Community Mobile Telephony Manual

Connecting the next billion

This manual is based on the results of a research project called Social Operating Model for a Self-Managed Telecommunications System, sponsored by the Coordination for the Information and Knowledge Society (CSIC) of the Mexican Ministry of Communications and Transportation (SCT), and undertaken in coordination with the Interdisciplinary Research Program on Human Development at the Autonomous Metropolitan University (UAM) in Mexico City.

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Introduction

The first indigenous community mobile telecommunications network started operations in 2013 in Talea de Castro, a community in the Mexican state of Oaxaca. It consisted of a private network scheme that used a segment of the spectrum reserved for unlicensed use. In 2014, what was then the Comisión Federal de Telecomunicaciones (Federal Telecommunications Commission) granted an experimental license in the 850MHz band for the segment 845-849/890-894 that was later ratified by the Instituto Federal de Telecomunicaciones (Federal Telecommunications Institute) (IFT).

This license was intended to identify the viability of new equipment for providing mobile communication services in remote rural communities with no coverage. More than a mere test, the intention was to prove that a new technological scheme —well organized and affordable— could be the basis for sustainably providing mobile communication services in localities considered unprofitable for traditional telecommunications providers.

When the experimental license expired, the system already included 19 localities with populations ranging from 200 to 3000 inhabitants. This not only confirmed the project's viability, but the possibility of expanding the network to communities to which this service had been denied for years. Moreover, the implementation of the network spurred conventional operators to develop their own models to meet the demands of larger communities (4000 inhabitants or more) that were previously unattended.

The success of the community approach was the starting point for a new legal framework, and led to a proclamation concerning the administration of the spectrum, which, for the first time in history, assigned a portion of the spectrum allocated for mobile communication services for community use:

> It should be noted that as of May 2014 the Institute consigned an experimental concession for the not-for-profit use and exploitation of one of the portions of the spectrum in Region 7 (Gulf and South areas). Thus, using the 4+4 Mhz segment, 8 networks have been installed. These networks successfully provide narrow band rural mobile communication services in 30 localities in Oaxaca, and have reached 3000 users within only 8 months of being operational.
> It should also be noted that these services are provided in the context of an operation based

> on community-based cooperatives, and the income obtained for charging network users is reinvested by the community itself for maintaining and expanding the infrastructure. This aspect is also the basis for the operation to be considered eligible for a social use license, which, by definition, requires that the entity making use of the spectrum be a not-for-profit operation.[1]

Over the period during which the experimental concession was active, the Secretaría de Comunicaciones y Transportes (Secretariat for Communications and Transportation), through the Coordinación para la Sociedad de la Información y el Conocimiento (Information and Knowledge Society Coordination office), signed an agreement with the Universidad Nacional Autónoma Metropolitana Xochimilco (Metropolitan Autonomous University Campus Xochimilco) to work collaboratively in a social operator model for a self-managed telecommunication system. This was done in coordination with original concession holder Redes por la Diversidad, Equidad y Sustentabilidad AC.

This manual is the result of two years of research in which the systematization of experiences allowed us to identify important elements in the model that could be important for other people developing similar tools or approaches in other regions of Mexico or in other countries.

This manual is addressed to public policy implementers, as well as to social entrepreneurs and communities interested in implementing the community telecommunication model for providing services for isolated areas.

This is just the first step towards building a new model of social coverage in which the beneficiaries are also themselves the service providers. The experiences regarding its implementation have opened new perspectives and put forward new developments that increase the model's reliability. The designers of the model have created a wiki with plenty of information and to which others can contribute by sharing the results and lessons of being part of this experience.

1 IFT. Plan Nacional de Atribución de Frecuencias (National Plan for Frequency Allocation). 2015.

01. What Is Community Mobile Telephony?

Community Telecommunications is a model based on the Public Policy Recommendations for the development of Information and Communication Technologies (ICT) among Rural and Indigenous Communities of the International Telecommunications Union (ITU 2010). These recommendations indicate that in order to provide services for these kinds of localities, system operation must be performed taking into consideration the organizational form of the local economy[2] and by establishing a chain of operators whose role is related to the service area in which they are most effective.

The model is based on a local network which is completely operated and managed by the community, and supported by a cooperative association to which all the communities belong. Long-distance calls are made using the Internet, which is provided by a separate micro-enterprise, while the Voice over Internet Protocol service used to connect calls is controlled by a small operator.

Thus, in a win-win situation, the community participates in the operation of the network and the users benefit from lower costs, ensuring the income from this operation remains within the community, and shared with an association to which they belong so they can invest in innovation and training.

How does our network operate?

The communities are the owners and the operators of the local mobile network infrastructure.

Together with TIC (Telecomunicaciones Indígenas Comunitarias) the community builds and manages the network through the installation of a cellular transceiver and the necessary equipment for its administration.

TIC develops the technology to improve communications services, manages agreements with Internet and VoIP providers and supplies technical support for the network.

Text messages and local calls stay within the network.

Long distance calls to Mexico City and the rest of the world require an Internet connection. The community hires a service provider.

Users can become members by paying a monthly fee agreed upon between TIC and the community.

Local calls and messages are unlimited.

Source: Infographic provided by Telecomunicaciones Indígenas Comunitarias (TIC AC)

2 This is based upon the tripartite economics theory of Braudel which is explained later in this manual. The theory identifies three economic levels: subsistence, local and global. For more detailed research on the subject refer to Özveren (2005) *Landscape of a Political Convergence in Finch & Orillard, Complexity and the Economy Implications for Economic Policy*, Edward Elgar Publishing, UK.

ELEMENTS OF THE MODEL

Community Mobile Telephony is based upon four essential elements:

1. Organizational Base

The social support which allows the community to operate a network through a community-based approach. This social base also allows many communities to collectively manage a license and provide maintenance services and personnel training.

2. Technological Base

Identifying the right technology for the communities and their organizations, one which is affordable in terms of price, maintenance and operating costs.

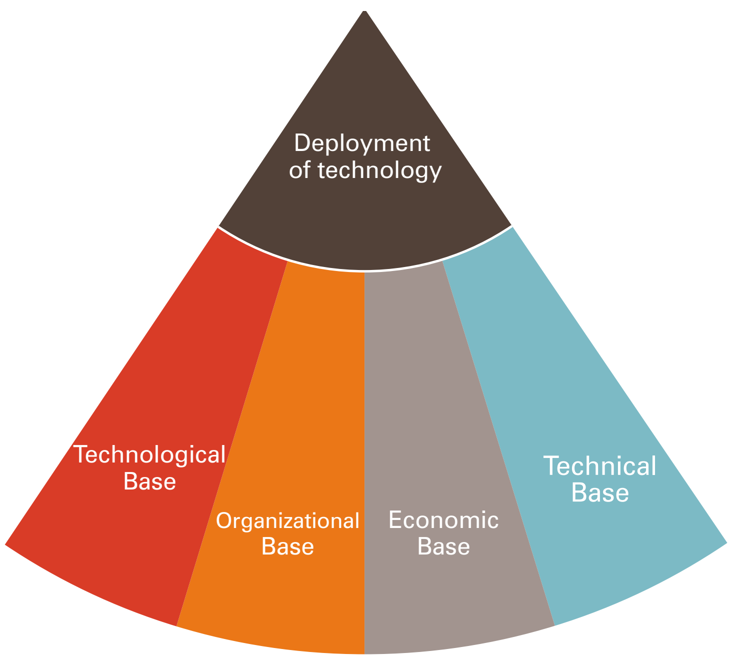
3. Economic Base

A business plan based on service unbundling according to economies of scale, which allows communities to provide the service at a low cost.

4. Technical Base

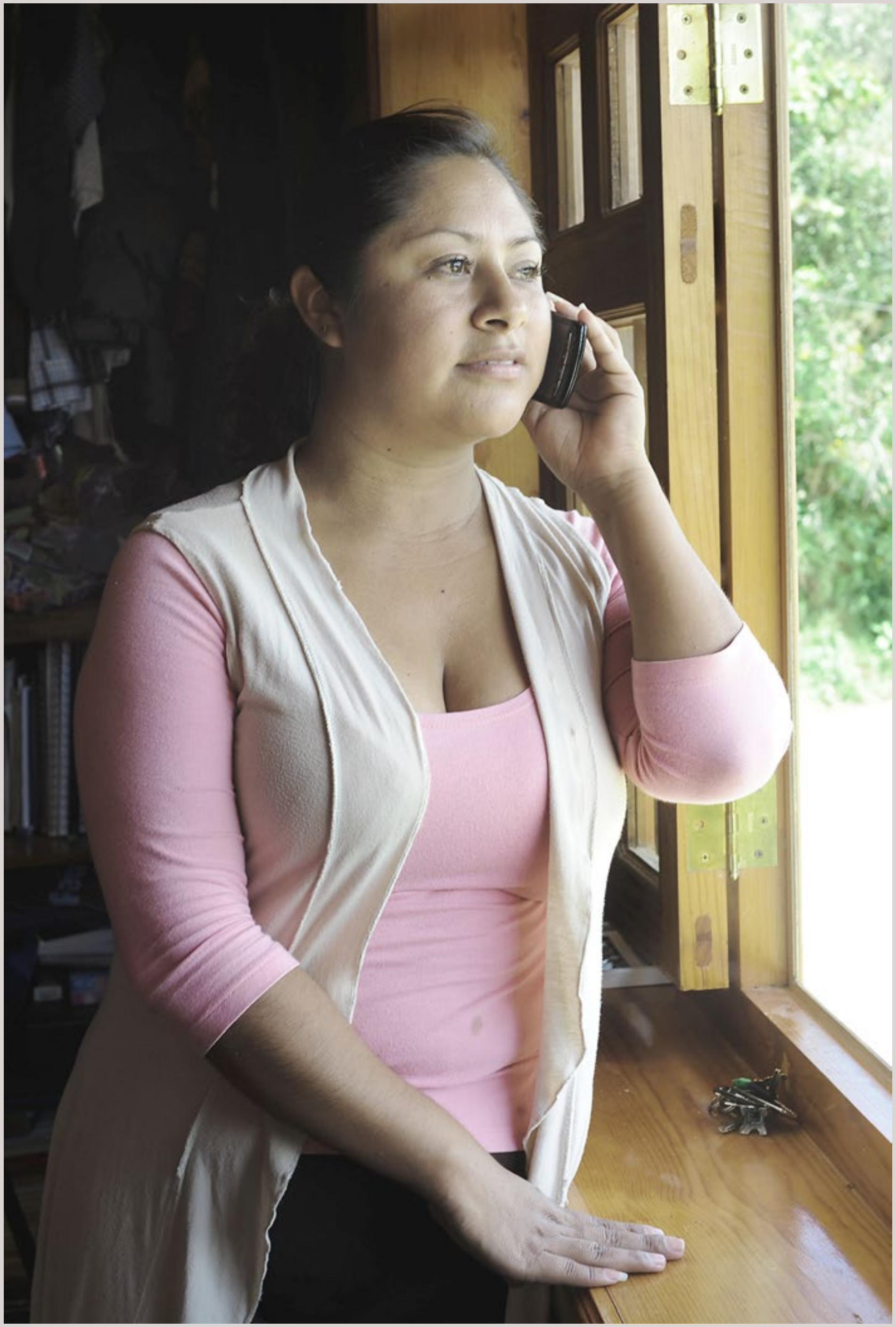
The material and human resources infrastructure that form the basis for the community to acquire the necessary skills for operating the service, as well as for the maintenance and development of applications and innovation.

Community Mobile Telephony Operation Scheme



This manual indicates how to develop these elements and specifies the necessary legal framework to backstop them.

02.
Legal Framework



The legal model consists of the legal framework applied to the self-managed telecommunication system. It comprises the implementation of internal regulations (individualized regulations) as well as the application of external regulations (laws and regulations). The model answers two important questions: 1) how does the system self-regulate, and 2) what current regulations are applicable?

