Muni-Wi: an exploratory comparative study of European and Brazilian municipal wireless networks

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EXECUTIVE SUMMARY

a) Goal

This report presents an exploratory comparative study of cases of *significant city-wide Muni-Wi (municipal wireless) network for civilian use.* Those municipal initiatives with evidence of full or partial deployment of wireless networks for the population were considered significant. The projects had also to provide evidence of monthly logs, sessions or registered users in order simply to confirm that the network was active. The defining point for significance was the existence of at least a 2 km^2 coverage area, as this could be considered a relevant coverage as far as outdoor internet in a city goes.

The goal was to access commonalities between multiple positive cases, that is to say cases with active Muni-Wi projects, expecting to bring complementary understanding of their outcomes or, at any rate, to systematize information for future Muni-Wi projects or related research studies. The results cannot be generalized, but may offer an initial basis for furthering the investigation with more cases or with similar methodological designs.

b) Cases

Six cases were investigated, namely, Bristol and Norwich, both in England; Issy-les-Moulineaux, in France; Piraí, Tiradentes and Sud Mennucci, in Brazil. The restriction to cases only in Europe and Brazil is justified because of an interest in comparing the approaches of developing and developed countries to similar matters, but also by the geographical research context of the project, involving a Brazilian researcher hosted by an European institution.

All cases studied here have been somehow previously recognized for their Muni-Wi projects. Issy-les-Moulineaux and Piraí have both been nominated to the Top Seven Intelligent Communities (ICF, 2008b). Bristol and Norfolk (Norwich) are both members of the DC-10 group, which brings together the ten finalists in the Digital Challenge, a competition promoted in the United Kingdom (See http://www.dc10plus.net). Tiradentes was chosen by the Brazilian Federal government to be a laboratory for other federal and municipal initiatives (MC, 2007), while Sud Mennucci was one of the first cities in Brazil to roll out a Muni-Wi project (Gaspari, 2005).

c) Theoretical framework and methodology

Theoretically speaking, this exploratory study draws upon a suggested C.I.B.G (Community, Infrastructure, Business Model, Governance) framework. The comparative study relies on Fuzzy-set social science, as proposed by Charles Ragin, to develop the comparative studies.

Briefly, the Fuzzy-set Qualitative Comparative Analysis (fsQCA) aims to offer researchers a way to deal with multiple cases and causal complexity, fostering the dialogue between evidence and theoretical knowledge. Therefore findings in the fsQCA constituted a reference for the researcher to develop further arguments about Muni-Wi initiatives.

The methodology is fundamentally interpretative, allowing for the attribution of degrees of membership in given sets, qualitatively defined and analysed in a configurational way, and is particularly useful for dealing with Small-N research.

d) Findings

The fsQCA identified a high diversity of approaches to Muni-Wi, as the six cities deploying significant Muni-Wi networks for civilian use opted for relatively different strategies. In sum, there is no reference model. No single condition analysed in the fsQCA could be identified as a necessary condition, that is, as a condition that must be present whenever the outcome is positive (existence of Muni-Wi). The fsQCA results were consistent with theoretical knowledge drawn upon in this research.

As reported in the conclusion, “there might be some objective reasons for this outcome (the variety of approaches), such as the absence of a reference model or the fact that some projects are still running in an experimental mode, on a trial and error basis. However, contingent local situations may have contributed to the complexity of the scenario depicted.

1. Introduction - Demands, challenges and opportunities for Muni-Wi projects[1]

The emergence of digital systems has rearticulated social relationships across multiple dimensions of human existence. Given the centrality of information and communication technologies (ICT) in the present technical period, the permanent development of data processing, storage, data mining, strategies to organize and transmit content in different formats is not the only imperative. Just as important is knowing the user's everyday life practices and how to foster the necessary technical and political conditions to direct all the communicational processes to the benefit of society. Alongside the quest for methodological and technological improvements, this research must be anchored in some key humanistic values, which, *lato sensu*, could be described as follows:

a. The subordination of innovation, creativity, and scientific knowledge to ethical principles which value life in all its dimensions;
b. The acknowledgement that human actions and the intentionalities of technical objects should be understood together .

In light of the above assumptions, the goal is to offer a comparative view of municipal wireless broadband network projects, in order to further the discussion of ICT presence in the urban space. From the start there is a recognition that, as Milton Santos once observed, even though the presence of the available techniques[2] is inevitable in material terms, since they adhere to the territory, they can receive different existential meanings (Santos, 2004). With the current techniques it is no different.

Whether in the theories or discourses in vogue about economical development, or in the most prosaic everyday life practices, ICT has reinvented social relationships, opening a multitude of possibilities, but also creating new forms of exclusion. Just take the economic aspect as an example. In Latin America, commerce and industry still have low rates of business Internet use when compared to Western Europe, the United States or Canada. Not surprisingly the continent also has lower rates of Internet access and lower educational levels, among other poor socioeconomic ratings. This is a conjunction of factors that undermines the region's e-readiness index and its capacity to take full advantage of ICT in a global market. Simply as a way of comparison, in annual research conducted by IBM and The Economist, on a scale of one to ten, North America's e-readiness index ranks at 8.58,

[1] All texts quoted from other languages were translated by the researcher.
[2] Technique is understood as both the instrumental and the social means by which human beings transform the world. The concept accounts for the impossibility of understanding human and non-human aspects separately (Santos, 2002).

followed by Western Europe with 7.99, whereas Latin America ranks fourth among five regions, with 5.21 (EIU and IBM, 2007).

The scenario may look worse if it is taken into consideration that even countries connected to the global network profit differently from the available technological infra-structure. In other words, connection, in technical terms, does not guarantee an equilibrium of fluxes, e.g., between Northern and Southern hemispheres, as there is a difference between the points (fixed) and the fluxes (Santos, 2002). Hence it is not a simple matter of connecting "nodes" (Mansell and Steinmueller, 2000, 38).

The architecture of the distributed network is particularly likely to increase illusions about the idea of being connected and the conditions of participation. In fact, the arguments are very close, as far as rhetoric goes, to those made for a certain type of neo-liberal and predatory form of capitalism – that the free flow of information between points will guarantee the necessary development of the network or the economy. However, though connected, local conditions are not the same everywhere, because people, corporations and regions take part in the whole process at different "speeds", not only technologically speaking, which are dependent on previous interwoven social and material systems.

Despite all the socioeconomic problems, technological advances will not stop. The evolution of ICTs marches firmly towards the omnipresence of wired and wireless communications processes, bringing new opportunities, but also new challenges. Among wireless devices, there is no doubt that the mobile phone is one of the key media of the present technical period. Cell phones are rapidly expanding their reach and, in some regions, have higher teledensity - most notably for pay-as-you-go (pre-paid) options - than other conventional media, such as fixed lines. As early as 2003 the number of mobile telephone customers surpassed those for fixed lines (Castells et al., 2006), since this is an excellent option for the low-income strata in areas where traditional wired telephony is far from being a universal service.

The fast expansion of mobile telephony is a sign of what is conventionally called technological leapfrogging (Soete, 1985). In other words, some communities jump technological development steps straight to wireless technologies. Technically speaking, in the very near future, 3G cell phones, with the very possibility of functioning over WiMax networks (Acharya, 2007),), will open the doors to important steps towards bridging the digital divide as far as broadband access goes. Sadly, their economic and political feasibility is a whole different issue.

Notwithstanding the pervasiveness of mobile telephony, the new possibilities of wireless communications go beyond cell phones to reach the most common objects, towards so-called ubiquitous computing, a trend announced more than a decade ago (Weiser and Brown, 1996). Social relationships, content production and transmission are undergoing profound change thanks to a myriad of oral, written and video communication channels. One may call it a revolution, but it may be prudent to recognize that it will take longer than announced by the marketing campaign for every new ICT gadget. In a less festive way, however, one can speak of profound change. Some techniques do tend to look universal, but they will never achieve such a status as they will systematically exist with other techniques (Santos, 2002). Either way, challenges are being presented to researchers and managers from public and private sectors.

The scenario herein discussed carries the crucial question of the democratization of ICT access. To overcome the digital divide has become a central challenge for developed and developing countries, regardless of the peculiarities of each case, with initiatives coming from public and private sectors, not to mention more or less independent efforts made by organized civil society. In general, projects to expand access to ICT find their arguments in economic motivations, most notably in the debates of the early 1990s, and in social concerns (Couldry, 2007). However, a recurrent matter of dispute is when, where and how governments, at all levels, or the private sector, step into municipal wired or wireless network provision. Back in 1999, Mansell had already advocated “pushing the margins of sustainable investment”, and adverted:

> Initiatives are needed urgently to extend the margin of sustainable access to ICTs. There is no need to target areas where market demand for ICTs is strong and suppliers are active in low risk, commercially sustainable markets or where government funding is available to support the provision of ICT applications and services (Mansell, 1999, 3).

The present state of affairs offers a kaleidoscopic array of positions mixing debates of human rights, political agenda and marketing strategies, but a common premise: the possibility of any social group to best profit from the communication fluxes.

Given the low teledensity rates in most developing countries, the communications industry, including telecoms and ICT companies, and governments at all levels (municipal, state or federal) foresee in wireless technologies a viable opportunity, sometimes via hybrid designs

with wired infrastructures, to close the digital divide. Despite some basic infrastructural problems remaining unsolved, a great number of wireless solutions, such as WiFi, WiMax, Wi-Mesh, VSAT, not to mention other 3G mobile phone options and other wireless technologies, have opened a new vein within the debate about public policies for the democratization of ICT access. However, a slight change in approach may be noticed. In some cases there is a shift from tackling specific disadvantaged social segments, such as low income neighbourhoods, elderly people or youth, to the deployment of city-wide public networks. The question still unanswered is whether these new strategies will be sustainable in the long run, fitting the community's needs, but also allowing ICT and communications businesses to flourish locally.

As far as the government role goes, some key issues must be attentively observed in rolling out Muni-Wi projects (Sirbu et al., 2006, Powell and Shade, 2006, Tapia et al., 2006):

a. When and how should government invest in last-mile solutions instead of leaving the matter to the private sector?
b. How is the project funded?
c. Which technologies should be chosen?
d. What kind of support should be given to citizens and local business (end-users)?
e. What sort of spectrum use policies should be adopted?
f. Does the entry of government as a wireless Internet access provider inhibit the development of private or communitarian initiatives?

Tapia *et al* also highlight the ambiguous role played by governments both as access providers and as consumers of broadband services (Tapia et al., 2006), since public wireless network infrastructure directly benefits other governmental activities such as communication among employees, security and emergency systems and database access, to mention a few.

The entry of municipal government into the provision of broadband Internet raises some questions within the private sector as well. In the United States, for example, a private lobby induced many state governments to approve new regulations aimed at orienting the participation of municipal public power in the sector (Shaffer, 2007, Tapia et al., 2006). After the political battle, there were new pre-conditions concerning community involvement in the project, and proof that the service provided will not have a negative impact on the local budget, and that governmental action will not compete with private sector initiatives (Tapia et al., 2006). Nonetheless Sirbu *et al.* acknowledge that, by the time they conducted the

research, it was not possible to be sure whether or not, in the long run, the presence of municipal governments will favour local development (Sirbu et al., 2006). Powell and Shade, in turn, fear that the restrictions imposed by state law may limit communitarian projects (Powell and Shade, 2006).

Even though local government involvement in the provision of public internet access is a matter of debate, one cannot afford to ignore the fact that, more often than is imagined, experts are coming up with proposals to charge per use, in the name of avoiding traffic congestion and of QOS (quality of service), among other arguments. Additionally, the possible limits, or failure, of private providers to deliver accessible services to low-income populations give plenty of arguments for directing public funding to expanding internet access or, at least, to creating subsidy policies for key market or cooperative players (David, 2007). Government ventures into Muni-Wi could be facilitated by specific conditions and opportunities (Lehr et al., 2006, Tapia et al., 2006, Shaffer, 2007):

a. The need to bridge the digital divide and the perception of broadband as a key element to local development;
b. Acknowledgement of government's role as a basic infrastructure provider;
c. Private providers fall short in offering broadband Internet access at affordable prices;
d. Existence of unlicensed electromagnetic spectrum;
e. Pre-existence of available infra-structure (buildings to install antennas, networks, control over urban space, etc.).
f. Existence of municipal administrative networks which can be extended to the public at large.

Arguments based on development concerns must be nuanced. There are only macro studies pointing to the relationship between ICT and economical development (UN, 2007, EIU and IBM, 2007). Direct inferences, above all at local level, are difficult to make because there is little data available and the impacts of telecentres, Muni-Wi, among other projects, are likely to be noted only in the long run and in indirect ways. However, on a preliminary level there is evidence of economic growth in some areas, with a high rate of adoption of broadband networks. (See Gillett et al., 2006). Malecki and Moriset's take on this is rather interesting (Malecki and Moriset, 2008). According to these authors, global companies do take the infrastructure into account, among other socioeconomic factors, when deciding where to bring their business but determinism must be avoided:

> The lack of broadband availability has almost never been in itself the propellant of economic development. On the contrary, broadband goes where business and wealth already have flourished. That is not to say that digital telecommunication, and IT in general, do not have effects on the economy (Malecki and Moriset, 2008).

Regardless of the absence of strong empirical evidence of economic growth fostered by broadband, the development argument is frequently at the forefront of Muni-Wi initiatives. This is hardly a paradox. It is reasonable to confront digital exclusion as a dimension of social exclusion More deeply, if it is true that the definition of poverty is also a political definition, whose measure is "given, above all, by the goals set by a society for itself" (Santos, 1979, 9), one may unequivocally argue that in the so-called Information Society, Communication Society, Knowledge Society, or any other preferred metaphor, access to ICT is a core issue.

The link between communication and economic development, if put in historical perspective, is far from being a new issue. In the 1970s, amidst the debate over *The New International Economic Order* (NIEO), disputes about the unbalanced situation of communicational fluxes gained exposure, leading to reflection, in the ambit of UNESCO, about a *New World Information and Communication Order* (NWICO or NWIO). The unfolding of debates and research reached its peak with the publication of the MacBride Commission's report, *Many Voices, One World* (1980). Though carefully constructed, the report lost its impact over time for political reasons, being subject to criticism as too leftist or government driven. In the mid 1980s, the issue was a matter of debate mostly in some academic circles and among activists (Siochrú, 2005).

The emergence of the commercial Internet in the early 1990s revitalized the debate about communication. The 'digital divide' than became a buzz word in political, economic and human rights debates. Within UNESCO, in partnership with the International Telecommunications Union (ITU), which is the UN's branch for telecommunications and perhaps one of the most influenced by private interests, discussions reached a new milestone with the first and second phases of the World Summit on the Information Society in 2003 and 2005.

Once more different criticisms of the Summit's outcomes flourished, remarkably with regard to internet governance, as the issue of American influence remained unsolved, and to the unbalanced participatory processes during the meetings (Cammaerts and Carpentier, 2005). Nonetheless the key documents produced at the Summit, the Geneva Declaration of Principles and the Plan of Action, give a good overview of the main economic and human

rights aspects at stake (See http://www.wsis.org). Taken as a whole, the documents have a much more liberal bias than the MacBride Report.

Notwithstanding the possible and necessary criticisms, the MacBride Report and the WSIS documents, together with other documents such as the Universal Declaration of Human Rights Declaration itself (UN, 1948), The Declaration on the Use of Scientific and Technological Progress in the Interest of Peace and for the Benefit of Mankind (UN, 1975), The Millennium Development Goals (UN, 2000), to mention a few, give plenty of room to build arguments for ICT oriented initiatives based not only on social development but also human rights. The debate may touch key issues such as electromagnetic spectrum as a public good, access to devices, content, copyright, freedom of expression, and other related topics.

Often the human rights dimension is overlooked when public or private managers are constructing arguments in favour of Muni-Wi projects or of ICT in general. Very often the dream of economic development is the initial driving force. Some human rights groups, however, are trying to change the most common view of the matter. The CRIS Campaign (Communication Rights in the Information Society, see (http://www.crisinfo.org), for instance, has been one of the most prominent movements in this direction. According to the handbook of CRIS, the rights to communication:

> since it is in the plural form, implicitly points towards existing human rights that relate to communication, and away from promoting a new formal right to communicate, in the singular, in international law. The emphasis shifts subtly to **realising the existing communication rights on the ground**, **not on establishing a new right under international law** (Siochrú, 2005, author's emphasis).

Even though human rights arguments set an excellent ground for the democratization of ICT access, they may sometimes be lacking when it comes to envisaging business models and the infrastructures necessary to guarantee the achievement of such goals. Could these grounds, then, be consequently seen as utopian? Perhaps, but this can also be viewed positively. Paulo Freire uses the idea of utopia as a dialectic for denouncing dehumanizing structures and advocating more humanizing ones. This is an effort that requires profound knowledge of the concept, not only in words but as praxis (Freire, 1980). Be that as it may, someone will still have to pay the bill, and it is worth finding ways to pay it if wireless or wired broadband access to the Internet is to be seen as a fundamental requirement of contemporary societies.

Despite the fact that arguments anchored in economic development and human rights claims need to be improved, there is no discussion here that they provide cues, if not possible paths, for the digital divide debate. Truth be told, there is too much to be done. Although the last few years have brought enough evidence that the Internet access gap is closing, questions remain about its pace and adequateness for contemporary human rights or for market needs. According to UNCTAD's *Information Economy Report 2007-2008*, based on the International Telecommunications Union database (UN, 2007), in 2006, the penetration of the Internet in developed economies was six times higher than in developing economies. Four years earlier the difference was ten times (See *Tables 1* and *2*).

Table 1. Internet users by level of development and region

	2002	2006
World	618,514,417	1,131,078,697
Developed economies	397,605,044	566,077,247
Asia	60,345,200	89,439,100
Europe	149,899,844	227,077,547
North America	174,952,000	231,060,600
Oceania	12,408,000	18,500,000
Developing economies	207,465,892	511,035,250
Africa	10,290,156	43,397,500
Asia	153,538,659	361,391,800
Latin America and the Caribbean	43,411,477	105,864,150
Oceania	225,600	381,800
Transition economies	13,443,481	53,966,200

Source: (Nations, 2007)

Table 2. Internet penetration by development level

	2002	2006
World	10.0	17.3
Developed economies	42.0	58.2
Asia	45.0	66.3
Europe	32.2	47.8
North America	54.1	68.4
Oceania	52.6	75.7
Developing economies	4.2	9.7
Africa	1.3	4.7
Asia	4.3	9.6
Latin America and the Caribbean	8.2	18.8
Oceania	2.8	4.4
Transition economies	4.1	16.3

Source: (UN, 2007)

Disparities in regional broadband access, see *Table 3* and *4*, bring even deeper concerns. In 2006 the penetration of broadband use among Internet subscribers was 14 times higher in developed economies when compared to developing economies. While 69% of internet users in developed economies had broadband access, only 35% of users in developing economies had high speed connections. Therefore the figures indicate that developing countries are increasing their numbers of Internet users faster than developed countries. However, the analysis cannot overlook the fact that developing countries have fewer users, a bigger population and a slower expansion of broadband access.

Table 3. Broadband subscribers by development level

	2002	2006
Developed economies	63%	69%
Developing economies	31%	35%
Transition economies	0%	2%

Source: (UN, 2007)

Table 4. Broadband penetration by development level

	2002	2006
Developed economies	5.0	18.4
Developing economies	0	1.3
Transition economies	0.4	1.9

Source: (UN, 2007)

The above data give important arguments for investment in policies and programs to disseminate broadband access. No question about the complex nature of governments' roles as providers and users and the possible impact on market development, but the urgency of actions for wireless, wired or hybrid networks solutions is undeniable. Local governments may act as crucial catalysts to bridging the digital divide and have legitimate reasons to take action. UNCTAD's report could not be more explicit: "It is important that government policies encourage competition and the expansion of consumer markets, as well as promote investment in, and develop, infrastructure and connectivity" (UN, 2007, 28).

Finally, the deployment of networks is far from being enough. What is at stake is not a technological problem, but an economic, political and social matter. As Mansell points out, "It is not enough to focus on supply-side market failures. The conditions for flourishing demand must be created if the margin of sustainable provision of universal access is to be extended" (Mansell, 1999, 12).

2. Theoretical framework

In this report the city is taken as the crossing point of local and global powers and the arena of cultural mediation, with permanent conflicts and tensions between public and private spaces, where different techniques are available to the everyday life struggle for survival (Santos, 2004). The urban space is at centre stage, holding the promise of better, cheaper and somewhat more environmentally friendly solutions to foster the necessary conditions for human beings to co-exist (UNFPA, 2007).

