community GSM Spectrum Allocation for communities in the Mexican regulation, the Universal Deployment model promoted by the guifi.net Foundation for high-speed network infrastructures, the APC Infrastructure sharing recommendations, the ITU sharing recommendations, the EU cost savings directive.

References: [69], [65], [64], [68], [63], Recommendation D.19 [67].

4.7. Community participation agreement (Pattern)

Problem: Definition of clear rules for participation that are create a well defined boundaries and unambiguous framework for collaboration.

Context: Community Networks can involve many diverse participants. In a crowdsourced infrastructure, the principles must ensure i) the openness of access to the infrastructure (usage), and ii) the openness of participation (construction, operation, governance) in the development of the infrastructure and its community [1].

Discussion: Different CN have defined their own community licenses. This formal or informal document is the basis for community participation. Without it conflicts can arise and destroy the community without remedy given that the boundaries of participation are not defined. This is related to the *flamewars* anti-pattern.

Solution: A document, typically know as participation license or community license, that defines an agreement between the participants in a CN. It defines the permissions, and therefore clearly defines the boundaries of participation. Typical clauses promote neutrality (no discrimination) and transitivity (share links alike, to allow expanding the network from any existing node).

Example: the Picopeering agreement, and the Network Commons License (NCL) also known as Compact license for a Free, Open & Neutral Network (FONNC).

References: [70], [71].

4.8. Shared network infrastructure information (Pattern)

Problem: Having a common repository of information that represents a network infrastructure.

Context: A structured repository of that represents the state of a network infrastructure provides transparency, an unambiguous common status information, and facilitates all community network related processes to build and operate the network infrastructure.

Discussion: Community Networks typically have a database that describe the relevant resources (e.g. routers, links, locations, address assignments, configuration, status) must be kept up to date to reflect the addition of nodes, their removal and changes to their configuration. It is desirable that the process requires minimal manual intervention and, if possible, that changes are reflected rapidly.

Solution: A centralized database with an exhaustive representation of the network infrastructure.

Example: LibreMap[4], NetJSON[5], Freifunk map[6], guifi.net map[7], QMPSU Map[8], Wind database[9].

References: [72], CONFINE Deliverable 2.3 [73].

4.9. Mutual support (Pattern)

Problem: Finding and combining complementary capacities to achieve a goal.

Context: Community networks are open for participation by any interested citizen, however interventions (such adding new nodes, creating new links) may require a set of concrete competences to be successful.

Discussion: Since CN are open for participation, and tasks may be complex, there must be a way to find out participants willing to contribute the necessary and complementary competences to perform certain tasks.

Solution: This is typically achieved through stipulated mechanisms to discover, attract or encourage the contribution of complementary capacities to make sure a goal can be achieved.

Example: Calls for participation, sometimes linked to the *crowdsourcing* pattern. Incentive mechanisms to promote and recognize voluntary contributions, as planned in ninux (see Sec. 3.11.2.3 about the valorization of the voluntary work with incentives and social digital currency).

References: Sec. 3.11.2.3, Deliverable D2.4 [56].

4.10. Stakeholders: volunteers, professionals, service providers (Pattern)

Problem: Diversity of ways and incentives to participate in CN and contribute to sustainability of the commons infrastructure and the benefits to each and all the participants.

Context: As CNs grow, different participants have different motivations, expectations, needs, incentives and interests. Differentiation allows to address each stakeholder group specifically, avoid conflicts of interests in the governance, operation, service provision, regulation, etc.

Discussion: In a generalization of the guifi.net community, as shown in Figure 4.8, we have identified five main stakeholders groups, the *volunteers*, the *governing bodies*, the *professionals*, the *customers*, and the *public administrations*, which form three sets, *non-profit*, *for-profit*, and *public interest*, according to their roles in the ecosystem and their motivations for participating in it.

The *non-profit* set is comprised of the volunteers and the governing bodies. The governing bodies deserve an explicit group because their mission is circumscribed to governance matters, which should not be mixed with the activities of the volunteers. In guifi.net there is a single governing body, the guifi.net Foundation (*Fundació Privada per a la Xarxa, Lliure i Neutral guifi.net*).