In order to answer these two questions, we began by analyzing the essential characteristics of the project and of the subjects being regulated, that is to say indigenous communities, hacker communities and telecommunication networks. We also based our analysis on the principles that guide the project.

Subsequently, we found the most adequate structure for these elements and we also identified the principles resulting from these structures. Finally, the elements which require regulation are also identified and the regulation itself is defined along with the legal framework in which it operates.

CHARACTERISTICS OF THE COMMUNITIES THAT ARE PART OF THE SYSTEM AND OF THE RESOURCES THAT COMPRISE THE NETWORK

The system is the result of two organizational components that are articulated to create a telecommunication network. Thus, for its regulation, it is essential to understand the guidelines and principles upon which these components function and interact. It is also important to know the functioning principles that derive from the kind of resource in question, in this case telecommunication and information networks.

The organizational components or entities that create this network are:

- Indigenous communities
- Hacker communities

The question that arises then is: which laws and regulations govern these entities and the networks?

Indigenous communities

It must be noted that the network exists in indigenous communities of a certain region, and that these communities, while they share some characteristics with other communities in Mexico and the world, are unique in some important ways. This must be taken into account when adapting the model to other regions with different forms of organization.

Regarding land and territory, among the communities of the Sierra Juarez in Oaxaca, private property is almost inexistent. Land is communal and decisions regarding its use are made by an assembly of co-proprietors or "comuneros" comprised of the heads of the household of the agrarian community (Bloom 2015).

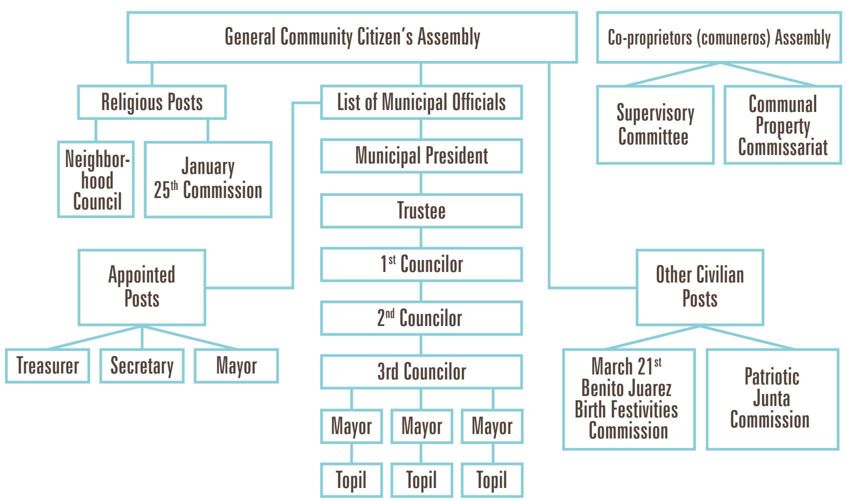
Municipalities enjoy the benefits of autonomy and most are governed by "usos y costumbres" (indigenous customary law), a hierarchically scaled system of community service (Bloom 2015) which is the basis for electing local authorities. This means that municipal presidents, as well as the town council, are elected by a community assembly, and occupy their role for a year or so with no financial recompense whatsoever.

Each community has an independent normative system, and its particularities are reflected in the way they elect their authorities, but also in how they manage services and resources like water, roads and education, and even in the way they celebrate. As we can see, these communities have full autonomy in regard to their system of government and also concerning the management of their resources.

If we look closely at the characteristics of these indigenous communities we can identify the following principles:

Autonomy: The capacity of self-governance and making collective decisions in regard to development. The highest authority for these decisions is the Assembly.
Key Positions of Elected Authority: It is comprised of service positions –with no remuneration–that extend for short periods of around one year and a half at the most.
Commonly held resources: the land and the territory are considered a common goods that cannot be appropriated and thus cannot become a source of personal enrichment.

The way these communities view the world has had an influence on what has been called by indigenous thinkers themselves as *comunalidad*, which, according to Floriberto Díaz is expressed as: "The earth as a mother



Local Government of Guelatao

Source:
Vázquez in Bloom, 2015

and as territory, the consensus of the Assembly for decision making, unpaid public service as an exercise in authority, collective work as an act of recreation and rites and ceremonies as an expression of communal gift" (Días in Rendón 2003).

These are the principles that govern daily life in the communities in which these networks are developed.

These principles are expressed in different ways in the processes of design, installation and operation, and in legal terms are reflected in the regulations concerning the ownership of the network, contractual relationships, use rights and licenses.

Hacker Communities

The technology upon which the network is based is primarily the result of two free software projects that were able to reverse engineer and re-encode GSM's closed source technology in order to make it available as open source technology (OpenBSC and OpenBTS).

The hacker and developer communities[3] that have managed to develop these projects are governed by certain principles which are compatible with the regulation systems applied in the context of resource governance, and which have been practiced ancestrally by indigenous communities (Laval & Dardot 2015).

According to these authors, hacker ethics is based on "a certain happiness *ethos*, and on a commitment with freedom, and is part of a relationship with the community intended for common benefit" (2015 p.195).

The dictionary of hacker jargon defines "hacker" as:

> People that enthusiastically dedicate themselves to programming and believe that making information part of a common good is their ethical duty so they share their skills and expertise by distributing free software and by allowing access –whenever possible– to information and resources related to computer science (Himanem, 2001, p.5).

Considering work as pleasure and knowledge as a common good are principles completely compatible with the concept of *comunalidad*, and, as Laval & Dardot (2015) rightly remark "hacker ethics play a role similar to that of the collective regulations that govern the institutions which are the basis of common natural goods [shared by the community]".

In an effort to identify some of the principles that emanate from this ethical approach we can identify the following:

Creative play: work is considered a creative act that is performed for fun and passion, not due to an obligation or for money; it is carried out collectively.
Solidarity: creation is carried out through processes of mutual assistance, whose only objective is to contribute to the thing being built.

3 The term hacker should not only be applied to the information or computer hacker. The hacker is an enthusiast-expert of any kind (Himanem, 2001, p.6).

Common goods: the goods shared by the community are considered common to all, not subjected to ownership, and as a consequence they must remain available for everyone to modify since there is value in keeping them away from private and public control (Lessig, 2001).

Constitutional and operational regulations: openness and collectivity imply a series of constitutional regulations and operational processes as well as instances for the resolution of conflicts.

NETWORKS AND SPECTRUM

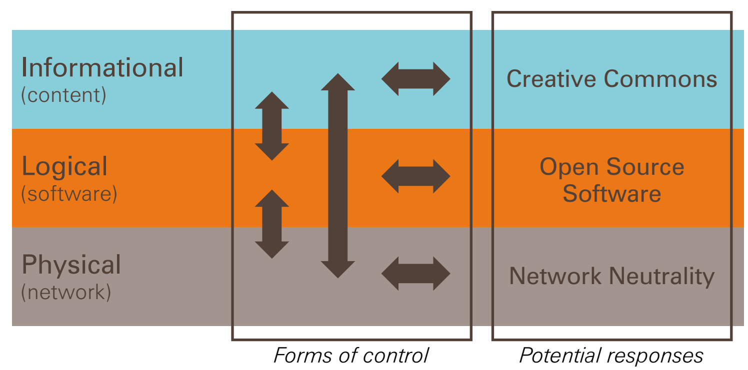
The definition of a common good has to do not only with its particular characteristics, but with the way the community establishes relationships with it. If we are to deal with networks and the spectrum we have to analyze both of these aspects.

A common good is one whose access must be allowed to anyone who meets certain requirements. It is in this context that both the spectrum and public telecommunication networks are considered common goods.

Since the means of communication are the subject of this analysis, we will refer to the layer model of Professor Yochai Benkler (in Lessing 2001, p. 23). According to this model there are three different layers in any communication framework. The first one is a *physical* layer: this refers to the physical medium through which data travels, which is to say cables or the spectrum. The second layer is the *logical* layer or *the code*, which refers to the programs that allow the operation of the physical infrastructure. The last layer, the *informational* layer, refers to the content, that is to say, what is being said. According to this network structure, each layer can be open or introduce restrictions, as the following table illustrates:

Protecting the commons

Three layers in infrastructure commons



Source Umemoto, 2006

Let us analyze the composition of the self-managed telecommunication system and how these three layers can be structured to see if they correspond to a free and open scheme or to a controlled one.

Physical Layer

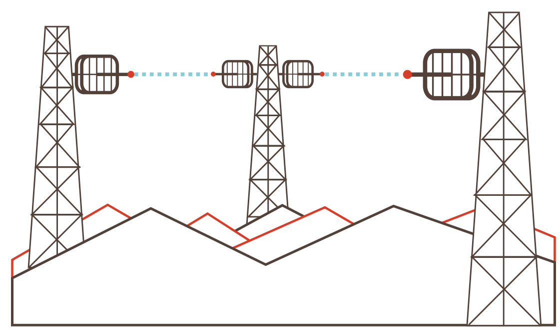
The structure at hand is a hybrid comprised of three different networks:

1. A local community network consisting of a transceiver owned by the community and a part of the spectrum in the 850Mhz band granted to an association (similar to a cooperative) to which the community belongs.

2. A transport network comprised of a system of WiFi links. The links belong to a regional ISP but the spectrum is unlicensed. There are plans to migrate to the 10Ghz band that will be granted as secondary use to the association that will allow its free use for coverage purposes. In this approach the links will be part of the ISP but the spectrum will be granted to the association (in the case of licensed spectrum).

3. Finally, the ISP is connected to a network backbone of a public telecommunication network.

GSM Local Network



WiFi or 10Ghz link

Network backbone

We will now analyze these segments to determine if they are free or controlled.

Segment	Characteristics
Local Network	(850Mhz Spectrum) Free and open commons: At first, any community interested in becoming operators of the system using their own normative systems can access this technology.
Transport network	(WiFi or 10Ghz Spectrum) Free and open commons: anyone can access this segment and it will remain so for 10Ghz as long as its use is intended for rural communities.
Network Backbone	Restricted: In this case a fee to an operator with substantial power is required. However, access could be unrestricted and free* if there was available optical fiber installation.

It is important to point out that we are detailing only the general characteristics, since the functioning of the network is complex and implies both controlled and open elements. For instance, even though the local network is free and open, it does not interconnect directly with other license holders, given there are matters of cost that might render the provision of the service inviable. Nevertheless, this restriction does not imply that the network is a closed one.

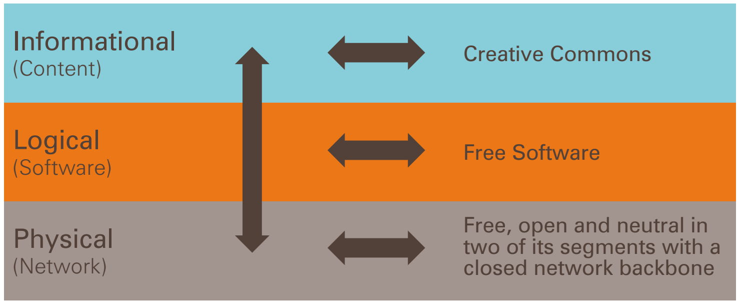
* By "free" we mean that the project considers only costs. Contributions or payment are solely for the sustainability of the common good.

Logic or Code

The local segment operates with free and open source software. Regarding the transport network, we are dealing with Internet, and it can be considered an open network, given its end to end protocol.

The network backbone, on the other hand, normally operates with closed source code and hardware, and the same happens with the interconnection to the telephone network.

According to the network structure previously described, the model's proposition is a commons-based structure in almost all its segments and looks like this:



Information

At first glance all the information flowing through the network is free, although regulations establish certain restrictions and deleting content can constitute an offense.