The way that the internet in the city is dealt with in the specialized literature varies and brings forward many interesting ideas. One can talk in terms of Community Networks – a concept that goes back to sociological analyses not necessarily involving ICT, but which gains new dimensions with the emergence of digital information systems; of Digital Cities (Ishida and Ibister, 2000, Lemos, 2007, Aurigi, 2005), with an emphasis on online environments; of Digital Communities (Sander, 2007); Digital Business Ecosystems (Nachira et al., 2007), focusing notably on services and business transactions. Despite the different approaches, Lemos summarizes the issue very precisely: "it is not a matter of a new city or of old urban forms destruction, but of recognizing the institution of a dynamic whereby space and social practices are reconfigured with the emergence of new communication technologies and telematic networks" (2007, 4).

Conceptually different as the above metaphors may be, they all deal with a common phenomenon: the presence of ICT in the city. In this sense, what is at stake in the aforementioned ideas is what could be called a *digital locus* (Josgrilberg, 2008b), wherein some dimensions of communities, ecosystems or cities develop.

> The digital locus is a place, in Certeau's sense, organized by strategies of power that articulate digital information and communication systems and mobilize the symbolic and infrastructural dimensions of the present technical period. It is a place wherein human beings are not only submitted to pressures, even multiple determinations, but also recreate life, create spaces (Josgrilberg, 2007). Therefore, the digital locus is a site of fulfilment and the struggle for survival. It has its social conventions and physical infrastructures that are systematically related to other previous systems and techniques – techniques used according to Milton Santos as the social and material means with which humankind create and transform the world (2002).
>
> The digital locus is than just one place among many overlapping ones that make "society breathable". Therein people not only engage themselves in different prosaic social relations, but also work and do business.

The definition of a digital locus herein presented draws upon the work of Milton Santos (Santos, 2002), a Brazilian geographer, and Michel de Certeau (Certeau, 1990), a French intellectual. The idea of place (*lieu*) is used in Certeau's sense, that is a "proper space" whose elements are organized in a relatively stable form, an "instantaneous configuration of positions", in reference to each other (Certeau, 1990, 172-173). The definition of place is contingent. For instance, there is the place of religion, family, fashion trends or teen conventions. The place somehow points to the references, or authorities, that organize any given social group. As such, one always inhabits different places which are organized by different power relationships. Therefore, here, the notion of power implies no moral or ideological judgment.

Every social group needs its authorities, symbolic or material, that make its existence possible. "They [authorities] permit communication and social creativity, for they provide, to the former, common references, to the latter, the possible paths" (Certeau, 1993, 18). However, the question for Certeau is what people make of such authorities, how they profit from fissures and different logics (tactics) to create spaces or reinvent life. Attention should be drawn to the silent movement, unaware of its own paths, that alters the balance of the place in the filigrees of the social fabric. In sum, there is a dialectical tension between places – which will always exist as momentary, perhaps apparent equilibriums – and everyday life practices.

The digital locus, its communications infrastructure and its discourses on technical objects offers another place of life fulfilment. This is neither a deterministic view nor a naïve position with regard to technology. ICT managers know that their systems, once incorporated by everyday life practices, are used in ways never imagined by their creators (Ciborra, 2004). However there is no relativism here either, imagining subjects totally free to do whatever they want with the media and related discourses at their disposal. The presence of different technical objects undoubtedly alters the way human beings perceive and constitute the world. Nonetheless the analysis cannot afford to ignore the indetermination intrinsic to human beings' presence in the world (Merleau-Ponty, 1975), and consequently in the use they make of ICT.

Given the complex relationship - complex at times in contradictory ways - between human beings and technical objects, one of the biggest challenges for communications researchers is to establish a system of concepts and analytical categories which accounts for the human and non-human dimensions of the subject matter and, more than that, a system that is open

to reinvention upon contingent situations. For instance, it is not enough to trace the logs of a website, one also must describe how different meanings are constituted on the basis of everyday oral relationships, sustained by local memories and references foreign to the rationality of the technical object; or else, one might describe how human beings constitute the world through technical objects, as extensions of the body, within different life projects, each with its own existing style, perceiving the media against a larger horizon than the immediate contact with the machine. Multiple systems of techniques coexist in the digital locus.

The concept of technique is understood as a "group of instrumental and social means, by which man (*sic*) realizes his life, produce and, at the same time, creates spaces" (Santos, 2002, 29). Therefore there is a difference between a technical object, e.g. a computer, and technique. Human and non-human aspects must be conceptually differentiated but analysed together. It is possible, however, to address the issue in terms of the dialectical tension between the technical objects' intentionality, Santos draws here upon Husserl and the intentionality of human actions (Santos, 2002). From this movement stems the social meaning of ICT.

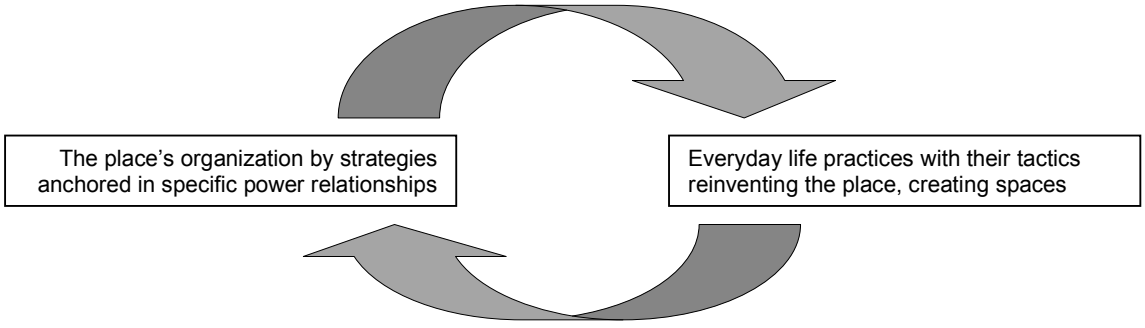
There will always be a group of techniques available, notwithstanding the apparent universality of digital systems. In every technical period (agricultural, industrial and so forth) some techniques emerge with a tendency to become universal; it is only a tendency, for these are never absolute but coexist within systems of techniques (Santos, 2002). In the so-called Information Society, the idea of different technical systems holds true. In philosophical terms, in Latin America, but not only there, would it not be more pertinent to talk in terms of *tiempos mixtos* (mixed times), where the pre-modern, the modern and the postmodern live together (Calderon, 1993, Calderon, 1987)? Or, as Calderon asks in a delightful way, "why does the revolutionary Gabriel García Márquez write with hygienic, electronic computer about the magic world of Mauricio Babilona and his yellow butterflies?" (Calderon, 1993, 55).

In investigating the human and non-human aspects of ICT, the questioning of some metaphors in vogue within the media and academia is necessary, as it is very easy to take the use of digital systems as a social sphere standing by itself. This semantic trap is permanent, set in tropes like digital world, cyber culture, information society, network society, digital ecosystems, digital cities, and the very digital locus itself, although the theoretical value of those ideas, their limits and possibilities must be recognized. From the ICT user's point of view, a money transaction, whether or not made on the internet, has that same impact on his or her pocket. Chats with friends in a online chat room, face-to-face or over the

phone are not activities which are worlds apart, but elements of a horizon that presents itself as a whole. It is only because the user, or the researcher for that matter, is engaged with that horizon as a whole that he or she can make distinctions or examine contiguities between the various elements and processes related to the installation of new technical objects in the urban space.

Users move within the digital locus, among other places. At an organized place, with all its symbolic and material power, users create spaces departing from an organization that is only apparently universal, static and without fissures. There is a similar dynamic to that of inhabiting a home or a city. The citizen or the inhabitant uses the available references in ways that, more often than not, differ from the architect's or urbanist's intentions. Often they are simple adaptations, but they can also turn out to be radical reinventions. The figure below attempts to represent such a dynamic process.

Figure 1. The dynamic between places and spaces

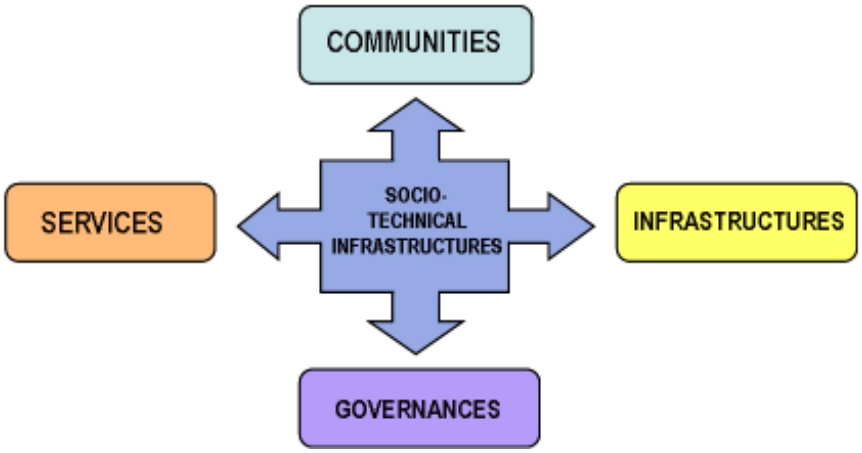


Muni-Wi research, than, can focus either on the organization of places or on everyday life practices, that is, the creation of spaces. Under ideal conditions, both dimensions would be taken into account. However, when this study opts to look at the implementation of municipal wireless networks, it is clear that its main goal is to describe and analyse the strategies organizing the digital locus. The scenario draws upon the investigation of public policies, management strategies, business models, technical objects and the motivations behind the creation of wireless networks, among other aspects.

In order to tackle the organization of a digital locus, as far as Muni-Wi projects are concerned, an adaptation of the C.I.S.G (communities, infrastructures, services, and governances) framework proposed by Botto and Passani comes in handy (*Figure 2*). The changes are necessary because the two researchers were addressing different issues,

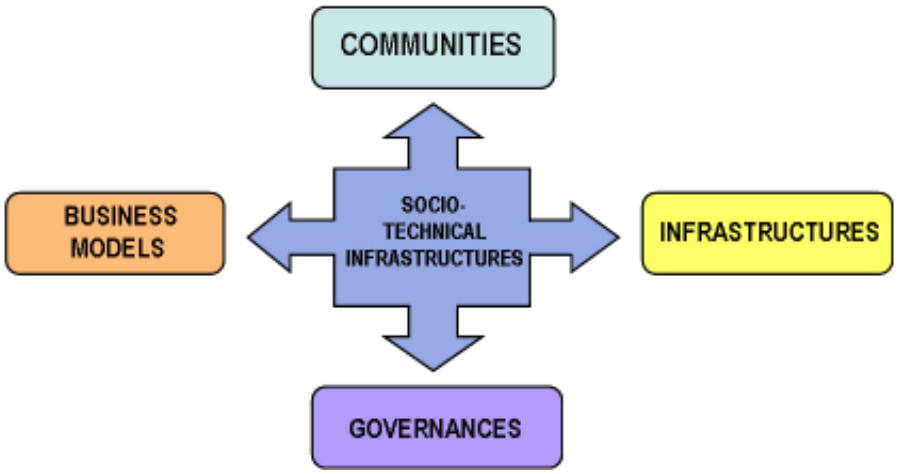
namely, the relationship between Digital Ecosystems and Community Networks. The original proposal follows (Botto and Passani, 2008, 18):

Figure 2. C.I.S.G. framework



The suggested C.I.S.G framework adaptation, in light of the goals of this research, substitutes the "service" dimension - a marked characteristic of Digital Ecosystems, the phenomenon studied by Botto and Passani - for the "business model". With this change, one would have the following figure (C.I.B.G) (*Figure 3*):

Figure 3. C.I.B.G. framework



In order to further these preliminary conceptual ideas, one needs to dig deeper into the *C.I.B.G* framework.

a) Communities

The idea of community used here includes every possible stakeholder involved in Muni-Wi, namely: citizens, local business, industries and government. The definition of a community is far from being consensual. Where are the limits of a community? Who is in or out? What about transient visitors? Does Muni-Wi necessarily imply a community network (CN)?

If one takes Botto and Passani's outline, drawing upon a literature review, some CN characteristics may be highlighted:

> a) *Geographically bounded setting*: physical reciprocity and physical and/or administrative boundaries denote a local community;
> b) *Different agencies involved*: residents, organizations, government and business;
> c) *Interests:* specific interests converge in community interests, or missions;
> d) *Activities*: the different agencies' interests, because of a more or less explicitly negotiated community interest, converge in community activities;
> e) *Computing*: computing activities and networked infrastructures enhance on-line spaces and activities for off-line communities (Botto and Passani, 2008, 27) .

All these elements may be brought together by bottom-up (grassroots) efforts or encouraged by local governments, in typically top-down initiatives. The initial driver depends on contingent situations with different arrangements between both ends (bottom-up and top-down).

In order to illustrate this point, once again it is possible to further the discussion on the basis of the OPAALS report. As a means to building their argument for the organization of Digital Ecossystems, four main community network organizations were identified, namely (Botto and Passani, 2008, 4):

- Traditional CN, - from FreeNets experience – focused on grassroots participation and the creation of democratic" on-line services;
- New grassroots CN, based on the creation and self-management of networked infrastructures at grassroots level;
- New government CN, focused on the creation of networked infrastructures at local government level;
- New government 2 CN, based on advanced and virtualised services provided via public infrastructures.

Without any doubts the physical network deployment is the easiest step, but it does not suffice to create a CN in a broader sense. Equally or more important is to bring together stakeholders and promote network demand. When this point of maturity is reached, perhaps it would be even more appropriate to speak of networked communities. Either way, the importance of the involvement of multiple stakeholders cannot be over-emphasized. On the other hand, just as important is to not overlook the complexity intrinsic in different levels of engagement with the network. As Mansell and Steinmueller write, "user is a enormously variegated category and that sensitivity to people's motivations, or lack thereof, for engaging with the new virtual or cyber environment is a prerequisite for the evolution of economic and social processes" (Mansell and Steinmueller, 2000, 37).

Therefore, alongside infrastructure deployment, a project can profit from a variety of specific policies to increment community involvement and boost demand through programmes or partnerships related to hardware access, training, participatory citizenship, to quote a few examples. Integrated management with other spheres of local government also increases the ICT infrastructure's cultural and social value. Finally, the project may also consider direct integration with previous existing networks such as universities, primary and secondary schools, health, police, NGOs, local organized groups, among other possible contributors. All these work fronts will help to bring the network alive.

b) Governance

Governance is one of those words that easily come out of experts' mouths when speaking of management and related issues – properly used or not, it sounds up-to-date. The term is applied to private and public organizations or institutions, not to mention specific areas such as IT and environment.

There is hardly a consensus on the concept in public management. While the general idea can be traced back to the early 1970s, the term became popular in World Bank policies on public management, in what could have been seen as a strategy to push forward the institution's goals by having a new set of political conditionalities, commonly carrying the sense of a minimum state for free market benefit (Doornbos, 2001, Rhodes, 1996, Frederickson, 2005). In the specialized literature, the idea of governance may relate to the structure of political institutions, market-driven approaches to public administration, network management, but also to issues such as accountability and transparency, to mention a few possibilities (Frederickson, 2005).

In view of the goals of this research and considering the role of governance within the proposed C.I.B.G. framework, Frederickson's definition will be enough to further the discussion. In the author's words, governance may be understood as a "set of principles, norms, roles, and decision making procedures around which actors (managers) converge in a public arena" (Frederickson, 2005, 293). Therefore, in the case of a Muni-Wi, one may include issues related to network openness (principle), participation conditions (norms), how the multiple stakeholders take part in the process (role), and overall network organization, development and sustainability (management).

Governance gives a reference to the network's existence, and is intrinsically dependent on the other three elements of the C.I.B.G. framework (infrastructure, community and business model). The definition of community, for instance, will determine the possible roles and, consequently, the other dimensions of governance.

Businesses models are also highly influential on possible types of public governance. Frederickson lists three of these (Frederickson, 2005, 300):

- interjurisdictional governance – "policy area specific formalized or voluntary patterns of interorganizational or interjurisdictional cooperation".
- third-party governance – "extends the functions of the state by exporting them by contract to policy-area specific non-profit, for-profit or subgovernmental third parties"
- public nongovernmental governance – "accounts for those activities of nongovernmental organizations that bear on the interests of citizens in the same way as governmental agencies".

These three types of public governance can all be related respectively to the businesses model depicted below under topic "d". Behind these types lies the hot and trendy topic of public-private partnerships. The key question is: which are the functions of public and private sectors? The answers will be mostly sustained by philosophical and political views of the state. Common sense argues for private partners' involvement where governments fail to provide for basic human needs or are less effective – and vice-versa. As far as municipal wireless networks are concerned, and based upon Minow's description of arguments for and against public-private partnerships, (Minow, 2007), the following table is drawn (*Table 5*):

Table 5. Arguments for and against public-private partnerships

Possible advantages	Possible risks
Increase of quality and effectiveness	Dilution of public values
Competition and incentives for improvement	Potential mismatch between competition and social provision
New knowledge and infrastructure	Divisiveness and loss of common institutions

Source: (Minow, 2007)

Equally important is to realise that, as Dunleavy *et al* submit, the relationship between governments and IT, and between the IT industry and service providers for that matter, has historically been neglected in terms of research and reflexion. Current trends show that the number of contracts with private providers is increasing and the development of in-house solutions are decreasing, not to mention the fact that recent orthodoxies in public management "impaired government IT modernization by hollowing out public sector staffs and capabilities" (Dunleavy et al., 2006, 7)

There is no simple answer as to whether the launching of Muni-Wi projects should count on private partnerships or not. None of the possibilities indicated in *Table 5* are granted from the start. Again, contingent situations, the local "rugosities" and resources indicate the most likely options. Very precisely, though, Minow submits that, in the end, where private partners are contracted to perform functions which otherwise are public, the government should be held responsible and report on the results achieved by the partnership (Minow, 2007).

c) *Infrastructures*

In the proposed C.I.B.G framework, infrastructure refers to all hardware and software required to roll out a Muni-Wi. For the sake of illustrating the comparative study herein proposed, a brief overview is offered.

If a Muni-Wi project relies, in general terms, on the premise of bridging the digital divide, its infrastructure should ideally comply with some key aspects (Gunasekaran and Harmantzis, 2007, Baccarelli et al., 2005):

- accessibility;
- availability;
- affordability of services;
- applications.

Addressing related issues when considering business ecosystems, Baccarelli et al. also indicate the need for (Baccarelli et al., 2005):

- high-speed access;
- latency and jitter;
- symmetry between uplink and downlink access rates;
- always-on connectivity;
- addressability.

Latency and jitter are specific parameters of interactive applications (games, video calls, conference calls, etc.) and addressability refers to the capacity of a user's terminal to be addressed – the author recognizes, however, that most residential users cannot profit from this feature because of Internet Protocol restrictions.

Within OPAALS' field of inquiry, which pushes the limits of many of the existing initiatives aimed at building a digital ecosystem, the following are seen as "basic requirements for CN [Community Networks] infrastructures" (Botto et al., 2008):

- full coverage and ubiquitous access
- access from a multiplicity of user devices
- mobility (allow roaming across the network)
- geospatial capabilities
- quality of service (the kind of services one can expect from the network)
- service support, service delivery platforms

With more socioeconomic concerns in mind, Mansell and Steinmueller highlight the need to develop the network in terms of (Mansell and Steinmueller, 2000):

- flexible design;
- inclusive design.

In sum, *the goal is to be able to access the network at any time, in the widest area possible, with broadband connexions, at affordable costs both to the end user and the managers, reaching people's specific needs and allowing for different ways to engage with the available infrastructure*. From the manager's point of view, the challenge is to go beyond the technical

objects and exploit the “unique intangible characteristics of the firm [or the city for that matter] including its networks of relations, and the unleashing of its innovative power” (Ciborra, 2004, 20).

