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THE CELLPHONE –TOWER-ANTENNA TRILOGY AS AN EXPRESSION OF INFORMATIONAL TERRIORIALITY IN BRAZIL

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A trilogia celular-torre-antena como uma expressão da territorialidade informacional no Brasil (Resumo)

A partir dos anos 2000 observa-se na paisagem dos principais centros urbanos mundiais a multiplicação de torres e antenas de telefonia celular. Embora em décadas anteriores já houvesse torres de rádio e de telefone fixo, elas não eram constantes. Tal constância é uma peculiaridade do período técnico-científico-informacional. O sistema de telefonia celular é composto por uma trilogia de objetos geográficos inseparáveis: celular, torre e antena. O propósito do artigo é analisar a territorialidade dos objetos desta trilogia que se expressa por meio da sua distribuição espacial e da ação de agentes sociais envolvidos na localização e regulação no Brasil. Á luz de um referencial teórico e empírico, a principal contribuição oferecida é reconhecer a existência de uma territorialidade informacional.

Palavras-chave: Celular, torre, antena, territorialidade.

The cellphone-tower-antenna trilogy as an expression of informational territoriality in Brazil (Abstract)

From the 2000s on it is observed in the landscape of the main urban centers worldwide the multiplication of cellphone's towers and antennas. Although in the previous decades, towers of radio and landlines could already be found, they were not constant. Such constancy is part of the technical-scientific-informational period. The cellphone system is composed by a trilogy of inseparable geographic objects: cellphone, tower and antenna. The purpose of the paper is to analyze the territoriality of these trilogy objects, which expresses itself through its spatial distribution and the action of social agents involved in the location and regulation in Brazil. Based on a theoretical and empirical framework, the main contribution offered is to recognize the existence of an informational territoriality.

Keywords: Cellphone, tower, antenna, territoriality.

La trilogie téléphone portable-tour-antenne comme une expression de la territorialité informationnelle au Brésil (Resumé)

Depuis le début des années 2000, on observe la multiplication des tours et antennes de téléphones portables dans les centres urbains du monde entier. Certes, dans les années précédentes, on voyait déjà des tours de radios et de lignes de téléphone, mais elles n'étaient pas aussi omniprésentes. Un tel développement fait partie de l'ère technologico-scientifico-informationnelle. Le système de téléphonie mobile induit une trilogie inséparable d'objets géographiques: téléphone portable, tour et antenne-relais. L'objectif de l'article est d'analyser la territorialité de ces objets, qui s'exprime à travers la distribution spatiale et l'action des acteurs sociaux impliqués dans la localisation et la réglementation au Brésil. A l'aide d'une étude théorique et empirique, la principale contribution cherche à reconnaître l'existence d'une territorialité informationnelle.

Mots clés: téléphone portable, tour, antenne, territorialité

Introduction

The presence of towers and antennas is visible in the majority of the urban centers around the world since the beginning of the 2000s. There had already been radio and landline towers as well as antennas in previous decades, but they were not regular geographic objects in the landscape. Such regularity is one of the symbols of the technical-scientific-informational period, which for Milton Santos corresponds to the “scientificalization and technologicalization of the landscape”; fundamental idea to discuss informational territoriality.

Cellphone, as a generic denomination, includes conventional phones, smartphones and portable modems and it was created to make telephone conversation easier between two people without the support of a fixed spot. Under the development of Information Technology (IT), it has accrued several applications such as the Internet, cameras and videogames. This multifunctionality is responsible for considering cellphone as a wide range geographic object to access and exchange information.

Experts consider 2004 as the year which first marks cellphone telephony in Brazil. This is due to an inversion on the telecommunication system- the number of portable telephone lines superseded landlines. 2012 is accepted as the second most important year, once there was a controversy, from 2010 to 2012, on the distinction between accesses and cellphones. According to Anatel - the National Telecommunication Agency- the number of mobiles supplanted the population when teledensity was 132 cellphones to each 100 inhabitants, which states its popularity.

Wireless carriers have installed a great number of towers and antennas to satisfy this growing demand in urban centers, which concentrated the largest number of users. This is the origin of the empirical perception of cellphones, towers and antennas as inseparable geographic objects that compose a trilogy that configures a system and expresses the informational territoriality. For that reason, a question must be asked: how is this informational territoriality trilogy expressed in Brazil?

The present article has the purpose to answer this question in a three-section discussion. Firstly, it exposes the history of the cellphone telephony system under a theoretical focus that sets the notions of tecnosphere, space-time, cyberspace, used territory and territoriality with the intention of understanding the concept of informational territoriality. Secondly, it analyzes the spatial distribution of the geographical objects of the cellphone-tower-antenna trilogy using 2012 data. In a first moment, based on the number of cellphones and on the population resident in different Brazilian federative units. Moreover, we consider the number of tower/antennas (Anatel's terminology) installed in the most hierarchically important urban centers, as defined by IBGE (Brazilian Institute of Geographic and Statistics) in the study "Regiões de Influência das Cidades" (IBGE-Regic). Both analyses allow us to classify the federative units and urban centers in relation to its higher or lower informational load. Finally, there is a discussion about the action of the social agents involved in the location and regulation of the geographic objects trilogy, which united to the spatial distribution, constitute two ways of expressing informational territoriality in Brazil.