The *for-profit* set is formed by the professionals (ISPs, installers, maintainers, etc.) who sell their services over the network and the customers who buy these services in exchange for money. Properly managed (this is one of the crucial issues of the governance model) this commercial activity has two direct positive impacts on the CPR. On one hand it brings the income that make the ecosystem economically sustainable and, on the other it promotes the maintenance and the upgrade of the infrastructure by the professionals because they depend on it.

Finally, the public administrations are responsible for regulating the interactions between the network deployment and *public interest*, such as public domain occupation.

[4] http://libremap.org/
[5] http://netjson.org/
[6] https://www.freifunk-karte.de/
[7] https://guifi.net/maps
[8] http://dsg.ac.upc.edu/qmpsu/
[9] https://wind.awmn.net/

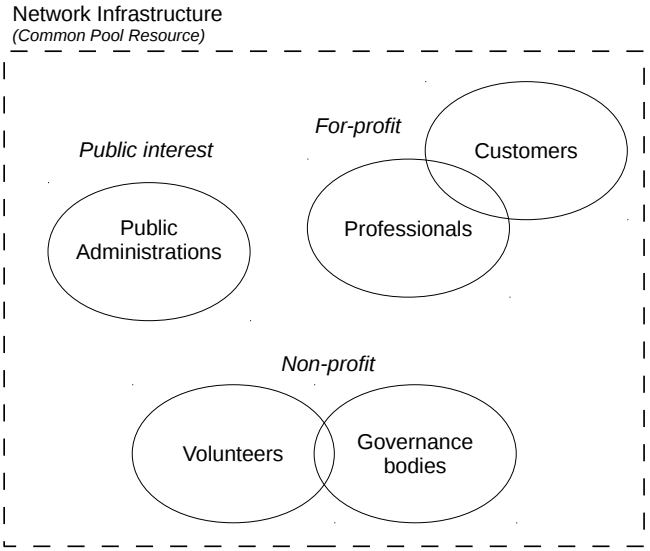


Figure 4.8: Identified stakeholders.

Solution: A set of different collaboration agreement templates for each stakeholder –this may require a legal entity for the commons–, the generic community participation license for all participants, and rules for participation in the governance of the community for non-profit participants only or consider a proportional representation for all stakeholders.

Example: The general participation framework described in [1] or the specific implementation in guifi.net.

References: Deliverable D1.2 [1].

4.11. Community work (Pattern)

Problem: Doing something collectively that cannot be achieved by a single participant.

Context: While many aspects of a CN can be done in isolation (the Do-It-Yourself (DIY) attitude), there are key tasks for a community that require complementary profiles to succeed.

Discussion: Several key tasks in a community may require diverse contributions from several participants. This may involve sharing and combining diverse knowledge (such as setting an optical or wireless long-distance link, or developing an open-source firmware or a central node database).

Solution: Setting up a team from a set of volunteers in a (mailing) list, defining a near-term goal, assigning responsibilities and commitments, with a date to deliver, and ensuring that at the end there is a reward, like a group celebration such as a group lunch or party such as in Fig. 4.9.

Example: Many deployments in guifi.net or ninux end with a group lunch to celebrate the collaboration and the collective achievement, and recognize the contributions.

Figure 4.9: The happy end of community work.

4.12. Community meetings (Pattern)

Problem: Coordination requires a sense of being part of a team, and sharing opportunities for easy spontaneous, opportunistic, informal and formal communication.

Context: Communities need to build a sense of group, which implies trust, shared values, since that creates opportunities for informal interaction, that can result in more focused activities such as knowledge sharing, coordination, community building, etc.

Discussion: Although discussions in the communities are primarily carried in mailing lists or other social media, periodic (weekly, by-weekly, monthly) face-to-face meetings facilitate many types of informal and formal interactions, interactive discussions, and decision making typically with a consensus-based method.

Solution: Periodic meetings create an opportunity for interaction, sharing information, exchanging devices and materials, building social bonds, decision making, conflict resolution, and having positive feedback (fun). These meetings can be unstructured (in the spirit of "what is discussed/decided is what it had to be") or structured, with an agenda, moderator, minutes, decision making policy. These meetings can be done remotely with conferencing tools, or in a given place. Each way has its own limitations and strengths.