The main wireless technologies used in Muni-Wi projects, which can be combined with wired networks, include (*Table 6*):

Table 6. Main wireless technologies used in Muni-Wi

	Band	Bitrate	Covered area
VSAT (Very Small Aperture Terminal)	C (3.7-4.2/ 5.92-6.42 GHz), Ku (11.7-12.2/14.0.14.5 GHz), Ka (17.7-21.7/27.5-30.5GHZ)	256 Kbps up to 60 Mbps	With LEO (Low Earth Orbit), the range varies from 500 up to 1500 Km, depending on the satellite positions and dishes
Wi-Fi (Wireless Fidelity, IEEE 802.11a/b/g/n)	May operate within unlicensed frequencies, 2.4 GHz, 5Ghz	Up to 54 Mbps	600 m
Wi-Max (Worldwide Interoperability for Microwave Access, IEEE 802.16n)	May operate within licensed and unlicensed frequencies, 2.3 – 2.7, 3.4- 6 and 5.8 GHz bands	Up to 72 Mbps	30 up to 50 Km
Wi-Mesh	Wi-Mesh extends the potential of Wi-Fi (802.11 Ad-hoc) networks allowing for multiple access points to communicate with each other and identify the best solution for dealing with the information traffic		

Source: WiMax Forum, Wi-Fi Alliance, (Gunasekaran and Harmantzis, 2007, GTA-UFRJ, 2002)

The most common option for municipal wireless broadband networks has been Wi-Fi, with Wi-Max increasingly becoming a viable choice. VSAT is particularly suitable for rural areas (Gunasekaran and Harmantzis, 2007), whereas 2.5 G, 3G and Mobile WiMax are technologies highly targeted at mobile telecommunications. Nonetheless it is worth asking why mobile phones would not be an option for bridging the digital divide, and how municipalities could be a driving force in this direction.

Muni-Wi deployment demands careful planning. Most of the money goes on fixed costs, namely the minimal infrastructure to roll the network out. Variable costs include operational aspects that will depend on the number of users. Network topology planning is one of the most important steps in the deployment of the necessary infrastructure, at times reaching 25% of the total initial costs, and is a key factor in the success of a project (Gunasekaran and Harmantzis, 2007).

In planning a network, there are definitions proved to be crucial (Esmailzadeh, 2006):

- target;
- coverage;
- base station and access point sites;
- connexions to the base station;
- services;
- growth (new sites, new cells, etc.).
- fees (spectrum use, power, etc.);
- site lease.

Briefly, in most cases the network will obey a cellular topology, including macro, micro and pico-cells, and in some cases repeaters (Esmailzadeh, 2006). Bluntly, a cell is defined by the reach of an antenna. The macro-cells offer the main coverage of a given area, but this can be complemented by micro or pico-cells that fill in the possible gaps. Depending on the target, a mix of technologies will achieve the best results. For instance, Wi-Max can be used as backhaul and Wi-Fi to cover the last mile (Gunasekaran and Harmantzis, 2007).

Finally, one of the present key issues is electromagnetic spectrum use (Walden and Angel, 2005, Esmailzadeh, 2006, Ting et al., 2005, Forge and Blackman, 2006). Most initiatives profit from unlicensed frequencies. For instance, in many countries the 2.4 Ghz frequency is license-exempt (Gunasekaran and Harmantzis, 2007). The same happens with 5 Ghz frequencies or higher, which are quoted as another option for Wi-Max (Intel, 2005). The spectrum concern relates both to the business model and to governance definitions, as, depending on the options, costs will have to take account of fees to use the air waves.

d) Business Model

A business model could be defined as

> a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences (Ostenwalder et al., 2005, 5).

What is important to note is that every business or management model has its respective *ethos,* and translating these into the public realm demands the reinvention of a given vocabulary (Alves, 2006). Choices made may have a direct impact on democratic and citizenship principles, as public Muni-Wi networks' broader goals differ from those of for-profit initiatives. Different business models are being tried, ranging from strictly government funded

networks to different models of public-private partnership, including privately operated Muni-Wi networks using public facilities.

The debate over municipal business models revolves around the role of governments as an "enabler" or a "rule maker", a question directly linked to the view of broadband as a "public good" or a "competition-related issue" (Picot and Wernick, 2007, 662-663), or, according to Gillet *et al's* taxonomy, to the government as rule-maker, financier, infra-structure developer or simply as a broadband user (Gillett et al., 2004). The entry of cities into the broadband provision business may impact local development, becoming a driver or a roadblock to platform and service competition (Picot and Wernick, 2007).

Following some of Daggett's and Hughes' definitions (Daggett, 2007, Hughes, 2005), but also adding the communitarian approach, it is possible to picture the following scenario:

a) Private

Or, as Daggett puts it, the status quo. The wireless broadband provision is operated by for-profit companies. In this case, local government will have little regulatory authority over the network (Daggett, 2007).

b) Public-operated

In the present capitalist system, this option is a common choice where the market falls short in satisfying demand. When schemes are fully operated by local government, major criticisms may be directed towards the risks involved in having municipalities deal with services which are not their expertise, and therefore risking spending public funds irresponsibly. Additionally, there is always the danger of inhibiting local competition (Shaffer, 2007, Hughes, 2005, Gillett et al., 2004).

c) Franchise model

According to Daggett, in the franchise model "the city grants the private company use of public assets for some period of time, and the company compensates the city for use of those assets" (Daggett, 2007, 12). Hughes proposes a variant where the community builds and operates the network, but leases "raw bandwidth" to commercial providers (carrier's carrier model). This approach reduces market entry costs (Hughes, 2005). The risks are more or less the same as those of a publicly owned network, as there is considerable investment and participation by municipalities.

Still on a leasing approach model, there is the possibility for municipalities to invest in the passive infra-structure and lease it to commercial operators, who would be responsible for installation and operation of the networks (Hughes, 2005).

d)Anchor Tenant Model

In this model, the municipality becomes the major tenant of a commercial operator which, in its turn, must accomplish some goals and provide some services established by local government. “The city grants the private company use of public assets (or assists in negotiating access from private entities) (...) In exchange, the city is compensated for use of public assets. The agreement contains a public benefits section that may include a share of revenue or limited free access to the network” (Daggett, 2007, 12).

e)Communitarian networks

Another approach could be the deployment of Wi-Fi community networks, where people share their links to the internet with other members of the community, e.g. http://open.sparknet.fi or http://www.fon.com. This kind of initiative is usually built on a bottom-up dynamic, with no intervention from government. However, the municipality can serve as a driver in this kind of project, facilitating the deployment of infra-structure, for instance access points. To the question “why on earth would I let other people freely use my access point?”, OpenSpark’s straightforward answer is “because joining OpenSpark community means that you can use other people’s access points” (OpenSpark, 2008).

The creation of fibre condominiums and the use of aggregation of demand strategies can be combined with some of the aforementioned business models, making the project more attractive to commercial providers (Hughes, 2005). It may or may not be expected that municipal projects will generate some revenue. Again, this depends on the business model. In Washtenaw County, Michigan, for instance, the municipal project offers free low-band Internet access, with fees for broadband services (Reed, 2008). Although this is a questionable counter argument, fees may even be considered a practice in contravention of governments’ constitutional character, as has already happened for the first time in the dispute between Piraí’s Muni-Wi project and Anatel, the Brazilian telecommunications regulatory agency (Anatel, 2006).

The entry of local government into the provision of broadband access is a hot topic. The Philadelphia case was typical. While the municipality claimed its role was that of a local development driver, private providers put up a fight, arguing that the government did not have the expertise to roll out a city-wide Wi-Fi project, and was therefore at risk of making

poor use of tax payer's money – obviously, companies might have been worried about their own revenues, but such an approach would not have resonated with public opinion (Shaffer, 2007). In fact, as Gillett argues, it is legitimate for cities to get involved with municipal wireless, as they function both as a driver and as a forum for experimentation. "The real question that needs to be addressed in this debate is how to ensure that city authority does not get subverted to create artificial limits on future wireless competition" (Gillett, 2006, 593).

The concern with public finances demonstrated by companies in the Philadelphia case is not necessarily wrong. At this point, after a couple of years, there is some bad news that would sustain the private sector's argument (2007c). There are projects, such as those in San Francisco and Chicago, which are slowing down their ambitions, facing important roadblocks and even being terminated (Gardiner, 2007).

In spite of all the doubts concerning Muni-Wi projects, municipalities around the world continue to venture into similar initiatives. As the preliminary findings of this report show, the uncertainty of existing business, governance and technological models does not stop local governments from trying to find their way towards city-wide wireless network deployment. The goals may vary from city to city, given local conditions, but they may include the desire to provide universal access, attempts to offer complementary access to other existing forms of Internet connection, and concerns with economic, environmental and political issues.

The cities considered in this investigation have somehow been recognized for their Muni-Wi projects. Given the exploratory nature of the study and the timetable for delivery of the report (five months), the cases were restricted to only six cities. The choice of cases in Europe and Brazil is rather contingent and stems from the institutional network established by the Graduate Communication Department at the Methodist University of São Paulo and the Media and Communication Department at the London School of Economics and Political Science, in a post-doctoral studies program funded by São Paulo Research Support Foundation (Fundação de Amparo à Pesquisa de São Paulo, http://www.fapesp.br).

As to the cities themselves, Issy-les-Moulineaux and Piraí have both been nominated to the Top Seven Intelligent Communities (ICF, 2008b). Bristol and Norfolk (Norwich) are both members of the DC-10 group, which brings together the ten Digital Challenge finalists, promoted in the United Kingdom (See http://www.dc10plus.net). Tiradentes was chosen by the Brazilian Federal government to be a laboratory for other federal and municipal initiatives (MC, 2007), whereas Sud Mennucci is one of the first cities in Brazil to roll out a Muni-Wi project (Gaspari, 2005).

In order to further the discussion, the cases will be presented in the following sections, after an overview of each country's overall situation with regard to internet connections.

3. Cases - presentation

3.1. Brazil, France and the United Kingdom: an overall view

This report addresses cases in three countries, namely, England, Brazil and France. Therefore it deals with rather different realities of ICT adoption and Internet access. The statistics available for each country may vary, not only in number but also in precision due to the different methodologies and interests at stake. However, as these numbers aim at portraying a larger horizon wherein the cities are immersed, different sources were used, even if there were no available data on all three nations for direct comparison.

ITU (International Telecommunications Union) free statistics dating from 2006 indicate the situation below (*Table 7*):

Table 7. Internet and broadband subscribers (Brazil, France and United Kingdom)

	Internet				Broadband Subscribers	
	Subscribers (000s)	Subscribers per 100 inhab.	Users (000s)	Users per 100 inhab.	Total (000s)	Per 100 inhab.
Brazil	16,525.0	8.87	42,600.0	22.55	5,921.9	3.14
France	15,252.0	25.12	30,100.0	49.57	12,711.0	20.93
United Kingdom	17,333.5	28.96	37,800.0	63.16	12,995.1	21.71

Source: (ITU, 2006)

In Brazil, the last *TIC domicílios e usuários* survey, released in 2007 by the *Centro de Estudos sobre as Tecnologias da Informação e da Comunicação*, which reports to the *Comitê Gestor da Internet* (CGI.br), the Brazilian internet management committee, indicates that 17% of households have Internet access, 50% of which are broadband connections. The survey, carried out in 2006 and covering 2,875 households, focuses mainly on urban centres. Another survey, presented in the same report, with 17 thousand interviewees, reveals that 41% had already used the Internet at some point (CETIC.BR, 2007).

An interesting finding of CETIC stems from an inquiry into the reasons why people do not have a computer. A survey, allowing for multiple answers, of 12,917 households in urban areas without a computer, showed that 78% indicated costs as the main reason for not acquiring one, but 30% revealed that there was no interest whatsoever. Another inquiry

among 1,165 households in urban areas with a computer, but no internet access, indicates that 58% blamed the situation on cost, but 16% also showed no interest at all (CETIC.BR, 2007).

In France, recent data from the *Autorité de Régulation des Communications électroniques et des Postes* (ACERP), the French telecommunications regulatory authority, published in *Le marché des services de télécommunications en France au 3ème trimestre 2007*, reported 16,5 million Internet subscribers, of whom 14,8 million were broadband users (ARCEP, 2008). Data from the *Institut National de la Statistique et des Études Économiques* (INSEE) states that, by 2005, 95% of youngsters between 15 and 19 years old had already surfed the Internet (Frydel, 2006). Data on why people in France do not take up Internet access was not found.

Back in the United Kingdom, the Office of Communications (OFCOM), regulator for the UK communications industries, reported in *The Communications Market 2007 Nations and Regio*ns that, in 2006, 61% of adults 15+ had internet access. In England alone the percentage reaches 62%. 45% both in the UK and in England alone had broadband access at home. The survey was conducted mostly in urban areas, with 4,048 respondents (OFCOM, 2007).

According to OFCOM data, among those who did not have home Internet access the most cited reason, from as many as 63% of respondents, was “no need”. The second most cited reason was the cost of setting up a connection (16%) (OFCOM, 2007).

Given each country’s population size, disparities between the active digital media universe can only stress the gap between the three countries. Nielsen//NetRatings estimates an active digital media universe of 25,407,485 in France (March 2008), 25,739,785 in the United Kingdom (February 2008), and 22,741,785 in Brazil (March 2008). The active digital media universe is defined by people who have used a computer with Internet access and actually used the network, launching any data tracked by the Nielsen//NetRatings metering system (Nielsen//NetRatings, 2008). According to official federal data (IBGE, INSEE and National Statistics Office), in 2007 Brazil had an estimated population of 183 million people and France 63.8 million, whereas the UK, in mid-2006, had 60 million, of which 50 million lived in England.

However, among users, the countries respective average Internet usage shows less variation as reported in *Table 8*:

Table 8. Internet usage (Brazil, France, United Kingdom)

Brazil	**March 2008**
Sessions/Visits Per Person	31
Domains Visited Per Person	57
PC Time Per Person	37:38:36
France	March 2008
Sessions/Visits Per Person	43
Domains Visited Per Person	96
PC Time Per Person	40:01:21
United Kingdom	February 2008
Sessions/Visits Per Person	32
Domains Visited Per Person	66
PC Time Per Person	29:22:19

Source: (Nielsen//NetRatings, 2008)

In light of the all above data, the existence of major gaps between the developing economy, Brazil, and developed economies, France and the United Kingdom, is clear. The different outcomes and goals presented by the cities chosen to be part of this study can be related, at least in part, to the respective country's overall situation. While some cases may have a clear focus on bridging the digital divide, others may regard the city-wide wireless network as a complementary form of access, allowing for different experiences of the urban space. Each case (Bristol, Norwich, Issy-les-Moulineaux, Piraí, Tiradentes and Sud Mennucci) is presented in the following pages.

At the end of the presentation of each case' a summary table is presented, based on the C.I.B.G framework depicted in topic 1.2. Cases are presented in alphabetical order.

3.2. Bristol (England)[3]

Bristol has a population of 410.500 in a 110 km2 area. The project Connecting Bristol can be traced back to early 2006, when a group of individuals, including private, public and voluntary sectors and academia, joined together in order to "to develop a vision for bridging the divides that hold back the city from achieving its full potential, recognising in particular that digital literacy is the key to social inclusion" (Josgrilberg, 2008a). The same group worked together when the UK Government announced the Digital Challenge 2007 (see http://www.digitalchallenge.gov.uk/). The competition aimed at identifying a national showcase for digital inclusion.

[3] Unless otherwise noted, the description of cases is the result of phone or Skype interviews with managers.

Connecting Bristol did not win the competition but was of the 10 finalists, which led to the creation of an alliance called DC10plus, also funded by the UK Government. The alliance's goal is "unravelling social inclusion issues by promoting the effective roll-out of technology-based initiatives" (DC10plus, 2008). "Connecting Bristol is active in all areas of this programme, and has evolved to be recognized as the city's digital hub, taking forward a diverse set of local, regional and national projects" (Josgrilberg, 2008a).

In the final bid for Digital Challenge, Connecting Bristol's goal was quite clear: "Connecting Bristol is our proposal for bridging the divides that hold back the city from achieving its full potential. Digital literacy is the key to social inclusion" (Hand and Miller, 2007, 5). The project, according to its final bid, had three main dimensions summed up by its infrastructure, based on a wide area fibre network and wireless access points; a group of mentors, called The Momentum Group, with more than 500 stakeholders responsible for building community capacity; and three showcase neighbourhoods with initiatives towards content production and services (Hand and Miller, 2007).

Connecting Bristol also attempted to integrate other activities for which technology is only a means to an end. The list of work streams and packages are summarized in *Table 9*:

Table 9. Connecting Bristol – Digital Challenge final bid

Work Stream	Work Packages	Mains Goals
Connectivity & Space	Sustainable Infrastructure – a firm foundation for change The Bristol (flexible) Space Programme	Not only deploying the infrastructure but also showcase examples of flexible work strategies and e-business
Building Capacity	The Momentum group – the Human Hub Outreach, Advice & Employment The Hardware Hub The Access Hub	Support the Momentum Group, address digital literacy, training, accessibility and employment issues.
Community Cohesion, Co-production and the Environment	Showcase Neighbourhoods Local to Global	Address community related issues, including safety, intergenerational learning, and environmental
Coordination, Evaluation Dissemination	Connecting Bristol Ltd Developing In-Sight through Evaluation The Personalised Showcase	Create the independent company and structure to manage the program, address issues related to accountability, funding, sustainability, evaluation, dissemination of findings, encourage authorities, leadership, develop multi-platform approach, provide leadership to the DC10

Source: (Hand and Miller, 2007)

Despite not wining Digital Challenge, and therefore not being able to profit from the money prize that would have guaranteed the project, the City Council did not give up on providing a wireless network for some sectors in Bristol. The local government reorganized the city's goals, profiting from many ideas discussed for Digital Challenge, and launched a wireless network with an initial budget of £ 50,000.00.

Following this revision of the project, four main streams of work were put forward, as presented in *Table 10* (literal excerpts):

Table 10. Bristol's present work streams

Stream of work	Goals
Ultra Flexible & Neighbourhood Working	a) Develop community ICT skills b) Tackle worklessness by realising tangible benefits for communities from new models of flexible and neighbourhood working that use ICT *Specific actions:* c) Piloting a "Homeshoring" flexible working model to employ 20 local people to respond to city council call centre enquiries, working flexibly in a neighbourhood ICT hub and from home. d) Using Slivers of Time to create an ultra-flexible employment agency and jobs market place for Bristol.
Next Generation Connectivity	e) High-speed connectivity is the corner stone of modern business. f) Identify and support new models of high bandwidth broadband connectivity, media rich content and interactive services. *Specific actions* g) Digital Master Planning, working with leading authorities, Government and industry to create a Connected Neighbourhood Forum. h) Wi-Fi and Wi-Max, working to extend Bristol's wireless footprint with the aim of creating a wireless access zone that will help stimulate regeneration and support remote, flexible and mobile working.
Digital Switchover	i) Ensure that Bristol is fully prepared for Digital Switchover, including the development of strategies to minimise the environmental impact of unwanted TV and recording equipment flowing into the waste stream. j) Explore the opportunities for greater use of local IP and Digital TV content
Independent Living	k) ICT will play an increasingly important role in health and social care. From the creation of smart home environments that can help carers monitor the well being of their occupants, through to online diagnostic services and tele-health.

Source: (Josgrilberg, 2008a)

Although the actions taken in each work stream are at very early stages, the initiative is attempting to encompass more systematically a broader view of ICT, including interests at environmental issues. There seems to be great emphasis on flexible working based on the mobility made possible by wireless technologies.

The wireless network for the population per se covers an 8 km^2 area around the Council's headquarters at City Hall. Access is free. Although it is not necessary to create an account, the user must register for each session of the service. The goal is to expand the network to other areas such as the new shopping centre to be built by private initiative and the harbour area, and to incorporate low income areas. In March 2008, there were approximately 20.000 sections opened in the network.

The City Council chose in 2006 the private operator (CitySpace) to run the central network. The project was launched using pre-Wi-Max as backhaul with connection to the internet via 100Mbps Ethernet or Ethernet over fibre (Caplan and Henri, 2006).

In the South of the city the Bristol Wireless co-operative runs a network operating with a mix of technologies including Wi-Fi, Wi-Mesh, optical fibre, dual radio among other older network legacies, using 2.4 Ghz, 5.3 Ghz (second-tier infrastructure) and 5.8 Ghz (backhaul) unlicensed frequencies. Wi-Max remains an option for the future.

Bristol Wireless's future plans include the provision of a local media server with content provided by local partners, particularly Knowle West Media Centre, embedding a media player in the splash page with free and open source software, FOSS.

The participation of different stakeholders is not systematic. Different social actors are invited as needed. In one of the less privileged neighbourhoods an association was being set up to run the network.