In order to specify the different scenarios regarding information restriction we must turn to the architecture of the community telephony network itself, which is comprised of three kinds of networks and implies a different legal system depending on the type of governance applied to each network.

The indigenous communities that own and operate the network are governed by the normative system of their territories according to Article 2 of the Mexican Constitution, while the other elements of the network are subject to the application of Mexico's legal system (Positive Law).

The way in which these community networks are configured ensures privacy regarding information and guarantees access as long as it is requested in accordance with existing regulations and the local normative system.

GENERAL STRUCTURE AND LEGAL FRAMEWORK

As should be clear by now, the system is not based on a centralized structure. Each part is completely independent and is able to operate separately. However, there are collaborative relationships that allow the whole network to function better. Like the rhizome, each element becomes in itself a root from which many different organizations might sprout. The local network is independent and can operate by itself. The same applies to the transport network and other elements.

Each part of the system has its own constitutive regulations and its own form of governance, and there is a general governance structure when the communities operate in conjunction. Each constitutive and governance structure is backed up by a legal framework or by an applicable regulatory or normative system.

4 The *Rhizome* is a philosophical model which is based on the structure of certain plants that share these characteristics. It encompasses four different principles coined by Deleuze and Guattari (2009), namely: connection and heterogeneity, multiplicity, assignifying rupture and cartography and decalcomania.

The Local Network

The legal framework in which the local network is inscribed corresponds to the regulatory or normative system of each community. According to Article 2 of the Mexican Constitution and based on Agreement 169 of the International Labor Organization, indigenous peoples and communities have the right to preserve and develop their ways of organization and their regulatory and normative systems, which are fully valid and applicable within their territories.

In most countries' telecommunications regulations, a distinction is made between private and public telecommunication networks. Private networks are conceived for private or experimental communication and do not require an operation license unless they use licensed spectrum or are intended for commercial purposes.

Even if there is specific regulation for community or indigenous networks, as is the case of Mexico, the architecture of the network implies that the local network is a private network owned by the community, since it is not a commercial operation and is circumscribed in a specific territoriality and whose owners are the network operators themselves. The local network facilitates the self-provision of services and its interconnection depends on another, different network.

As we can see, the *constitutive regulations* are derived from the internal regulation systems of each community. That is to say that community norms will determine the processes upon which the local network shall be established. In most of the communities in Oaxaca in which this system is being developed and deployed, the highest authority is the community assembly. The assembly determines the appropriate communication system, the people in charge of setting it up, the obligations of citizens concerning the system and the way the service will be managed. Consequently, the elements that comprise the network are commonly held by the community and are not subject to individual ownership, unless the community itself decides to disassociate them from the common pool.

System governance is simple: a local administrator holds his or her position for a fixed period and must answer to the town council and assembly directly. In most cases the head of the town council carries out his or her job without payment and any issue regarding system administration is discussed and resolved by the assembly.

The Transport Network

The transport network usually consists of a small commercial operator that brings Internet service to communities through a series of wireless links. The legal framework to which this network is subject is national telecommunications legislation and regulation. In the case of Mexico, these small Internet service providers may be license holders or registered resellers.

It may be the case that these operators use transport frequencies granted to the same association that supports the local networks, which is to say, to the communities of which it is comprised. In this case the governance regulations for these frequencies are related to the internal regulatory system of the organization and to the regulation systems of the communities that comprise it; this being the case as long as they do not transgress the nature of the concession and remain a not-for-profit social affair.

The Governance Committee

The network is comprised of a group of operators that exploit a common good. The governance of common goods is very specific when considering if the good is a rivalrous good or not.

It has always been said that the spectrum is rivalrous, a term which refers to a finite good whose consumption by one consumer prevents simultaneous consumption by other consumers. However, this status is not derived from the characteristics of the spectrum itself, but from the type of equipment used (Peralta, 2011). Using intelligent systems[5] , spectrum capacity can be improved, although it could still present moments of saturation at peak usage times. However, it is theoretically possible that the spectrum could be used by many with no interference whatsoever (Peralta, 2011).

Regardless of if we consider the spectrum a rivalrous good, we still need an organizational scheme or a governance system. In this case, the governance of the spectrum is carried out through a civic association, but it could be assigned to a different kind of organization entitled to collectively use this common good, even an automated system.

In the case of community telephony, the association constituted for its governance has two common goods under its care: the spectrum itself and the knowledge regarding the technology based on which it can be operated. And since both are considered common goods they are not subjected to private ownership and are open access.

The constitutive bylaws of the association are mainly derived from the consensus among the actors involved in the operation of the scheme; in this case indigenous communities and hackers. There are four types of partners:

Technicians: people who share their knowledge regarding technology.
Operators: the communities which are tasked with the management of each local network.
Pre-operators: communities interested in becoming operators.
Allies: people willing to contribute to the project in different ways.

The only requirement to incorporate a community into the association is that it expresses its interest in becoming an operator and that it commits itself to fulfill the mutual collaboration and network administration obligations. The very expression of that interest implies that the regulations of each community must be fulfilled, so that there can be consent. In most of the communities in the Sierra Juárez in Oaxaca this consent is expressed by means of an assembly and by the appointment of a committee.

In other words, the constitutive regulations of the system are the result of an agreement between different parties that leads to an organizational base. In this case, there is an implicit offer for communities to

5 Note for instance WiFi networks which are able to operate using the same spectrum simultaneously without interfering with each other.

join the association, which grows stronger when a new community approves the decision to become part of the project and commits itself to participate in the governance system.

This agreement entitles the association to request —on behalf of the actual and potential member communities— an indigenous social license for a frequency band for the mobile telephony system. This concession is granted to a specific area in which potential localities are located. As new communities become integrated, the association notifies the Federal Telecommunications Institute of their incorporation, which implies their use of the spectrum in that locality or group of localities.

Governance Laws

Given the fact that these are local networks, governance is undertaken by the community. Each locality determines its own usage of the network, as long as it is compatible with the obligations that each community must meet as a member of the association. For instance, a community may establish a given fee for the service as long as it is enough to cover the maintenance fee charged by the association per user.

Decision making regarding issues beyond the capacity of each locality, such as interference and roaming, are solved by the staff of the association. If the problem goes beyond a technical issue, it is dealt with by the Coordination Council which integrates representatives from both the technical and operational partners. If the situation goes even beyond these instances it is discussed and solved by the Assembly.

The main sanctioning mechanism for operators is the cessation of service and temporal or definitive suspension of rights.

Types of Law and Applicable Law

Law	Type	Instrument	Applicable Law
Founding Treaty	Constitutive Laws	Articles of incorporation or founding documents	Civil Law, specific regulations, telecommunications, specific regulations regarding indigenous rights
Incorporation Agreement	Constitutive Laws	Documents attesting free, prior and informed consent by the community in accordance with their internal norms	Regulation systems and indigenous rights
Spectrum Use Agreement	Constitutive Laws	License	Telecommunications and indigenous rights law

Law	Type	Instrument	Applicable Law
Local network Management and Service Provision	Governance Laws	Communal Assembly agreements and general agreements regarding service provision for association members	Regulation Systems for the Community, Agreements reached by the Assembly of the association
Quality	Governance Laws	Agreements reached by the Assembly of the association and within the community when applicable	Regulation systems and local standards according to context
Interaction among Local Networks	Governance Laws	Agreements reached by the Coordination Council and by the associations' Assembly	Self-regulation of the association
Outbound calls and Internet Access (Quality of Service)	Governance Laws	Commercial agreements concerning service for each community, along with their suppliers and general agreements between the association and different service providers	Commercial, customer protection and telecommunication regulation
Software development	Constitutive and Governance Laws	Creative Commons, AGPL	Regulation Systems and Copy Left

As we can see, the network is mostly a self-regulated system, since it is controlled and operated by the users themselves. The jurisdictional regime in which it operates is limited and the Mexican regulatory environment is ideal for its development since it makes available a specific license for indigenous communities that can coexist within a standard private network scheme.

Therefore, in this context, an ideal legal regime would imply a specific license for social and not-for-profit operators, as well as the existence of national legislation in concordance with international law like Agreement 169 of the International Labor Organization and the United Nations Declaration on the Rights of Indigenous People.

We also require an allocation regime with no financial limitations regarding the use of frequencies for social purposes. This implies avoiding exorbitant costs for the assignment of frequencies so that small community operators have access to them. In other words, a regime that complies with Article 13, paragraph three of the American Convention on Human Rights:

> It is essential that the assignment processes for licenses or for frequencies be open, public and transparent. They must be subjected to clear and previously established regulations and they should imply strictly necessary, fair and equal requirements. In this process it is important to ensure that there are no unreasonable obstacles or unfair access conditions to media. The assignment, suspension

> or non-renewal of frequencies on the basis of discrimination or arbitrary considerations should also be avoided.[6]

In Mexico the Federal Telecommunications and Broadcasting Law (LFTR) has established direct spectrum assignment for these kinds of media and it has determined two primary uses for the same band: a primary use for social coverage in rural areas and —in case it is required— a commercial use for urban areas (IFT.PABF 2016 P.14).

This law has also established a process of assignment by region which considers potential localities. This makes it possible for many social license holders to coexist in one region as long as they concentrate their activities in localities with no coverage.

We believe social use should not generate spectrum use fees when it comes to social, community or indigenous media, and although there is no current exemption, in 2015 the Executive branch sent the Congress an initiative concerning the matter that was later approved and which exempted users from charges for reviewing applications and granting licenses, on the grounds that:

> It has become necessary to approve the present proposition in order to allow said community and indigenous media to fulfill their social goals, and in so doing to contribute to effectively fight inequality in these contexts. This circumstance has been recognized constitutionally and legally as a situation to be avoided.

The Indigenous Issues Commission of the House of Representatives of Mexico (Comisión de Asuntos Indígenas de la Cámara de Diputados) presented a proposal to modify Article 239 of the Federal Tax Law (Ley Federal de Derechos) in order to confirm the exemption from fees for spectrum use rights for social license holders.

It should be noted that the current regime for determining charges for spectrum use rights considered by Article 239 of the Federal Tax Law regarding Article 244-B of the same regulation is not consistent with the Federal Telecommunications and Broadcasting Law or Mexico's National Spectrum Plan (Plan Nacional de Espectro), since it does not make a distinction concerning the area in which frequencies are operated. Thus, for instance, it considers the value of spectrum in cities like Acapulco or Ixtapa in Guerrero as being equal to municipalities like Metlaltonoc, which is one of the poorest areas of that state.

This approach may be valid for commercial assignments like those carried out through tenders for commercial license holders. But it is certainly not fair when assigning specific coverage within a region for both social and commercial purposes. Moreover, these regulations do not make a distinction in terms of the license holder's goals.

The legislation considers an indigenous community poised to acquire a telecommunication service —based on Article 2 of the Constitution— the same as a private enterprise that acquires it for commercial purposes.
A collective subject that finds the means to exercise a human right and meet a basic demand not covered by the State or by current license holders is put in the same category as a private enterprise that carries out for-profit activities.

6 OAS. (2010). Una Agenda Hemisférica para la Defensa de la Libertad de Expresión.

As can be clearly appreciated, the dispositions of the aforementioned regulations contravene Article 31 section IV of the Mexican Constitution since they are opposed to the principles of proportionality and equality, which must govern all tax-related contributions. These principles, according to the Supreme Court of Mexico, are the basis for taking into account individual differences, and taxing according to the activity, source and amount of income and necessities of the collectivity[7]. Considering the aforementioned regulations we may say that currently this is not the case.

It should also be noted that license holder communities are highly and very highly marginalized and therefore their capacity to pay is not the same as that of a commercial license holder. The communities are already contributing to the State inasmuch as they are assuming the cost of maintaining a telecommunication service that should be provided by the State or by existing license holders. This implies considerable benefits for the State since, only in terms of expenditure, the assignment of the concession represents savings amounting to 7 to 14 million[8] pesos per year regarding Internet coverage for the 300 municipalities included in the concession area. Therefore, it would not make sense that, in order to raise 500 thousand pesos from fees and taxes, one would reject the possibility of decreasing State expenditure by at least 7 million pesos.