Example: The weekly meetings in several of local groups in CNs like ninux and guifi.net.

References: [74].

4.13. External implementation (Anti-pattern)

Problem: Addressing needs in a community through the deployment of an external implementation.

Context: Typically in calls from a community, emergencies, campaigns, with an international component.

Discussion: This a typical discussion in the are of Information and Communications Technology for Development (ICT4D) with a distinction between emergencies relief and cooperation for development. The urgency to bring a solution prevails over the process required to understand the need, the environmental conditions, empower the local community, work with them or just support them to find a local solution. In simple terms, the durability of an infrastructure is proportional to the amount of time in the preparation and the level of local involvement, sense of ownership and entitlement.

(Anti-)Solution: Juast after a call, bring a pile of devices and experts that deploy an operational network and leave them connected but ignorant of the operation and troubleshooting of the network, or the financial aspects of it. Did I mention the locals? No, because they don't speak English.

Improvements: Training, preparation with target communities and follow-up in key areas: technology operation and maintenance; planning, business models and economic sustainability training and advice; digital literacy.

Example: Wireless deployments in emergencies that are left in place but the locals ignore all details except its usage. After any minor problem the network becomes useless and the infrastructure is abandoned due to lack of local knowledge.

References: [75], local ownership [76], active entitlement [77].

4.14. The club of techies (Anti-patttern)

Problem: CN are by techies for techies (only).

Context: Many CNs are bootstrapped by a group of tech savvy people that enjoy testing connectivity solutions. It starts because that group has the skills to start the network.

Discussion: The infrastructure may grow quickly among other similar technologists, but it may be unable to go beyond that group given the technology and complexity barrier. Normal citizens may find it not accessible not due to the economic cost, but due to its complexity and the lack of training or the need to invest too much time to benefit from it. The core techie group may not appreciate "externals" that do not share their passion and language, or that want to connect without being able to contribute technically.

(Anti-)Solution: CN for those that really understand the technology, share a nerd language, and can invest a lot of time in it.

Improvements: Development of training material and activities, pairing techies with "normal" citizens, twinning, developing tools to simplify the deployment, usage and maintenance of the network.

Diversification of the activities including and highlighting non-technical contributions to the network.

Organize courses for externals led by techies. They have a lot of experience and information to share, and with guidance from non-techies, they can help the non tech savvy to be introduced in the movement. Plus, if these courses are done with the help of some external association it can be a way of enlarging the audience of the community.

Example: Unfortunately any CN is part of the problem. All suffer from different degrees of club behavior. A positive example of this anti-pattern is the Battlemesh[10] as illustrated in Fig. 4.10.

[10]Image from the excellent Wireless Battle Mesh (Battlemesh: http://battlemesh.org/) event, a great techie forum, Maribor 2015

Figure 4.10: Techies get together with tables full of tortured cables, devices and stickers.

4.15. Flame wars (Anti-pattern)

Problem: Different participants get into emotional discussions as a result of a real or apparent conflict.

Context: Communities need to take collective decisions that affect differently the membership. This involves very diverse people, with different values, objectives. Sometimes discussions lead to an amplified conflict.

Discussion: Interaction in network-based communication tools, particularly text-based, can create situations where a conflict cannot be solved by argumentation, but amplified. Flame wars might involve many people and generate hostility. In the Usenet community it was common to say that some discussions became unproductive, generating "more heat than light" (Hamlet).

(Anti-)Solution: Sending more messages to clarify and continue the discussion, hoping to guide it to a solution.

Improvements: A conflict resolution system that can stop the discussion (even blocking the mailing list or other communication mean, and follow a structured process to close the discussion).

Example: The conflicts resolution system is a systematic and clear procedure for resolution of conflicts with a scale of graduated sanctions. It consists of three stages —-conciliation, mediation, and arbitration—- all of them driven by a lawyer chosen from a set of volunteers. The cost of the procedures is charged to the responsible party or to both parties in case of a tie. This system was developed based on experience and has defined in a precise manner to help in addressing these conflicts in a quick and standard way, with help from lawyers, and scalable for a growing community. It was developed at a time when the flame wars between a few participants threatened the entire project. The guifi.net Foundation had to take a leading role in its development and implementation.