The interview with local managers revealed that the first efforts could have been ahead of their time as the benefits of a Muni-Wi were not clear to local authorities or to the population, which previously had little access to laptops and Wi-Fi enabled devices. But some nice surprises also popped up along the way, like how the City Council's gardens were rediscovered by students, mostly from the University of Bristol, who come to access the network on sunny days.

3.2.1. Bristol – C.I.B.G summary

Bristol's initiative can be described, as far as its relationship with the community and governance go, as a top-down driven initiative which is trying to incorporate more systematic ways of involving other stakeholders.

In that direction, the project profited from intense discussions fed by efforts towards the city's final bid for Digital Challenge 2007. At present, the initiative also comprises a wide range of policies, including training and flexible employment-driven programs, even though these are at early stages. Bristol's approach differentiates itself from other cases investigated in this report by a much broader policy scope, going beyond training towards the development of flexible employment strategies and concern with environmental issues.

The project's infrastructure covers 8km^2, operating at 5.3, 5.8 and 2.4 Ghz, using a mix of technologies, including fibre, pre-Wi-Max and Wi-Fi, with a classic public funded free access to the network. *Table 11* summarizes the Bristol Muni-Wi project's key features:

Table 11. Bristol - C.I.B.G framework

BRISTOL, ENGLAND, UNITED KINGDOM	
Start	2006
Population (2006)	410,500
Area	110 km^2
C.I.B.G FRAMEWORK	
Community	Government top down initiative with complementary policies
Infrastructure	8 km^2 network, fibre, pre-Wi-Max, Wi-Fi hotspots and kiosks
Business Model	Public funded, free access for citizens and visitors upon acceptance of terms of use
Governance	Public funded and operated, with occasional meetings with stakeholders, and initial systematization of an association to manage the network in a lower income neighbourhood

3.3. Issy-les-Moulineaux (France)

Issy-les-Moulineaux is located in the Greater Paris area. With an estimated 63,000 inhabitants, this French commune covers an area of 4.3 km² (INSEE, 2008). Since 2003 the local government has deployed many Wi-Fi points of access within public buildings such as the Centre Administratif Municipal, the Parc Municipal de Sports, Le Stade restaurant, the hall of the Hôtel de Ville and its multimedia room. The initial driver is the municipality's

managers own interest in anticipating technological developments. Issy received an award as one of the Top 7 Intelligent Community 2007 (http://www.intelligentcommunity.org/).

With the exception of the multimedia (54 Mbps) room, all sites provided 802.11b at 11 Mbps. In September 2006, the town deployed a pilot Wi-Fi Mesh network with Cisco, which was taken over by Orange and Neuf Cegetel in November 2007 (2008a). Private networks now cover 40% of the commune's territory, with 75 hotspots in total. A special municipal budget was defined in order install the first ten hotspots, at a cost of € 150,00 each, totalling € 1,500.00[4] . The network is operated with fibre optic backhaul, Wi-Fi hotspots and Wi-Mesh.

Neuf Cegetel provided free access to its Wi-Fi hotspots from the project launch until the end of May 2008, as long as the user had the necessary equipment. After the promotional period, users had pay a fee of € 1,50 per hour, which can be payed by SMS. Neuf Cegetel broadband clients also have free network access (Medeville and Chatin, 2007). From December 2007, Orange, as its turn, operating a Wi-Mesh network in partnership with Strix Systems, offered 50 hours for each pass bought from 7/12/07, at (Neves and Aymard, 2007). The pass at cost of € 4.50, since the promotional launch, is good for 24 hours from the time of purchase. Access within public buildings is free of charge.

Giiven the still early stage and piloting status of the project, launched by the end of 2007, and the fact that the network is being operated by private companies, there was no precise estimate of network usage by the time this research was conducted. However, adding up the number of hotspots registered by private operators, there are 75 access points in the city. As only one of the operators had already assessed its data by the time of the interviews, it is hard to judge the network's overall performance. Nonetheless, if both operators had similar performance at their access points, it would be possible to infer somewhere between 2.500 and 3.500 logs per month between December 2007 and March 2008, disregarding individual users who access the network more than once.

There are some interesting nuances in Issy-les-Moulineaux's project. Both private networks allow free access to the city's portal http://www.issy.com and the municipal web TV at http://www.issy.tv(2008e). Another dimension worth noting is the city's and the two operators care for architectural matters. Private operators and local government also showed extremely care with visual interference in the city's landscape, be wether the access points are installed in lampposts, private or public buildings.

[4] One private manager considered this figure to be too low.

Another solution worth noting in the case of Issy is how a private operator has profited from existing WiFi networks. Neuf Cegetel facilitates its broadband clients becoming part of the FON (http://www.fon.com) and of the "Neuf WiFi" community, therefore counting on hundreds more potential hotspots in Issy. The Neuf Box (WiFi) allows users to enable their ADSL box to share their Internet access. After joining the community, clients also benefit from Internet access from other members, that is, people who share their Wi-Fi Internet link, not only in Issy but around the world.

As far as the companies' operation goes, private operators gave a fundamental role to local government. As there is no clear business model for Muni-Wi networks and the deployment costs of such infrastructures are very high, the risks are evident. The municipality, however, has a high potential for participation, as it owns many facilities that can certainly assist the project's expansion, e.g., sites for hotspots or access points and means of access which will enable the optical fibre network to expand. Another suggestion was for the local government to directly invest in the network, not only in wireless solutions but also possibly in other technologies, and to let private companies operate them in a market completion basis.

From a political point of view, there are debates within the community about possible health hazards of the signals and concerns already mentioned about the network's architectural integration with the city's landscape. Again local government plays a key role here in helping to clarify these matters with the citizens.

Finally, given the city's urban architecture, the installations of antennas is a far from easy job. Nonetheless, in contrast to other cases discussed in this report, cultural barriers to the adoption of the technology seemed not to be a problem.

3.3.1. Issy-les-Moulineaux – C.I.B.G summary

Issy-les-Moulineaux differs radically from all the other projects investigated in this report as the only one which is privately operated and funded by fees. From the governance point of view, it could be classified, as discussed in *Section 2*, as third-party governance, as local government "extends the functions of the state by exporting them by contract to policy-area specific non-profit, for-profit or subgovernmental third parties" (Frederickson, 2005, 300) – leaving aside for now the debate about to the extent to which internet provision should be a governmental function.

Issy-les-Moulineaux is also one of the cases, together with Piraí (See 2.5), with a hybrid technological model, benefiting also from optical fibre, which makes these projects less dependent on unlicensed spectrum. As the project is privately operated, the case shows less evidence of directly integrated policies or community involvement, but offers an interesting difference in allowing users to freely access government services on the web. One of its highlights is one private operator's initiative to articulate its project with existing networks.

Table 12. Issy-les-Moulineaux - C.I.B.G framework

ISSY-LES-MOULINEAUX, FRANCE	
Start	2003 in public buildings, 2006 open doors network. 2007 outdoor Muni-Wi
Population (2006)	63.000
Area	4.4 km^2
C.I.B.G FRAMEWORK	
Community	Government top down initiative
Infrastructure	Public Wi-Fi network inside public buildings, 75 hotspots. Optical (backhaul) fibre, Wi-Fi hotspots and Wi-Mesh covering near 40% of the city's territory (1,7 km^2)
Business Model	Paid connection with free access to the city's portal and Web TV.
Governance	Privately operated and fee funded. The expansion of the network is discussed with the municipality and private actors as there is a need to use public and private facilities.

3.4. Norwich (England)

Norfolk has an estimated population of 832,400 spread over 5370 km^2 (2007b). Its initiative, Norfolk Open Link, claimed to be the first community free wireless network in the United Kingdom. The two-year pilot, from May 2006 to April 2008, had a budget of £1.35 million, funded by the East of England Development Agency. The project started officially in July 2006, but its planning can be traced back to 2005. The project is run by Norfolk County Council and covers the centre and three sectors of Norwich City. The city covers an approximate area of 115 km^2 and has 367.035 inhabitants, but 121.600 people live in the Norwich City Council area (2008d).

Norwich's Muni-Wi initiative runs on a pilot basis. According to its official website, despite possible success, the continuation of the project is uncertain: "The current plan is for the service to be switched off at the end of March 2008" (2008b). Norfolk County Council, at the time of this investigation, was producing a report on the impact of the project. It is hoped that some sort of wireless service will be continued for the public sector. The project fortunately

received an extra three months authorization to operate in order to complete the work on the project evaluation and development of options.

As this is a pilot project with fixed resources, restrictions were imposed in terms of access speed and session length. Business community and general public have access to Wi-Fi services at 256 kbs with each session limited to one hour. Public sector staff can access at 1Mbs with no limit on session time. These restrictions also helped to ensure that there was no competition with commercial Wi-Fi providers (2008b).

The network coverage includes the city centre, the Forum, Chapelfield Gardens, Hay Hill, Gentlemen's Walk, Gaol Hill and Theatre Street, and some areas on West and East sides of the city, thanks to more than 200 Telabria APM 300 aerials, each with a reach of 250m to 300m reception radius, operating at 2.4 Ghz, covering a total of 15 km^2. The aerials, spread over 11 sectors, feedback to 'backhaul' sites, using different wireless technologies, which are linked to the project's 40 Mbps internet link located at County Hall.

Anyone with an Wi-Fi enabled (802.11 b/g.) PDA, laptop or other media can freely access the network. No registration is required and there is no filtering, but terms of use policy must be accepted (See http://www.norfolkopenlink.com/terms/acceptable_terms.htm). There is a telephone Customer Support service at 66 pences per minute (BT landline; costs from other operators will vary), Monday to Friday, from 9am to 5pm (2008b).

Key partners include Norfolk County Council, in partnership with Norwich City Council, South Norfolk District Council, the University of East Anglia (UEA), Norfolk and Norwich University Hospital, Norfolk Constabulary , Norwich City College and The Forum Trust (2008b). The coverage map can be seen at http://www.norfolkopenlink.com/coverage/overall_coverage.htm. Synetrix Ltd (http://www.synetrix.co.uk) are responsible for the design, installation and operation of the wireless network.

Among the challenges faced by local managers, the following were highlighted:

a) predicting usage levels - the very few existing projects make it difficult to assess the potential demand to ensure that the design was correct in terms of coverage and capacity;
b) location and hosting of access points - initial assumption was that the majority of access points could be fixed to street lighting columns, this proved to be more

complicated as many of the lighting columns were not suitable (e.g. could not take additional weight loading, did not have space inside to accommodate the electrical switches, did not have correct type of electrical configuration to allow the connection of the access point).

c) finding suitable sites to act as backhaul sites (needed line of sight to main connection which linked to internet feed).

In March 2008, the last figures showed that the project had from 40,000 to 45,000 connections per month, with 2,500 to 3,500 unique visitors and up to 45 thousand sessions.

3.4.1. Norwich – C.I.B.G summary

Norwich was perhaps the most experimental of all the projects investigated in this report. It even had a date to finish its activities. Totally funded by a regional agency, the project had space to be more experimental in its technological choices. It imposed access restrictions, as the free sessions were limited to one hour at 256 kbps.

What is interesting to note is that, despite the access restrictions, the project had a considerable number of monthly logs, from 40,000 to 45,000, which may indicate the recognition of the initiative as a possible complementary form of internet connection.

The community involvement is characterized by a wide range of official partnerships, but there were no articulated multi-stakeholders on the board. As such, it is also a typical top-down driven initiative

Table 13. Norwich - C.I.B.G framework

NORWICH, ENGLAND, UNITED KINGDOM	
Start	2003 in public buildings, 2006 open doors network. 2007 outdoor Muni-Wi
Population (2006)	367,035
Area	115 km2
C.I.B.G FRAMEWORK	
Community	Government top-down initiative
Infrastructure	Wi-Fi and 'backhaul' sites using different wireless solutions on a experimental basis
Business Model	Free on acceptance of terms of use
Governance	Meetings required need with different stakeholders, publicly funded and network managed by a private operator.

3.5. Piraí (Brazil)

Piraí is a city of 24.170 inhabitants, covering an area of 505 km^2, located in Rio de Janeiro state, in the South East Brazil, with a R$ 818.032.000 GDP in 2005 (IBGE, 2008). The city's project, Piraí Digital received a Top Seven Intelligent Communities 2005 award (ICF, 2008b). The first discussions can be traced back to the mid 1990s, with their origins in the city's local development plan. Its slogan is "information is a right, technology is the means" (2008c).

The privatization of a Brazilian power company, a move that led to 1.200 job cuts among 22.500 habitants, worked as a key driver toward development initiatives. Given the strong impact on local job losses, the municipality articulated an industrial condominium, cooperatives, and fish culture poles in an attempt to recover from the damages caused by the economical threat. The case was awarded the Public Management and Citizenship Prize promoted by Fundação Getúlio Vargas (SP) and Ford Foundation in 2001.

The project's official presentation outlines a vision of integration of government, education, community and private sector. The program aims at "the democratization of access to means of information and communication, generating economic and social development, and widening the city's horizons" (2008c). On a more specific level, Piraí Digital has as its goal:

> • To democratize and optimize the use of information and communication technological resources in order to collaborate to knowledge production and socialization;
> • Modernize and rationalize public administration;
> • Disseminate a knowledge society and promote activities which allow for the community an agile incorporation of such a concept, in a way that:
> - Makes viable social development and facilitate the access to information to everyone;
> - Guarantees the availability and access to the new technologies;
> - Eliminates the physical barriers to information access;
> - Guarantees the efforts coordination and regulation to create a physical structure of logical access and high performance, to be used by digital inclusion actions as well (2008d).

In its "strategic action", the project advocates the revision of the city's Local Development Strategic Plan to incorporate the "digital municipality" view, the involvement of the city's various actors around processes aimed at local improvement of social, economic, environmental, cultural and political conditions, the articulation of public, private and third sectors, and the creation of a City Board able to integrate the Strategic Plan's actions, taking into account the Director Plan[5] and the Local Agenda 21.

[5] The creation and approval of a Director Plan is constitutional imperative for every municipality in Brazil with more than 20.000 habitants. Once approved it has a municipal law status.

The infrastructure deployment, aimed at universal access goals, started in 2002. The goal was to provide an infrastructure capable of transmitting data, voice and image. At first, the city went totally wireless with a public fee for different bands ranging from 128 kbps to 512 kbps, with prices between R$ 39.00 and R$ 90.00. The cost of the network and a two-year legal dispute with Anatel, the Brazilian telecom regulatory agency, led the managers to opt, in 2007, for a free public hybrid infrastructure profiting from 13 towers, operating at 5.8 Ghz, spread all over the city, and complementary cables accessing different sites, depending on geographical and architectural contingencies. After Anatel's ruling, provision of free internet had also to be limited, mostly to public facilities, including telecentres, kiosks, some hotspots and residences in low-income areas.

The present network is city-wide, covering urban and rural zones. The network can be accessed at 1 Mbps either by cable or via a USB kit sold at local stores. Piraí opted for a point-to-point network design controlled by a central system control. Citizens and visitors must register at a website in order to gain access to the network.

An initial budget reached R$ 2 million, but the city did not manage to raise the necessary funds. The solution then was to find other options within an existing fund, targeting the interconnection of administrative services. However, the budget was scaled down to R$ 50 thousand. Today the Internet link is provided free by the state and monthly costs, including those of personnel, reach almost R$ 17,000.00.

There are almost 20 hotspots, a number that can be much higher, if some residences using antennas and public buildings included. Piraí became an anchor point for the Rio de Janeiro state initiative to deploy a "Digital Corridor", using Wi-Max, benefiting the so-called Coffee Valley cities.

As noted, the business model changed in 2007. The municipality had to review its plans in light of Anatel's ruling on Piraí's solicitation for a Multimedia Communication Service License. The dispute evolved around the local governments rights to offer this kind of service (Anatel, 2006). Despite this setback in 2006, the city appealed the decision on the basis of Brazilian law Nº 9,998, which established the Telecommunications Services Universalization Fund (FUST) in order to guarantee funds for universal access where the investment on service exploration cannot be recovered (2000).

After the legal dispute with Anatel, residential access was delegated by the municipality to private providers and only a few low income areas have free internet access. Nonetheless, the network provides internet access in all public buildings, 398 community computers for civilian use, 23 schools, 4 telecentres, 9 kiosks, hotspots including different buildings, public spaces and some residences. Almost 10.000 users are registered to use the facilities.

A series of complementary policies and programs were developed, including, among other initiatives, e-mail provision for the population and the training of school teachers. Every step was debated by the City committee created for the project, which involves almost 70 institutions, including government, legislators, private associations, labour unions, universities and other stakeholders. The Federal Fluminense University (UFF) is in charge of the network's executive management.

The fact of being the first of its kind in Brazil was a major difficulty, as there were no other references to build upon. Nonetheless, the Mayor was a big promoter of the idea, which greatly assisted the enterprise. At first, the shift of local management from proprietary to free software was the first hurdle to be faced. Later, training the staff to maintain the network became an issue. Nowadays, the lack of funds to produce new content is a problem.

Some surprises also came along during Piraí Digital's history. For instance, a pilot project at a local public school with wireless access and one laptop per child had an interesting outcome: kids do not seem to want to leave the school even during holidays. The city also became a reference point where industrial and commercial salespeople travelling in the Rio - São Paulo axis can stop to check their e-mails and extranets.

In the way of more curious everyday life stories, there are those of elderly people wanting to register for the network on its second day of operation, having just bought their very first computer; intermunicipal bus drivers checking their horoscopes in kiosks located at the central station before travelling; and an IBRD (International Bank for Reconstruction and Development) manager's surprise, during a visit, when he spotted a barefoot fisherman surfing the Internet to check fish prices.

3.5.1. Piraí – C.I.B.G summary

Piraí is the oldest of all the projects investigated, with initial discussions going back to 2002, but the project was partially interrupted because of a legal dispute with the Brazilian Telecommunications Agency. Back on track in 2007, Piraí Digital's maturity becomes evident in its community involvement, as it was the only one to have an organized multi-stakeholder

board to discuss the network's activities, while the executive operation was handed to a federal university.

Infrastructure-wise, the project has a hybrid technological design, using cable and wireless access solutions at different points in the city - an evolution from its first design which was totally wireless based. Access is free but was limited to public buildings, kiosks, telecentres, hotspots and a few residential points after a dispute with the Brazilian telecommunications regulatory body. *Table 14* summarizes the key features of the project:

Table 14. Piraí - C.I.B.G framework

PIRAÍ, BRAZIL	
Start	2002 the first network and 2007 the new project after a legal dispute.
Population (2006)	24.170
Area	505 km2
C.I.B.G FRAMEWORK	
Community	Government top down initiative, integrated polices including e-mail provision and training
Infrastructure	City wide point-to-point network, Wi-Fi, operating at 2.4 Ghz and 5.8 Ghz, and cable
Business Model	Free (hotspots, kiosks, telecentres and some residential use for low-income areas)
Governance	Official local committee discusses all steps, executive management by a federal university

3.6. Tiradentes (Brazil)

Tiradentes is a small town in Minas Gerais state, with 6,547 inhabitants spread over 83 km^2 (IBGE, 2008). In Brazil, the region is known for its historical architecture which makes tourism and handcraft products some of its main economic activities alongside agribusiness. Tirandente's geography is full of hills and mountains, therefore presenting a particular challenge to wireless network deployment.

Thanks to a partnership between the municipality, the Brazilian Ministry of Communications and private companies such as Cisco, Telemar and Metasys, the city launched its project, Tiradentes Digital, in 2006. The federal government invested R$ 560,000.00, leaving executive functions to the Federal University of Ouro Preto (Gomes, 2006, MC, 2007)

Tiradentes Digital was born from a convergence of local and federal interests. At federal level, the Brazilian Communications Ministry had just created a Digital Inclusion Committee. At local level, the Federal University of Ouro Preto, Minas Gerais State, had already taken its first steps into the deployment of a Muni-Wi at Ouro Preto. In 2005, the federal government

sent a small delegation, including the Communications Minister himself, Hélio Costa, to get to know Ouro Preto's initiative better.