In regards to the legal regime of the license holder, we are dealing with a not-for-profit model. These are indigenous communities that join together to further the development of their people, which is in line with the assumption in Article 79 fraction VI subsection G of the Income Tax Law (LISR). In order to establish a congruency with the assumptions of the Federal Telecommunications and Broadcasting Law (LFTR) regarding the requirements that must be met by social, community and indigenous license holders, the Income Tax Law must recognize the qualities of these entities. This being due to the fact that one of the requirements for the concession to be granted is that the institution should be not-for-profit.

7 Cárdenas, Fernando. *Proporcionalidad y equidad de los impuestos en Diccionario Jurídico Mexicano* Porrúa UNAM, Mexico 1994.

8 The calculation is based on satellite connectivity considering the current monthly cost of México Conectado as well as that of commercial satellite connectivity.

03.
Technolog-ical Base

Community Mobile Telecommunication is based on a technology with two main characteristics:

Low cost: A total cost which can be covered by marginalized and highly marginalized communities (comprising about 100 families): approximately USD $5 000 or less.
Easy to use: In situ operation is reduced to a minimum. Most problems can be remotely managed.

Regarding technological aspects, the Community Mobile Telephony project has been possible due to the development of two technologies: SDR (Software Defined Radio) and GNU Radio. SDR is a radiocommunication system in which many hardware elements (mixers, filters, modulators, demodulators, detectors, etc.) are executed in software through a personal or any other embedded computer. Even though the concept of SDR is not new, the recent evolution in terms of digital technology has made it possible, from a practical point of view, to actually carry out many of the processes that were previously only theoretically possible.

Thanks to SDR, much of the signal processing is carried out using general purpose processors, instead of using specifically designed hardware. This allows for changing the protocols and waveforms simply by changing software parameters. It is envisioned that, in the long term, Software Defined Radio will become the dominant technology in terms of radiocommunication. This favors the eventual development of cognitive radio[9].

GNU Radio is a tool or open source software that provides signal processing blocks for implementing radio systems defined by software. It can be used with low cost RF hardware to create software defined radios or with no hardware at all in simulations. It is widely used in academic environments and in amateur and commercial contexts as well since it can provide support for researchers working in mobile communication and radio systems in the real world.

These two developments, GNU Radio and SDR, gave way to the first experiments using software-implemented cellular technology. This meant that network implementers did not have to rely on patented equipment which is normally very expensive. From these experiments emerged two important software projects for creating GSM networks, OpenBTS and OpenBSC. The latter is described below.

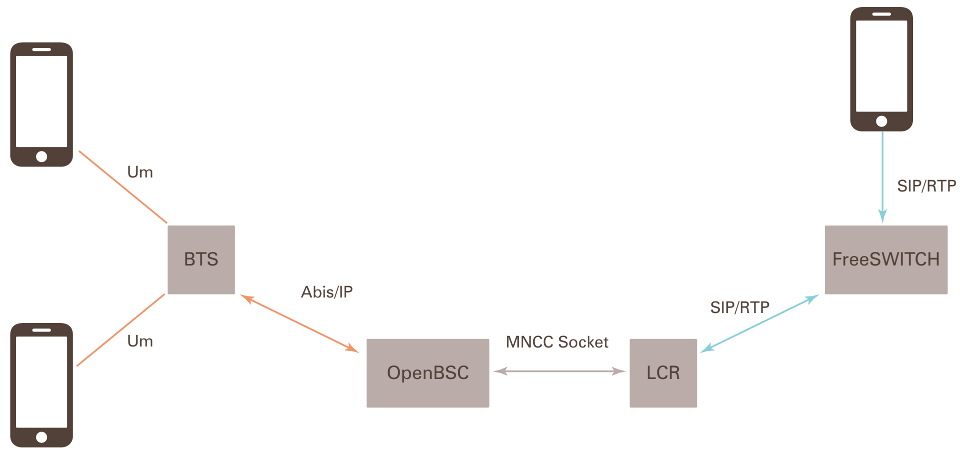
The implementation of two free software projects for GSM implied experimental processes and the inclusion of different actors in an otherwise traditional and opaque environment. This has had an impact on the total cost for building a GSM system and it has meant the democratization of the knowledge required to set up a network of this kind.

GSM equipment providers have relied on closed source software and network operation has implied access to specialized information and to equipment which is hardly available to the public. Now different innovations, as detailed above, make it possible for normal people (not just telecommunications engineers) to create a GSM network. Now one only need be a free software aficionado and able to handle some concepts regarding networking and informatics.

9 Cognitive Radio is a communication paradigm in which the transmission and reception parameters can vary in order to deliver their mission more efficiently and without interfering with each other or other stations.

SYSTEM CONFIGURATION

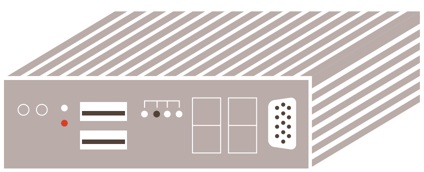
The next figure provides a general view of the network architecture of the Community Mobile Telephony system, although it can vary depending on each of the communities' conditions.



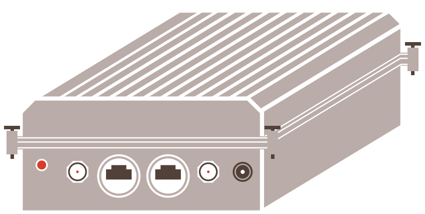
Network Architecture Diagram

Equipment and Transmission Media

Hardware:



BSC Base Station Controller



BTS Base Transceiver Station

WiFi Links

Software:

OpenBSC
Part of the Osmocom project, it is a GSM network-in-the-box software that implements key GSM hardware components such as BSC, MSC and HLR allowing for the operation of a small, self-contained cellular network. In order to connect calls outside the OpenBSC network, the network works in tandem with LCR to route outgoing calls using the SIP protocol.[10]

LCR (Linux Call Router)
An ISDN-based software Private Branch Exchange for Linux.[11]

Freeswitch
An open source scalable telephony platform that was designed to route and interconnect popular communication protocols using audio, video, text or any other media. It also provides a stable telephony platform based on which many telephony applications can be developed using a wide range of free tools.[12]

Kannel
A compact and very powerful open source WAP and SMS gateway, used widely across the globe for serving trillions of short messages (SMS), WAP Push service indications and mobile Internet connectivity.[13]

Custom Software
There are two software packages designed in their entirety by Rhizomatica. These are:

1. RCCN: which exposes a REST API (Representational State Transfer Application Programming Interface).[14]
2. Rhizomatica Administration Interface (RAI): This is the interface used for managing the network in communities. RAI is a php package that uses the REST API and exposes an administration interface over http that allows administrators to register users, administer payments and send text messages and also enables access to system statistics in real time.

10 For further information and a description of the aforementioned components, go to: http://openbsc.osmocom.org/trac/wiki/OpenBSC

11 For further information and a description of the aforementioned components, go to: http://linux-call-router.de

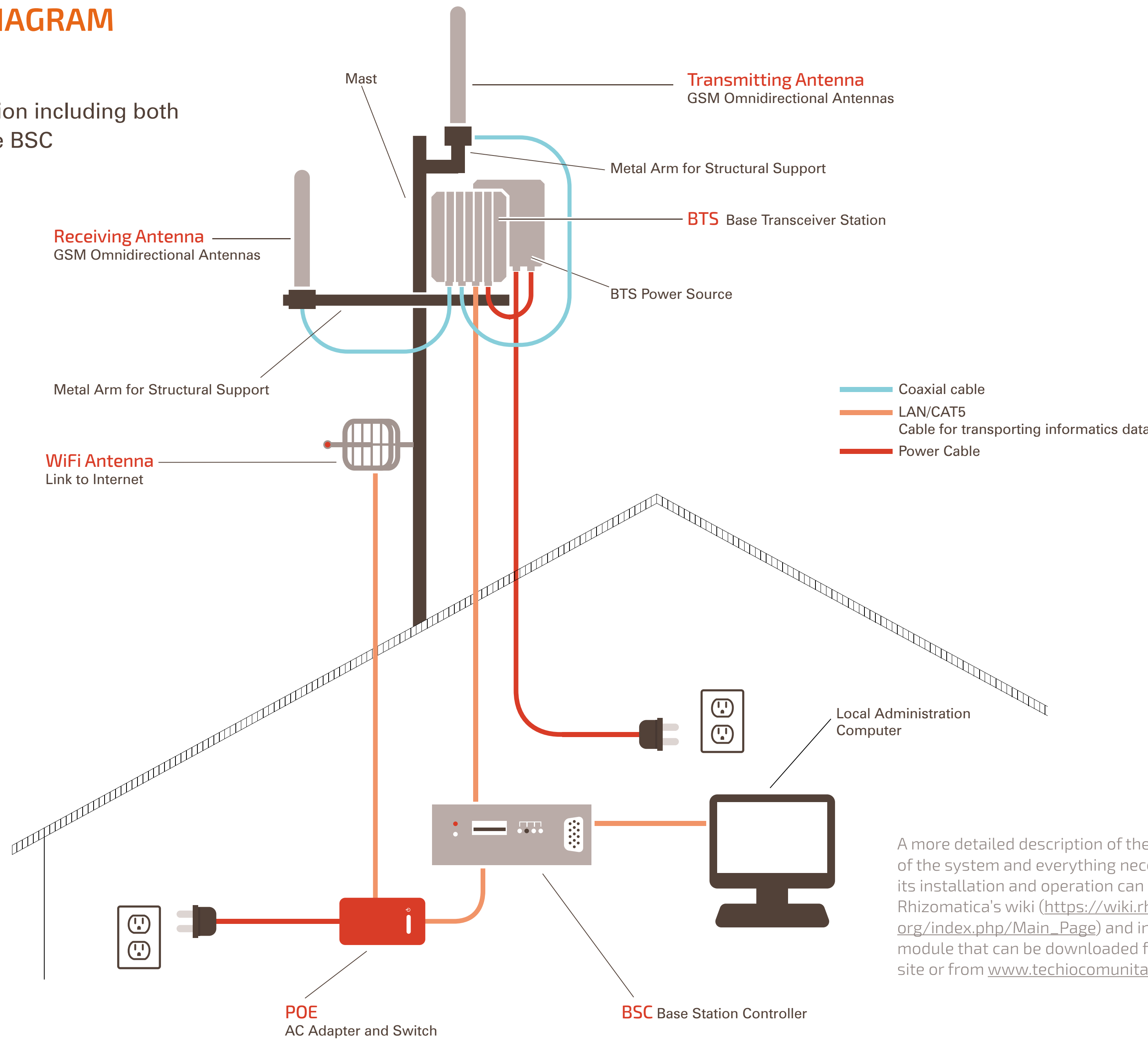
12 For further information and a description of the aforementioned components, go to: https://freeswitch.org/

13 For further information and a description of the aforementioned components, go to: http://kannel.org/

14 To learn more about RCCN y RCCR, go to: https://github.com/Rhizomatica/rccn

SYSTEM DIAGRAM

Simple installation including both the BTS and the BSC



A more detailed description of the components of the system and everything necessary for its installation and operation can be found in Rhizomatica's wiki (https://wiki.rhizomatica.org/index.php/Main_Page) and in the training module that can be downloaded from this same site or from www.techiocomunitario.net

04.
Economic Base

The economic foundation of this project consists of a business model in which every part of the network can count on the necessary resources for it to be sustainable. Since it is a social endeavor and not a commercial one, it does not seek to maximize profits but rather seeks sustainability. The most important thing has always been that the income generated allows for continuity of the service and its improvement.