References: [48].

4.16. Overbuilding (Anti-pattern)

Problem: External network providers, such as incumbents or providers deployment proprietary network infrastructures, may use competitive tactics to prevent a commons to develop.

Context:

In many countries we have seen that dominant telecom providers may be doing quick overbuilding actions to prevent any other provider to expand in a region by making strategic investments to block alternatives.

Discussion:

For instance, when a CN decides or starts to deploy in an area, a dominant telecom provider might decide to quickly deploy and start serving in a few key locations to make any other investment not economically feasible. They don't intend to really address the needs of the community, but just prevent or block others to do it with the minimal investment and coverage that makes alternative deployments unfeasible. The proverbial dog in the manger, which neither eats nor allows others to do so.

(Anti-)Solution: Communities plan full deployments (covering all households, including the more and the less financially feasible), and use community shares or loans to perform the deployment as quickly as possible to reduce the temporal window where overbuilding can produce a effect. Once 100% of homes are covered by the CN, overbuilding becomes futile.

Improvements: Deterrent effects in deployments: planning deployments covering 100% of a given area, no publicity before the deployment is done, initial commitment of citizens like with community shares, which contribute to disincentive reactive deployments by incumbents or privative operators.

Example: Most of the times a community announces a plan to deploy a community or municipal network in an underserved area, the incumbent quickly deploys the minimal infrastructure to make the local deployment unfeasible. There are examples all over the world of this behavior, not very productive since the overbuilding is not an alternative but just a deterrent: it does not try to satisfy the needs of all the underserved population or locations, but just connect the minimum to prevent the viability of alternatives. The B4RN model of 100% coverage and community shares has succeeded in many areas in preventing overbuilding, since when the news are out, everyone in the community is connected or committed through investment, and overbuilding there will be a clear waste: no one will choose to leave the local community for a slower and more expensive service.

4.17. Customer stealing (Anti-pattern)

Problem: Participants, particularly professionals, act strategically to steal customers from other professionals, typically in the same area, instead of looking to new customers.

Context: It is easier to steal a customer from another professional rather than expanding to new customers or new regions. Stealing customers may appear to work in the short term, but brings instability to the community and since it creates uncertainty to the professionals and the value of their services, it affects negatively the sustainability of the commons and the community in general.

Discussion: The expansion of the user base and the area covered is the best strategy in the medium and long term for the sustainability of the commons and its professional participants. In fact, the faster, wider and better the network infrastructure commons is, the more business opportunities for professionals. The real competition is with external operators and service providers that have proprietary/privative infrastructures, particularly incumbents given its economies of scale and influence. The population that has bad, expensive or no service are a great opportunity for the expansion of the commons to new people and new areas.

(Anti-)Solution: Competition to steal customers from other local professionals involved in the commons. Connected to the next "dumping" anti-pattern.

Improvements: Focus on creating new markets: new customers, new areas, new services.

Example: Several cases among professionals in guifi.net of competition, differentiation, and specialisation to benefit from complementary offers from other providers.

4.18. Dumping – Downward spiral of prices below cost (Anti-pattern)

Problem: Participants forget that beyond the initial cost of purchase and installation of a network device and link, there is a need to contribute to the development and maintenance of the network infrastructure. Participants do not want to pay any fee to maintain the network infrastructure beyond its own node and link. Professionals and service providers using a CN infrastructure compete in price and features compromising the sustainability of the infrastructure.

Context: Humans have bounded rationality, and may not have a clear distinction between the commons and their own interests or beliefs; or between its own link and the whole network. A volunteer or professional participant (individual or Small and Medium Enterprise (SME)) can be confused by the openness of a commons infrastructure, and assume things are free and magically sustainable. Participants forget that beyond the initial cost of purchase and installation of a network device and link, there is a need to contribute to the development and maintenance of the network infrastructure.