After the visit, the Communications Ministry decided to deploy three pilot projects in Belo Horizon (a big city), Barbacena (a medium-sized town) and Tiradentes (a small town). At this point, only Tiradentes is aiming for a public wireless network, whereas the other two projects are working with segmented bands for specific administrative purposes. The official launch date of the Tiradentes network was 24 March 2006. The project's goals included (Falcão and Marostegan, 2006):

a) the creation of an Internet provision model for public institutions and population
b) to improve school support
c) to favour tourism services
d) social inclusion through digital inclusion
e) to favour the digital literacy of the population
f) to promote ICT use

By June 2006 the Federal University of Ouro Preto (UFOP) had been invited to be the project's executive coordinator. Since then, three work streams have been emphasized:

a) infrastructure
b) demand creation
c) governability

The infrastructure dimension is aimed at network deployment *per se*. Demand creation includes user training with a special focus on the educational sector and on promotional strategies such as events and the distribution of promotional material. Governability addresses issues related to governance and the business model.

In 2006 Tiradentes Digital connected the city's historic centre and its schools through a wireless mesh network provided by Cisco. In 2007 the goal was to provide new services, extend access to a broader population and work on the network definitions (Falcão and Marostegan, 2006).

Up to April 2008, aside from schools and public buildings, the city had a 0.5 km^2 Wi-Mesh public wireless network covering its touristic centre with five antennas, with 2,900 monthly logs. The goal is to expand the network, adding other 11 antennas and covering a 5 km^2

area. Users within the network access it freely at 2 Mbps 2.4 Ghz frequencies. Only the backhaul operates at 5.8 Ghz. The project uses an internet link provided by Oi/Telemar, a major telecom company in Brazil. As the network's equipment was provided by Cisco, software by Metasys, and the federal government is funding the project, the municipality did not have to invest. The executive coordination, however, estimates that the cost of network deployment has reached up to R$ 200 thousand and that the monthly costs to maintain it are around R$ 30 thousand, aside from human resources.

Tiradentes Digital faced some specific difficulties in rolling the project out:

a) presenting the project to the population, since many local political l interests are at stake
b) the need to develop a local ICT culture
c) creation of a sustainable model
d) restrictive telecommunications legislation

The involvement of stakeholders in the project development seemed to be a key issue for the executive coordination at UFOP. Although a municipal action group has been established within the local government, the city tried in 2007 to create some sort of consultative committee, but did not succeed, again because of divergent interests. The goal remains a priority in 2008.

Local cultural development is tackled through the existing initiatives in schools and other public departments. The creation of a sustainable model is a top priority for 2008. Internet access is seen as a basic need like water and electricity by local managers. There is a view that the city must define its needs in terms of bands and services in order to set network limits. There are arguments for a fee-based model and for the need to allow municipalities to use other lower frequencies, aside from license-exempt frequencies, which would demand a change in the regulatory marks.

Some local initiatives caught the Tiradentes Digital managers by surprise. Some city dwellers realised that if they had a directional antenna at home they would be able to access the public network available in the city centre. In the second semester of 2006, the result was an immense increase in network use, provoking a little chaos with several service interruptions. It was "chaos" in good way, as it revealed the population attention to the project. One of the most rewarding aspects of the project was to see teachers with no previous ICT skills uploading their websites or blogs.

Among the reported achievements, the project can highlight (Falcão and Marostegan, 2006):

a) 100% trained local teachers
b) increase in the city's internet users and computer selling
c) local handcraft and products e-business development
d) internet popularization among low income segments.

3.6.1. Tiradentes – C.I.B.G summary

Tirandentes is another pilot project. This time the initiative is funded by federal government money in partnership with private companies, and managed by a federal university. Once more what is at stake is a top-down driven initiative which is attempting more systematic forms of stakeholder involvement.

As far as its policies are concerned, managers put strong emphasis on education to generate network demand within the community. Promotional events attempt to attract even more users.

Table 15. Tiradentes - C.I.B.G framework

TIRADENTES, BRAZIL	
Start	2006
Population (2006)	6.547
Area	83 km2
C.I.B.G FRAMEWORK	
Community	Government top down initiative, integrated policies with emphasis on demand creation at local schools
Infrastructure	0,5 km2 network, Wi-Mesh
Business Model	Free
Governance	Publicly funded by federal government in partnership with private companies and a university.

The project offers free internet access at 2Mbps, but a debate about the business model and its governance will take place this year. When this research was conducted, the network coverage was relatively limited (0.5 km^2), but the idea was to expand this to 5 km2. Wi-Mesh was the key technological choice.

Table 15 summarizes the project's overall C.I.B.G framework.

3.7. Sud Mennucci (Brazil)

Sud Mennucci is a small city in the North East of São Paulo state, Brazil. With only 7,714 inhabitants, 85% of whom live in the urban area. The city covers an area of 591 km^2 (IBGE, 2008, Okajima, 2007). Agribusiness and the cattle industry are the municipality's main economic activities.

The first studies on the deployment of Sud Mennucci's Muni-Wi project started in 2002. The initial driver was the need for an Internet connection to supply municipal administrative demands in order to reduce the costs of an interurban dial-up connection. Initial studies were conducted by City Hall's IT technicians and IT managers from the local alcohol industry. At a first evaluation, optical fibre and Wi-Fi appeared to be the best choice. The latter, however, was the cheaper solution.

In 2003, as the local government realized that there was more bandwidth than needed by administrative public services, the signal was opened to the community. The new goal was to bridge the digital divide, as local community was having to spend too much money on interurban calls to regional Internet Service Providers (ISP). By September 2003 the city had 10 registered users – registered points include only business and residential users, not including schools, libraries and other public facilities. In 2005, in a turn of events worth an agenda-setting study, an article published in a national newspaper boosted the population's interest in the network (Gaspari, 2005). Now, in 2008, almost a thousand residences and business offices are registered in the municipal network.

The project's initial investment reached R$ 18 thousand. In 2005 there was an update . The first infrastructure (aerials, radio, etc.) was brought to a different city district, Bandeirantes D´Oeste, 20 km from the center of Sud Mennucci. At the same time another R$ 20 thousand were invested in the city-center network. In 2007 a second update proved necessary and another R$ 70,000.00 were invested in new antennas, radios and servers. Presently, Sud Mennuci's Muni-Wi has a monthly cost of R$ 5,800.00 for a 4 Mbps link, and an extra R$ 700.00 for a 512 kbps link for the Bandeirantes D'Oeste District.

The residential and business wireless network uses Wi-Fi at 2.4 GHz, in a point-to-point network design, with 64 kbps access per point. Signals, from a 40m antenna, reach a radius of 10 km (314 km^2), but city managers claim to be ready to expand the networks with new cells. The internet link is provided by Telefônica.

Only the administrative network operates with a 5.8 Ghz frequency, apart for facilities at Bandeirantes D'Oeste District. The Education Department and two schools are connected by optical fibre. City Hall is still seeking a Limited Private Service license, provided by Anatel, the Brazilian regulatory agency.

The population must acquire antennas from private stores, costing from R$ 200.00 to R$ 300.00, and have these installed on their houses or offices in order to access the municipal network. However, if someone is near to the central antenna or to an existing residential antenna, with no physical interference, he or she may have access to the network.

In order to access the network, there is a registration process. The citizen must go to the City Hall and apply to the service, under the following conditions:

a) applicants must live in the city;
b) applicants cannot be in debt to the municipality.

The technical requirements include access to a computer compatible with Windows 95/98/2000/XP, Mac OS or Linux, with network access to 2.4 Ghz band. If there are no impediments the applicant will receive access to the network within three working days.
By March 2008 Sud Mennucci had 990 registered points, 140 of them in Bandeirantes D'Oeste District. City Hall's target is 80% of the residences in the city.

With the Muni-Wi deployment, the city faced new local demands in different areas. A partnership with the Fundação Paula Souza provided training for IT technicians. Basic computer training started being offered through the Family School project, using local public school infolabs opened on weekends. The project also attracted other educational institutions, which are offering e-learning programs via interactive multimedia classes. There are also some software houses developing pilot projects for City Hall. Two private info stores were opened as well. In the City Hall official website there is information about how to open a private ISP, with orientations on how to acquire an Internet link, and the possible number of customers per access point in WLAN, among other tips.

3.7.1. Sud Mennucci – C.I.B.G summary

Sud Mennuc has a residential and business-oriented approach to Muni-Wi. Unlike the other cases, the civilian network's initial driver was not only the need to bridge the digital divide but also a spin-off from the identification of local government administrative bandwidth excess.

The project's governance has typically top-down driven features. New targeted policies or programs for network deployment were created along the way, in response to community need.

The business model is also rather conventional for this kind of project. The initiative relies on the municipal budget to offer free internet access to registered users through a Wi-Fi network at 64 kbps per point, with an expressive coverage of 314 km^2. See *Table 16* for the C.I.B.G summary.

Table 16. Sud Mennucci - C.I.B.G framework

SUD MENNUCCI, BRAZIL	
Start	2002
Population (2006)	7.714
Area	591 km2
C.I.B.G FRAMEWORK	
Community	Government top down initiative, integrated policies with emphasis on training
Infrastructure	Wi-Fi, directed to residential and business use, covering 314 km^2, and some public buildings fed by cable
Business Model	Free upon registration at City Hall
Governance	Publicly funded and operated, with occasional stakeholders meetings.

4. Methodological proceedings

4.1. Fuzzy-set analysis (fsQCA)

The comparative study herein proposed uses Qualitative Comparative Analysis in its Fuzzy Set approach (fsQCA), as developed by Charles Ragin (2000) Unlike the conventional quantitative variable approach, where the researcher is interested in analysing the isolated effect of each independent variable on the probability of observing an outcome of interest, in QCA the researcher is interested in finding out the causes that must be present for an outcome to occur or the combination of causes that lead to an outcome. Thus, because it allows the identification of the combination of causes that lead to an outcome, QCA helps to address the important -yet often overlooked- issue of social complexity, which implies that social phenomena are inherently complex and that it may not be always true that a single variable explains why an outcome occurs.

QCA takes cases as configurations of different set conditions for the independent variables (called causal conditions) and the dependent variable (called outcome). In its crisp set approach, the cases analysed can assume a value of 0 or 1 for each causal condition and for the outcome. A 0 indicates that a case has no membership in the specific set condition and a 1 indicates full membership. In the Fuzzy Set approach, which will be employed in this study,

cases can assume different levels of membership in addition to null or full membership, because this approach also includes "fuzzy" membership scores such as 0.25 "almost no membership"; 0.5, "neither full nor null membership"; 0.75, "almost full membership". Thus, as will be seen in this research, if a city has almost null membership in the set of cities with *Significant city-wide Muni-Wi network for civilian use*, it will be given a score of 0.25. Once the scores for all the cases are laid out in the table, it will be possible to identify the conditions that must be present for an outcome to occur, or the combination thereof that lead to a certain outcome. Such analysis is carried out with ad-hoc software.[6]

Because QCA has a configurational approach and focuses on the cases that are "relevant" for a researcher, that is the set of cases that present some degree of membership in the causal conditions and the outcome of interest, this technique is ideal for small N studies like the one proposed here. Furthermore, its ability to account for social complexity, where more than one cause can lead to an outcome, also makes it an ideal technique for this research.

According to Charles Ragin, fsQCA "is fundamentally an effort to represent social phenomena using social theory as a guide" (Ragin, 2000, 163). The goal is to help researchers make sense of their cases by helping them to identify the possible conditions of an expected outcome (Ragin, 2006a). As Ragin puts it, "fuzzy sets resonate with the measurement concerns of qualitative researchers, where the goal often is to distinguish between relevant and irrelevant variation – that is, to interpret it – and with the measurement concerns of quantitative researchers, where the goal is the precise placement of cases relative to each other" (Ragin, forthcoming-a)

Note, however, that in social science it is almost impossible for any given social phenomenon to be the product of a single causal condition. Thus from the start a researcher may be interested in assuming causal complexity. In other words, different groups of conditions may lead to similar outcomes and he or she may even find instances of the outcome where one or more conditions are absent.

Fuzzy-set social science aims at offering researchers a way of dealing with multiple cases and causal complexity. The findings will constitute a reference for the investigator to develop his or her arguments about a given matter, question a situation, and propose new ways of approaching the issues at stake. That is why fsQCA is particularly interesting for researchers intending to shed light on public policies.

[6] The software can be downloaded from fsQCA website at http://www.u.arizona.edu/~cragin/fsQCA/

As explained before, fsQCA is based on configurational analysis using set-oriented methods, sustained by combinatorial logics and Boolean algebra. The fuzzy-set approach allows for the systematic organization of information, attributing degrees of membership to sets which are conceptually defined. Degrees of membership are evaluated in light of a reference table built upon theories, existing evidence about cases, and qualitatively defined sets and anchors. In general, membership in a fuzzy set social science approach varies between 0 and 1 (Ragin, 2000).

The classification of information within intervals differentiates the fuzzy-set analysis from traditional Qualitative Comparative Analysis (QCA) based on crisp sets. While the first allows for variation within a given interval between full or null membership in a set condition, see *Table 17*, the second is anchored in a binary logic of belonging or not to a determined set condition.

Table 17. QCA/ fsQCA comparison

QCA	Fuzzy-set – five values
1 = fully in 0 = fully out	1 = fully in .75 = more in than out . 5 = neither in or out (*crossover*) .25 = more out than in 0 = fully out

However, as fsQCA extends QCA, it is worth understanding the latter in order to better comprehend the former. Take, as a hypothetical example, the case of universities with open content available to the public. Consider now that, among others, two possible conditions will be investigated: a) whether the university is government funded; 2) whether the university is located in a rich country.

In a traditional QCA, the following results, hypothetically speaking, yield the results presented in *Table 18*. 1 indicates the presence of the outcome or condition and 0 indicates the absence of the outcome or conditions.

Based on *Table 18*, the researcher could assume that, in the cases studied, whenever the outcome is present, the condition “government funded” is present. However, one scarcely finds a university that opens all the content it produces to the public. There might be middle-way options, with some texts, for example, available only to regularly enrolled students. Similarly there are different degrees of government funding. One may speak of a public

university, but also of a university which enjoys fiscal benefits from the government. Here the fuzzy-set analysis comes in handy, as there are varying degrees of membership in each set.

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Table 18. QCA- Example

Uni	O	R	G
A	1	1	1
B	1	0	1
C	0	1	0
D	0	0	0
E	0	0	1
F	1	1	1

O - open content available to the public (outcome)

G - government funded

R - rich country

In order to refine the analysis of the crisp sets used in *Table 18,* the outcome could be transformed into a five-value fuzzy-set:

- 1 = fully in the set
- .75 = more in than out of the set
- . 5 = neither in nor out of the set (*crossover*)
- .25 = more out of than in the set
- 0 = fully out of the set

Table 19. fsQCA - Example

UNI	O	R	G
A	1	.75	1
B	.5	.5	.75
C	.25	.75	.25
D	.25	.25	.5
E	.5	0	1
F	.5	1	1

O - open content available to the public (outcome)

G - government funded

R - rich country

Then one could hypothetically have the arrangement presented in *Table 19.*

In fsQCA, sets are defined according to the particularities of the cases, the evidence found and its characteristics, to existing theories, and to the researcher's knowledge. For that reason fsQCA is fundamentally an interpretative tool (Ragin, 2000). It is an attempt to avoid overlooking the complexity of any phenomena investigated, by means of qualitatively defined sets and anchors with a systematized way of portraying the outcomes. As Ragin explains, "qualitative anchors make it possible to distinguish between relevant and irrelevant variation" (Ragin, forthcoming-b). In the end, much of the success of the research will depend on the

researcher's knowledge of how to theoretically sustain the qualitative anchors and their values, and his or her capacity to score each case's membership in the set

In conclusion, before proceeding to the explanation of how the scores can be analysed, a short summary of fsQCA steps may be helpful. There are six key steps in designing a fsQCA (Ragin, 2000):

a) definition of case
b) conceptualization of sets
c) definition of scale
d) identification of the possible highest value in the scale (fully in a set)
e) identification and description of evidence
f) identification of items of evidence within the scale

4.1.1. Analysing results in fsQCA

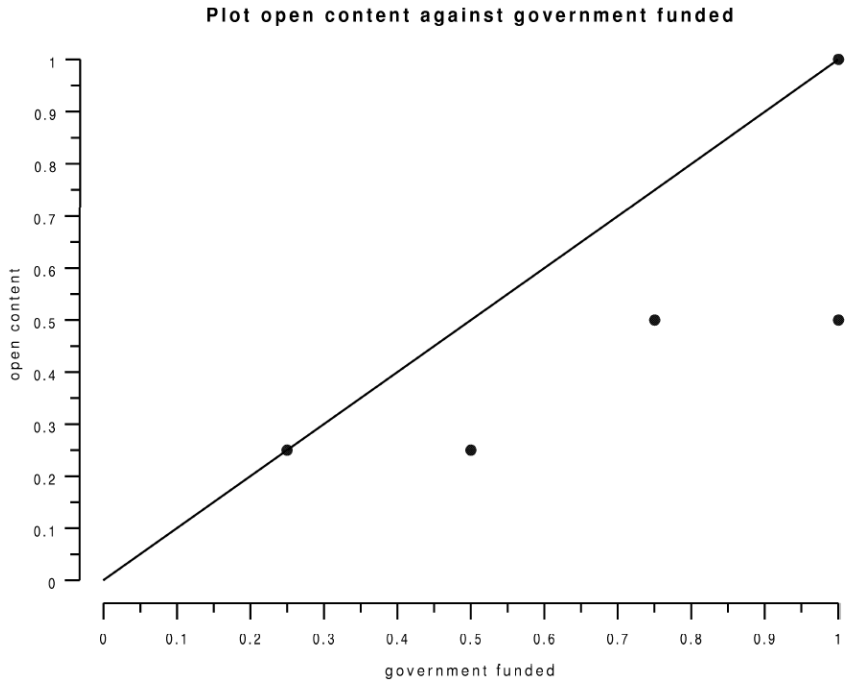
The most important set theoretic dimension to be investigated when doing fsQCA is the subset relation. The goal is to analyse "if cases sharing several causally relevant conditions uniformly exhibit the same outcome" (Ragin, forthcoming-b). In fsQCA, "a set A is a subset of set B if the membership scores of cases in set A are less than or equal to their respective membership scores in set B" (Ragin, 2000, 214).

The university example discussed above may help to clarify this point. If one uses the scores in *Table 19* and plots open content (O) against government funded (G) the results yield a lower triangular plot, as presented in *Figure 4* (Y = outcome; X = set being tested). Therefore a subset relation exists, as the case scores in the outcome are consistently less than or equal to the score in the condition tested. This pattern offers an argument that when the outcome is present the condition tested is consistently present. Therefore it is a *necessary condition* because it is present every time the outcome occurs. For the sake of the analysis, it is important to note that cases with low score in the outcome belong to the set to a minimum degree. Only cases with 0 score are out of the set.

A condition may be necessary but not sufficient to produce the expected outcome. A causal condition is sufficient if it leads *by itself* to the outcome; this means that whenever the cause is present, the outcome must also be present. However, as Ragin explains, "when causation is complex, no single condition may be either necessary or sufficient. Instead, a researcher may only find causes that are sufficient only in combinations" (Ragin, 2000, 230). In fact, causal complexity is a feature of most social phenomena. Following the subset principle

already introduced, it can be argued that a combination of conditions is *sufficient* when they are a subset of the outcome, that is when their combined membership score is less than or equal to their membership in the outcome, therefore producing an upper triangular plot. Given the particularities of the methodological design of the present research (See next section), more emphasis is given here to the analysis of necessary conditions.

Figure 4. Example of necessary condition - Plot open electronic content against government funded



Combinations can be produced by common Boolean algebra operations such as “and” (minimum of combined scores), “or” (maximum of combined scores) or “ negative” (1 minus the score in the set). The study of negative cases, for instance, allows for testing sufficient conditions by assessing which conditions are present or not, in what degree, when the outcome is not present.

As already mentioned above, fsQCA is a way of making sense of cases in comparative studies. Therefore the relevance of a given condition (or combination of conditions) for producing the outcome (sufficiency) or whether a condition is consistently present in all instances of the outcome (necessity) can be assessed by veristic and probabilistic criteria (2008b, Ragin, 2000). Ragin developed the ideas presented in *Fuzzy-set social science* (2000) in recent efforts to provide more refined techniques to investigate consistency (“the degree to which cases sharing a condition or combination of conditions agree in displaying

the outcome"), coverage ("the degree to which a cause or causal combination "accounts for" instances of an outcome"), and how to use truth tables to improve analysis (Ragin, 2006b, 2, Ragin, forthcoming-b).

In the analysis of necessary conditions, the consistency of a cause must be 1.0 (Ragin, 2006b). For instance, when the sets and scores presented on *Table 19* are considered, the following results are achieved (*Table 20*).