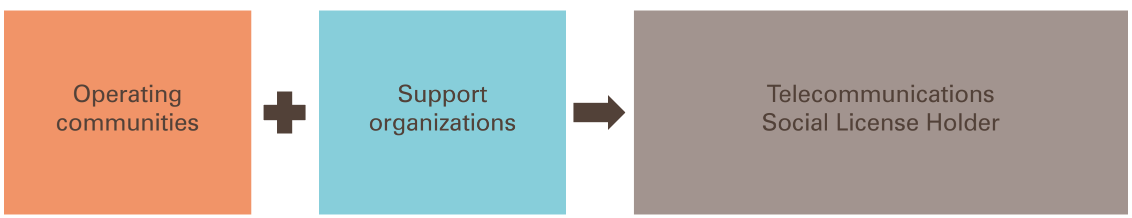
In this section we analyze the business model of the Community Mobile Telephony project which implies looking at the license holder and the operating communities that take part in it. The ISP and the VoIP operator are not taken into account since they are service providers that were already operating independently before the implementation of the model.

For the purpose of this analysis we will analyze the business model canvas and we will take a look at a financial evaluation that was designed for the community telephony license holder operating in Mexico.

THE BUSINESS MODEL

Community Mobile Telephony is conceived of as a social enterprise. This means that it pursues a social, economic, environmental or cultural mission seeking public or community benefit. The project provides telecommunication services in order to accomplish this mission, and a substantial part of its income is invested in goods and services that benefit the network.

It can be structured as cooperative or as a civil society organization, comprised of communities that own the network and also the support organizations. The community contributes the investment in infrastructure and the operation of their local networks, and the organization the basic technical knowledge regarding maintenance, technological development, legal support and administration.



Taking into account the social business model canvas (Burket 2010), the following is a detailed analysis of the components of the social business model on which the Community Mobile Telephony operates:

Key Partners	There can be two different kinds of key partners. First, those who comprise the license holder organization, and second, those with which alliances must be established in order to operate other segments of the network. In the first group we have the actors without which it would be impossible to keep the local networks running. The second group constitutes the entities which are only necessary to provide supporting services to these local networks. **Operating Communities**: these are partners that invest in the infrastructure of their local network and at the same time operate it.	**Support Organizations**: these organizations support the network regarding technical, administrative and legal issues. **ISPs**: these are small Internet operators that provide connectivity to the operating communities. **VoIP Operators**: these provide the Voice over IP service for connecting outgoing calls. **Other financial associations**: these are organizations that contribute financing for starting projects as they build towards the point of sustainability; they may also provide support for technological development.
Key activities	Here we will list those activities carried out by the license holder and the communities that comprise it. These activities are essential for the correct functioning of the network. **Construction of a local network** fully operated and managed by the community in collaboration with the key organizations through a cooperative association to which all the communities belong. **Off-net calls** are made using a VoIP service through a local ISP. **Establishment of a relationship** between communities in order to encourage local/regional development based on complementarity.	**Permanent political and legislative advocacy** in order to ensure that legal and institutional frameworks allow the operation of community networks. **Identification of and encouragement** to attend to the necessities of each community's development through the use of mobile technology/telephony. **Training and advice** to the communities regarding issues of operation and maintenance. **Research, development and technological, legal and economic innovation** in order to improve the operation of the project.
Key Resources	This refers to the physical, financial and human resources that are required to operate the social license holder entity.	**Technical Resources** • Reception and transmission equipment owned by the communities. • Open source software.

Key Resources *(continuation)*	• Concession for Radio Spectrum. • Internet service provider in each site. • Voice over IP service. **Financial Resources** • Financial investment for each state office of the license holding entity. • Financial investment for deploying the network in each community. • Operational and maintenance costs.	**Human Resources** • Social license holder entity staff. • Trained staff working in the communities. **Physical Resources** • License Holder State Offices • License Holder Personnel
Value Proposition	This is what distinguishes this license holder from others. Again, it should be noted that the main value of this project is that it builds a network that belongs to the users, and, therefore, can develop applications in accordance with local necessities. **Provide a mechanism** for rural, marginalized and indigenous communities to manage and operate their own mobile telecommunications network in order to encourage local development and to contribute to the construction of local/regional autonomy.	**This increases cellular penetration** and also reduces costs up to 97%, which ensures that part of the earnings accrue to an association to which the community belongs. This is then invested in innovation and training. **Possibilities for improvement** and development of telecommunication applications suitable for addressing the real needs of each community. **Reduction of the digital divide** with corresponding beneficial impact.
Relationships with Communities and Users	Here we enumerate the relationships the license-holding entity establishes with its beneficiaries. • Installation of cellular transceivers in communities. • Consultation regarding operation and maintenance. • Integration of the network with Internet Service Providers (ISP) and with Voice over IP service providers.	• Technical support for the communities. • Reinforcement of community autonomy in order to reach self-defined development objectives through the use of a mobile network.
Information Channels	Here we include the means through which potential partners can get information to consider joining the license holder:	• State promoters • Word of mouth • Media coverage • Links with communities, civic associations and NGO’s

Beneficiaries	This is the segment of the market to which this project pays specific attention. • Highly marginalized and indigenous rural communities.	• Communities without telecommunication coverage and high rates of migration to the United States. • Communities with 200 to 5000 inhabitants in the Mexican states of Oaxaca, Guerrero, Chiapas, Veracruz and Puebla.
Cost Structure	The social business model divides the activities carried out by the community from the ones performed by the social license holder. The latter is in charge of providing installation services and all the necessary equipment in order for the communities to operate their own mobile telecommunication network. It is important to point out that the capital investment (CAPEX) for acquiring equipment and installing the network is paid for by the community itself. This network connects to a local Internet Service Provider (ISP) so that in turn it can be connected to a Voice over IP service and be able to route and connect outbound and inbound calls (off-net). **Cost per community** • Initial investment of USD $10 000 which includes buying and installing the necessary equipment to operate the telecommunication network. This includes USD $2000 for installation and training costs. • Operating Expense (OPEX) Operator/local administrator's wage: USD $160 per month. Internet access: USD $80 per month. Monthly cost of off-net calls via VoIP = total of the off-net calls X total price of the calls. Consultancy and technical service fee of USD $0.80 per subscriber. Depreciation and maintenance of the equipment.	**License holder costs** • Investment (CAPEX) Tools – USD $10 000 Computers (4) – USD $2 700 Office Furniture – USD $1000 Truck – USD $20 000 • Operating Expenses per month (OPEX) Human Resources (Coordination, Operations, Public Affairs, Finances, Legal Affairs, Innovation, Interinstitutional Relationships, Technical Support, Human Resources) – USD $10 240 Insurance for Employees – USD $140 Fixed Office Expenses (rent, power, water, Internet) – USD $320 Travel and truck maintenance – USD $560 • Monthly Operating Costs per State Human Resources (Technician, Technical Support, Community builder, Administrative assistant) – USD $5 520+ Insurance for Employees – USD $96 Fixed Office Expenses (rent, power, water, Internet) – USD $320 Travel and truck maintenance – USD $560 More accurate figures will be presented further on.

Income Sources

As in the previous case, there is a distinction made between the community's income and that of the social license holder. The community charges a $40 mexican peso monthly fee to each user for maintenance and operation of its network. From this amount it keeps 25 pesos and assigns 15 pesos for each user registered to the license holder for technical and legal services and for consultation regarding the overall operation of the network.

In turn, the license holder must cover the expenses of the national office and, if applicable, that of the state offices. In order to do that, it is suggested that 10 out of the 15 pesos that a given state contributes each month is destined to the state offices. The rest should be used for the expenses of the national office.

Income per community

- A $40 pesos fee for each community subscriber
- Income via off-net calls = total of the off-net calls X total price of the calls.
- Public budget and contributions from the localities' migrants.

License holder Income per State

- Income for installation per community: $ USD 2 000
- Consultancy and technical service fee of 15 pesos per subscriber in each community in which the service is available.
- Financing and contributions from national and international organizations.

FINANCIAL EVALUATION

Two scenarios were considered for the financial projection, a positive scenario and a negative one. These included the three actors taking part in the operation: the operating communities, the social license holder and the state offices managing expansion.

The positive or optimistic scenario includes the installation of one network per week in order to reach 52 in one year starting from 2016. The negative or pessimistic scenario considers only 22 networks installed per year.

Table 1. Networks installed per year

Networks installed per year	Positive Scenario	Negative Scenario	Total (Positive Scenario)	Total (Negative Scenario)
2018	52	22	121	83
2019	52	22	173	105
2020	52	22	225	127
2021	52	22	329	149
2022	52	22	381	171
2023	52	22	433	193
2024	52	22	485	215
2025	52	22	537	237

Source: prepared by the authors

It is planned to increase coverage of services in one state in 2016 in order to reach between 39 and 69 communities. An additional state office is also considered for 2017 as well as beginning the installation of a network in that new state. 2018, 2019 and 2020 will see the beginning of operations in new states.

Table 2. Estimated members (networks)

Total estimated members	Positive Scenario	Negative Scenario
2014	2,000	1,600
2015	4,250	3,400
2016	17,250	7,800
2017	30,250	12,200
2018	43,250	16,600
2019	56,250	21,000
2020	69,250	25,400
2021	82,250	29,800
2022	95,250	34,200
2023	108,250	38,600
2024	121,250	43,000
2025	134,250	47,400

Source: prepared by the authors

We therefore expect to have between 47 400 and 134 250 subscribers of mobile community networks in 2025. Although this figure is not relevant in terms of the mobile telephony market in Mexico, with almost 100 million subscribers, the delivery of this service represents a mechanism for rural, marginalized and indigenous communities who lack this service to manage and operate their own mobile telecommunication networks. It also encourages local development and contributes to the implementation of local and regional autonomy.

Capital investment and operating expenses

Since the investment in network construction is made by the communities themselves, it is important to distinguish between the expenses incurred by the community and those of the social license-holder.

Investments and expenditures made by the community

Each community must invest about 11 000 American dollars in deploying the network and the expenditures are organized as follows:

Table 3. Capital Expenditure (CAPEX) made by the community

Amount	Item	Total Cost (Mexican Pesos)	Total Cost (American Dollars)
1	Telecommunications Equipment	$82,318.50	$4,950.00
1	IVA	$13,304.00	$800.00
1	Added taxes/Import Charges/Import taxes	$21,402.81	$1,278.00
1	Freight	$4,989.00	$300.00
1	Cables, antennae and power supply units	$10,809.50	$650.00
1	Installation	$33,260.00	$2,000.00
1	Protection Equipment/ Protective Gear	$16,630.00	$1,000.00
	Total	$182,713.81	$10,987.00

Source: prepared by the authors

The equipment completely depreciates in value every ten years, so planning the next investment at the end of this period is recommended.

The communities also incur operational expenses which are detailed below. It should be made clear that the VoIP calls may vary according to the monthly consumption of each community.