1 – The cellphone telephony system in the context of the technical-scientific-informational period

Mobile telephony, in the outset of the twenty-first century, represents a progress in relation to the second half of the twentieth century. The embryo sprang up in the United States, more specifically in Saint Louis, Missouri, in 1946, when the first devices were installed in vehicles. However, the high costs and the precarious quality restricted the service to a few. (DODD, 2001).

These devices already adopted the base station as structure, later called 'radio base station', which consists in a tower that supported an antenna to broadcast a sign to a mobile phone.(STALLIG,2002). Such a structure has been maintained since the prototypes developed in the 60s and 70s, the differential being that it used a greater number of towers to increase the capability of transmission, reduce the frequent interruptions and boost the number of clients. The word cellphone is derived from the area within the range of towers and antennas in sub-areas, denominated cells, reason why the term 'cellular network' was coined.

During the 80s and the 90s, miniaturization of microprocessors introduced innovations into the device, which not only became smaller, since it had its internal circuits substituted by transistors, and caused the shift from the first to the second generation of cellphone network services.

The popularization of cellphones and technological convergence has demanded more cells to receive a rising volume of voice and data traffic since the 2000s, thus originating the third (3G) and fourth (4G) generations of cellphone networking. The 4G services reaches four times less area if compared to 3Gs, thus requiring more radio base stations. This is reason why the number of towers and antennas has been multiplied.

This brief story confirms that the cellphone network is composed by the three inseparable geographic objects: cellphone, tower and antenna. It's impossible to speak about cellphones without mentioning towers and antennas, thus admitting they are a trilogy. According to Milton Santos: "there is a true technosphere, a crescent artificialized nature, consisting in the presence of huge geographical objects, idealized and built by men, and articulated among themselves as a system (SANTOS, 1996, p. 127)." Technosphere, according to Santos, is one of the elements of space:

> [...] space may be perceived by the technosphere and the psycosphere and both shape the technical-scientific environment. Technosphere is the result of a growing 'artificialization' environment. The natural sphere is gradually substituted by a technical sphere, in cities and in fields. Psychosphere is the result of beliefs, wishes and habits that inspire philosophical and practical behaviors, interpersonal relations and the communion with the Universe. (SANTOS, 1996, p. 32 – own translation)

The cellphone-tower-antenna trilogy is emblematic of the techno-scientific environment because its geographical objects, articulated in a system, are part of the technosphere. Therefore, a "cellphone network" must be acknowledged. At the same time, the trilogy is part of the psycosphere since cellphones have become an object of desire.

Santos considers the techno-scientific environment referential to the current period of the history of geographic environment, preceded by the natural environment and by the technical environment, which he later named as informational-techno-scientific environment. It is different from the previous not only for the interaction between technic and science, but due to its informational load. In the author's point of view, " the technical objects tend to be at the same time technical and informational in this period […] actually, the main fuel for its operation is also information.

This statement makes it possible to say that cellphones, towers and antennas, due to its informational load, besides being geographic objects, are techno-informational ones. They are the icons of the essence of the techno-scientific-informational environment that present two outstanding characteristics: the accrued technological production in different historical periods and the exponential growth of the circulation of information.

About the first characteristic, David Harvey argues that the periodic crises of overproduction, created within capitalism, started to be overcome with the shortening of time and the increasing efficiency in the spatial distribution of goods. Both result of what the author calls “space-time compression” (HARVEY, 1993, p. 219). In the same direction, Paul Virilio refers to “the decline of the extension of geographical space in favor of the absence of chronographic time” (VIRILIO, 1993, p. 95).

Considering the notion of space-time cellphones are supposedly contributing to promote not only the shortening and absence of the duration of time, but also to the decline of the extension of space and its consequent dilation. According to Virilio, this dilation is only possible because:

> From now on, beings and things surrounding us are nothing but FIELDS, and the real, a unique NETWORK, but a CYBERNETIC one, once everything is within this ‘field’ and only in it. […] Cyberspace or, more exactly, ‘the cybernetic space-time’, will be originated by this finding. (VIRILIO, 1993, p. 113 e 122 – own translation)

Virilio’s cyberspace, understood as cybernetic space-time, gives the opportunity to present here definitions such as Pierre Lévy’s, to whom cyberspace is the new means of communication which is born with the worldwide interconnection of computers. It involves “ not only the material infrastructure of digital communication, but also the ocean-wide universe of information that it pertains, as well as the human beings that surf and feed this universe. (LÉVY, 1999, p. 17). In fact, cellphones nowadays are fused to computers, thus being more and more inserted into Lévy’s cyberspace. For their practicality and versatility, cellphones intensify the use of the digital infrastructure system and the access to the information universe of networks.

From the context of the technical-scientific-informational period, the space-time compression and cyberspace emerges the debates on deterritorialization. Rogério Haesbaert challenges deterritorialization when he states that: “it is ignored that even the ‘virtual’ space of cyberspace still needs material bases and face-to-face contact” (HAESBAERT, 2006, p. 59)

The cellphone network system is one of the best examples of this statement, once its users neither have a necessary fixed territorial origin nor a territorial destination, and therefore may access and generate communication flows between several territories. However, towers and antennas are needed as their material bases.

As stated by Boaventura Souza Santos, these material bases are a vital ‘territorial anchor’ (SOUZA SANTOS, 2001) even in times of globalization. In the case of the cellphone network system, towers and antennas are anchors that make the exponential growth of the circulation of information possible, which is the second outstanding characteristic of the technical-scientific-informational environment.