Table 20. Example - Consistency

Outcome variable: O	
Conditions tested:	
	Consistency
R	0.750000
~R	0.583333
G	1.000000
~G	0.250000

Consistency is measured by:

$$(Yi \leq Xi) = \sum (\min(Xi, Yi)) / \sum (Yi)$$

Again, according to *Table 20*, the outcome "open content" is a subset of "government funded" universities. The researcher can then argue that "government funded" is a necessary condition, but not sufficient, for the outcome.

To simplify the explanation of necessary conditions, consider *Table 21*, drawn from Ragin (2000). Whenever there are cases in cell 2, an argument for a necessary condition or combination of conditions is plausible. However, such a result does not account for sufficiency, as the negative cases (outcome absent) are not considered.

Table 21. Example – Cause is necessary but not sufficient

Outcome	Cause absent	Cause present
Present	[cell 1] no cases	[cell 2] cases
Absent	[cell 3] not relevant	[cell 4] not relevant

The assessment of necessary or sufficient conditions, however, is only an intermediate step in the research development. There must be a follow-up and exploration of the dialogue between evidence and theory. As Ragin puts it, "once a statement describing causal complexity has been derived, it still necessary to evaluate it. Does it make sense? Are the results consistent with theory? Do they advance or refine theory?" (Ragin, 2000, 246). Or in

its later developments, “the ultimate ‘test’ of the results of a configurational analysis is not their consistency or coverage but how well they help researchers make sense of their cases” (Ragin, 2006b, 20).

4.2. Specific considerations with regard to the methodological design of the present research

The present research is fundamentally exploratory in nature and searches for commonalities shared by positive cases, that is, cases which scored more than 0 in the expected outcome. Given its preliminary character and membership scores, it opted to evaluate only monocausal arguments and possible subset relations of necessity with the expected outcome, namely, *significant city-wide Muni-Wi network for civilian use.* Definitions concerning the outcome and conditions are presented on the next topic.

Because of its exploratory nature, dealing with positive cases only, this report is restricted to the investigation of necessary conditions. In order to discuss sufficient conditions, negative cases, with a score of 0, should also be considered. “This situation often arises when the boundaries of the set of negative cases [...] is unclear, arbitrary, difficult to pin down, or potentially infinite” (Ragin, 2000, 98). This is exactly the situation of *significant city-wide Muni-Wi networks for civilian use* in Brazil and Europe. The cases with non-significant city-wide Muni-Wi network for civilian use (negative cases) are almost impossible to assess, as this is the situation of the great majority of cities. Hence the goal of this report is to possibly improve the comprehension of the outcome or, at least, indicate some viable lines of inquiry.

Another possible matter of dispute is the number of cases. The limitation to only six cases is due to time restriction. This exploratory study was conducted in five months, including all stages of research, such as bibliography review, methodological refinement, research into cases, interviews with twelve managers, and writing up.

The limited number of cases does not allow for any generalization of the results. Rather, the hoped-for achievement of this investigation is to open lines of inquiry about Muni-Wi projects. The idea is to enlarge the scope of this research with more cases in the future and with the necessary improvement of set definitions and qualitative anchors.

When the number of cases is limited, it is easier to achieve perfect consistency (1.0). However, perfect consistency in a small number of cases, say six, may be less relevant for a social scientist than a lower consistency in 30 cases. Nonetheless, there are ways to evaluate the importance of findings in small-N cases studies by adopting linguistic qualifiers

and by setting benchmarks for the proportion of a given cause or combinations of causes that display an outcome. For instance, the researcher can assess quasi-sufficiency or necessity by using qualifiers such as “more often than not”, “usually” and “almost always”, with defined arbitrary benchmarks, e.g., .5, .65, .8 respectively, based on probabilistic criteria (Ragin, 2000). However, as the results of this research show, none of the conditions investigated ever achieve perfect consistency, despite the limited number of cases. That is why this methodological refinement was dismissed, and the explanation of linguistic qualifiers usage will be skipped (See chapter 4, Ragin, 2000). In fact, as will be shown in the analysis of the findings of this research, the absence of necessary conditions already poses a variety of elements which may further the discussion of Muni-Wi.

Having made these necessary remarks on methodology, it is time to move on to the definition of sets.

4.3. Sets conceptualization

The use of fuzzy sets demands a theoretical conceptualization of the expected outcome and qualitative anchors (breakpoints) that will guide the analysis. It is necessary to define how membership of a set is scored, which depends largely on the evidence available about the cases and on the researcher’s theoretical knowledge. As indicated above, in *Section 1.3*, this exploratory study used a five-value score from 0 to 1.

Table 22. Set definition - Muni-Wi elements

Strategies, management and policy related issues	Infrastructure related issues
- Spectrum use (licensed or open) - Infrastructure management (public, private, public-private partnership, community network). - Business model (public, sponsored, communitarian). - Policies (supply, investment in undeveloped areas, demand promotion, group oriented, etc.)	- Mobile telephony (3G e 4G) - Wi-Fi - WiMAX, WiMAN, etc. - Mesh networks - Radio frequency

The definition of sets took into account evidence available about all cases and the specialized literature and theories in the field. In this research, the key theoretical references were depicted through the C.I.B.G framework in *Section 2*. As summarized in *Table 22*, the different elements were considered in the definition of sets based on the specialized litterature (van Winden and Woets, 2004, Mansell and Nikolychuk, 2002, Lehr et al., 2006). *Table 23* presents the sets used in the fsQCA.

Table 23. Expected outcome and set definition

OUTCOME
Significant city-wide Muni-Wi network for civilian use
SET
Community involvement
Municipal funding
New related programs or policies to increase demand
Reliance on unlicensed spectrum

A five-value scale was chosen to evaluate the membership of cases in a set. This definition is based on the observation of two crucial aspects: 1) the characteristics of the object; 2) the quality, quantity and consistency of the evidence available for analysis. In general a five-value scale is more adequate where there is enough evidence about the cases, but the data is not systematically organized or easily comparable from case to case (Ragin, 2000).

Therefore the fuzzy-set proposal is presented as follows:

- 1 = fully in
- .75 = more in than out
- . 5 = neither in nor out (*crossover*)
- .25 = more out than in
- 0 = fully out

Defined qualitative anchors, or breakpoints, for each set studied guide the evaluation of membership in a set (fully in or out of the set). These definitions are built upon the case studied and calibrated according to the researcher's theoretical knowledge (Ragin, 2000). The interpretation of evidence allowing for membership attribution starts only when the membership score table is established.

The description of cases in this research draws upon systematic analysis of information collected on the Internet, including media, government, international organization reports and consulting offices, but also in specialized literature and interviews with project managers.

The expected outcome to be compared is the local network relevance in light of its coverage and use. The other sets were defined in accordance with some of the dimensions proposed in the C.I.B.G. framework (See 2). The definition of each set and how the membership scores were defined will be considered next.

4.3.1. Expected outcome – Significant city-wide Muni-Wi network for civilian use

The assessment of how a municipality uses ICT, including internet access provision, is rather diffuse. It may involve not only broadband distribution, but also an array of services and policies that increase the social value of the installed network. The Intelligent Community Forum, for instance, uses five indicators to define its intelligent community, namely, broadband infrastructure, knowledge workforce, innovation, digital exclusion and marketing (ICF, 2008a). One could also take the International Telecommunications Union's ICT basic core indicators and bring these together with the analysis data on radio, TV, fixed line telephone, mobile telephone, computer, aside access, location and activities performed on the internet (ITU, 2005). The Economist Intelligence Unit, in turn, gives different weightings to connectivity and technological infrastructure (20%), business environment (15%), social and cultural environment (15%), legal environment (10%), government policy and vision (15%), consumer and business adoption (25%), in calculating its e-readiness ranking (EIU and IBM, 2007).

Some of the above dimensions are directly or indirectly investigated in this research as it also addresses technological infrastructure, access, digital inclusion, innovation, government vision and policy, and legal environment. With the theoretical background discussed in *Section 2* in mind, thus assuming the dialectical movement between the digital locus organization, based on contingent power relations, and a creative movement of everyday life practices, the comparative study herein presented looks at the assessment of wireless networks from a strategic point of view. In other words, the main interest lies in the decisions taken to deploy the network, hence attention is drawn to the place or the digital locus organization. What the users are making of the network provided cannot be investigated at this point because of a series of constraints, but most importantly due to the impossibility of *in loco* observation or interviews.

This exploratory inquiry considers the possible necessary conditions for the outcome in question, namely, *significant city-wide Muni-Wi network for civilian use*. Framed otherwise, these are cases of *significant city-wide Muni-Wi network for civilian use*. Therefore it is not enough to have cases with wireless network for administrative purposes. Nor does this

research focus on network use, as there were not enough reliable data to establish comparisons.

The analysis of membership in the significant city-wide Muni-Wi set is based on two elements: 1) Evidence of network full or partial city-wide coverage and 2) evidence of considerable number of logs, sessions or registered users. The qualification of significance is based on an arbitrary decision of the researcher. The breaking point to define significance was the existence of at least a 2 km^2 coverage area, as this could be considered a relevant area as far as outdoor internet in a city goes. The number of logs will simply sustain the fact that the network is active.

In light of the above references, the qualitative anchors in the *significant citywide Muni-Wi network for civilian use* fuzzy-set were defined as follows. Cases with evidence of city-wide coverage and use scored 1.0 (fully in). Cases with partial, but over 2km^2, city-wide network coverage and use scored 0,5, which is the crossover point. Cases without evidence of *citywide Muni-Wi network for civilian use* scored 0.0 (fully out of the set), and therefore were considered irrelevant for the purposes of this exploratory investigation, as discussed in *Section 4*.

It is important to note that the membership score by no means aims to assess the performance or success of each case, especially since the available data in each case does not allow for a direct comparison as many variables come to the fore, such as population density, educational factors, legal issues, economic aspects that have direct impact on the population's access to devices (laptops, PDAs, last-generation mobile phones, etc.), not to mention the fact that network designs vary greatly – point-to-point, private operated, public operated, Wi-Fi hotspots, among other possibilities.

The goal is rather to identify cases of significant Muni-Wi network deployment for civilian use. In addition, projects like those of Issy-les-Moulineaux and Tiradentes, which scored .25 in the set, are in their very early stages and intend, in the future, to have wider network coverage. However, this research must deal with the present available evidence

The evaluation of success can become even more complex when we consider the fact that a high number of logs does not imply that universal access has been achieved. It might happen that mostly technologically savvy individuals are logging in. A city-wide network does not guarantee its use - it may be necessary to demand policies oriented to expanding access to computer or other devices simply because the population has no money to buy

these. That being noted, one must bear in mind that all membership scores are simply a methodological tool to identify cases belonging to the same type and assess the elements that contribute to their outcome.

That being clarified, *Table 24* indicates the membership in the outcome:

Table 24. Membership score: significant citywide Muni-Wi network for civilian use

ID	City	Score	Label
1	**Bristol**	.5	Neither in nor out
2	**Issy-les-Moulineaux**	.25	More out than in
3	**Norwich**	.5	Neither in nor out
4	**Piraí**	1	Fully in
5	**Tiradentes**	.25	More out than in
6	**Sud Mennucci**	.5	Neither in nor out

The scores, as already explained, take into consideration network coverage and usage. Therefore all the above Muni-Wi projects constitute positive cases, that is, they show evidence of urban wireless internet adoption. What varies is their degree of belonging in the set. As shown in *Table 21*, only Issy-les-Molineaux and Tiradentes had network coverage smaller than 2 km^2 at the time this investigation was conducted, which justifies their lower score in the set "significant relevant Muni-Wi network deployment for civilian use".

Piraí had wider coverage and showed strong evidence of usage. The project is presently limited by legal issues and debates that are still going on. Nonetheless as there is enough evidence of hotspots, some residential use and a variety of facilities open for civilian use profiting from the wireless network, the case scores 1.0. Similarly the uncertain future of Norwich's project did not prevent the case from scoring in the set. Hence all six cases presented enough evidence to confirm that the network is active, as shown in *Table 25*.

Table 25. Cases – Coverage and usage

ID	City	Coverage	Access
1	**Bristol**	8 km^2	20,000 logs per month
2	**Issy-les-Moulineaux**	1.6 km^2	3,000 logs per month
3	**Norwich**	15 km^2	40,000 logs per month
4	**Piraí**	100% rural and urban areas	10.000 registered users
5	**Tiradentes**	< 1 km^2	2.900 logs per month
6	**Sud Mennucci**	15 km^2	990 registered residential or business users

In conclusion, all cases provided evidence of a Muni-Wi network for civilian use but, given the established crossover point of 2 km^2 coverage, there were varying degrees of membership in the *significant citywide Muni-Wi network for civilian use* set.

4.3.2. Community involvement

As indicated in *Section 2*, an important element in every Muni-Wi network deployment, may be not only the involvement of multiple stakeholders, but also that the socio-infrastructural architecture can profit from different driving forces. Both dimensions will have a direct effect on expected outcomes as steps towards a community network or, as already discussed, the very possibility of communities in network. As noted before, four main types of community network organizations can be envisaged (Botto and Passani, 2008):

- Traditional CN, - from FreeNets experience – focused on grassroots participation and the creation of democratic" on-line services;
- New grassroots CN, based on the creation and self-management of networked infrastructures at grassroots level;
- New government CN, focused on the creation of networked infrastructures at local government level;
- New government 2 CN, based on advanced and virtualised services provided via public infrastructures.

Given the goals of this research, the traditional CN definition must be discarded, as it does not consider the actual physical network infrastructure. Hence, three examples are left: *new grassroots community network*, *new government community network*, *new government 2 community network*.

As portrayed by the OPAALS report, and summarized in *Table 26*, the initiatives may have more or less bottom-up or top-down arrangements as far as infrastructure development goes (Botto and Passani, 2008) .

Table 26. Community Network Designs

Traditional	New grassroots	New gov	New gov 2
-	Bottom-up	Top-down	Top-down

As each community evolves, more bottom-up or top-down features may be added. It all depends on how the project deals with its relationship with existing stakeholders.

The way stakeholders participate or are involved is a crucial matter for governance. A recurrent model is the creation of boards or regulatory bodies constituted by multiple actors with consulting or executive functions. Despite difficulties in evaluating the direct impact of each possible arrangement, it is plausible to say that every organizational arrangement interferes in the existence of more or less democratic processes which, in the long run, are likely to be more stable and avoid monopolistic scenarios.

Community involvement is also intrinsically related to issues of accountability, which alongside governance, as shown in 2, is another buzz-word in public management. This research aligns with Goetz and Jenkins' overall definition of holding accountability as a "relationship of power" as regards "the capacity to demand someone engage in *reason-giving* to justify her behaviour, and/or the capacity to impose a penalty for poor performance" (Goetz and Jenkins, 2002, 5).

All that being said, the membership score in the *community involvement* set ultimately investigates management patterns in Muni-Wi projects and the degree of community involvement at executive or, at least, consulting levels. Community participation may occur through official boards, occasional meetings or even when local government profits from existing communitarian arrangements. Evidences of these features will guide the scores in the set.

Therefore membership scores in this set are defined on the basis of official community involvement in managerial processes. The score ranges from 1.0 (fully in), that is cases with official boards at consulting or executive levels, to 0.0 (fully out), which are cases with strong reliance on top-down initiatives with only occasional meetings with stakeholders. The breakpoint (0.5), neither in nor out of the set, is those cases where there are not only occasional meetings with stakeholders, but also a wider scope for official partnerships including private, public and civil organizations. *Table 27* shows the membership score results in this set.

Table 27. Membership score – Community involvement

ID	City	Score	Label
1	**Bristol**	.75	More in than out
2	**Issy-les-Moulineaux**	0	More in than out
3	**Norwich**	.5	Fully in
4	**Piraí**	1	Neither in or out
5	**Tiradentes**	.5	More in than out

6	**Sud Mennucci**	0	More in than out

Piraí showed clear evidence of stakeholders' involvement, gathering around 70 institutions, associations, local government and local legislators in an official board. Tiradentes and Norwich, in a less systematized way, showed a diverse set of official partnerships, including institutions from public and private sectors, but also from civil society and universities. Both Tiradentes and Bristol had already started debating mechanisms to include different social actors in the Muni-Wi management process. Bristol, however, scored higher in the set as it has already initiated an association to manage the network in a lower income neighbourhood.

All other cases reported holding meetings with different stakeholders whenever needed, that is contingent upon situations. For instance, in Issy-les-Moulineaux, network expansion depends on a series of agreements on the use of public facilities and on architectural issues. Sud Mennucci's project involved, from the start, IT managers from the local alcohol industry.

As surprising as it may seem, the only case that showed some evidence of working with existing community networks was Issy-les-Molineaux's project, that is the only one with direct management from private networks and paid services (2007d). All other initiatives were pretty much top-down actions, as far as the infrastructure goes, which are in different ways trying to cope with community demand.

As presented in the Issy case description, one operator, Neuf Cegetel, allow its broadband clients to share internet access through their Neuf Box (WiFi), allowing others to access their network. By joining the FON or Neuf-WiFi community, their clients will also profit from access to other community members, that is, people who have also agreed to share their Wi-Fi Internet link (2007a). However, of this set membership score, it must be noted that this very interesting initiative does not include the community in its managerial processes.

In the end, only Piraí has a systematic way of incorporating the community's views in its actions. All other projects are driven pretty much top-down. Some of the cases aim to incorporate more participative processes but, at the time this research was conducted, they were at a discussion stage. Norwich, given its experimental basis, is not addressing the issue. Overall, occasional meetings with other social actors tend to be the main characteristics of the projects studied. In all cases, including Piraí, the government played a key role as an initial driver.

4.3.3. Municipal funding

This set is directly related to network affordability for end users**.** Is it free, paid or does it have fees for different services? These possible arrangements depend largely on each Muni-Wi's degree of dependence on public funding.

As observed in *Section 2*, affordability is a key issue for the project's success, especially when the goal is to bridge the digital divide (Gunasekaran and Harmantzis, 2007). That is to say, the more the project aims at low-income communities, the more the final cost to the user becomes an issue. However, the fact of having fees to access the network does not indicate that the service provided is not affordable for final users, as the relation between final cost and affordability may vary greatly from region to region given local economic conditions.

The competitive environment in the provision of wireless broadband Internet is highly determinant as far as affordability goes. Publicly funded projects may be free or have different fees for different services. From the end user's point of view, to have an additional paid service provided by local government may become a serious impediment, as it is quite common to have the citizens and local businesses already complaining about existing taxes. Moreover not many municipalities have the necessary budget to deploy such an infrastructure, even within a public-private partnership.

Public-private partnerships at the different levels of the network, sometimes involving for-profit players, bring new elements to the final costs. The involvement of for-profit companies will not necessarily increase the costs for the final user - that all depends on the government business model.

Because of the multiple business models available, the level of municipal investment in wireless internet provision is central not only for end users, but also to the overall budget of the city. The allocation of funds for a new service is always a risky step. Government, however, can work as a driver for other business initiatives, if there is an attractive local market, although it may limit the entry of new players. There is no simple answer to the best model, as this depends largely on contingent situations.

Given the key role played by municipal funding, and the recurrent debate about the extent to which municipalities should get involved in Muni-Wi projects, the membership score in the set is constructed on evidence of local government investment in infrastructure deployment and operation.

Cases which are entirely funded by local government, even if executive functions are devolved to private companies, scored 1.0 (fully in the set). Cases where municipalities profit from key investments made by other sources, either in infrastructure or in personnel, scored 0.5 (crossover). Muni-Wi projects which are entirely funded by third parties, even if operated by local government, are considered fully out of the set (0.0). *Table 28* shows the membership score in this set:

Table 28. Membership score – Municipal funding

ID	City	Score	Label
1	**Bristol**	1	Fully in
2	**Issy-les-Moulineaux**	.25	More out than in
3	**Norwich**	0	Fully out
4	**Piraí**	.5	Neither in nor out
5	**Tiradentes**	0	Fully out
6	**Sud Mennucci**	1	Fully in

The most frequently adopted business model among the cases investigated was the provision of free internet access. Only Issy-les-Moulineaux has a less government-dependent design, but it still has a high reliance on public buildings and public access points in order to deploy its optical fibre network. The project also had a small initial investment from local government.

Sud Mennucci and Bristol work with municipal money. The experimental Norwich project is funded by a public agency. Piraí, in turn, has a free link to the Internet provided by the state government and the City Hall funds the network deployment. Tiradentes has almost no local government investment, profiting from strong private partnerships and expressive federal investments.

