

TOPOLOGY, NODALITY AND SPACE OF INTERNET FLOWS

Dariusz Ilnicki, Krzysztof Janc

Department of Spatial Management, Institute of Geography and Regional Development,
Faculty of Earth Science and Environmental Management, University of Wrocław,
ul. Kuźnicza 49/55, 50-119 Wrocław, Poland, ilnicki@geogr.uni.wroc.pl, janc@geogr.uni.wroc.pl

Abstract

The Internet, despite being hailed as the end of geography, created its own geography of nodes and nets. On its basis, the space of flows is created, which is the result of interactions between the Internet users. The net users form its tissue; they are the nervous system of the Internet space. However, the Internet still seems to be a phenomenon which is the subject of psychological and sociological study. The locationlessness of the Internet is only apparent. Knowing that the phenomena occurring in the Internet space are characterized both by concentration and deconcentration, the question arises whether they actually lead to the creation of new territorial configurations. Is the statement formulated by M. Castells (2003) in *The Internet Galaxy* in 2001 still valid? The answer to the above-posed question was formulated based on three internet data sources.

After the dominance of the Internet space by users from the United States of America, which lasted till 2000, this space is currently being shaped by inhabitants of the USA, China, India and Japan. The former geographical approach to this issue has been changed. The dominance is being taken over by the Asian, and not European and American Internet users. The shape and internal structure of global space of flows is determined by North American and Western European nodes. The Asian space of flows is less visible. It constitutes its additional rather than crucial element. Africa and Latin America are *'the worse pole'* of dichotomous digital division of the world. In the topology of the Polish Internet one can see an analogy to *'the American star'* mentioned by K.N. Cukier (1999 after Castells, 2003). On the local scale, cyberspace coexists with geographical space.

It seems that the Internet, the net space, does not lead to the creation of new or not rationally explainable territorial configurations. To a larger extent, we are dealing here with a phenomenon of transferring *'accents'* in *'cyber-geographical'* space. It results in some deviations *in plus* or *in minus* from *'traditional'* perception of the diversity of the world, in the context of social, geographical and civilizational development.

Key words: Internet, space of flows, net connections, global and local scale, digital divide, Poland

INTRODUCTION, OUTLINE OF THE PROBLEM AND SOURCES OF DATA

The Internet Era was hailed as the end of geography. However, it has its own geography – topology – geography of networks and nodes (Castells 2003). As a result of mutual interactions between the web as a unit and nodes, a new form of space, characteristic of the information era, is being created. It's by no means a placeless space of flows. Non-spatial perception of the Internet, and

resulting from it *"lack and unwillingness"* to undertake its examination in the field of geography is the result of subconscious comparison of *"the real space"* with *"the virtual space"*. They are, for no apparent reason, perceived separately. Such perception emphasizes the privileged position of the physical space. Through *"being a part of the network"* we occupy a particular place, we communicate with other places and it depends solely on us whether we choose to perceive them and ourselves only through the keys we press, the

screen of the monitor, i.e. placelessly, or aware of their relationships – acknowledge their variety and richness. We are more than just passive observers of the e-reality, we constitute its tissue and nerve. We manage and create the e-economy, a new geography of development (see Castells 2003).

The Internet, in its geographical aspect, may be examined on three levels, i.e.: (1) its technical development, that is Internet technical infrastructure; (2) spatial distribution of the Internet users; (3) “production” of solutions connected with the development of the global network and, probably most importantly, providers of its content (Castells 2003). From the geographical point of view, the last two aspects are the most significant. It needs to be stressed, however, that it’s not only about spatial distribution of the Internet users, but also about interactions between them, and thus, about space created through these contacts. Only then we can talk about nodity and hierarchy of places and in consequence answer the question whether phenomena of concentration and deconcentration occurring simultaneously in the space of the Internet lead to the creation of new territorial configurations. Despite the global reach of the Internet, it’s territorially diverse. This concerns all the aspects of the geographical approach to the analysis of the Internet. The biggest territorial imbalance concerns production and consumption of the network’s content. It is sometimes called an asymmetry (Castells 2003). Among causative factors there are: wealth in the broad sense, development – technical advancement and connected with it technical infrastructure, access to education, influence of the state. Therefore, in the context of the above-mentioned question, we can ask whether the Internet creates its own space, or tends to “imitate” socio-economic diversity not only on a global scale, but also at lower territorial levels.

The analysis of the Internet as well as the elements connected with it can be divided into three areas: spatial, technical and sociological (Torrens 2008). However, the Internet as a medium is more often studied in sociological and technical terms. The geographical analysis of the Internet covers mostly its infrastructural aspect, which is extended by spatial diversity of the origin of the Internet users

(Castells 2003). The problem with the geographical approach to the phenomenon of the Internet consists in the lack of data describing it. This concerns in particular the data characterizing flows in the broad sense and formed on their basis relationships between geographically defined places. The development of geographical field of research is possible and necessary for three reasons (Kitchin 1998). Firstly, there is an uneven access to the Internet space (*digital divide*). Secondly, despite the fact that information in the Internet does not have geographical location, their “usage” is connected with a particular place in the geographical space. Ultimately, the functioning of the Internet is dependent on the elements of the infrastructure localized in the real, geographical space. Works of the following authors represent geographical approach to research: Townsend (2001), Grubestic (2002) and Zook (2005). They raise the issues connected with spatial distribution of Internet domains which are complemented by analyses of Internet firms and Internet providers (see: Zook 2005). Invariably, they revolve around the analysis of the Internet infrastructure (Gorman and Malecki 2000, Malecki 2002). More and more frequently the fact of using the Internet by its users is related to their socio-economic status (Warf 2001). Thus, these works enrich the “simple” analysis of the origin and spatial diversity of the Internet users. Much less frequently we can encounter studies concerning flows of information and their relationships – connections – in the Web (Dodge and Kitchin 2001). The present study makes explicit reference and “*situates itself*” in the research of this element of the Internet reality¹.