Table 4. Operational Expenditures of Communities

Amount	Operational Expenses	Monthly Gross Pesos	Gross Dollars per Month	Annual Gross Pesos	Gross Dollars per Year
1	Salary for part-time operators	$2,993.40	$180.00	$35,920.80	$2,160.00
1	Internet access	$1,663.00	$100.00	$19,956.00	$1,200.00
1	VoIP Calls Estimate	$1,068.00	$64.22	$12,816.00	$770.64
1	Consultancy and Technical Service	$3,000.00	$180.40	$36,000.00	$2,164.80
1	Rent, electricity, water services and similar expenses	$831.50	$50.00	$9,978.00	$600.00
	Total	$9,555.90	$574.62	$114,670.80	$6,895.44

Source: prepared by the authors

Investments and expenditures made by the social license-holder

The social license-holder invests in the following items:

Table 5 . Capital expenditures by the social license-holder. National office

Amount	Item	Unit price (pesos)	Total Price (Pesos)	Total Price (Dollars)
1	Tools	$160,000.00	$160,000.00	$9,621.17
4	Computers	$10,000.00	$40,000.00	$2,405.29
1	Office Furniture	$10,000.00	$10,000.00	$601.32
1	Truck	$300,000.00	$300,000.00	$18,039.69
1	Servers	$116,410.00	$116,410.00	$7,000.00
	Total	$480,000.00	$510,000.00	$30,667.47

Source: prepared by the authors

However, most expenditures are operational rather than capital, as is shown below:

Table 6. Operating Expenses of the social license-holder. National office

Item	Human Resources	Gross Pesos per Month	Gross Dollars per Month	Gross Pesos per Year	Gross Dollars per Year
1	General Coordination	$25,000.00	$1,503.30	$300,000.00	$18,039.69
1	Operations Coordination	$25,000.00	$1,503.30	$300,000.00	$18,039.69
1	Relationship Building Coordination	$17,500.00	$1,052.31	$210,000.00	$12,627.78
1	Institutional Relations coordination	$25,000.00	$1,503.30	$300,000.00	$18,039.69
1	Finance Coordinator	$17,500.00	$1,052.31	$210,000.00	$12,627.78
1	Innovation and Continuous Improvement Coordination	$25,000.00	$1,501.31	$300,000.00	$18,039.69
1	Human Resources Department	$17,500.00	$1,052.31	$210,000.00	$12,627.78
1	Deployment	$12,000.00	$721.59	$144,000.00	$8,659.05
1	Technical Support	$12,000.00	$721.59	$144,000.00	$8,659.05
1	Computer Development	$12,000.00	$721.59	$144,000.00	$8,659.05
1	Legal Department/Legal	$17,000.00	$1,022.25	$204,000.00	$12,266.99
1	Finance Subdivision	$12,000.00	$721.59	$144,000.00	$8,659.05
	Total	$217,500.00	$13,078.77	$2,610,000.00	$156,945.28

Item	Human Resources	Gross Pesos per Month	Gross Dollars per Month	Gross Pesos per Year	Gross Dollars per Year
1	Office expenses (rent, electricity, water, Internet)	$6,200.00	$372.82	$74,400.00	$4,473.84
1	Insurance for staff	$3,000.00	$180.40	$36,000.00	$2,164.76
1	Truck insurance	$1,000.00	$60.13	$12,000.00	$721.59
1	Maintenance and management of servers	$7,483.50	$450.00	$89,802.00	$5,400.00
	Total	$17,683.50	$1,063.35	$212,202.00	$12,760.19

Source: prepared by the authors

Some of the human resources employed for national management of the national office are also available to the state offices, creating efficiency and as a consequence the total expenditure per year is reduced as the table below shows:

Table 7. Total Costs for the social license-holder. State Office

Type of cost	Pesos	Dollars
Capital Expenditure	$510,000.00	$30,667.47
Operative Expenditure per Year	$953,400.00	$57,330.00
Total Year 1	$1,463,400.00	$87,997.59

Source: prepared by the authors

This decrease in expenditure is due to a considerable reduction in human resource costs at the state level: it implies 5 people in its initial stage which can be reduced to only 3 once things are underway.

Profit or estimated loss
The estimated profit or loss for the year 2025 was calculated in the same way we projected the expenditure for the communities and for the social license-holder. In the case of the optimistic scenario we took into account an average of 250 subscribers per network, while in the pessimistic one we only considered 200 subscribers.

Financial Evaluation of a community with a network
Here we can see how network operation by the community is sustainable even in the pessimistic scenario which considers 200 subscribers for each network.

Table 8. Financial Evaluation for a Community with a Network

Item	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Contributions for Installation	$182,713.81											
Variable Income per Service	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00
Capital investment/ expenditure for Installation (CAPEX)	$182,713.81											
Variable Costs per Service	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80
Total Income	$297,937.81	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$115,224.00	$297,937.81	$115,224.00
Total Costs	$297,384.61	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$114,670.80	$297,384.61	$114,670.80
Total Profit Or Loss	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20	$553.20
Accumulated Profits Or Losses	$553.20	$1,106.40	$1,659.60	$2,212.80	$2,766.00	$3,319.20	$3,872.40	$4,425.60	$4,978.80	$5,532.00	$6,085.20	$6,638.40

Source: prepared by the authors

Financial evaluation of the license-holder at the state level
Since the operation does not enjoy external contributions from non-government organizations, the investment in a support and consultancy center becomes profitable only until year 12 in the pessimistic scenario, as is shown below:

Table 9. Financial Evaluation for a Social License-holder in a State

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Income for Installation	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00
Income for Consultancy and Technical Support	$44,000.00	$88,000.00	$132,000.00	$176,000.00	$220,000.00	$264,000.00	$308,000.00	352,000.00	$396,000.00	$440,000.00	$484,000.00	$528,000.00
HQs State Costs	$1,463,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00
Contributions												
Total Income	$775,720.00	$819,720.00	$863,720.00	$907,720.00	$951,720.00	$955,720.00	$1,039,720.00	$1,083,720.00	$1,127,720.00	$1,171,720.00	$1,215,720.00	$1,259,720.00
Total Cost	$1,463,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00	$953,400.00
Total Profit or Loss	-$687,680.00	-$133,680.00	$-89,680.00	-$45,680.00-	-$1,680.00	$42,320.00	$86,320.00	$130,320.00	$174,320.00	$218,320.00	$262,320.00	$306,320.00
Accumulated Profits or Losses	-$687,680.00	-$821,360.00	-$911,040.00	-$956,720.00	-$958,400.00	-$916,080.00	-$829,760.00	-$699,440.00	-$525,120.00	-$306,800.00	-$44,480.00	$251,840.00

Source: prepared by the authors

The above results have to do with the fact that there is slow return on investment in telecommunications networks, as well as with the high capital investment costs necessary to start operations. However, the positive scenario proves there can be accumulated profits close to 19 million pesos by year 12. This will allow the expansion, improvement and development of the network.

Expanded Financial Evaluation of the license holder
For this financial evaluation the whole business plan is taken into account along with the expansion model for 4 states. Additionally, we have considered contributions by funders. These contributions are vital for the long term sustainability of the project. As in previous cases, the negative scenario is provided as a contrast for the estimated accumulated profits or losses of the project.

Table 10. Table. Additional Financial Evaluation for the Social License-Holder. National and State level

Item	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Income for Installation	$266,080.00	$299,340.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00	$731,720.00
Income for Consultancy and Technical Support	$288,000.00	$612,000.00	$1,404,000.00	$2,196,000.00	$2,998,000.00	$3,780,000.00	$4,572,000.00	$5,256,000.00	$6,156,000.00	$6,948,000.00	$7,740,000.00	$8,532,000.00
HQs State Costs (Oaxaca)	$3,332,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00	$2,822,202.00
HQs State Costs				$1,463,400.00	$2,416,800.00	$3,370,200.00	$4,323,600.00	$3,813,600.00	$3,813,600.00	$3,813,600.00	$3,813,600.00	$3,813,600.00
Contributions (Shuttleworth/ Networks)	$300,000.00	$4,127,000.00	$1,963,000.00	$1,963,000.00								
Total Income	$854,080.00	$5,038,340.00	$4,098,720.00	$4,890,720.00	$3,719,720.00	$4,511,720.00	$5,303,720.00	$6,095,720.00	$6,887,720.00	$7,679,720.00	$8,471,720.00	$9,263,729.00
Total Cost	$3,332,202.00	$2,822,202.00	$2,822.202.00	$4,285,602.00	$5,239,002.00	$6,192,402.00	$7,145,802.00	$6,635,802.00	$6,635,802.00	$6,635,802.00	$6,635,802.00	$6,635,802.00
Total Profit or Loss	-$2,478,122.00	$2,216,138.00	$1,276,518.00	$605,118.00	-$1,519,282.00	-$1,680,682.00	-$1,842,082.00	-$540,082.00	$215,918.00	$1,043,918.00	$1,835,918.00	$2,627,918.00
Accumulated Profits or Losses	-$2,478,122.00	-$261,984.00	$1,014,534.00	$1,619,652.00	$100,370.00	-$1,580,312.00	-$3,422,394.00	$3,962,476.00	-$3,710,558.00	-$2,666,640.00	-$830,722.00	$1,797,196.00

Source: prepared by the authors

This information confirms that by 2025 there will be a positive balance for the social license-holder, provided there are 22 networks installed per year starting from 2016, each with 200 subscribers on average.

Even taking into account possible complications, Community Mobile Telephony, when considered as a social business, proves to be sustainable in the long term even in areas of low-profitability and is strengthened by communities as infrastructure owners participating in an association that handles common technical, legal and administrative issues.

ACTUAL PROJECT FINANCES (2017)

The finances of the actual network over the past three years have varied considerably from what was outlined in the previous section. These variations apply to the license-holder and not the communities, whose finances have been quite similar to the projections.

The growth of the network in its first years has been smaller than the initial projections. This was mainly due to technical issues during these first years stemming from the fact that the technology involved was relatively new and untested. Moreover, this technology had not been previously installed in networks such as these, nor in the conditions of the localities in which they operate where power fluctuations occur on a daily basis and climate conditions are often adverse.

The aforementioned situation led to an approximately six-month period in which existing sites underwent revisions in order to improve electrical installations and upgrade the facilities with lightning protection, making them more resilient. During this period no new communities were accepted and as a result the project's rate of growth was reduced.

Due to these setbacks, and in order to make the project viable, the possibility of the license-holder also acting as the VoIP operator is being considered with the intention of achieving sustainability in the fifth year (third year from the granting of the license, taking into account the two-year experimental period in 53 localities).

Table 11. Projection based on one monthly installation

Income and expenses	January 2017 (20 localities)	January 2018 (35 localities)	January 2019 (53 localities)
Instalation	$50,000.00	$60,000.00	$66,666.00
Services	$45,000.00	$78,750.00	$119,250.00
Calls	$30,000.00	$52,500.00	$79,500.00
Expenses	$236,000.00	$236,000.00	$236,000.00
Monthly Total	$111,000.00	$44,750.00	$29,416.00

Source: prepared by the authors

This proves that the economic model of community telephony is sustainable even at small scales. To this date, this is the only viable model for remote communities of 200 to 3000 inhabitants.

05.
Organiza-tional Base

In its recommendations for public policies concerning TIC development for indigenous peoples and communities —which are based on the model of Braudel (1980), the International Telecommunications Union (ITU) establishes that the economy is comprised of three levels, each one capable of fully satisfying all human needs through specific institutions which are suitable for their economic environment (ITU, 2013). This is graphically expressed as follows:

World Economy
Large companies, financial institutions, the State: serves global markets

Local Market Economy
Small businesses, self-employment: serves local needs

Subsistence Economy
Few market economy activities and mainly informal activities: serves a subsistence economy

The ITU document mentions that the most common mistake made in the context of public policies seeking to take telecommunications to rural areas is trying to make companies that operate in the context of a global economy work within a subsistence economy model, which implies the need for large subsidies.

This is why the document recommends promoting projects based on this tripartite economic architecture; projects that allow the network to be operated in each segment or level by the most efficient actor.

Community mobile telephony is based precisely on this model: the community operates the local network (subsistence), a regional micro-enterprise provides the connectivity service and a global or national company provides the latter with connection to the network backbone.