4.3.4. New related programs or policies to increase demand

Local government involvement in wireless internet provision is hardly a simple matter of technological choices. In fact this seems to be the easiest part. The existence of integrated programs or policies could increase the available infrastructure usage and, more importantly, may help address issues key to the city's development. Hence technology is not held as a major solution for political and economical problems, as most local difficulties in urban spaces find their solution in human actions not in technical objects. Programs and policies should aim at adding value by giving emphasis to activities that "make a significant difference in closing the universal access gap" (Mansell, 1999, 27).

In order not to make the technological infrastructure an alien prosthesis for most of the city's population, despite its coverage, Muni-Wi projects can address dimensions of citizens' everyday lives that go beyond bytes transmission. Alves is precise in his depiction of public policies. For him, public policies

> can be defined as temporal institutions, permeated by historical heritages, which produce a series of objective and subjective experiences and embrace multiple fields of knowledge. In its administrative dynamic, they include education, health culture, leisure, sports and social service actions [as the author observes further, alongside infrastructure and economic concerns]. As such, they partake in the lived and known world of common citizens and managers, acquiring organicity within the local-regional government programs and plans official image. But they do not exist – as a political value – without the citizenship action, without the cultural history memory, and without the references which update the communitarian life. They do not exist out of the previous social dynamic and the come to be dialogue (Alves, 2006, 4).

The integration of policies is a challenge for every municipality. More often than not, the bureaucratic arrangements of local governments lead to the creation of small power feuds within the larger public management. The need to overcome the barrier between technicians and educators, for instance, is one among the many possible conflicts. However the assessment of any ICT project undoubtedly involves multiple competences.

Despite possible internal conflicts, the advent of a Muni-Wi may lead to new programs and policies discussed at first hand by local government or demanded by the population. Here two complementary streams of programs or policies were considered:

a) Skills development – Basic training programs for the population and technical skills development to provide services (support, etc.) for the network
b) Demand promotion – Fiscal incentives for hardware and software acquisition, specific services like e-mail, blog and site hosting, online municipal-related services, media literacy programs, online participatory citizenship strategies.

For the sake of membership scores, only new programs officially related to network deployment were considered. Hence other initiatives profiting from the network's existence – for instance, other independent local initiatives - were left out of the evaluation. This methodological option stems from the impossibility of assessing information in all areas of each city.

Cases with not only broadband deployment policies, but also with official initiatives related to skills development and demand promotion were considered fully in the set (1.0). Projects covering at least one of the aforementioned streams of work were located at the crossover point (0.5). Cases which rely solely on network deployment, therefore without any direct complementary program or policy, scored 0.0, being completely out of the set. See *Table 29* for the membership score in this set.

Table 29. Membership score – New related programs or policies to increase demand

ID	City	Score	Label
1	**Bristol**	1	Fully in
2	**Issy-les-Moulineaux**	.5	Neither in nor out
3	**Norwich**	0	Fully out
4	**Piraí**	1	Fully in
5	**Tiradentes**	1	Fully in
6	**Sud Mennucci**	1	Fully in

In order to facilitate the comprehension of the membership score in the set concerned, an overview of policies and programs adopted by each municipality is presented bellow in *Table 30*.

What is important to note in this set is how the Muni-Wi brought together new programs or policies to increase demand. The effectiveness of each initiative was not directly addressed here.

Table 30. Cases – Policies and programs

City	Policies and programs
Bristol	Training, demand (ultra flexible & neighbourhood working)
Issy-les-Molineaux	Demand (free access to the municipal portal and municipal web TV)
Norwich	No integrated policies or programs as it is a pilot project
Piraí	Training and demand (e-mail for the population)
Tiradentes	Training and demand (promotional events)
Sud Mennucci	Training (basic skills and service oriented), demand (weekend access on local schools)

4.3.5. Reliance on unlicensed spectrum

Technological choices impact on costs and performance and on the flexibility of the network to expand its infrastructure. Given the central role it plays, the technological choices may directly interfere in the use of the available facilities and in the sustainability of the project.

More than that, they impose limits and possibilities on network coverage and, consequently, on usage.

A Muni-Wi project in general uses Wi-Fi, Wi-Max and Mesh technologies, but may also integrate a mix of wired options. Just as a reminder, there are other debates going on about the future of local public networks using FTTH (fibre to the home), not to mention PLC (power line communication) (Daggett, 2007, Arnaud, 2005, Botto et al., 2008). What remains an open question is the viability of using 3G cellular systems in municipal initiatives. For Botto et al (2008), local governments do not take this option into consideration, whereas the operators have not yet envisaged a viable project for a city. The fact that the 3G market segment is in general left entirely to private interests may also inhibit enthusiasm for Muni-Wi initiatives.

However the available wireless technologies used in Muni-Wi projects end up being restricted to unlicensed frequencies, in some cases because of technological specifications, but also due to existing regulatory marks. In most countries, the spectrum is a public good allocated by the government. The most valuable part of the spectrum ranges from 3 kHz to 300 GHz. As different frequencies imply different propagation characteristics, the value of each band is intrinsically related to its frequency. Lower frequencies, with longer wavelengths, have better propagation and therefore are the most valuable.

In general, municipal projects based on Wi-Fi use the 2.4 GHz band, which is unlicensed and sometimes called the “junk band” - a fact that leads us to question whether it is not necessary to have better bands allocated to municipal wireless network projects. However, to address the issue of the bands necessary for municipal initiatives is to touch on the overall problem of spectrum scarcity. Federal governments often face a variety of dilemmas: the need to release more spectrum, which is limited; the difficulty of reviewing management practices, which go back to the late 1920s; the apparent impossibility of recovering bands, especially those which are poorly utilized. The issue also revolves around the doors opened by new developments for better management of the airwaves, profiting from smart radio technologies and envisaging a common spectrum scenario, and arguments that spectrum is a problem that the market can solve (the “coasian” answer) (Wellenius and Neto, 2006, Faulhaber, 2006, Snider, 2003).

Notwithstanding possible spectrum management systems, the fact is that present bureaucratic conditions make the entry of new players in the deployment of wireless networks difficult, leaving space for wireless Internet networks practically only within the

unlicensed bands. The options, as they impact end users' access in terms of quality and location, may be a key issue for municipal initiatives.

In light of the debate about the technological options and frequencies available for Muni-Wi, this set focuses on the extent to which reliance on unlicensed frequencies is a condition necessary to the outcome. In fact there are possibly only two ways to avoid such a restriction: 1) to integrate wired solutions in the project; 2) to obtain a license to operate on restricted frequencies. In light of these two possibilities, the membership score in the set considers each project's degree of dependence on license-exempt spectrum, both in the backhaul and in the last mile. Projects relying on unlicensed frequencies both in the backhaul and in the last mile are considered fully in the set (1.0). Those cases using intermediate solutions, either by opting for complementary wired technologies or by using licensed frequencies at some point of the signal distribution, are located at the crossover point (0.5). The cases which are not dependent on unlicensed frequencies are fully out of the set (0.0). One may ask if it is ever possible, given the present conjuncture, to roll out a Muni-Wi project without considering unlicensed frequencies (fully out). The answer is yes, even if it is on an experimental basis as in Ouro Preto (Marcondes, 2006).

Based on the qualitative anchors defined above, the membership score in the set is reported below in *Table 31*.

Table 31. Membership score – Reliance on unlicensed spectrum

ID	City	Score	Label
1	**Bristol**	.5	Neither in nor out
2	**Issy-les-Moulineaux**	.5	Neither in nor out
3	**Norwich**	1	Fully in
4	**Piraí**	.5	Neither in nor out
5	**Tiradentes**	1	Fully in
6	**Sud Mennucci**	1	Fully in

The variation in the membership score is fully dependent on the technological choices made by each Muni-Wi project. As seen in *Table 32*, Brsitol, Issy-les_Moulineaux and Piraí use, at some point, wired solutions. All the cities rely on Wi-Fi or Wi-Mesh networks to reach their end users. Sud Mennucci uses optical fibre only for a few administrative buildings, therefore not in the outdoor network open for civilian use.

Table 32. Cases – Technological mix

ID	City	Technological mix
1	**Bristol**	Wi-Fi, Wi- Mesh, optical fibre and other legacies
2	**Issy-les-Molineaux**	Optical fibre (backhaul), Wi-Mesh, Wi-Fi
3	**Norwich**	Radio, microwave (backhaul), Wi-Fi
4	**Piraí**	Cable, Wi-Fi
5	**Tiradentes**	Wi-Mesh
6	**Sud Mennucci**	Wi-Fi, cable for some administrative buildings

As far as the frequencies used go, most of the projects are restricted to 2.4 and 5.8 Ghz frequencies. 5.8 Ghz were used as backhaul, as show in *Table 33*.

Table 33. Cases – Frequencies used

ID	City	Frequencies
1	**Bristol**	2.4 GHz, 5.4 GHz and 5.8 GHz
2	**Issy-les-Molineaux**	2.4 GHz
3	**Norwich**	2.4 GHz
4	**Piraí**	2.4 GHz and 5.8 GHz
5	**Tiradentes**	2.4 GHz and 5.8 Ghz
6	**Sud Mennucci**	2.4 GHz and 5.8 GHz

After going through all the membership scores in the outcome and condition sets, the next step in the fsQCA is the investigation of necessary conditions, according to the methodological principles discussed in *Section 2.8*. These procedures will be carried out next.

4.4. Analysis of necessary conditions

Before discussing the membership scores, it is useful to remind the reader about some particularities of the present methodological design. As already discussed in *Section 4.2*, this investigation is exploratory in nature and its results offer only preliminary cues about Muni-Wi projects. Hence the findings cannot be generalized. Given this methodological option, only positive cases were considered, that is, cases which scored above 0 in the outcome s*ignificant city-wide Muni-Wi network for civilian use*.

As this investigation deals strictly with positive cases, only the necessary conditions are discussed. It is useful to remember that a causal condition is necessary if it is present in all instances of the outcome. Thus, the analysis of necessary conditions is usually of primary interest to researchers, as stipulating which causes are present in every instance of the

outcome of interest can provide important clarity in the analysis of social phenomena. However, it is important to note that social phenomena are generally complex and that it can often be hard to point to a single necessary condition. *Table 34* presents the overall membership score in the outcome and set conditions.

Again, it should be noted that the scores in MW (outcome) reported in *Table 34* do not point to the success or lack of success of each case. What it is important is to realize that these are all positive cases and that therefore all the cities deployed Muni-Wi projects. The score in the outcome is based on network coverage with active users. Hence, aside from coverage, the additional evidence with regard to users aims solely at confirming that the network was active, with no evaluation therefore implied. This second piece of evidence was the number of logs or registered users.

Table 34. Membership score – Summary table

	MW	CI	MF	NP	US
Bristol	.5	.75	1	1	.5
Issy	.25	0	.25	.5	.5
Norwich	.5	.5	0	0	1
Pirai	1	1	.5	1	.5
Tiradentes	.25	.5	0	1	1
Sud Menucci	.5	0	1	1	1

MW (outcome) - Significant city-wide Muni-Wi network for civilian use
CI - Community involvement
MF - Municipal funding
NP - New related programs or policies to increase demand
US - Reliance on unlicensed spectrum

The most striking finding in the membership scores in *Table 34* is the diversity of the cases. Despite the limited number of cases (6) investigated, no single necessary condition was identified. As already discussed in *Section 4.1.1*, in order to analyse necessary conditions, the outcome (Y_i) is plotted against a condition or combination of conditions (Xi). The subset relation is established when $Y_i \leq X_i$, yields a lower triangular plot with all cases bellow the diagonal. With the scores presented in *Table 34*, no single necessary condition was found, not even when these were plotted in their negative form ($1\text{-}X_i$), that is ~CI, ~MF, ~NP or ~US, where ~ indicates negation (not), e.g., not-CI or not-MF. This is not surprising as it corroborates our view that the study of Muni-Wi is a complex phenomenon and that no single condition is necessary in order to account for the success or lack of success of these networks. Therefore, far from preventing us from exploring in more depth the causes that lead to the establishment of significant municipal wireless networks for civilian use, this finding encourages the researcher to explore this topic in more depth. This would entail

carrying out an analysis of sufficiency, that is, identifying the combination of causes that lead to the outcome. As already explained, due to the limited number of cases in this study and to its exploratory nature, this second analysis has not been carried out at this time. However, it is possible to posit that the fact that no single necessary condition is found in this analysis gives support to the idea of increasing the number of cases in the study of municipal wireless networks in order to test whether there are a combination of causes that are sufficient, that is, a combination of causes that lead to the outcome of interest.

Table 35. Analysis of necessary conditions - consistency

Outcome variable:mw	
Conditions tested:	**Consistency**
CI	0.750000
~CI	0.583333
MF	0.583333
~MF	0.500000
NP	0.833333
~NP	0.250000
US	0.833333
~US	0.416667

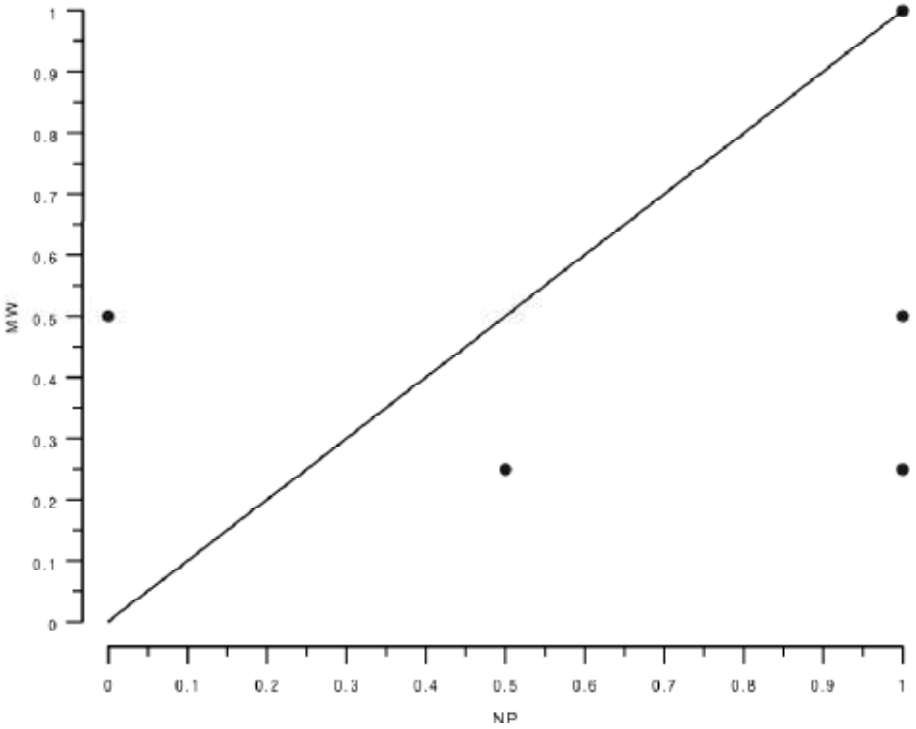
In a more refined analysis of necessary conditions, it is of great interest to calculate consistency, that is, "the degree to which the cases sharing a given condition or combination of conditions [...] agree in displaying the outcome in question [...]. That is, consistency indicates how closely the subset relation is approximated (Ragin, 2006, 2). *Table 35* reports consistency in these results.

If all cases report Y_i (outcome) values less than or equal to the score in their Xi (condition), the consistency formula would return a value of 1.0, that is, perfect consistency. Such a result indicates that the outcome is a subset of the condition tested. Therefore the condition tested would be a necessary condition.

Table 35 shows that US and NP are the conditions which most approximate 1.0 consistency but, given that they do not reach a value of 1.0, this confirms that they are not necessary conditions. Even with high consistency, note, as shown in *Figures 5* and *6,* that there are cases located above the diagonal, that is, where $X_i \leq Y_{i,}$ in both conditions tested (NP and US)[7].

[7] For those who are not familiar with these kinds of plots, it must be noted that there are fewer intersecting dots than the number of cases because some cases coincide in their membership scores.

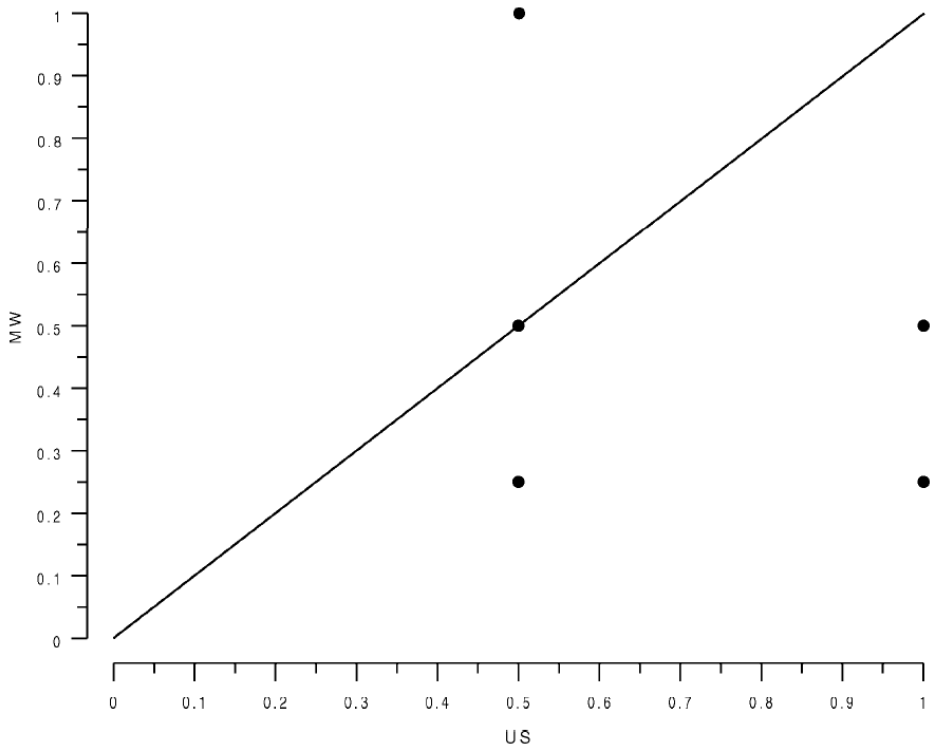
Figure 5. Plot "Significant Muni-Wi network for civilian use" against "New related programs or policies"



It became unnecessary to further the analysis of combined conditions, as the test of the possible 16 combinations, a number which can be reached by 2^k formula where *k* is the number of conditions, either returned low consistency or had no or just one case within the tested combination. This result could be achieved by using a truth table algorithm, as explained by Ragin (Ragin, forthcoming).

The effort to carry out an analysis of necessary conditions is not the final step. Now one must submit the findings to theoretical criticism. Even though no necessary conditions were identified, this outcome raises some interesting questions, especially in an exploratory study like the present investigation. This debate will be pursued next in the *Conclusion*.

Figure 6. Plot "Significant Muni-Wi network for civilian use" against "Reliance on unlicensed spectrum"



5. Conclusion

This report concerns the brave trajectory, with attempts and errors, of pioneering projects. Despite possible criticism of technological, business and political choices, what emerges as a tremendous achievement is the step forward made by local governments in getting to grips with new forms of social exclusion, and seizing the best opportunities in the so-called information economy.

However, as reported in *Section 4.4*, no single necessary condition for "significant city-wide Muni-Wi network for civilian use" (outcome) was identified in the fsQCA. Consequently it is possible to submit that there are many ways to reach the same outcome given the high causal complexity of the subject matter. One possible interpretation of these findings could be, as Ragin proposes, "that if important causal commonalities cannot be identified, then perhaps the outcome is not really the same across all positive cases and thus must be disaggregated into types" (Ragin, 2000, 207). This could well be true. If the cases were to be disaggregated into types, say, private operated and public operated, perhaps more commonalities could be found. Another option would be to single out those cases with strict use of wireless technologies, in other words with no support from wired technologies such as

cable or optical fibre. These variations could, hypothetically speaking, provide more consistent results in terms of necessary conditions.

As this investigation was exploratory, the intention here, however, was to explore the diversity of cases. Therefore the results in the fsQCA are not frustrating; on the contrary, they stimulate debate and reflexion on Muni-Wi projects. The diversity found, the very complex causation patterns, may give researchers and public managers more systematized arguments for the overall impression that there is no defined governance, technological or business design. In this sense, widening the number of cases in future studies and proceeding with the analysis of the combination of causes that lead to significant municipal wireless networks, that is identifying the combination of causes that are sufficient, stands out as one of the most important recommendations from this research.