Identification of the above-stated problem will be done on the basis of three Internet sources of data.

The first of them is statistical data collected by International Telecommunication Union (ITU) (www.itu.int). It covers four groups of issues. These are: (1) basic indicators concerning the size of the population, GDP and telephone subscribers; (2) the number of the main telephone lines; (3) the number of telephone subscribers

¹ So far the geographical approach to the study of the Internet has been hardly represented in the Polish subject matter literature. These studies are: Ilnicki (2002, 2003, 2004), Ilnicki and Janc (2008), Micek (2008), Retkiewicz (2008 a, b).

Table 1 Fraction of the number of the Internet users and its relation to the population potential in total

Continent	2000	2001	2002	2003	2004	2005	2006	2007
<i>% Internet users</i>								
Asia	28.3	30.7	34.2	35.9	37.5	39.0	41.7	46.9
Europe	28.1	27.9	26.9	28.3	27.8	26.6	25.5	22.8
North America	36.5	33.5	30.0	26.5	25.1	23.6	21.1	18.5
Latin America	3.9	4.7	5.4	5.8	5.8	6.6	7.1	7.2
Africa	1.2	1.3	1.6	1.9	2.3	2.9	3.5	3.6
Australia & Oceania	2.1	2.0	1.8	1.7	1.4	1.3	1.2	1.0
<i>% Internet users – % population potential</i>								
North America	29.7	26.8	23.3	19.8	18.4	16.8	14.3	11.8
Europe	15.0	15.1	14.2	15.7	15.4	14.4	13.2	10.7
Australia & Oceania	1.6	1.5	1.3	1.1	0.9	0.7	0.7	0.5
Latin America	-3.1	-2.3	-1.5	-1.2	-1.2	-0.4	0.0	0.3
Africa	-11.8	-11.8	-11.6	-11.5	-11.2	-10.9	-10.6	-10.9
Asia	-31.4	-29.1	-25.6	-23.9	-22.3	-20.7	-17.7	-12.5

Source: own study based on www.itu.int.

(users) of mobile phones; (4) information technology indicators covering: the number of the Internet users – the Internet subscribers using leased and modem lines as well as subscribers with broadband access.

The next two sources of data do not have “*complex character*”. They describe a part of the Internet reality. However, due to their mass character, they seem quite reliable. The first source is data made available within the framework of the research project DIMES (www.netdimes.org) concerning topology and structure of the Internet, collected with the help of the Internet community. Among the data published, there is information concerning the occurrence of connections (edges) between geographically defined places. The Polish source of data, however, taken from the Internet website www.opengeo.pl is a compromise between the number of Internet users and places (sources) of traffic generation. In a sense, it represents the number of subscribers – the Internet users. Thus, this data can be interpreted as reflecting the number of the Internet terminals, or places where one can “*access*” the Internet. In the accessible database, apart from the IP number, there is geographical information referring to administrative-territorial division, covering the name of the town, poviát and voivodship.

GLOBAL CONTEXT

At present, the number of Internet users in the world, as for the year 2007, is estimated at nearly 1.5 billion people. This is just over 1/5 of the world’s total population (22%). Although, at first glance, this number may seem disappointing, it needs to be remembered that in the year 2000 it was only a little over 6%. The average annual growth of the fraction of the Internet users was about 2%. In the last two years, this number grew by about 1/3 of the present number. The present, dynamic growth in the number of the Internet users still cannot be identified with common access to the Internet. The first proof of this phenomenon is its “*continental*” diversification of the proportion – fraction – of the Internet users. Basing on “*the division of the world*” proposed by the ITU², we can observe a dichotomous division into the rich north and the poor south (see Ilnicki 2003) (Table 1).

After the first two-year period of the greatest concentration of the Internet users in North America, in 2002 Asia took the lead. In the next year, the North American continent lost its second

² Americas (North, Latin, South), Africa, Australia and Oceania, Asia, Europe.

position to Europe. At the moment, half of the Internet community is made up of the inhabitants of the Asian continent. Since 2002, the dominance of the United States in this respect ceased to be indisputable. The remaining three continents complete the consumers' space.

This state of affairs is obviously the consequence of diversity in population potential. Comparison of the fraction of the Internet users with the size of population in general shows that these numbers correspond with each other only in the case of Latin America, Australia and Oceania (see Table 1). North America and Europe with their overconcentration are polar opposites of Africa and Asia with their "scarcity" of the Internet users compared to their population potential. Such approach favours North America. Europe, with its higher fraction of the Internet users, makes "the old continent" an equal partner in the shaping of a network society. A very good illustration of these statements and generalizations is a map showing spatial diversity and the change in the number of the Internet users in the first and last years of the researched period as well as the indicator of their concentration per 100 inhabitants in 2007 (Figure 1). After initial dominance of the United States of America, at present, the space of Internet consumers is made up of the inhabitants of the USA, China, India and Japan. Since 2000, the share of these 4 countries has been at an average level of 57%. The former pattern of geographical perception of this phenomenon has been changed. In the world, the Asian Internet users are beginning to outnumber the American and European ones. It needs to be stressed, however, that Brazil, Germany, Great Britain, South Korea, Italy, France and Russia also have a significant participation in the number of the Internet users. In the case of the remaining three continents, with particular focus on Africa, slight changes in the number of the Internet users are observed. Africa cannot any more be perceived only in terms of a "digital abyss" separating it from the world. Its homogenous and stable character singles it out from the remaining continents. Africa is an element of "the periphery of the Castellan galaxy of the Internet". "The common access" to the Internet is characteristic only of Europe and North America (see Figure 1).