In this sense, Santos explains that the objects need “to be located to achieve the expected results.” At once, he recognizes “scientificalization and technologicalization of the landscape (SANTOS, 2002, p. 215), which in the trilogy here discussed refers to an multiplication of the number of antennas and towers, objects which the location is decided by the actions of social agents.

Objects and actions are understood under the perspective of space as “indissoluble binding systems of objects and systems of actions which indicate how the territory is used: how where, who, why and what for”(SANTOS & SILVEIRA 2001, p. 11). The category ‘used territory’ makes it possible to introduce the notion of territoriality that derives from the comprehension of territory as “an appropriated and used extension”. Namely, deterritoriality is not in the territory, but in its use.

Some authors focus on clarifying the meaning of territoriality. Marcelo José Lopes de Souza defends that territoriality is tied to “spatially delimited relations of power” (SOUZA, 1995, p. 99). Neio Campos and Mara Flora Krahl suggest that territoriality is the practice that assures ‘the appropriation and permanence of a territory by a specific social agent” (CAMPOS & KRAHL, 2006, p. 97). Robert Sack states that territoriality is ‘the attempt by an individual or group to affect, influence or control people, phenomena, and relations, as it limits and guarantees its control over a geographic area.”

These meanings, far from being contradictory, complement each other. The key word for Souza is power. For Campos & Krahl is social agent, and for Sacks is control. The binomial expression space-used territory proposed by Santos & Silveira can also be added to these words. Thus, here we understand territoriality as: power exerted by social agents that produce space by means of objects and actions to attain the control over the use of a specific territory.

In the case of the cellphone network system, territoriality is exerted by the power of social agents that obtain the control over the use of specific territories by deciding where to locate and how to regulate the techno-informational objects of the trilogy cellphone-tower-antenna. The spatial distribution of these objects and the social agent's actions express an informational territoriality that will be discussed hereinafter.

2 – The informational territoriality expressed in the spatial distribution of the cellphone-tower-antenna trilogy.

The Brazilian cellphone network system started to be built in the 80s in Rio de Janeiro city, pioneer of landline telephony in the 19th century. At first, it was designed to serve 10 thousand users, but a great number did not have access since the price of the service was too expensive - each device would cost 20 thousand dollars. The proliferation of cellphones would only happen in the beginning of the following decade, when the telecommunication infrastructure was improved, and soon after, in 1997, with the opening of the market to private enterprise that reduced its price.

In 2012, the four major wireless carriers had commercialized 256 million mobiles to a population of 200 million Brazilians. The shares were: Vivo – 29,5%; TIM – 26,8%; Claro – 24,6%; e Oi – 18,6%. These numbers are the result of a competition fomented by a popularization strategy, based in two alternative plans: post paid – monthly subscription; and pay as you go – credits purchased in advance. The last one was chosen by 80% of the population since it is possible to control expenses without compromising income. On the other hand, wireless carriers have to offer a first rate service by properly distributing an amount of towers/antennas throughout the territory.

The analysis of the spatial distribution of technical-informational objects of the cellphone-tower-antenna trilogy - based in resident population, number of cellphones and tower/antennas is achieved by two indicators that measure the informational load per macro-region:

- teledensity – reflects the demand *per capita* in the federative units (the relation between the number of cellphones and resident population); and

- inhabitants per tower/antenna – reflects the infrastructural supply implemented in most hierarchically important urban centers (the relation between resident population and the amount of tower/antennas).

About teledensity, as shown in Table 1, it can be emphasized that two thirds of the population and of cell phones are from eight federative units - São Paulo, Minas Gerais, Rio de Janeiro, Bahia, Rio Grande do Sul, Paraná, Pernambuco e Ceará. It is also noticeable that almost all federative units present a teledensity rate of over 1,00. In other words, the number of cell phones exceeds the population.

Nevertheless, the federative units with the greatest population and cell phones do not necessarily present the higher teledensity rates. Besides São Paulo, Rio de Janeiro and Rio Grande do Sul are the Distrito Federal, Mato Grosso do Sul, Rondônia, Goias, Mato Grosso and Rio Grande do Norte, whose teledensity is higher than the national average of 1,32. By adopting this average as a parameter, these nine federative units are the ones with the highest informational loads, in relation to telendensity, as shown in Figure 1. A noticeable fact is that all federative units of the mid-west have a high informational load, which may be associated to their insertion into the economic frontier of the country, where high-tech agro-industry prevails. In opposition, only one of the states of the Northeast region, Rio Grande do Norte, registers a teledensity higher than the average.