The diversity of arrangements must be also explored. For instance this may have its roots in the project's goals. While the Brazilian cases, Piraí and Sud Menucci, have a more universal approach, covering expressive urban and rural areas, the European cases tend to focus on a sort of complementary option for internet access on the streets and on the move. The European cases also included bigger, richer and more urbanized areas.

Table 36. Cases – Project launch

ID	City	Start
1	**Bristol**	2006
2	**Issy-les-Moulineaux**	2007
3	**Norwich**	2006
4	**Piraí**	(2002,interrupted) 2007
2. 05	**Tiradentes**	2006
6	**Sud Mennucci**	2005

The maturity of each project may also account for the differences in outcome. As shown in *Table 36*, just two of the Muni-Wi initiatives are more than three years old. Three cases are running on an experimental basis, namely, Issy-les-Moulineaux, Norwich and Tiradentes. This scenario may have impacted the development of community involvement mechanisms and new direction-related policies.

The novelty of the phenomenon of Muni-Wi in the regional scenario is likely to be a key factor for the reported variety of approaches as well. As one manager highlighted, lack of systematized local or regional data on municipal wireless networks on which to build is one

of the main difficulties in starting up a project. As most managers know, the conducting of benchmark studies is a very important step in any project management methodology. As there is no clear reference to draw upon, projects are launched and managed partially on a trial and error basis.

These final reflexions about the lack of necessary conditions in the cases investigated can be pursued by referring back to the C.I.B.G. (community, infrastructure, business model, governance) framework presented in *Section 2*.

First, consider the community and governance dimensions. Scores in this the set CI vary from 0 to 1, that is, there was at least one case with strong community involvement and cases with no or limited community involvement (See *Table 34*). In fact, to integrate community in management and evaluation processes in any public initiative is a demanding challenge for any government, at any level, in any sector. In Muni-Wi is no different.

Of course the absence of community involvement may result from a lack of political will on the part of local authorities. However, in Muni-Wi the risk of overlooking community involvement increases when the diffusion of information and communication technologies (ICT) is taken as a need *per se*. When such a scenario unfolds, it is very easy to delegate ICT projects exclusively to experts. Wi-Max, Wi-Mesh, Wi-Fi, free software, proprietary software, frequencies, routers, QOS: a whole language becomes the excuse for sustaining top-downdriven initiatives and totally depoliticizing the project (Santos, 2003, Dantas, 2002).

However, as one of the managers interviewed remarked, we should not dismiss the fact that at the beginning the benefits of having a wireless network may be not clear either to the population or to the local authorities, due to lack of understanding about the usefulness of the technology. People may ask basic questions about how this new infrastructure can change their lives, especially if there are already other means to access internet services. But it can also simply indicate a general lack of comprehension of the possible benefits of a technology, e.g. the internet. There are reports that this could be the case in low-income families or among less educated people (Youtie et al., 2007, Garbacz and Thompson, 2007). One may consider the proposition that a Muni-Wi project may be ahead of its time as far the local culture goes, making it harder to gather political and financial support at start-up.

Nonetheless, many features of Botto and Passani's outline of Community Network could be perceived in varying degrees. To some extent it is possible to identify a geographically bounded setting, both physical and administrative, with different agents involved,

notwithstanding their level of participation. There were some sorts of converging interests relating to the needs of a city for internet access and ICT facilities and an infrastructure that allows for different activities and the enhancement of off-line communities (Botto and Passani, 2008, 27)

Still in light of C.I.B.G's community and governance dimensions, it must be realised that community's needs have not passed unnoticed in the cases studied. Even though consistency scores in the CI were low, consistency in the set "new demand related programs or policies" (NP) was closer to 1.0 (perfect consistency), reaching a 0.83 score. Somehow the score in the NP set brings to fore the intention of many local governments to increase demand and, hopefully, augment local presence in the information economy.

On the other hand, one cannot neglect the evidence that cases at experimental stages, with no or low scores in the NP set, can still produce the same outcome, that is, significant city-wide Muni-Wi network for civilian use. This leads the discussion to interesting questions about the nature of the network. What is at stake? Is it a matter of infrastructure and then people will naturally use or populate it, as they do a street or a square? To what extent can public managers influence network use? The answers to these questions are open.

Let us refer now to the infrastructure dimension of the C.I.B.G framework. In spite of not reaching the perfect consistency of 1.0, the US set (strong reliance on unlicensed spectrum) has a higher consistency score (0.83). If one hypothesis is to be put forward, based on such evidence, it is that consistency in this set may increase or at least remain at similar levels when a similar investigation is pursued with more cases. The set was the only one with no instances of non-membership. However, the scores were not high enough to characterize a necessary condition when plotted against the outcome. A possible interpretation of this result is that reliance on unlicensed spectrum could be necessary, but not strong reliance on unlicensed frequencies (the set in question), given the fact that there might be complementary technological options.

The reliance of all municipalities researched in this report on unlicensed bands in order to deploy their networks, as in many other city projects worldwide, brings to the fore the difficulties presented by spectrum regulatory regimes. In the name of avoiding interference in market competition, regulation impairs the potential usage of the airwaves where there is no private interest or where prices are prohibitive to a large part of the population.

Telecommunications regulatory standards force municipal initiatives most of the time to use 2.4 Ghz frequencies, the so called “junk band”, or 5.8 Ghz. One of the key problems of these frequencies may be the interference levels. It is important to note that many city governments have specific bands for some public services, e.g. security. However, Muni-Wi for civilian use brings new elements to the spectrum management debate. Even if municipalities do not become local providers for residential and business users, a vast array of public services in education, management, health , traffic control, to cite just a few cases, may profit from more reliable bands.

The technological protocols also influences local government IT managers to opt for 2.4 Ghz frequencies. This range of options is in part limited by the technologies available for laptops, PDA, among other devices, to access wireless networks.

But again, notwithstanding the limitations imposed by regulatory marks and available wireless technologies, some cities managed to find their way around these by using wired solutions such as cable or optical fibre. Further investigation of more cases might even find municipal projects benefiting from licensed frequencies, even if this is on an experimental basis. For instance, see the case of Ouro Preto in Brazil (Marcondes, 2006), a pilot project that was not addressed in this research because it has been discontinued.

The results in the fsQCA also pose a series of questions related to the third dimension of the C.I.B.G framework, namely the business model. In the cases studied, “municipal funding” (MF) yielded the lowest consistency of all conditions studied (0.58), as reported in *Table 35*. Investments were made not only by local government, but also by private companies, regional agencies and federal government. Again, local socioeconomic conditions and project goals may have impacted the scores in this set. Experimental projects could also have contributed to the final results.

What is clear, taking into account only the cases investigated in this research, is that there is no defined business model as far as funding goes. Even if this finding cannot be generalized, it helps to confirm a general impression in the Muni-Wi business. Uncertainties about the municipality’s role and the initial stages of many technologies are likely to be at the core of such variations.

As discussed in *Section 2,* part of the problem concerns the role of governments as enablers or rule-makers, the understanding of wireless internet as a public good or as a problem for

the market to solve, and the extent to which the entry of municipalities into such a business will impact competition and local development (Gillett et al., 2004, Picot and Wernick, 2007).

Reflexion on the outcomes in the fsQCA can be improved and become more theoretically complex if we bring to mind the concept of a digital locus, as discussed in *Section 2*. The discourses on Muni-Wi and its infrastructure organize just one place among others where the city inhabitants' life unfolds. The relation with the new place provided by local government and everyday life practices produces a movement that alters the references and practices of both sides. Government, media, academia, etc., and other institutions are in a privileged discursive position that sets a stage for the movement of everyday life. Network users, on the other hand, reinvent the place or the digital locus. At some point, those in positions of power may be required to review their options.

As far as the interpretation of the lack of necessary conditions in the fsQCA goes, the high diversity of conditions for similar outcomes could also have its roots in the ordinary movement of the everyday life of public managers and the town's inhabitants. The elements for such a statement appear in this research as a noise that disturbs the apparent control of technological designs, management references or the very methodological choices made in this research.

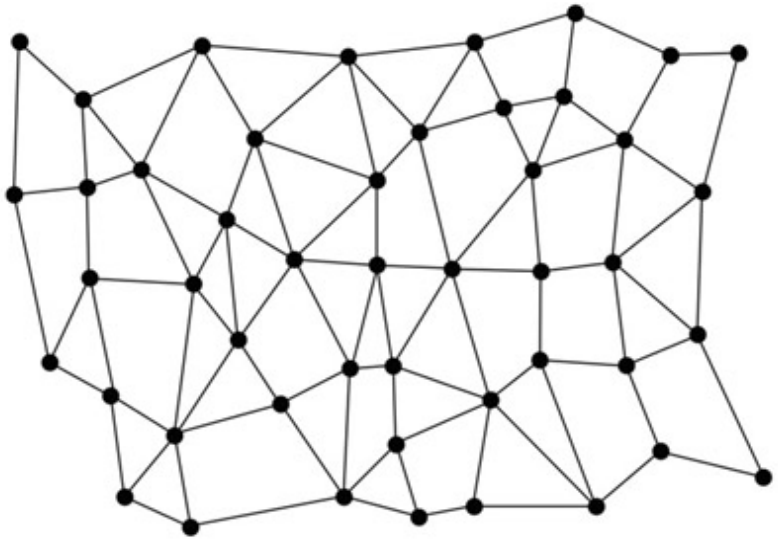
The basic question is: how come, with such a limited diversity (few technological choices, few management models available, etc) there is such a complex scenario of conditions in the six case studies? The few examples or noises in this research, as referred to in the above paragraph, are enlightening. Managers at Issy-les-Molineaux, as a starting point, reported fears in the community concerning the Wi-Fi signal and profound concern with the city architectural elements. Certainly the concerns with these elements are solidified in the everyday life of streets and local public managers' offices. At some point these concerns may have started influencing the predictable world of methodologies and management recipes for network development. To use optical fibre as backhaul, for instance, tackles both problems. Perhaps to limit the expansion of the network will also become an option.

Take another example and refer to the case of Tiradentes. To what extent has the surprising movement of the population towards buying directional antennas to capture the Muni-Wi signal forced the managers to review their management principles? There is no mistake in underscoring the unpredictability of everyday life in Muni-Wi management. Silently, surreptitiously, the movement on the streets influences top-level decisions. This hidden or

silenced element may be partially responsible for the lack of commonalities, as far as necessary conditions go, between the cases investigated in this report.

What may be seen is a problem, unpredictability in the controlled world of IT, that should also be used for the good. Consider now the promotion of new policies to increase demand. For instance, think of the students wanting to access the internet outdoors in the gardens of Bristol's City Hall. This unprecedented and unpredicted phenomenon could point to possible uses of parks and squares.

Figure 7. Paul Baran's model for a distributed network



Only naive managers would despise the rich world of everyday life. A Muni-Wi is far from being just a matter of connecting points. Paul Baran's already classic model (*Figure 7*) for a distributed network helps to picture the idea (Baran, 1964).

Figure 7 may be good enough for some introductory types of network design, but is far from being an adequate model for Muni-Wi, let alone an adequate description of a society. Contingent local situations interfere in what the users make of the available infrastructure. Schools, public offices or even families in the same neighbourhood will provide different uses and force managers to adopt contingent solutions.

When the human factor is added to the *distributed network* model, a mosaic emerges where each point is simply a door into a reality that does not fit into the design; or else, each local social dynamic exceeds the limits established by the network – if movement is added to this

image, its features are more kaleidoscopic than those of a static mosaic. *Figure 8* attempts to portray this argument.

There will always be local memories, solidarity and silent movements that undermine designs or, if these phenomena are to be seen in a favourable light, point to possible paths, creative solutions or new usages. In the end, local culture, including economic and political aspects, could have a great deal of responsibility for the different arrangements of Muni-Wi projects.

Of course one cannot afford to take account of all these variations. Conversely, it must be acknowledged that what is at stake is a dialectical movement between the technological and symbolic references provided by government and what people make of these. Managers end up, willingly or not, taking into consideration, the everyday life movement of the city in their decisions. Success may be achieved by their capacity to systematically incorporate such a movement into their managerial practices, in other words, how they will manage to take care of the human and non-human elements of every Muni-WI through specific policies and technological options, and with the necessary flexibility to reinvent the network. One way or another, these contingent situations may be at the root of the diversity found in this report as far as the fsQCA of Muni-Wi projects goes.

Figure 8. The human dimension of a distributed network

Source: Methodist University Image Bank, produced by Heron Cardoso Lopes for this report

The possible argument of everyday life as itself a factor in the lack of necessary conditions or the high diversity can be furthered by reflecting on the everyday life of managers themselves. Ciborra's propositions can certainly enrich the discussion. Although the author's interests were in information systems management within organizations, his arguments shed light on the discussion developed here. In his words,

> The subjectivity factor should not be overlooked, either. Though technology strategy could be seen as the outcome of objective forces, such as market pull an technology push during a given technological stage, the subjective, interpretative element represented by management perception is what shapes the ultimate thrust to action (Ciborra, 2002, 130).

In order to complement the whole idea, a further quote from the same text: "Therefore there must be a hidden context that kept providing sense to managerial action" (Ciborra, 2002, 133). Would it not be reasonable to submit that public managers are also under similar conditions? Are not decisions about Muni-Wi highly contingent, context-based and interpretative?

Take for instance ideas about bridging the digital divide. Even if there is an apparent underlying common sense to this goal and the hope of producing some sort of impact on economic developments, the question of why and how digital inclusion should be fostered must be asked. As put forward by Lemos and Costa, does inclusion mean simply to adapt people to using new technical objects, and to an unequal form of societal organization, or are there technical, social, cognitive and economic issues at stake that may free the so-called communication emission pole (Lemos and Costa, 2007)? One can go even further and ask, with Benkler, if it is not only businesses which are changing, but if the seeds have not already been planted a new "political imagination" (Benkler, 2006). These are highly interpretative answers that could impact technological, business and governance models in Muni-Wi.

Technology is particularly prone to set up some of the most recurrent managerial traps. Again Ciborra's remarks come in handy. Sometimes the network is a phenomenon that is taken for granted within the IS business. However, it is "a model that biases, deflects, and ultimately blocks reflection" (Ciborra, 2002, 177). Leaving the environment of the private company and bringing the discussion to the realm of Muni-Wi, one may say that more often than not an ideal design forces itself upon the city dynamics, where everyday life is full of demands, fears, dreams, memories, past technical systems - to mention a few elements - that may undermine initial steps by local government.

In the end the diversity of the six Muni-Wi approaches investigated in this exploratory study looses part of its surprising effect. The lack of necessary conditions in terms of a fsQCA becomes, in conclusion, consistent with theoretical knowledge in this report. As submitted previously, there might be some objective reasons for this outcome, such as the absence of a reference model or the fact that some projects are still running in experimental mode, or on a trial and error basis. However, contingent local situations may have contributed to the complexity of the scenario depicted.

5.1. Final remarks and suggestions for further research

The uncertainty about choices regarding the future of Muni-Wi is not a question. Nonetheless it appears that some sort of arrangement will continue to exist in different models, with more or less municipal investments, depending on local socioeconomic factors. News about drawbacks in some cities, notably in the United States, and the lack of a reference model do not seem to diminish the will of municipalities to expand their wireless networks for civilian use, at least in the six cases investigated in this report.

The limits and possibilities of municipal engagement in Muni-Wi projects depend upon contingent situations. Therefore the issue of local public networks must be addressed beyond the bias of simply limiting municipalities' participation in the name of supposed competition. Rather what should be regulated is *how* they can participate, as they may be a key driver for ICT adoption. The entry of local government into internet provision must also be facilitated, for instance, in low-income areas. As Wellenius and Neto submit,

> Governments seeking to benefit from the new technologies must remove impediments to their adoption. This requires being aware of the new opportunities and challenges, identifying aspects of the legal and regulatory framework that pose obstacles to early adoption, and strengthening capacity to implement modern solutions in a fast-changing global environment (Wellenius and Neto, 2006, 24).

Among different sorts of impediment, regulatory restrictions on spectrum use may be considered a problem. Limitations on transmission by and access to wireless devices may also pose some difficulties. Another impediment for the lower-income strata of the population is the cost of hardware. This includes computers and other devices capable of accessing a wireless network, especially when there are no other public facilities available, such as kiosks, telecentres or other possible points of access. Another risk lies in local governments' purchasing logic and in specific legislation which may force managers to look for the cheapest technological solutions, which may be not the best ones in the long run.

The various phases of a Muni-Wi project include overlapping stages such as (W2i, 2007):

- identifying a core action group
- building community consensus
- devising a business case
- establishing a management model
- locating funding sources
- exploring partnership opportunities
- reaching out to technology providers

However, the ability to cope with everyday life network practices, discovering new services, network architectures, policies and other aspects may guarantee the social value of the initiative.

Despite business models, in the case of direct operation by local government it could be advisable, when the law does not already require this, to establish a legal entity, with regulatory powers which is separate from that of the operators (Hughes, 2005). This may prevent a conflict of interests at municipal level.

What is crystal clear is that the challenges faced by local public-sector managers when deploying Muni-Wi are enormous. Technological, economic and political traps are spread all over the road. There is always an imminent risk of overlooking the sometimes surprising world of everyday life in the name of an ideal network model, a chimera which may envisage an imagined future high-tech city by denying its past. However, when and where less is expected, suddenly "the amazing enunciation fades out because it has avoided confronting the real city" (Alves, 2006, 6). While systems models, methodologies and plans strike the city vertically, the horizontal processes or communicative movements indicate the possible meanings of the network (Santos, 2002).

In fact, as Alves suggests, local public-sector managers "dangerously navigate through a discursive sea, among conservative modernity's indispensable values, semantic traps and falsifications" (Alves, 2006, 14). Following the hype around ICTs and possible local economic boosts deriving from their adoption, municipalities may more often than not be forced to develop policies to bridge the digital divide by focusing only on the supply side. As Youtie *et al* submit, the hidden logic of "build it and they will come" may not necessarily hold true (Youtie et al., 2007).

Sometimes not even cheap or free access to ICTs is sufficient to promote their use. The population's capacity to recognize the usefulness of the new technical object in their personal

or professional lives plays a key role in the outcomes. The targeted final user judgements can be impaired by socio-economic aspects and educational levels. Technologically savvy individuals tend to adopt the new facilities provided by the municipality more rapidly (Youtie et al., 2007)

Equally important is to realize that the goals of Muni-Wi can evolve into "social" or "distributive" policies if they encompass the full "circle generating social relations" (Alves, 2006, 17). This further step depends on how municipalities face the presence of technical objects within the city, and on the involvement of local stakeholders. Perhaps local authorities should consider "transversal emphasises", e.g. in the way that Bristol did with its Ultra Flexible & Neighbourhood Working. Such emphasises could be defined by social actors through participative processes. Special attention must be paid to the city's memory and to the specific needs and projects of the community.

Attention to communities' existential dimensions may lead to a better comprehension of how citizens inhabit the digital locus. What is at stake, from the public manager's perspective, is the deployment of an organization, founded on specific power relations, which overlaps with existing social dynamics and infrastructures, in other words, past references which indicate limits and possible paths for the new network. This image is illustrated by the example reported by a Muni-Wi manager of a barefoot fisherman checking fish prices on the Internet in a kiosk in Piraí.

Considering the exploratory nature of this study, one of its goals was somehow to open more questions about Muni-Wi. There are plenty of these. Three will be highlighted.

First, as this was an exploratory research project, the findings presented here should be put to the test with more cases. Perhaps the future researcher may even want to review the sets tested or how the qualitative anchors in the fsQCA are defined, by drawing upon the overall theoretical and methodological references put forward in this report.

A second line of inquiry would turn its attention to comparing users' everyday life practices in two Muni-Wi projects. Here the suggestion would be an exploratory ethnographical or phenomenological investigation. Possible findings could then be tested in a variable-oriented research study, in order to reach some sort of generalization of outcomes.

Finally, the third suggested research was inspired by a fact reported by Sud Mennucci's Muni-Wi manager. As reported in *Section 3.7*, an article published by a national newspaper

has boosted network demand. This poses some interesting questions in terms of *media agenda setting*, in relation not only to Muni-Wi, but also to ICT adoption in general.

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