The above-presented and described aspect of the functioning of the Internet space in fact talks only about the distribution of "Internet terminals". There is, however, no interaction between them. Space of flows is dependent on the Internet technical infrastructure. K.N. Cukier (1999, after Castells, p. 235) called topology of the Internet "...a star with the United States in the middle". It was hard to reject such an expression at the moment it was coined. It seems, though, that the North American star is starting to "fade". We are witnessing the rise of "the European star" (Figure 2).

In the examined period 1.7 million edges were identified in the world. Among them, there occurred over 13.3 million connections. In total, nearly 80% of edges and connections constitute "the inner" space of flows, which was called "own potential" (see Figure 2). Space of the Internet, despite its global openness is "closed" regionally and locally.

The United States of America have the biggest own potential (see Figure 2). Their share is 56% of the world's inner flows. In the following places (in declining order of share) are: China (6.8%), Germany (4.6%), Great Britain (4.1%), Canada (3.1%) and Japan (2.8%). The inner space of flows may be interpreted as concerning nodity, i.e. attractiveness of the Internet space. It may also form the basis for classification of the places and their position in the hierarchy. We can identify three main nodes of the Internet space: North American, Western European and Asian. The Asian node, in contrast to the European one, has "dispersed" character. These three nodes of space of flows defined in this way refer to the large cities: New York, London and Tokyo.

When we incorporate external flows in the space of internal flows we will see that its shape and inner structure is determined by North American and Western European nodes. The Asian space of flows, although distinct, is noticeable to a lesser degree. Moreover, there is no clearly visible "closing" of the space of flows between the Western European and Asian nodes. Africa and Latin America, with the exclusion of the Republic of South Africa and Brazil respectively, once again remain on the periphery of the space of flows.