Table 1: Informational Load of the Federative Units according to Teledensity

Macro-region	Federative Unit	Number of cell phones [1]	Population[2]	Teledensity
North	Acre-AC	912.041	758.786	1,20
	Amapá-AP	910.746	698.602	1,30
	Amazonas-AM	3.995.972	3.590.985	1,11
	Pará-PA	8.473.554	7.792.561	1,09
	Rondônia-RO	2.234.709	1.590.011	1,41
	Roraima-RR	499.229	469.524	1,06
	Tocantins-TO	1.773.686	1.417.694	1,25
Northeast	Alagoas-AL	3.585.259	3.165.472	1,13
	Bahia-BA	16.831.908	14.175.341	1,19
	Ceará-CE	9.980.529	8.606.005	1,16
	Maranhão-MA	5.733.335	6.714.314	0,85
	Paraíba-PB	4.564.087	3.815.171	1,20
	Pernambuco-PE	11.529.224	8.931.028	1,29
	Piauí-PI	3.588.338	3.160.748	1,14
	Rio Grande do Norte-RN	4.296.349	3.228.198	1,33
	Sergipe-SE	2.631.708	2.110.867	1,25
Midwest	Distrito Federal-DF	5.979.700	2.648.532	2,26
	Goiás-GO	8.704.742	6.154.996	1,41
	Mato Grosso-MT	4.324.388	3.115.336	1,39
	Mato Grosso do Sul-MS	3.625.863	2.505.088	1,45
Southeast	Espírito Santo-ES	4.538.319	3.578.067	1,27
	Minas Gerais-MG	24.865.808	19.855.332	1,25
	Rio de Janeiro-RJ	22.718.715	16.231.365	1,40
	São Paulo-SP	62.947.829	41.901.219	1,50
Sotuh	Paraná-PR	13.878.006	10.577.755	1,31
	Rio Grande do Sul-RS	14.883.611	10.770.603	1,38
	Santa Catarina-SC	8.123.412	6.383.286	1,27
Total Brazil/ Average		**256.131.067**	**193.946.886**	**1,32**

Sources: 1 -Anatel, 2012 (a); 2-IBGE, Estimativa da População, 2012

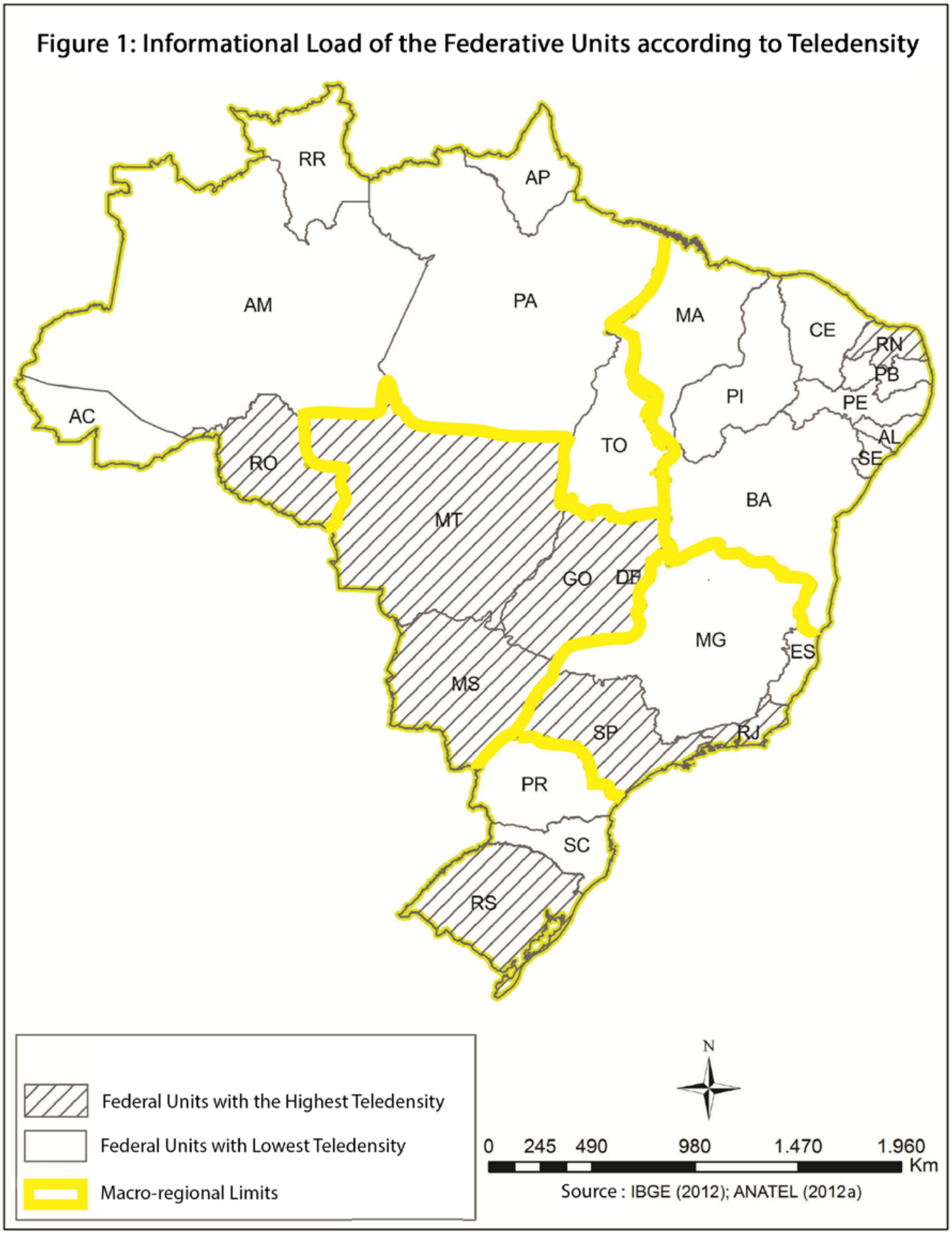
Figure 1: Informational Load of the Federative Units according to Teledensity
RR
AP
AM
PA
MA
CE
RN
PB
PI
PE
AC
TO
AL
SE
RO
MT
BA
GO
DF
MG
ES
MS
SP
RJ
PR
SC
RS
N
Federal Units with the Highest Teledensity
Federal Units with Lowest Teledensity
Macro-regional Limits
0 245 490 980 1.470 1.960
Km
Source : IBGE (2012); ANATEL (2012a)

Still concerning teledensity in the federative units, it is important to stress two extreme cases: Maranhão and Distrito Federal. The first presents the lowest teledensity in the country (0.85), while the last, containing only the city of Brasília, has one of the lowest populations, while presenting the highest teledensity in Brazil (2.26). Namely, more than two cellphones per inhabitant. These data overlap with the GDP *per capita* of Maranhão (R$ 7.859,71) and of Distrito Federal (R$ 63.020,02) (IBGE, 2011).