Discussion: Freedom to join the network does not preclude contributing to the cost of the commons (not free of charge). There is sometimes the assumption that community initiatives may be "magically" free, just as opposition to expensive private resources and services. Open access (freedom) to a commons does not mean it is free of any cost. The two main sources of confusion are that the commons infrastructure is free of cost once deployed (for maintenance or usage particularly), and that lowering prices is the best strategy (related to the previous "work stealing" pattern). Ignoring these costs may appear as a good way to get more customers (for a professional participant) or more participants (for a volunteer), but it is unsustainable for all: for the newcomers that do not get what they expected, for the intermediary that is in a conflict and at loss, and for the commons infrastructure that is subject to an unsustainable usage. The lack of nurturing of the commons leads to a scenario of "tragedy of the commons".

(Anti-)Solution:

- *Trivialization*: the network is just a sum of nodes contributed by participants, not more, and it would magically work for anyone and forever with no maintenance costs.
- *Omission*: a participant does not plan for recurrent contributions to maintenance, it just reacts to crisis (congestion, repairs).
- *Dumping:* Professional operators using the commons may reduce the prices for services below the cost (not collecting contributions to maintain the infrastructure commons) or deliver more features than competitors (below their internal costs).

Improvements: For participants: create a non-profit user association that collects periodic contributions to maintenance cost. For professional service providers: Separate the fixed per-client contribution to the infrastructure costs from the added value services costs provided by the service provider.

Example: guifi.net in Barcelona or in the rural area around the Ebro river have created user associations (eXO, Augute) that collect network maintenance fees to ensure the sustainability of the infrastructure. See Fig. 4.11.

The guifi.net Foundation model of service invoices for professionals using the commons infrastructure, that details in two separate sections the service fees, and the required contribution to the commons. See Fig. 4.12.

Figure 4.11: The user association in the Ebro region of guifi.net with network maintenance quotas.

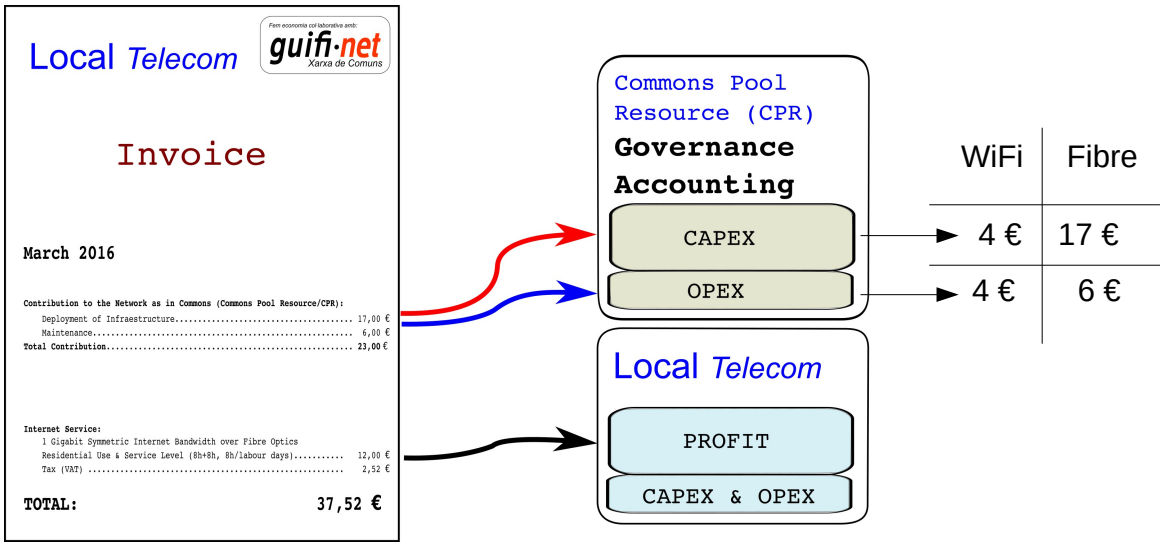


Figure 4.12: The model service invoice promoted by the guifi.net Foundation.

4.19. Social imbalance (Anti-pattern)

Problem: Participants in an open group may not be balanced across all dimensions. Typically there's a strong gender imbalance to men, a interest imbalance to technically focused people. How to compensate these imbalances with an inclusive spirit?