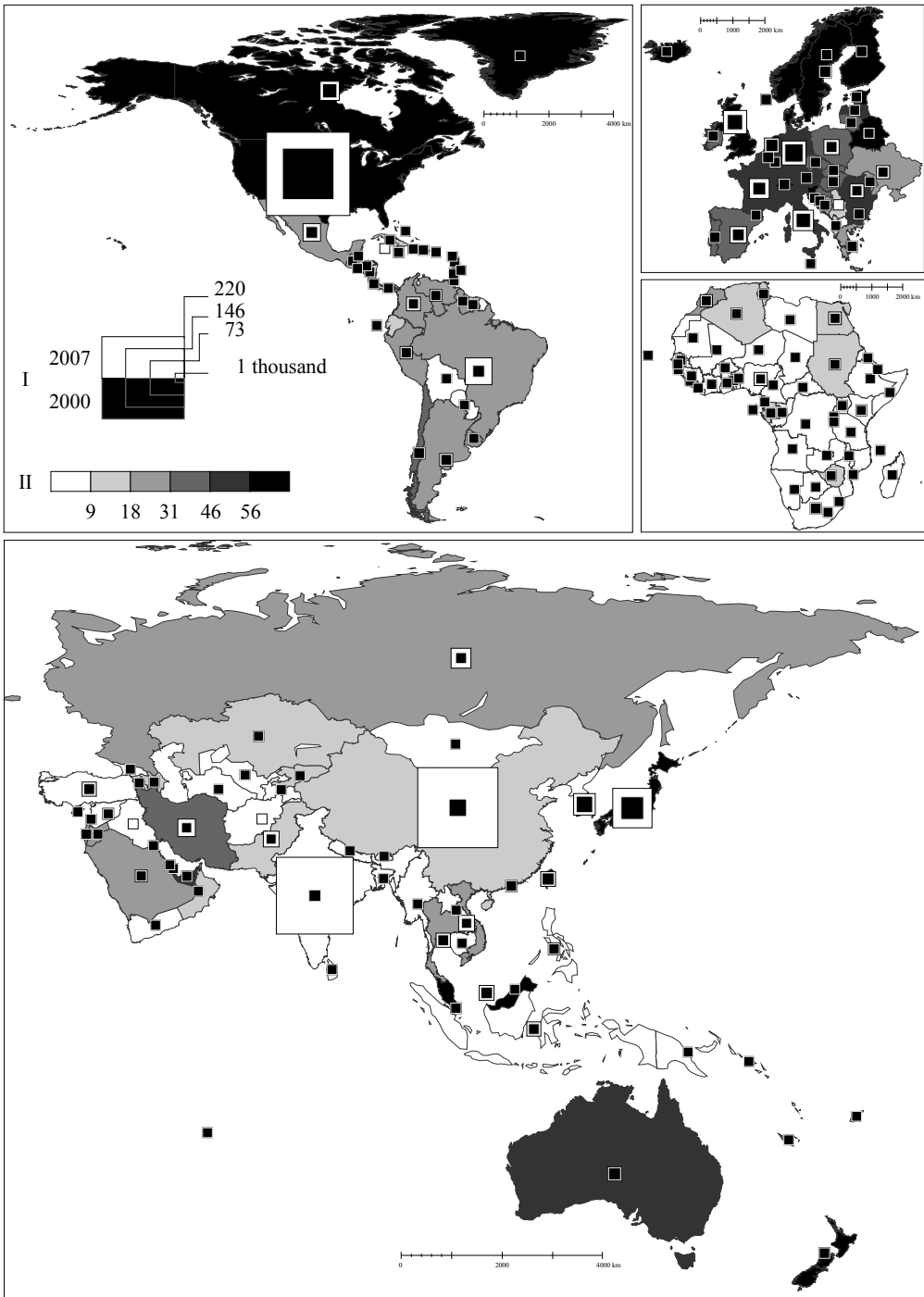


Figure 1 Spatial diversity and the change in the number of the Internet users between 2000–2007 (I) and the index of the number of the Internet users per 100 inhabitants in 2007 (II).

Source: own study based on www.itu.int.

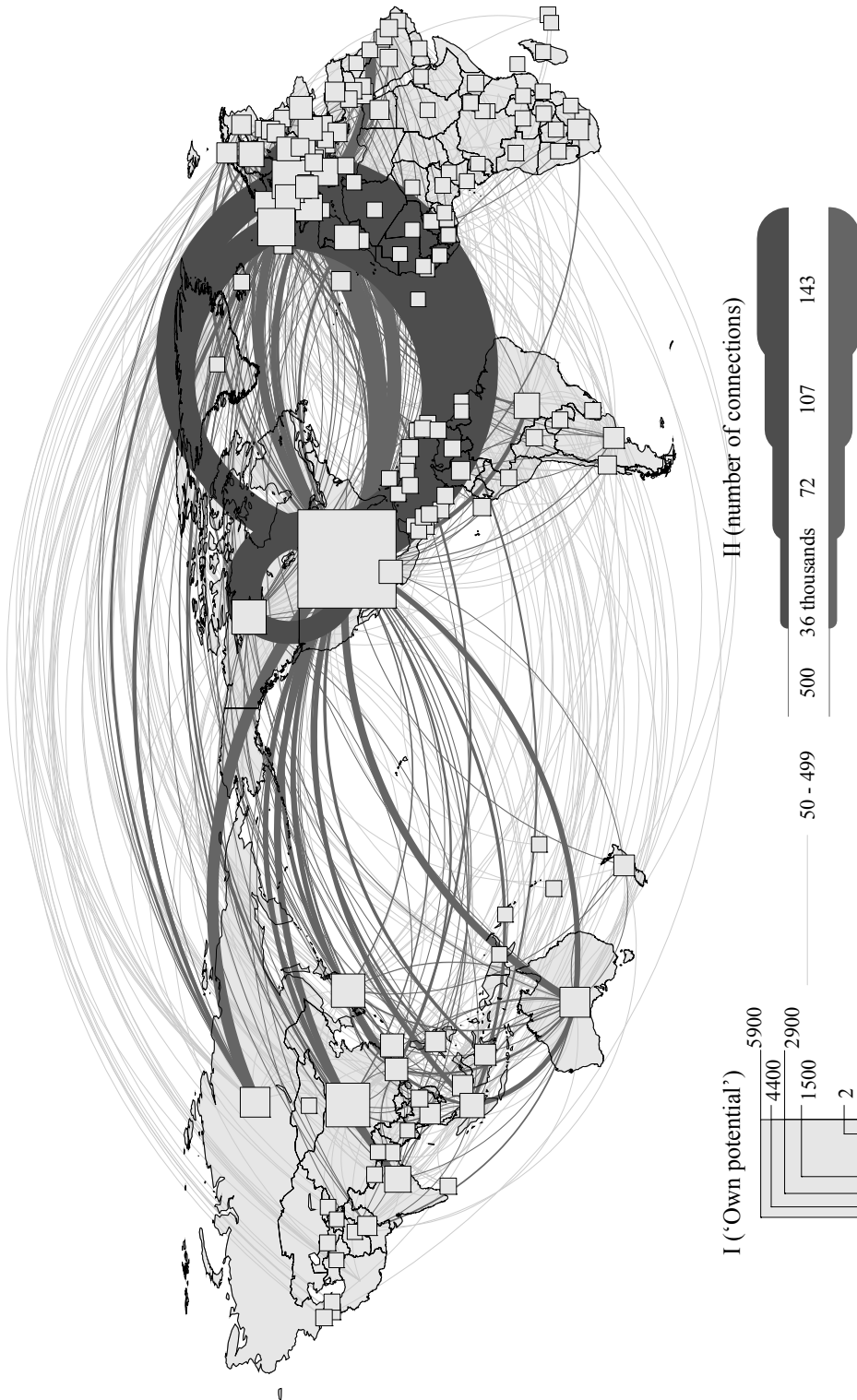


Figure 2 'Own potential' of the flows – within each country – (I) and the space of flows – connections–among the countries of the world for the streams of at least 50 connections (II) in the period of 14 months (January 2007 – February 2008)

Source: own study based on www.netdimes.org.

They are “*the worse pole*” of the dichotomous, digital division of the world³. This division is a kind of carbon copy of the wealthy north and poor south, at the basis of which lies wealth in the broad sense, measured by GDP per capita.