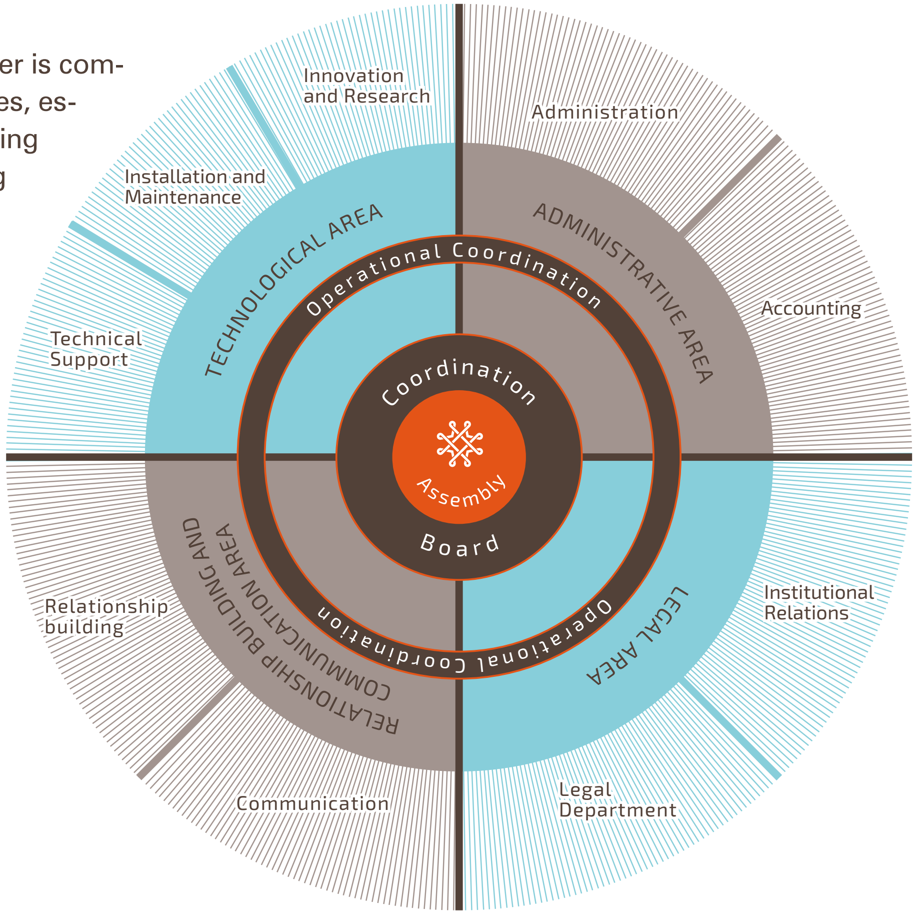
There is, however, an additional component in order for the operating communities to be able to work beyond the subsistence level: they require an organization able to support them at the local and global level, given the necessary interaction with these levels in the administrative, legal and technological areas —otherwise it would be very difficult to ensure the sustainability of the networks.

This section explains how the local operators (the communities) —to which we have given the name of "social license holders"— organize themselves. This organizational model is based on organized communities which are capable of acquiring, managing and operating a network according to their own community governance system.

We are going to refer to the general structure of the organization and to its essential processes. It must be noted that the information we present here is taken from the experience of working in Mexico, and that given the particular circumstances of this country, it was decided to use this organizational model. However, it is always important to identify the essential elements and that requires an understanding that there must be a local form of organization for the communities based on a subsistence economy and at the same time another instance or entity that brings them together either formally or informally in order to ensure interaction in different contexts. These coul be cooperatives, public/private associations, chambers of commerce and any other instance that allow the participation of these communities and the organizational structure needed to perform the different roles at local and global levels.

ORGANIZATION AND ROLES

The organizational structure of the license holder is comprised of three essential areas: governing bodies, essential areas and supporting areas. The governing bodies ensure the participation of the operating communities in the decisions made by the license holder; the essential areas undertake functions related to the objective or mission of the license holder which means they are directly related to the operation and the development of the service, whereas the supporting areas support and ensure the continuity of the essential areas.



Organizational Chart

Governance Structure

The governance structure is comprised of a decision-making body and an executive body. In the case study upon which this manual is based, the decision-making body is an assembly of members in which all operating and technical partners participate[15]; these were described with more detail when we dealt with the legal context.

The executive body consists of two representatives of the operating partners (community members) and two representatives of the technical partners appointed by the assembly. The role of the executive body is to ensure that the operation of the network is done according to the guidelines proposed by the assembly.

15 The operating partners are the communities that manage the network and the technical partners are the individuals, organizations or collectives who are experts on technology or regulation and who contribute to the technological development of the project.

Essential Areas

In order for the system to operate effectively we have identified three key areas which have to do with operation, building relationships among communities and innovation.

Operation
Implies the tasks related to network deployment, technical support and software development. This area requires personnel to do installations, ensuring the system is operational, and providing technical support for the communities as they deal with network issues. Given the fact that this is software defined radio, most technical issues or errors can be resolved by improving and developing software.

Some of the work carried out in this area involves:

Deployment:

1. Analyzing the technical viability of installing telecommunication networks in the communities that require service.
2. Planning and coordinating visits to the communities to plan the installation of telecommunication networks.
3. Coordinating the installation of networks in the community.
4. Participating in the technical training of the communities concerning the operation of the telecommunication network.

Technical Support

1. Ensuring the ticket system works.
2. Capturing the technical support requirements in the ticket system.
3. Passing the tickets to the corresponding area.
4. Attending to corresponding tickets.
5. Following-up on tickets in order to solve technical problems.
6. Supporting the Deployment Area with statistics in order to identify recurrent technical problems.
7. Participating in the technical training of the communities concerning the operation of the telecommunications network.
8. Identifying needed improvements to the different processes, training programs, documentation and the ticket system in order to make technical support more effective.

Software development and Innovation

1. Ensuring the information and computer systems of the social license holder work properly.
2. Analyzing technical support statistics in order to identify the most serious and recurrent problems.
3. Identifying improvements to the information and computer systems of the social license holder in order to make operation easier.
4. Analyzing the requests for improvements that modify the structure of the information and computer systems.
5. Determining along with the Operations Coordinator whether modification requests are applicable or not.
6. Designing, approving and implementing modifications and new functionality of the information and computer systems.
7. Identifying technological solutions and testing them in order to provide better telecommunication service.
8. Identifying improvements to the processes in order to speed up the installation of community telecommunication networks.

Relationship building and communities

Given the fact that the organizational architecture of the license-holder is a federation or conjunction of private networks of each community, it is necessary to implement mechanisms for the attention to specific needs of each local network, as well as improve interaction amongst them. The purpose of the relationship building activities is to bring together local networks and ensure interaction amongst people and communities; it aims to allow the organization to become a network of networks.

The Relationship Building area is aimed at generating actions on behalf of the license holder to improve the capacity of each network and the interaction among them with the license holder. Among its tasks are:

1. Visiting communities to understand the state of the network and the necessities and aspirations of each user.
2. Preparing informational materials on the social license holder and the community telecommunications network.
3. Designing training manuals concerning the operation and technical support of the telecommunication equipment used in the communication network.
4. Training the partner communities on the characteristics of the social license holder model.
5. Supporting members' training regarding the operation and technical support of the telecommunications equipment used in the community network.
6. Organizing the Annual Assembly of members for the social license holder.
7. Systematizing the results and conclusions of the Annual Assembly for the social license holder.
8. Suggesting innovations concerning products, services and processes.

Innovation

As with most any organization involved with technology, the possibility of continued existence is related to its capacity to innovate in order to be more efficient and attend to the demands of its beneficiaries.

It is important to emphasize the fact that because this technology is relatively new in the context of telecommunications, the equipment and its applications are still under development, hence the importance of this area.

The Innovation area of a social license holder like this, given its scarce resources, must be constituted in coordination with universities, hackers, developers, researchers and technology enthusiasts that are able to carry out —as mostly voluntary work— the collective realization of technical projects and development. Some of the suggested functions for this area are:

1. Calling and organizing planning meetings for innovation purposes.
2. Reviewing innovation plans with the people involved.
3. Providing follow-up to the implementation of the innovation plans.
4. Reporting on the results of innovation and continuous development with the support of each one of the coordination areas.
5. Suggesting innovations for products, services and processes.
6. Coordinating the community of volunteers.
7. Providing follow-up to the innovation activities carried out in conjunction with other organizations or collectives.

Supporting Areas

The main supporting areas are the ones related to administration and finances as well as the regulatory area, which was especially important in the case of the organization upon which this manual is based. The organizational has called this area Institutional Relations. Since the administration and finance areas carry out ordinary activities relating to their field, they won't be dealt with here.

In contrast, the Institutional Relations Area deals with regulation and is indispensable for this kind of license-holding organization, though it does not necessarily comprise the organization's personnel and responsibilities can be managed by an external organization. Its relevance resides in the fact that this is a new model for which there is no definitive regulation; therefore it requires a constant dialogue with the authorities.

Among its functions we can include:

1. Coordinating the development of regulatory prospects in the context of telecommunications.
2. Approving political advocacy strategies relating to the regulation of telecommunications.
3. Carrying out the regulatory advocacy strategy.
4. Building and developing relationships with national and international government and non-governmental institutions.
5. Supervising the report and the follow-up of incidents registered in the community telecommunication networks and in the communities operating them.
6. Suggesting innovations for products, services and processes.

Based on the aforementioned, we present the organizational flow chart of the project detailed in this manual in order to provide insight as to how these elements are expressed on the chart and relate to one another. As you will see, in the organizational chart there are more areas than those that have been mentioned. We consider, however, that the ones explained here constitute the essential structure of a project such as this.

It is important to point out that a national office requires very few personnel, given the fact that each community network is autonomous; essentially, one person should be able to operate a local network working part time, provided the community is there for support. A state office could be operated, in the near future by three or four people performing deployment, support, relationship building and administrative tasks.

PROCESSES

The social license holder proposed for this model operates on the basis of five essential macro-processes that are lineally sequenced. This results in the delivery of community telephony service and its improvement.

There are also three support macro-processes that are not necessarily performed consecutively, as is shown below:

Essential macro-processes:

1		2		3		4		5
From promotion to service request	→	From service request to installation	→	From installation to training	→	From training to technical support	→	Technical Support/Relationship building to Innovation

Supporting macro-processes:

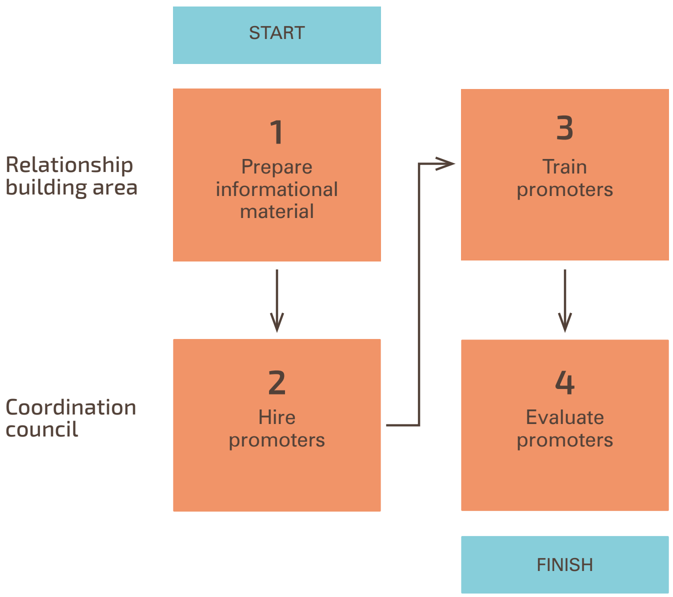
6	7	8
Finance	Legal	Human Resources

The detailed processes are available in the operational model. For the purpose of this manual we will present only the graphic representation of each essential macro-process.