Context: Communities tend to be more welcoming to people that match the profiles of the majority. Many CNs have a strong imbalance in terms of gender and interests.

Discussion: A decision making protocol is needed when the community enlarges. Communities start with local, small-scale groups and auto-coordinate. Then when the community enlarges, people will still want to use the informal way of decision taking they used in the past, while it is not usable anymore.

(Anti-)Solution: Not doing anything because "*the community is open to anyone*".

Improvements: The choice of reference models, examples, speakers to external audiences, specific support to

new members from existing members with a close profile, help to address these imbalances. People representing a community become role models, and deliberately or not, embed their own values and language in their interactions. Therefore, they create proximity and facilitate understanding with potential members with similar profiles.

Example: The gender and techie imbalance in probably all CNs.

5. Reengineering

The result of interacting with several CNs is the direct and indirect exchange of experiences and organizational instruments to handle similar issues with slightly different local nuances. As part of our mission, combined with the interests of the networks involved in this study and a few more not reflected but contacted, we have identified several areas for further development.

Therefore the next step is re-engineering: Work with selected CNs to incorporate such governance instruments within the routine management of CNs. These range from improvements and restructuring in terms of their outside view or inside view, to organizational developments expected as the communities plan to evolve.

The candidates for specific re-engineering activities are the following:

- The investment model for guifi.net, inspired by the experience of B4RN.
- The economic sustainability models for W4C in the communities and its formalization, and for the regional network interconnection in the case of Rhizomatica.
- The development of the compensation system inside the eXO community in Barcelona, in parallel with the introduction of the compensation table in the metropolitan area of Barcelona.
- The formalization of the ninux governance, including valorisation of voluntary work and incentives.
- Increasing public accountability and more balanced participation of minorities in the FDN and Tetaneutral communities, part of FFDN.
- If the conditions are favorable, we also plan to support the design and implementation of a federation for the replication of the Zenzeleni CN to more than 10 similar communities in the region. That includes the development of a governance model for each, for the regional backbone network interconnection, and the provision of shared Internet connectivity.

The next deliverable 1.4 will report on the process, the outcomes of the adaptations, and an evaluation of impact.

6. Conclusions

This work extends our results in organizational aspects in Deliverables D1.1 [2] and D1.2 [1] including in the analysis and re-engineering other relevant CNs globally: W4C and Rhizomatica.

We first present a social-science analysis of CNs, with a first part that looks at CNs as an "inverse infrastructure" to emphasize the growing relevance of community organizations involved in shaping an alternative pattern to the dominant networking and ISP business oriented models. Afterwards we present a review of the most relevant contributions that have emerged in the field of social science and organization studies concerning the notion of "community", with particular attention to the internal governance issues.

We provide an analysis and identification of good governance tools as a result of collaborative research about several representative CNs: guifi.net and eXO (Spain), Ninux.org (Italy), FFDN and Tetaneutral (France) already covered in our previous research, and new CNs: W4C (India) and Rhizomatica (Mexico). In doing so, we also explored in depth the governance bottlenecks. We look at the defining traits of each CN looking at its **outside view** of what it does and with who, the external relationships and its **inside view** of how it does, the internal relationships. For the outside view we are inspired by the social business model canvas model [46]. For the inside view we look at an evolution of the organizational framework from deliverable 1.2 [1]. As part of the analysis, we also gave advice and provided good practices from other CNs oriented to sustain CNs' management, resilience, and sustainability.

From that research we have identified a set of the most common and relevant organizational patterns and anti-patterns in CNs that are presented in an structured way.

As part of the analysis we have identified several organizational and governance tools for further development in some of the CNs involved. This re-engineering means Working with each CNs interested to incorporate such governance tools and promote certain organizational patters or mitigate certain anti-patters, always adapted to the characteristics of each. Improvements and restructuring can have different degrees of impact in the outside or inside view of a CN, and different time scales for implementation. The results of the re-engineering and evaluation will be reported in Deliverable D1.4.