In generating the space of flows, the most visible is the USA–Western Europe system. The other components of the space of flows are “*interactions*” generated between: the USA, Great Britain and Canada; Great Britain and the USA; Canada, Germany and the USA. In the next 30 positions in terms of the number of connections, as the source feature USA (16 times) and European countries, among which the most frequently appear: Great Britain, Holland and Germany. There is a clear dominance of European countries. The African continent turned out to be “*outside the space of flows*”. In terms of the number of incoming and outgoing connections between the USA and the countries with which they “*exchange the most information*”, we are facing a situation in which inhabitants of the USA connect more with the world than the world with them (see Figure 3). The average ratio is: two incoming connections to three outgoing ones from the USA⁴.

The space of the Internet does not seem to lead to creating new, or rationally inexplicable, territorial configurations. This is more about shifting “*accents*” in “*cyber-geographical*” space. This consists in deviation *in plus* or *minus* from “*traditional*” perception of the diversity of the world, in the context of social, economic and civilizational development in the broad sense. Therefore, the space of the Internet remains in feedback with the level of “*average wealth*”, which, similarly to the space of flows, divides the world into “*the better north and the worse south*”. At the same time it shows a new geography of development – self-stimulating system of North America–Europe, with Asia “*overshadowed*” by the main stream of flows.

³ So far the expression “*digital division*” referred to the diversity of the Internet access in terms of various demographic, cultural, social and economic categories. This expression also appears in the context of “*digital exclusion*”.

⁴ A comparison of flows was also made between the United States of America and: Australia, Holland, Canada, Germany, Great Britain.

LOCAL CONTEXT

When narrowing the scope of the analysis of the Internet space from global to the local one, it's reasonable to assume lack of spatial egalitarianism both as regards the distribution of the Internet users (IP numbers) and the space of flows. With this assumption, the question remains whether distribution of “*network terminals*” corresponds with the existing territorial configurations. If so, then to what extent?

At present, in Poland, the number of registered and functioning IP numbers can be estimated at around 12 million. This number indirectly indicates the number of active Internet users. Their unambiguous location is known in 35% of cases. Spatial distribution of Internet access points (IP) corresponds with the significance of particular towns and their place in the hierarchy of the settlement network. Warsaw concentrates 28% of 4.2 million IP numbers. For the remaining large cities the concentration of the Internet users is as follows: Kraków (8.4%), Poznań (7.5%), Katowice (6.0%), Łódź (5.1%), Wrocław (5.1%) (Figure 3). A relatively large concentration is also found in Gdańsk, Lublin, Gliwice, Szczecin, Olsztyn (2-5%). In the case of this group of locations there is also a close correspondence between the number of terminals and their population potential.

Compared to June 2008, spatial distribution in the following month was changed – there occurred a kind of “*filling of the space*” (see Figure 3A and B). The change concerned both “*the mass*” of IP numbers, which grew by nearly 500,000, as well as locations. The increase in number of locations was four and a half times, from 511 to 2,327 locations. 53% of the increase in the number of IP addresses occurred in 14 previous locations. This concerned the biggest urban centres. Medium-sized and small towns began to be more noticeable. This change is not only connected with an increase in the number of “*network terminals*”, but it is also a consequence of an increase in the popularity of the openGeo project.

When viewed in the light of network terminals, the space of the Polish Internet reflects the spatial dimension of socio-economic diversity of Poland. This refers to social diversity resulting from the