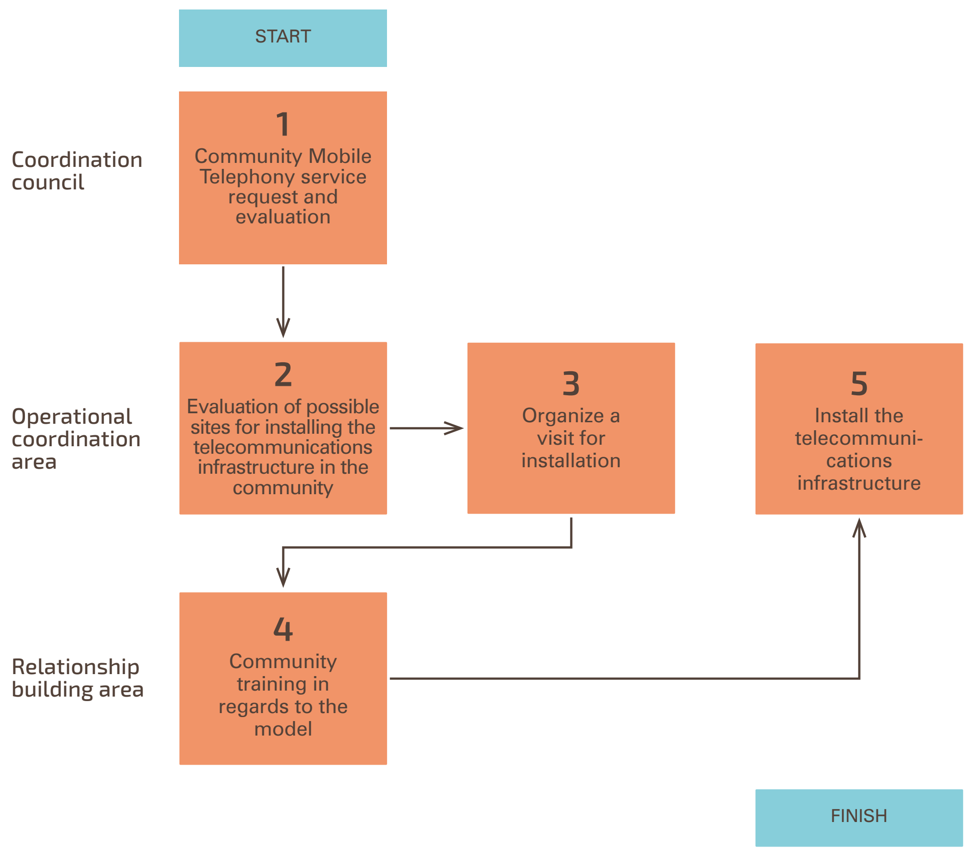
First steps

- The assembly approves the project and meets the requirements for the operation of the network.
- The community buys the equipment.
- The TIC team installs and sets up the network.
- TIC provides training to administrators.
- The network begins operations.

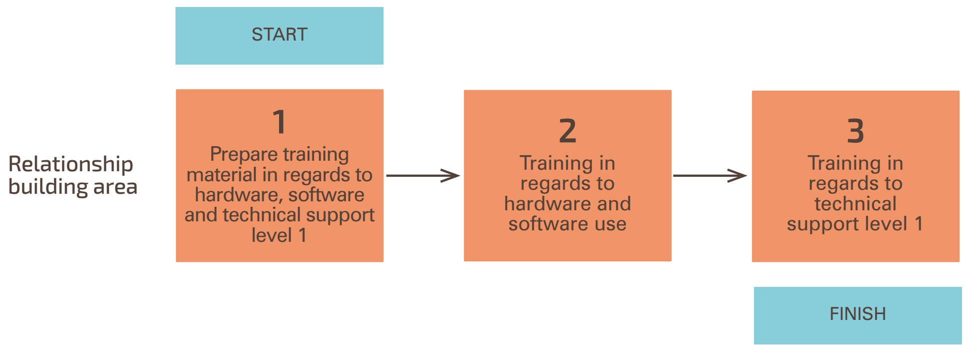
Macro-process 1: From promotion to the request of the Community Mobile Telephony service.



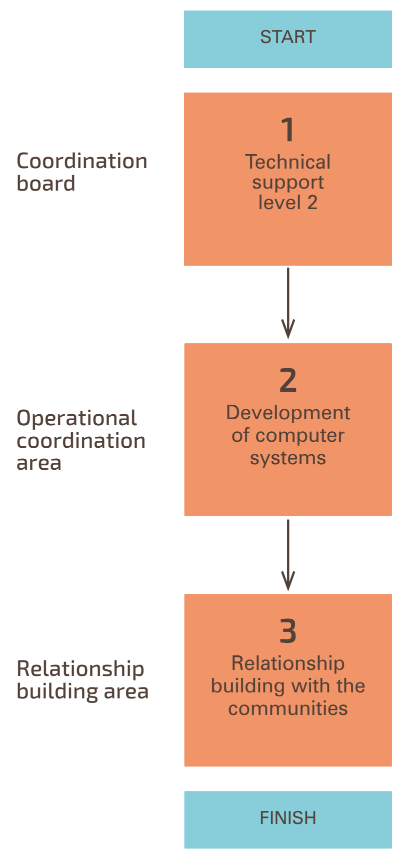
Macro-process 2: From the request of the Community Mobile Telephony service to Installation



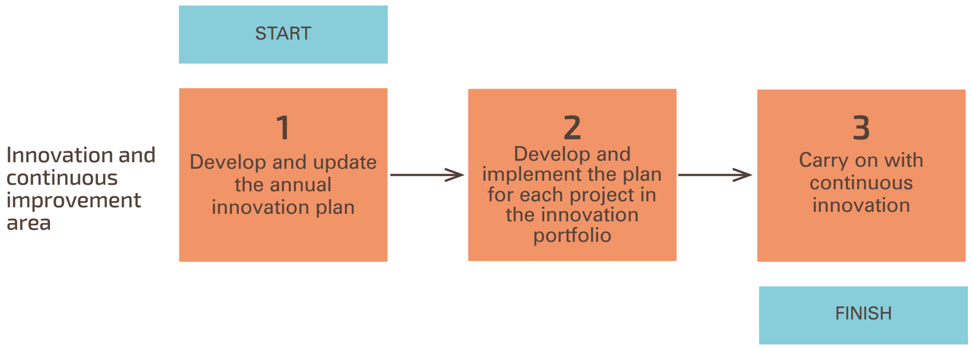
Macro-process 3: From the Community Mobile Telephony installation to Training.



Macro-process 4: From Training to Relationship building with communities and Innovation



Macro-process 5. Technical support/Relationship building with communities to Innovation



06.
Challenges

After three years of being operational, Community Mobile Telephony has proven to be a valid option for communication in isolated areas where no conventional operator has reached. This has encouraged further investment in equipment development similar to the one currently used in this model, and also recommendations in terms of regulation for other countries to consider this type of approach in their spectrum planning and management mechanisms.

However, we still need to create an ecosystem that allows the development and expansion of these kinds of models which are designed to provide sustainability above profitability. Up until now, most public policies and regulation concerning telecommunications have concentrated on the latter.

If we really want to connect those still unconnected, it is necessary to change perspectives and be able to create the technical, economic and regulatory bases in terms of public policy for this to happen. In order to do so, it is important that the resources currently being used for Universal Service Funds, which are available in many countries, be used not only to subsidize companies whose business model does not work in those areas, but to create the necessary conditions for the approaches that do work to operate. This means:

- Generate funding to support these kinds of social enterprises, from their early stages to launch.
- Allow access to essential infrastructure such as spectrum and backbone networks from a perspective that considers their contribution to the fulfillment of a social need and the fact that they are not-for-profit organizations.
- Assign funding for research and development of software and equipment specially designed for these areas.
- Create a legal and public policy framework that allows the operation and development of small community operators in these zones.

This will undoubtedly allow us to achieve the objectives concerning social coverage with a substantial reduction in terms of resources, which could be used for other areas or projects.

Bibliography

Benkler, Y. (2005). *La riqueza de las redes: cómo la producción social transforma los mercados y la libertad*. Barcelona: Icaria.

Bloom, P. (2015). *Telefonía Celular Comunitaria como una alternativa al sistema hegemónico de telecomunicaciones en México: un estudio de caso de las nuevas iniciativas de la Sierra Juárez de Oaxaca*. Tesis de Maestría del Posgrado en Desarrollo Rural. Ciudad de México: UAM.

Braudel, F. (1980). *On history*. Chicago: University of Chicago.

Burket, I. (2010). *Using the busines model canvas for social entrepreneur design knode.* Retrieved from https://mbs.edu/getmedia/91cc0d01-3641-4844-b34c-7aee15c8edaf/Business-Model-for-SE-Design-Burkett.pdf

Diccionario jurídico mexicano. (1994). México: Porrúa-UNAM.

Deleuze, G. y Guattari, F. (2009). *Rizoma*. Ciudad de México: Fontamara.

Himanem, P. (2001). *La ética del hacker y el espíritu de la era de la información 2001*. Retrieved from http://eprints.rclis.org/12851/1/pekka.pdf

Huerta, E. (2013). *Recomendaciones de política pública para el desarrollo de las TIC en comunidades indígenas*, Unión Internacional de Telecomunicaciones. Retrieved from http://media.wix.com/ugd/68af39_468d7225d72146f4b1f4d89d0789c213.pdf

Laval, C. y Dardot, P. (2015). *Común: ensayo sobre la revolución en el siglo XXI*. Barcelona: Gedisa.

Lessig, L. (2001). *The future of ideas: the fate of the commons in a connected world*. Nueva York: Random House.

Instituto Federal de Telecomunicaciones (2015). *Programa anual de uso y aprovechamiento de bandas de frecuencias 2015*. Retrieved from http://www.dof.gob.mx/nota_detalle.php?codigo=5387867&fecha=06/04/2015

Instituto Federal de Telecomunicaciones (2016). *Programa anual de uso y aprovechamiento de bandas de frecuencias 2016*. Retrieved from http://www.ift.org.mx/sites/default/files/conocenos/pleno/sesiones/acuerdoliga/dofpift230915406.pdf

Organización de los Estados Americanos. (2010). *Una agenda hemisférica para la defensa de la libertad de expresión*. Retrieved from https://www.oas.org/es/cidh/expresion/docs/publicaciones/agenda%20hemisf%C3%A9rica%20espa%C3%B1ol%20fina%20con%20portada.pdf

Finch, J. & Orillard, M. (2005). *Complexity and the economy implications for economic policy*. UK: Edward Elgar Publishing.

Peralta, J. (14 de noviembre de 2011). Mitos y cuentos del espectro. *Revista Etcétera*. Retrieved from http://www.etcetera.com.mx/articulo/Mitos+y+cuentos+del+espectro/10100

Rendón, J. (2003). *La comunalidad. Modo de vida de los pueblos indios*. Tomo I. Cultura Indígena. México: Conaculta.

Umemoto, K. (2006). Presentation *The knowledge economy and the knowledge society*. Retrieved from https://es.slideshare.net/asaito/knowledge-economy-and-society

Unión Internacional de Telecomunicaciones. (2014). *Informe final. Conferencia mundial de desarrollo de las Telecomunicaciones*, Dubai: UIT.

Appendices

1	Example of documents shared with communities interested in the Community Mobile Telephony project	Consult here in spanish
2	Example of documents shared with communities that have recently joined the Community Mobile Telephony project	Consult here in spanish
3	Infographics: "This is how the Community Mobile Telephony network works" and "Frequent problems and solutions"	Consult here in spanish
4	Chart showing case file example forms and their legal implications	Consult here in spanish
5	Affero General Public License version 3 (AGPLv3)	Consult here
6	Example of Telecommunications License	Consult here in spanish
7	Proposed amendments to Article 239 of the Federal Tax Law	Consult here in spanish
8	Resolution 268. Implementation of Recommendation ITU-D 19 for the Americas Region. Included in the Final Report of the 28th Meeting of the Permanent Consultative Committee I: Telecommunications/ Information And Communication Technologies, 17–20 May, 2016	Consult here
9	Decree whereby the Federal Telecommunications and Broadcasting Law of Mexico is issued. Published in the Official Gazette of the Federation on 14 July, 2014	Consult here

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