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A. Appendix: Interview Consent Form

This interview is part of the EU Horizon 2020 research project “netCommons: network infrastructure as commons”: www.netcommons.eu.

Scholars from the five EU-based institutions involved in the netCommons project carry out the survey research. The study does not have any commercial purposes, the involved researchers do not have any monetary benefits by conducting the study and the results will be published in the form of a report and research papers based on the interview/survey. Furthermore, the collected data will be published in anonymous form as open data. The open data will not contain any personal identifiers, which is data that we are not interested to collect, do not ask for and do not publish. We will not ask you to provide personally sensitive data in this interview/survey and all the answers provided will be used only in aggregate and anonymous form.

By signing this form, you confirm the following:

- I agree to the digital recording of the interview/survey
- I agree that the answers I give are stored in digital form in a database in such a way that I am not personally identifiable (anonymous or pseudonymous form)
- I have been given the opportunity to ask questions about the project.
- I understand that my taking part is voluntary. I can withdraw from the study at any time during the interview/survey and I do not have to give any reasons for why I no longer want to take part.
- I understand my personal details such as my name, email, phone number and address will only be used by the researcher to contact me and not be revealed to people outside the project.
- I understand that my words may be quoted in publications, reports, web pages, and other research outputs in anonymous or pseudonymous form only (no name or other personal identifiable data will be mentioned).

The person responsible for the treatment of the data used in this interview/survey is:

Dr. Stefano Crabu | CNRS - Institute for Communication Sciences (ISCC)

E-mail: stefano.crabu@cnrs.fr

If you have any questions, don’t hesitate to contact him/her.

I agree to these terms and want to participate in the interview/survey. Yes No

Signed: Date:

B. Appendix: Interview guidelines

TABLE 1: INDIVIDUAL TRAJECTORY

QUESTIONS	ADDITIONAL QUESTIONS	RATIONALE
What are the salient moments of your engagement in the community until now?	Why (in terms of motivations) and in which way did you start to collaborate with the community? What was your engagement path up to here? (also in other grassroots / civil organizations) How did you try to contribute to the development / growing / reinforcement of your community ? Which are the main drivers in pushing you to be actively engaged in the community ?	Understand the key turning points and motivation in the engagement pathways.
How did you hear about the activities of the community ?	In your opinion, were information on community activities well publicized and accessible?	Understanding the access in the CN.