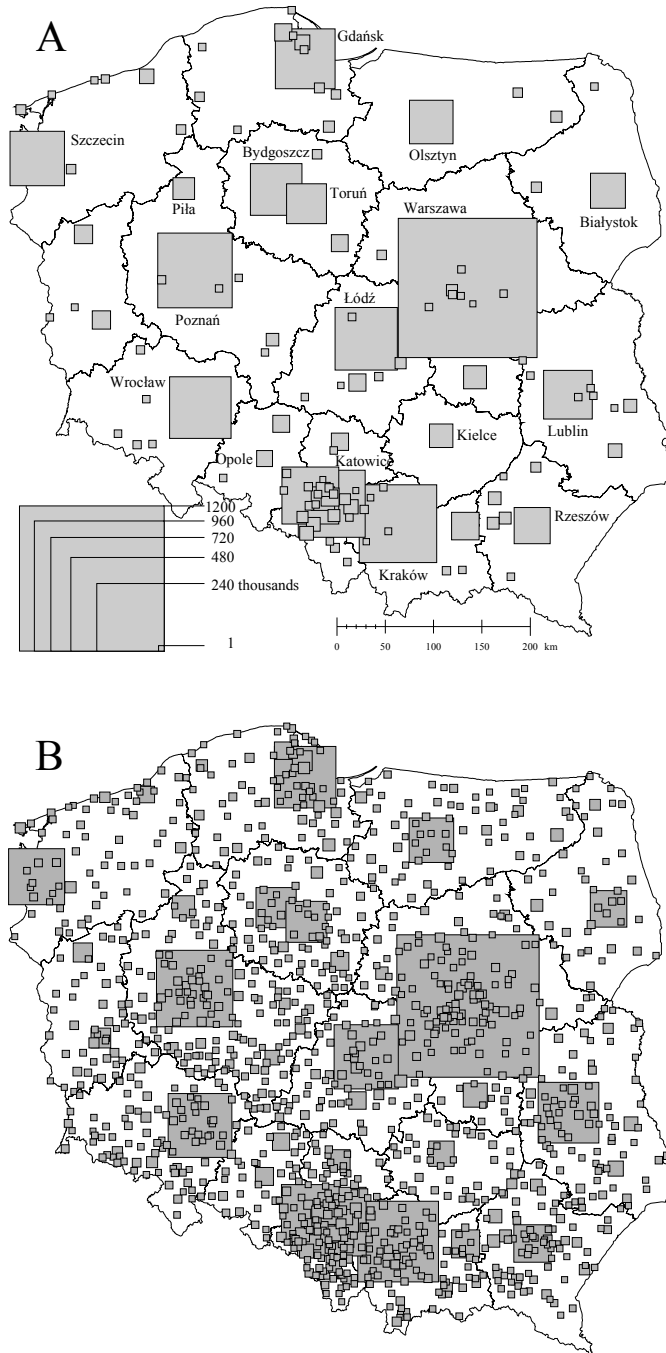


Figure 3 Geographical distribution of IP numbers for June 2008 (A) and July 2008 (B), excluding locations with up to 20 numbers.
Source: own study based on www.opengeo.pl.

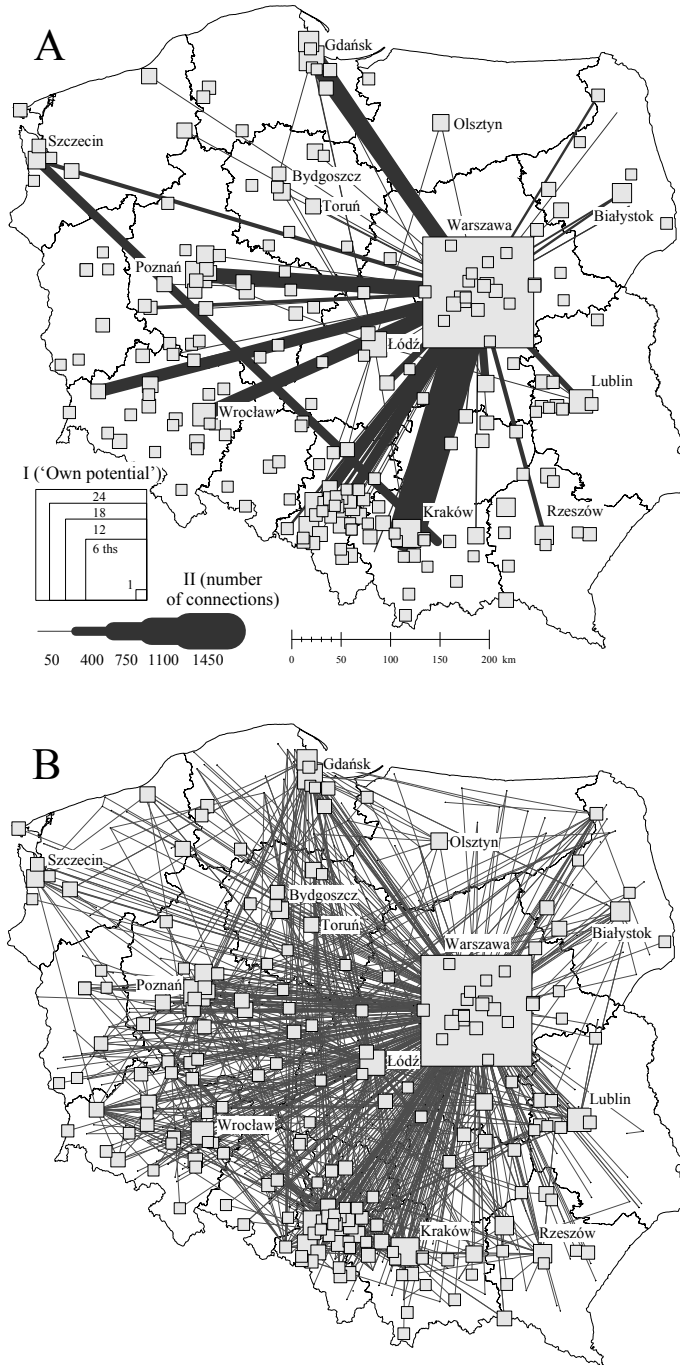


Figure 4 The space of flows – connections – for the locations of particular towns for connections above (A) and up to 50 connections (B) in the period of 14 months (January 2007 to February 2008)
 Source: own study based on www.netdimes.org.

character of the place of residence. The level of education, age and other factors⁵ influence the need to use the Internet. They constitute a significant “regulator” of the existing picture of the Polish space of the Internet users. On the basis of the above, we can tell that we are dealing with a duplication of the real space by the cyberspace.

The dominance of Warsaw in the space of the Internet gains clarity when we take a look at the shape and structure of the space of flows (Figure 4). Warsaw’s “own potential” is several times bigger than that of the city in the second position. The advantage over Kraków, which is in the second place, is 35 times bigger. Thus, we can talk about an escalation of disproportions existing in the real economy. This disproportion is big enough to treat the other locations as peripheral ones in the space of flows. The following nodes in the hierarchy are: Kraków, Poznań, Łódź, Trójmiasto (with the leading role of Gdańsk) – the Upper Silesian Conurbations with Gliwice, Wrocław and Lublin. The regions in the north and east of Poland do not exhibit any nodality.