Teledensidity, which measures the informational load contained in the aggregate demand of cellphones per federative unit, must be complemented by another indicator that measures the supply of implemented infrastructure to meet the demand: inhabitants per tower/antenna in the most important urban centers of each federative unit. Such indicator represents the territorial anchor of the trilogy and it refines teledensity, once it does not consider the territory in the federative units as homogeneous.

With this purpose, it is used, as a reference, the aforementioned IBGE-Regic study that divides Brazilian urban centers into the following groups: Great National Metropolis, National Metropolis, Regional Capital Type-A, Type-B, and Type-C, Sub regional Center and Zone Center. After selecting the first six divisions in the present discussion, 82 centers were totalized as: one great national metropolis, two national metropoles, nine metropoles, eleven A-type regional capitals, twenty B-type regional capitals and thirty-nine C-type regional capitals. These urban centers are distributed into macro-regions: 10 in the North, 21 in the Northeast, 5 in the Midwest, 29 in the Southeast and 17 in the South.

Tables 2 and 3 show, in this order, the inhabitants per tower/antenna indicator for the 31 most important urban centers in nine federative units with the highest informational load when considering teledensity, and 51 urban centers in the remaining units. Overlapping the data of both tables, synthetized in Figure 2, and adopting the Brazilian average of 3,428.7 inhabitants per tower/antenna as a parameter, it is possible to notice that the 47 centers below average have a higher supply of infrastructure, while the 35 above average have low infrastructure. This is due to the fact that the lower the indicator is, the higher the number of installed tower/antennas.

These results are an approximation when considering the best or worst user's connectivity, since they are within the Brazilian average of inhabitants per tower/antenna inside the municipal limits defined by IBGE. It is probable that some of the urban centers with low infrastructure may be within the range of tower/antennas located in neighboring municipalities. In order to identify such cases, a complementary study would be necessary to consider the territorial limits of the micro-regions where these urban centers are inserted. Such a task is not included in the method adopted in the present article.

Table 2: Inhabitant per Tower/Antenna of UrbanCenters and Federative Units with the Highest TeledensityTeledensidade

Macro-region	Federal Unit	Urban Center/ Hierarchy[1]	Population[2]	Number of tower/antennas[3]	Inhabitants per Tower/ Antenna
North	Rondônia - RO	Porto Velho-CR B	442.701	154	2.874,7
	Rio Grande do Norte - RN	Natal-CR A	817.590	293	2.790,4
		Mossoró-CR C	266.758	63	4.234,3
Midwest	Distrito Federal - DF	Brasília-MN	2.648.532	1.266	2.092,0
	Goiás - GO	Goiânia-M	1.333.767	548	2.433,9
	Mato Grosso - MT	Cuiabá-CR A	561.329	271	2.071,3
	Mato Grosso do Sul - MS	Campo Grande-CR A	805.397	349	2.307,7
		Dourados-CR C	200.729	47	4.270,8
Southeast	Rio de Janeiro - RJ	Rio de Janeiro-MN	6.390.290	2.836	2.253,3
		Campos dos Goytacazes-CR C	472.300	135	3.498,5
		Volta Redonda-Barra Mansa-CR C	439.060	109	4.028,1
	São Paulo - SP	São Paulo-GMN	11.376.685	4.181	2.721,0
		Campinas-CR A	1.098.630	915	1.200,7
		Ribeirão Preto-CR B	619.746	231	2.682,9
		São José do Rio Preto-CR B	415.769	121	3.436,1
		Araçatuba-CR C	183.441	60	3.057,4
		Araraquara-CR C	212.617	68	3.126,7
		Bauru-CR C	348.146	124	2.807,6
		Marília-CR C	219.664	58	3.787,3
		Piracicaba-CR C	369.919	120	3.082,7
		Presidente Prudente-CR C	210.393	63	3.339,6
		Santos-CR C	422.569	219	1.929,5
		São José dos Campos-CR C	643.603	222	2.899,1
		Sorocaba-CR C	600.692	187	3.212,3
Sotuh	Rio Grande do Sul - RS	Porto Alegre-M	1.416.714	700	2.023,9
		Caxias do Sul-CR B	446.911	166	2.692,2
		Passo Fundo-CR B	187.298	63	2.973,0
		Santa Maria-CR B	263.662	77	3.424,2
		Ijuí-CR C	79.396	20	3.969,8
		Novo Hamburgo/São Leopoldo-CR C	456.544	140	3.261,0
		Pelotas-Rio Grande-CR C	528.277	172	3.071,4
Total Urban Centers			34.479.129	13.978	
Total Brazil			193.946.886	56.577	3.428,7