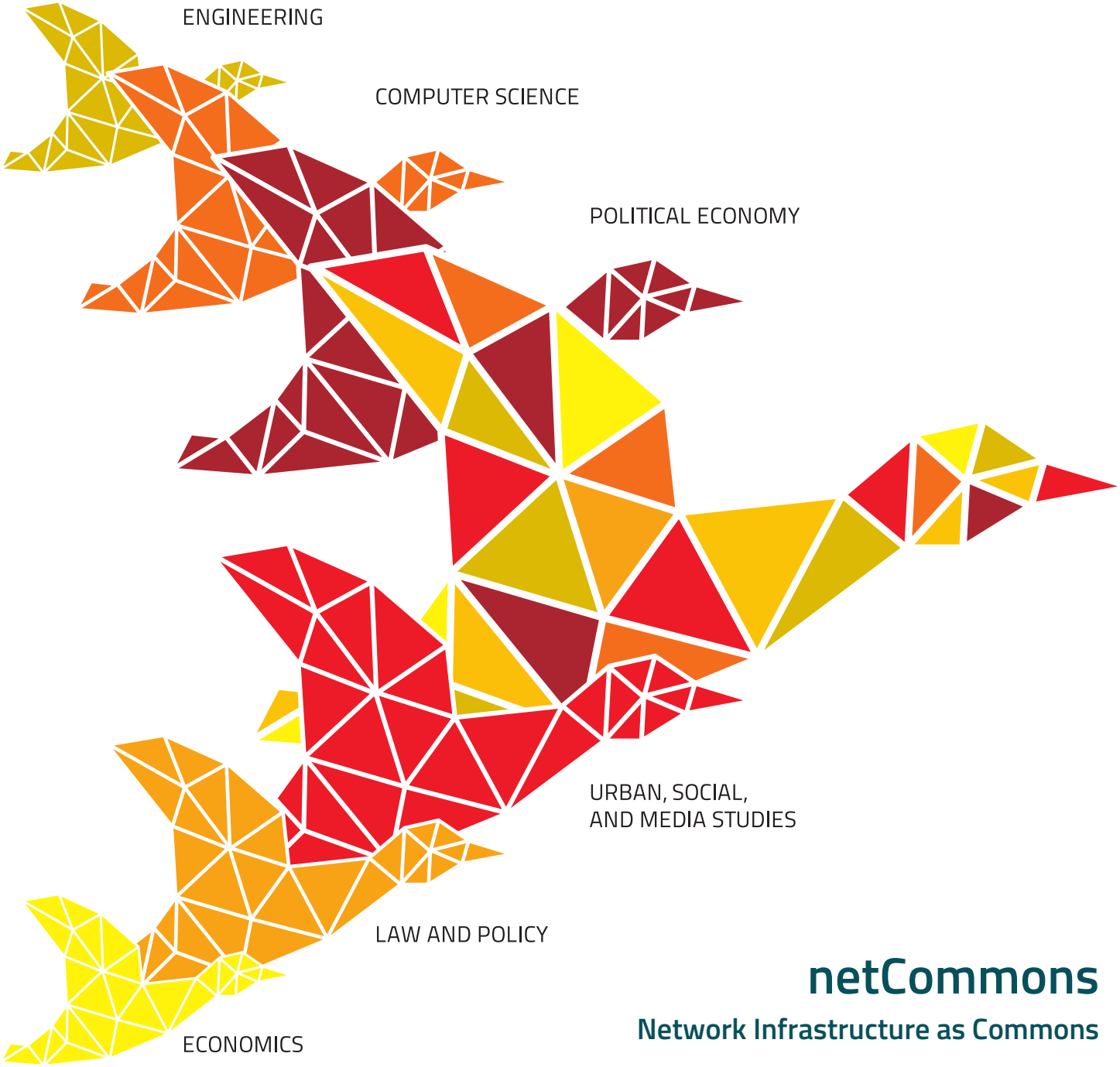
TABLE 2: ORGANISATIONAL CULTURE AND EVERYDAY LIFE

This part of the interview will focus on the current Organizational Culture, internal governance and “everyday life” in CN

QUESTIONS	ADDITIONAL QUESTIONS	RATIONALE
How many members your community has ? Who are the most active members? What skills do they have? What are the main tools and spaces for communication and collaboration ? (online meetings, regular face-to-face assemblies, online platforms, chats, mailing list, and so on: investigate the characteristics) How would you describe your current social and collaborative relationships in the community ? What the climate of the community is (friendly, conflictual, hostile, supportive, competitive...) ? What are the main organizational values (technological innovation, solidarity, participation, digital technologies as a common good, achievement of established goals, etc.) ? Are there formalised in any documents (a common manifesto)? Are they shared from all the members? In what ways the relevant and crucial decisions about the CN are made (general assemblies, online discussions, informal meetings) ? ACCOUNTABILITY In which ways crucial and/or critical decisions/events are communicated to the participants of the community ? To what extend are you satisfied about your experience in the community ?	Are there any formal / informal incentives (both direct and indirect) to support the expansion of the participation? In your opinion, what could be effective incentives for participation ? Are there sub-groups in the CN ? Who and why? What kind of activities are most valued/celebrated? Are the relations in the community mainly formal or informal ?	Organizational culture, decision-making process and quality/level of the participation
Are there different expectations towards women and men involved in the community ?	Are there different informal rules for women and men? What are considered the best participant in the community?	Gender culture
Do you have support from public institution to develop the community? Which kind? (agreement, contract, and so on).	If not, why?	External relationships

TABLE 3: PERSPECTIVES ON THE FUTURE OF THE CN

QUESTIONS	ADDITIONAL QUESTIONS	RATIONALE
How do you imagine the short term future of the community? (in terms of development, services, expansion of the participants base and so on) Do you have any specific project which you would to develop within the community? On the other side, what are your main concerns about the community?	What kind of activities would be useful to support the development of the community ?	Understanding the future of the CN



netCommons

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