Polish space of flows represents nearly 94 thousand connections, among which nearly 72% are generated by the inner traffic. When considering streams of flows between particular locations we can say that Warsaw is the main force responsible for generating the space of flows. It forms the central point in the Polish space of the Internet and generates 60% of the traffic between the locations. Warsaw is both the source and the destination (10%) of the vast majority of interactions between the Internet users⁶. The lack of significant flows between the other large cities is surprising. There are scarcely any edges whose source or destination is other than Warsaw. Locations in the east of Poland, which are the least

socially and economically developed, are definitely less active. Regions located to the north and north-east of “the Warsaw node” constitute Polish periphery of the Internet space.

To complete the picture of flows in the Internet, one should have a look at the small-size streams of flows – below fifty connections (see Figure 4B). Also in this case Warsaw forms the main node of flows. However, the traffic is largely bidirectional (from and to Warsaw).

The topology of the Polish Internet is somehow analogous to “the American star” of K.N. Cukier, resulting from the global approach to the analysis of the Internet. In the case of Poland it needs to be emphasized that this “star” is characterized by a lack of significant connections between the biggest locations. They do not form the meeting place for a few edges – they are rather their destinations or the starting point of the stream directed towards and from Warsaw. Such a picture of the Polish space of flows stems from the fact that it is still undergoing the process of formation. The shaping structures of the network allow specifying its main regularities. However, the shaping of this phenomenon still requires constant monitoring.

Conclusions resulting from the analysis of global topology of the Internet largely translate into the local context. What is most important, on the local scale the cyberspace co-exists with the geographical space creating a new layer of spatial diversity. Interestingly, as in the case of the global aspect where the division into “the rich north” and “the poor south” is duplicated – in the case of Poland the shape and structure of the network are reflected in the traditional division of the real space into a well-developed, richer west and poorly developed, poorer east.

CONCLUSIONS

When we consider the Internet in terms of its time frame, we can say that it has always existed. Only when we realize that it didn’t start to develop dynamically until the end of the last decade of the 20th century, we begin to notice that it is just starting to gain momentum. However, the examination of the Internet space of flows can be

⁵ Time budget that is available to a particular unit; mental resources (knowledge, social and technical skills); social resources (social networks and relationships – in the place of residence and the workplace), cultural resources (Selwyn and Facer 2007:36).

⁶ This is obvious if we take into account the existence of central institutions, cultural resources, company offices and organizations in the capital. Their quicker „connection to the network” in comparison with the other potential tenants of the virtual house generates the present space of flow.

dated to the beginning of the 21st century (Castells, 2003, 2007). However, there are still more questions than answers. For this reason, examinations of the Internet in the broad sense should be intensified and more widely incorporated into the current of geographical examinations.

The Internet, despite its futuristic vision of common digital egalitarianism, presents more and more clearly contrasts resulting from the diversity of the level of development. When describing the development of the Internet in the light of its users and the traffic they generate, territorial division into the privileged north and the weaker south becomes even more apparent. African countries are drifting on peripheries of the Internet galaxy. "The reality of the Internet", its shape and structure are created by the users from North America and Western Europe. The Internet users from Asia play complementary role. The space of inner flows, described as own potential, allowed identifying three nodes: North American, Western European and Asian. Despite a clear concentration of the volume of flows as well as their territorial origin, it's hard to state categorically that in the space of the Internet takes place the creation of new territorial configurations. It's rather "the old systems" that become more visible. This statement is also true when the analysis of the Internet space is limited to a particular country (Poland). Firstly, the relationship between territorial distribution of the Internet users and spatial diversity of the level of development becomes visible. Secondly, in the shaping of the space of flows, the leading role and nodity of Warsaw with a marked preference for the west of the country become noticeable. This corresponds with the division into Poland A and Poland B. It seems that the Internet tends more to "imitate" socio-economic diversity not only on a global scale, but also at lower territorial levels, rather than create its own space.

The geography of the Internet is a promising research area. It requires, however, at least an interdisciplinary approach, if not a research team. Geographers do not understand "the language of the Internet" completely (if at all), whereas IT specialists, Internet administrators, concentrating on its proper functioning do not realize what kind

of data concerning the Internet they can provide. This does not have to be a sequence of zeros and ones or a virtual creation, but a picture – a map – which will be understood without words.