Sources: 1-Regic/IBGE, 2007 (GMN-Grande Metrópole Nacional, MN-Metrópole Nacional, M-Metrópole, CRA, B e C-Capital Regional); 2-IBGE, Estimativa da População, 2012; 3-Anatel(b), 2012(b);

Table 3: Inhabitants per Tower/Antenna of UrbanCenters and Federative Units with the Lowest TeledensityTeledensidade					
Macro-region	**Federal Unit**	**Urban Center/ Hierarchy¹**	**Population²**	**Number of tower/antennas³**	**Inhabitants per Tower/ Antenna**
North	**Acre - AC**	Rio Branco-CR C	348.354	100	3.483,5
	Amapá - AP	Macapá-CR C	415.554	99	4.197,5
	Amazonas - AM	Manaus-M	1.861.838	573	3.249,3
	Pará - PA	Belém-M	1.410.430	460	3.066,2
		Marabá-CR C	243.583	58	4.199,7
		Santarém-CR C	299.419	50	5.988,4
	Roraima - RR	Boa Vista-CR C	296.959	68	4.367,0
	Tocantins - TO	Palmas-CR B	242.070	107	2.262,3
		Araguaína-CR C	156.123	37	4.219,5
Northeast	**Alagoas - AL**	Maceió-CR A	953.393	324	2.942,6
		Arapiraca-CR C	218.140	40	5.453,5
	Bahia - BA	Salvador-M	2.710.968	742	3.653,6
		Feira de Santana-CR B	568.099	107	5.309,3
		Ilhéus-CR B	189.052	51	3.706,9
		Vitória da Conquista-CR B	315.884	45	7.019,6
		Barreiras-CR C	141.081	28	5.038,6
	Ceará - CE	Fortaleza-M	2.500.194	718	3.482,2
		Juazeiro do Norte-Crato-Barbalha-CR C	436.187	80	5.452,3
		Sobral-CR C	193.134	26	7.428,2
	Maranhão - MA	São Luis-CR A	1.039.610	302	3.442,4
		Imperatriz-CR C	250.063	52	4.808,9
	Paraíba - PB	João Pessoa-CR A	742.478	266	2.791,3
		Campina Grande-CR B	389.995	84	4.642,8
	Pernambuco - PE	Recife-M	1.555.039	589	2.640,1
		Caruaru-CR C	324.095	80	4.051,2
		Petrolina-Juazeiro-CR C	506.851	89	5.695,0
	Piauí - PI	Teresina-CR A	830.231	227	3.657,4
	Sergipe - SE	Aracaju-CR A	587.701	193	3.045,1
Southeast	**Espírito Santo - ES**	Vitória-CR A	333.162	188	1.772,1
		Cachoeiro de Itapemirim-CR C	192.156	53	3.625,6
	Minas Gerais - MG	Belo Horizonte-M	2.395.785	1.021	2.346,5
		Juiz de Fora-CR B	525.225	191	2.749,9
		Montes Claros-CR B	370.216	78	4.746,4
		Uberlândia-CR B	619.536	276	2.244,7
		Divinópolis-CR C	217.404	92	2.363,1
		Governador Valadares-CR C	266.190	62	4.293,4
		Ipatinga-Cel Fabriciano-Timóteo-CR C	430.896	115	3.746,9
		Pouso Alegre-CR C	134.215	42	3.195,6
		Teófilo Otoni-CR C	135.549	28	4.841,0
		Uberaba-CR C	302.623	163	1.856,6
		Varginha-CR C	125.208	44	2.845,6
Sotuh	**Paraná - PR**	Curitiba-M	1.776.761	785	2.263,4
		Cascavel-CR B	292.372	88	3.322,4
		Londrina-CR B	515.707	227	2.271,8
		Maringá-CR B	367.410	112	3.280,4
		Ponta Grossa-CR C	317.339	103	3.081,0
	Santa Catarina - SC	Florianópolis-CR A	433.158	346	1.251,9
		Blumenau-CR B	316.139	134	2.359,2
		Chapecó-CR B	189.052	43	4.396,6
		Joinville-CR B	526.338	156	3.374,0
		Criciúma-CR C	195.614	51	3.835,6
Total Urban Centers			30.704.580	9.794	
Total Brazil			**193.946.886**	**56.577**	**3.428,70**

Sources: 1-Regic/IBGE, 2007 (M-Metrópole, CR A, B e C-Capital Regional); 2-IBGE, Estimativa da População, 2012; 3-Anatel (b), 2012

Figure 2: Informational Load of Urban Centers according to Tower/Antennas Infrastructure

Taking the high hierarchy of these 82 urban centers into consideration, these numbers are below expectation, fact that may be explained by the indicators of the Northeast, which is a macro-region with the lowest implemented infrastructure. The best-equipped centers, in terms of assisted inhabitant per tower/antenna are the capitals of federative units - Natal, Maceió, João Pessoa, Recife and Aracaju. The same happens with the North macro-region - Porto Velho, Manaus, Belém, Palmas. Actually, the best-equipped centers are predominantly the Southeast and South macro-regions, where 34 of the 47 classified are located.

Analyzing both tables, it is observed that the hierarchy of urban centers does not determine the implemented infrastructure, once there are centers in all groups which present lower infrastructure than the average, except for the great national metropolis, São Paulo, and two national metropoles, Brasília and Rio de Janeiro. This is the case of two metropoles, Salvador and Fortaleza, two A-type regional capitals, São Luis and Teresina, seven B-type regional capitals and 21 C-type regional capitals. It's worth noticing that Campinas, a regional A-type capital, presents the best inhabitant per tower/antenna indicator in the country, followed by Florianópolis, Vitória, and Uberaba.

Finally, it's important to emphasize that these data show no correspondence in the relation between federal units' teledensity and the infrastructure supply of the most hierarchically important city centers. Paraná, a federative unit with low teledensity, stands out as the most illustrative case of this lack of correspondence, once all its centers have a high infrastructure - Curitiba, Cascavel, Londrina, Maringá and Ponta Grossa.

Despite their specificities, in relation to the number of urban centers included in the diverse federative units, the present cases allow us to notice that there is a gap between the demand per capita indicators and the infrastructural supply (inhabitant per tower/antenna). They depict the informational load within the spatial distribution of the cell phone-tower-antenna trilogy, one of the ways to express the informational territoriality, must be measured by both indicators. These two indicators, together, may reveal the priorities of the social agent's performance policy.

Facing the popularization of cell phone, it is possible to admit that it may contribute to diminish this gap and, therefore, reduce the known inequalities, here confirmed in the identification of the informational load in the federative units and its main urban centers. In many of these, there has already been a latent demand, plus a good chance of a growing potential one. Meeting these demands will require a more effective action by the social agents involved in the location and regulation decisions of the objects of this cell phone-tower-antenna trilogy, another way of expressing informational territoriality in Brazil.

3 – Informational territoriality as an expression of the social agent's action.

The importance of cellphones to consumers is evident; its growing mobility introduces countless benefits into the labor universe and private lives. In fact, despite the consumer being the fundamental agent in the cellphone network system, the action of purchasing a mobile is part in a production chain that involves other social agents: the wireless carrier and the State. They are in charge of deciding on the location and regulation of two of the objects (towers and antennas) of the trilogy, without which, the consumer would not be able to properly use the acquired device.

The action of these agents is relevant in the discussion about informational territoriality since they exert the power to control the use of some specific territories by changing pre-determined uses or by creating new ones. However, this exercise invokes the owners' and dwellers' reaction, who feel bothered by the consequences of such decisions, once they establish several impacts. Thus, beyond the wireless carriers' and the State's actions, the provoked reaction expresses an informational territoriality that results in a long process of conflict and negotiation.

This process is accounted in an explanatory research, which is based on the information obtained in interviews granted by cellphone network system technicians. Two singularities are revealed: a direct relation between the wireless carriers and the State, and consequently between the location and regulation. Their actions often interlace, despite the first being responsible for the location of towers and antennas and the latest for regulation, as will be seen hereinafter.

The action of wireless carriers start by choosing the kind of tower and antenna, as well as the site, which takes into consideration the demand, the expected coverage area, and the natural and man-built characteristics, such as landform, vegetation, density and the predominance of horizontal or vertical features. Demand is a core notion to define the number of towers and antennas in order to supply a satisfying service. Nevertheless, the environmental traits define the correct location since antennas are supported by three kinds of cell towers placed on the ground or on buildings:

- Compact metal tower – occupies an area proportionally smaller to its height, which ranges from 20 to 30 meters and may be installed in dense urban centers to reach a great number of users. (Picture 1)
- Metal Lattice Tower- occupies an area proportionally bigger than its 30 meters in height and may be installed in less dense city areas, rural zones or next to roads in order to reach a small number of users. (Picture 2)
- Roof top metal lattice – installed on the top of buildings in urban centers where there is a high demand and not enough area to place the previous models. (Picture 3)

Picture 1 – Compact metal tower

Source: Tofeti,2013.

Picture 2 – Metal lattice tower

Source: Tofeti, 2013.

Picture 3 – Roof top metal lattice

Source: Tofeti, 2013.

The first two tower models have a major impact in landscape, whereas the third can be mistaken as part of the skyline. Most urban centers are willing to reduce the number of towers in order to avoid visual pollution, mainly heritage centers, such as Brasilia and other historic cities. Technological innovations have made it possible to hide towers, i.e., making their profiles less aggressive.

Once the site, the tower model and the antenna it will support are chosen, the wireless carrier's project starts to weave into the State's regulatory action in the local and national spheres, because the installation of both depends on: the public or private domain of the real-estate, the urban or rural nature of the area, obtaining the building and radiofrequency permit, and the electromagnetic emission certificate. Finally, it might need an environmental impact report and a declaration stating that it does not interfere in a heritage landmark. So, at least five of the authorizations are supplied by the State.

When a public property is chosen, the arrangement for settlement is negotiated with the local authority, which charges an urban property and land tax for its use. In case it is a private urban property, the wireless carrier negotiates a rent directly with the owner, but the local authority must grant the building permit. If it is a rural property, the interlocutors are the National Institute for Colonization and Agrarian Reform (INCRA),that charges a rural land tax or the owner. The Brazilian Agency of Telecommunications (ANATEL) is present in all situations, and, in some cases, the state or federal bureaus, which are responsible for the environment, might be consulted, as well as the National Institute of Historic and Artistic Heritage (IPHAN).