References

- Castells, M.** 2003: *Geografia Internetu: usiecionione miejsca*. In *Galaktyka Internetu*. Dom Wydawniczy Rebis, Poznań, 233–273.
- Castells, M.** 2007: *Spoleczeństwo sieci*. Wydawnictwo Naukowe PWN.
- Dodge, M., Kitchin R.** 2001: *Atlas of Cyberspace*. Pearson Education, London.
- Gorman, S. P., Malecki, E. J.** 2000: The networks of the Internet: an analysis of provider networks in the USA. *Telecommunications Policy* 24, 113-134.
- Grubestic, T. H.** 2002: Spatial dimensions of Internet activity. *Telecommunications Policy* 26, 363-387.
<http://www.itu.int/ITU-D/ict/e/y/Indicators/Indicators.aspx>, International Telecommunication Union, accessed 2008-07-01.
- <http://www.netdimes.org/DIMESControlCenter/MonthlyData.jsp>, The DIMES project, accessed 2008-07-01.
- <http://www.opengeo.pl>, openGeo project, accessed 2008-07-01.
- Ilnicki, D.** 2002: Fenomen kawiarenek internetowych. In **Jażdżewska, I.** ed.: *Współczesne formy osadnictwa miejskiego i ich przemiany*. XV Konwersatorium Wiedzy o Mieście, Łódź, 249–262.
- Ilnicki, D.** 2003: Wyznaczniki współczesnych przekształceń w sferze usług nowych, a poziom rozwoju gospodarczego. In **Rogacki, H.** ed.: *Problemy interpretacji wyników metod badawczych stosowanych w geografii społeczno-ekonomicznej i gospodarce przestrzennej*. Bogucki Wydawnictwo Naukowe, Poznań, 295–309.
- Ilnicki, D.** 2004: Kawiarnie internetowe w Polsce. Aspekt przestrzenny. *Prace Komisji Geografii Komunikacji PTG*. Wydział Ekonomii Uniwersytet Rzeszowski, Warszawa–Rzeszów, T. X, 383–396.
- Ilnicki, D., Janc, K.** 2008: Węzłowość i przestrzeń przepływów Internetu: ujęcie globalne i lokalne. *Geopolis – Elektroniczne Czasopismo Geograficzne* 1/2008, 5–23.
- Kitchin, R. M.** 1998: Towards geographies of cyberspace. *Progress in Human Geography* 22 (3), 385-406.
- Malecki, E. J.** 2002: The Economic Geography of the Internet's Infrastructure. *Economic Geography* 78 (4), 399-424.
- Micek, G.** 2008: Rozwój usług informatycznych w Polsce w ujęciu przestrzennym. In **Dominiak, J.** ed.: *Przemiany w sferze usług w Polsce*. Bogucki Wydawnictwo Naukowe, Poznań, 93–110.

- Selwyn, N., Facer K. 2007: *Beyond the Digital Divide. Rethinking Digital Inclusion for the 21st Century*. Futurelab, Bristol.
- Retkiewicz, W. 2002: Przestrzeń wirtualna jako miejsce pracy, usług, wypoczynku i „zamieszkania”. In Jażdżewska, I. ed.: *Współczesne formy osadnictwa miejskiego i ich przemiany*. XV Konwersatorium Wiedzy o Mieście, Łódź, 263–272.
- Retkiewicz, W. 2008a: Hotspoty jako element przestrzeni informatycznej w miastach. *Acta Universitatis Lodzianensis, Folia Geographica Socio-Oeconomica* 9, 32–40.
- Retkiewicz, W. 2008b: Wybrane koncepcje cyberprzestrzeni w geografii. In Maik, W., Rembowska, K., Suliborski, A. eds.: *Terytorium, region, miejsce – czas i przestrzeń w geografii*. Podstawowe idee i koncepcje w geografii, t. 4, WU WSG, Bydgoszcz, 115–128.
- Townsend, A. M. 2001: The Internet and the rise of the new network cities, 1969-1999. *Environment and Planning B* 28, 39-58.
- Warf, B. 2001: Segueways into cyberspace: multiple geographies of the digital divide. *Environment and Planning B* 38, 3-19.
- Zook, M. A. 2005: *The Geography of Internet Industry. Venture Capital, Dot-coms, and Local Knowledge*. Blackwell.

Résumé

Topologie, nodalita a prostor internetových toků

Ačkoliv byl internet kdysi označen jako konec geografie, vytvořil vlastní geografii uzlů a sítí. Na jeho základě se tvoří prostor toků, které jsou výsledkem interakcí mezi uživateli internetu. Uživatelé sítě tvoří jeho tkáň, představují nerv prostoru internetu. Stále však se internet jakožto postmoderní médium ukazuje jako jev, jež se více hodí pro psychologický a sociologický výzkum. Určitá bezejmennost internetu je ovšem jenom zdánlivá. Při vědomí, že jevy probíhající v prostoru

internetu charakterizují paralelní koncentrace a dekoncentrace, vyvstává otázka: Vedou tyto jevy fakticky ke vzniku nových teritoriálních konfigurací? Nebo je konstatování M. Castella (2003) použité v práci *The Internet Galaxy* (2001) i nadále pravdivé?

Úvodní dominance internautů ze Spojených států amerických v prostoru internetu (do roku 2000) polevila, dnešní prostor uživatelů internetu tvoří jak lidé z USA, tak také z Číny, Indie a Japonska. Podíl těchto čtyř zemí se pohybuje průměrně na úrovni 57 % (2000–2007). Dřívější model geografického uspořádání internetového prostoru se změnil. Postupně začínají ve světovém měřítku převládat asijské, nikoliv evropské nebo americké internauty. Tvar a vnitřní strukturu globálního prostoru internetových toků determinují severoamerický a západoevropský uzel. Asijský prostor internetových toků je viditelný v menší míře. Současně chybí „uzamčení“ prostoru toků mezi západoevropským a asijským uzlem. V podstatě představuje tento prostor doplnění prostoru internetových toků, jehož je důležitým prvkem. Afrika a Latinská Amerika jsou oním „horším pólém“ dichotomické číslkové struktury světa. V topologii polského internetu sledujeme jistou analogii „americké hvězdy“ (K. N. Cukier, 1999, cit. Castells, 2003). Na lokální úrovni kyberprostor koexistuje s geografickým prostorem.

Zdá se, že internet jako prostor sítí neumožňuje vytvořit nové, nebo jinak racionálně vysvětlitelné teritoriální konfigurace. Ve větší míře se setkáváme s jevem přenosu „akcentů“ v „kybergeografickém“ prostoru. Jeho podstatou jsou vzdálenosti *in plus* nebo *minus* vůči „tradičně“ vnímanému světu, a to v kontextu široce definovaného socioekonomického civilizačního rozvoje.