These procedures show that there is a supposedly slight balance of power between the wireless carrier's actions and the State's, in order to implement a tower and antenna network in accordance to Anatel's standards and to adjust it to the rules on the land use of the territory. It is not uncommon for a wireless carrier's project to be rejected, once the demands from local authorities and neighbors have become stricter. The solution, in these cases, is to look for other sites. An example happened in Belo Horizonte, where the local authority instituted these rules: a 100 meter-minimum distance between buildings and towers/antennas (Pictures 1 and 2) and 30 meters for roof top models. Other local authorities have established a minimum distance from schools and hospitals.

The main complaint of wireless carriers is the tightening of rules due to the demand originated by 3G and 4G mobile generations, which require an increase in the number of towers and antennas. In 2012, Anatel punished the wireless carriers that operate in Brazil for the bad quality of services. New contracts with consumers were forbidden while investment plans on the cellphone network system infrastructure were not presented. According to Carta Capital magazine (2013), this ban has guaranteed R$ 25 billion in investments a year up to 2017. In face of these arguments, it seems that local and federal authorities have acted in opposite directions. Local authorities have limited the indiscriminate installation of towers in city centers, and on the other hand, Anatel has pressed wireless carries to invest more in the quality of services, which results in more towers and antennas. Due to this dilemma, wireless carriers have sometimes been part of local forums in order to understand the land use territory regulations.

That is not the end of the negotiations and conflicts. After the tower and antenna are installed, the informational territoriality that is the expression of the actions of the wireless carrier and the State, is also expressed by the reaction of the owner or the dweller in relation to the changes in the use of the territory. These changes reflect worries about health problems caused by the radiation emitted by the antenna and due to considering it a source of visual pollution, once the landscape has been changed, consequently devaluating the property.

The technicians, who where interviewed, with their experience in different urban centers, tell that there are four recurrent cases of these reactions, mainly in the metropoles defined by the IBGE-Regic study:

- The dweller is at the same time the owner of a residential or commercial urban property or land where a tower and an antenna were installed, and whose location is considered strategic by the wireless carrier. This individual earns a high rent for a partial-property assignment that allows the increase of the property value by improvements. This is why he is in favor of the permanence of such objects, not minding the probable effects on the local's health or to the landscape. As he is at the same time owner and dweller, he has complete decision power. In average, the value of the rent diminishes from 10 minimum wages, for central areas or its surroundings in the metropoles, to 1 minimum wage, for areas in the outskirts.
- The owner and the dwellers of a collective residential or commercial property, where a tower and an antenna were installed, may not agree on the presence of these objects, once none of them have the complete power of decision. The owner earns a high rent, but does not think the financial return is enough to invest in meaningful improvements. The dwellers may be divided into those who are pro or against its presence. Those in favor argument that if the owner transfers the value of the rent to the condominium, the management fees might decrease. Meanwhile, those against emphasize their worries about health and the visual pollution, even though they might take advantage of the monetary benefits. Either way, the conflict to be negotiated may be latent or effective.
- The owner of a residential or commercial property which does not have any tower and antenna, but these were installed in a neighboring property. The owner opposes their permanence because of possible harmful effects to health and to the landscape. Despite denying any devaluation of his property, he anticipates a hard time trying to sell or rent it, due to the negative presence of these objects. Consequently, he requests to the wireless carrier the removal of the tower and an antenna. According to accounts told by technicians, this is the situation that originates most complaints, denoting that the conflict among neighboring owners is the result of monetary benefits being paid only to the owners of properties where the towers and antennas are installed.

- The installation of the tower and an antenna takes a dweller by surprise after having chosen to live in this place or its vicinities for not presenting these kinds of objects. The individual regards them as extremely harmful to his health. A conflict of interest opposes the dweller to the owner of his property and neighboring ones for not being heard about the installation. Collective acts might be organized to request the displacement of the tower, in case the wireless carrier does not take account of his opinion. That is why the last may suffer constant attacks of a community association.

The presented cases reveal that the location of towers and antennas arouses conflict and the need of negotiation. It also illustrates that the behavior of both, owner and dweller, vary depending on the process of real-estate appreciation, decreasing from the central area to the outskirts, and the opposite movement in relation to landscape preservation. In the central areas, where the verticalization is more common, towers are shorter and integrate the skyline, as one moves towards the outskirts, towers become more visible due to the horizontalization of the landscape. Moreover, independently of the closer or further from location the central area, towers and antennas are suspected of having a negative impact on the dwellers health.

Final Comments

Cellphone has become an icon of popular consumerism since the beginning of the 2000s, although it is only one of the components of a trilogy of geographic objects that is not very visible: cellphone-tower-antenna. Born in the context of the technical-scientific-informational period when the first debates on deterritorialization emerged. In the present article, it is defended the idea that territory is essential to the cellphone network system, since towers and antennas, which support the operation of cellphones, represent their territorial anchors. More than reinforcing the core role of territory, it admits the existence of an informational territoriality that is expressed by the distribution of the objects in the cellphone-tower-antenna trilogy and by the action of the social agents responsible for its location and regulation. The spatial distribution of these objects in the federative units and in the most hierarchically important urban centers, measured by teledensity and inhabitants per tower/antenna indicators, makes it possible to understand that the

Northeast is the region that has the lowest informational load in Brazil. On the other hand, the wireless carriers' and the State's actions make emerge conflicts and negotiations provoked by the reaction of the owner and the dweller in face of the impacts to health, landscape and property devaluation. Regarding the State, the stricter role of local authorities, more and more sensitive to these impacts, is emphasized.

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