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INTERNET INFRASTRUCTURE DEVELOPMENT IN TRANSITION ECONOMIES

Part I

Survey carried out by the UN/ECE secretariat

Background

As requested by the Committee for Trade, Industry and Enterprise Development at its 1999 session, this Survey is being provided as part of the substantive preparations for the Forum on Electronic Commerce for Transition Economies in the Digital Age to be held on 19 and 20 June 2000, at the Palais des Nations, Geneva, and for the follow-up activities to be considered by the Committee on 21-23 June 2000.

It provides an overview of the current status of Internet infrastructure development in transition economies by addressing major issues relevant to the Information Society and, in particular, to Internet enterprise development in the region. The Survey is divided into two parts:

- I. Overview, Internet Use, National Policy Initiatives and Conclusions
- II. Internet Infrastructure, Domain Name Systems, Service Providers and Competition Levels

Given the rapid changes in the Internet environment, the current accuracy of the figures and statistics cannot be guaranteed. However, the secretariat welcomes any contributions to updating this information.

Mention of a company or enterprise in this survey does not imply that the UN/ECE makes any judgements or recommendations in respect of the quality or reliability of the services or products provided by that company or enterprise.

Executive Summary

- Part I of the Survey provides an overview for the region, and by sub-region, of the Survey results. It examines the level of Internet access and use by country, provides a reference list of National Information Society Initiatives and then draws conclusions. Part II (TRADE/2000/19) examines the technical indicators of Internet development in the region, focusing on Internet network backbone infrastructure, Internet hosts including secure servers, Internet service providers, Internet exchanges and the Domain Name System. It also includes a profile of telecommunication services. The appendices (TRADE/2000/18/Add.1) include reference material such as a compilation of recent telecommunications legislation and a brief inventory of international organizations' work on e-commerce.
- The preliminary findings indicate that although Internet connectivity and e-commerce are growing very fast, many of the countries surveyed lack the necessary infrastructure in physical, technical and regulatory terms to participate fully in the Information Society.
- A pattern of uneven development is emerging in several sectors of Internet development, as well as in the rate of growth for each country. The central European and Baltic countries currently have more Internet hosts, secure servers, percentage of Internet users, and a wider range of services available over the Internet than the other regions of the transition economies.
- In the Black Sea region we can see a pattern of positive development on the whole; however, there are wide variations in some elements of the Internet environment. Ukraine has a particularly large network, but relative to the size of the population, its network ranks in the lower half of the transition economies; and the Caucasus and central Asian CIS countries have significantly lower levels of development than the Central European and Baltic countries.
- However, on the micro level of Internet development, this Survey indicates that, despite the significant barriers to Internet connectivity that remain, there is substantial new potential for economic opportunities. In most of the transition economies, there is an increasing effort to tap the potential of a relatively high-speed Internet connection at a lower cost.
- The Survey has identified a series of actions required to increase the participation of the region in the knowledge-based economy. These include increased access to the Internet and new communications technologies, competitive pricing mechanisms for Internet connectivity, capacity building and the promotion of a skilled workforce to tap the potential of Internet-based enterprise development in the region.
- Governments and enterprises in the region may wish to consider how to give a new momentum to building the Information Society in order to make the accumulated experiences and the current process of transition towards a market-based economy fully compatible with the rapid technological change in global markets. To this end, the role of Governments could be further explored in accelerating the new Internet-based transition process; in particular for those areas in which public-private sector partnerships could benefit from closer collaboration with international organizations.
- The Committee for Trade, Industry and Enterprise Development may wish to make some recommendations for action by both national Governments and regional international organizations such as the UN/ECE which could be developed further to achieve the aforementioned goals in an efficient and effective way.

CONTENTS

	<u>Page</u>
Executive summary.....	2
Introduction	4
Content Overview.....	4-5
Methodology of the Survey.....	5
I. OVERVIEW OF INTERNET DEVELOPMENT IN TRANSITION ECONOMIES	5-12
Introduction.....	5-6
Regional Overview	6-7
Subregional Trends.....	7-12
II. INTERNET USE.....	12-22
Measuring Internet Use.....	12
Internet Hosts	13-16
Secure Servers	16-18
Internet Access and Usage Patterns	18-20
Internet based Services by Institutions	21-22
III. NATIONAL INFORMATION SOCIETY INITIATIVES	23-24
IV. CONCLUDING REMARKS	25-26

Introduction

1. Information and communications technologies are becoming key factors and agents in the far-reaching changes that are overtaking the world economy. Transition economies are not exempt from this revolutionary change. The compelling force of these technologies is now carrying Central and Eastern Europe and countries of the former Soviet Union toward an economic structure that is very different from the time when the transition process began a decade ago.

2. These new technologies are being transformed into the infrastructure for a knowledge-based economy, which is based on the exchange of intangibles — ideas, information and intelligence. There are many terms for this new world — "information society," "knowledge-based economy," "digital economy" and "new economy". In this new environment, geographical boundaries will be diminished in their importance as an economic factor, and consequently the world will converge toward a global market place.

3. The creation, manipulation and sharing of information and knowledge will become an integral part of this global market place. Knowledge will become available more easily enabling wiser decisions to be taken in many economic activities — from business to government to health care to education to work. With technologies that increasingly blur distance, the challenge of seizing the opportunities of the new age is not merely national, but global in nature. With this new reality comes an ever more pressing need to align national strategies with the worldwide movement toward a global information society.

4. Within information and communications technologies, it is the Internet which is revolutionizing the way the world economy is being developed. A new knowledge-based economy is starting, and the traditional patterns and practices of private sector development are ceding to the Internet-based enterprise development. It is imperative that transition economies move quickly to meet the challenges and seize the opportunities of the new digital age and the promises of the new economy.

5. The current survey aims to provide an overview of the existing status of Internet infrastructure development in transition economies and assess the emerging pattern of network-based economy. To this end, we have identified and analysed the key determining factors for Internet development. The following is the structure of this survey.

Content Overview

Chapter I Overview of Internet Development in Transition Economies

9. This chapter summarizes the technical findings of this survey at both the regional and sub-regional level. It includes summaries with regard to the numbers of Internet hosts and secure servers, Internet access and use, Internet services, teledensity, backbones and Internet address registries.

Chapter II Internet Use

10. This chapter examines the nature of Internet use in transition economies via two general approaches to producing survey data: on the one hand, we examine the data available through survey software applications that generate information on the number of host computers connected to the Internet in each country, as well as data on the number of hosts that employ e-commerce enabling secure server platforms; on the other hand, we have gathered together all available surveys that measured the degree of Internet use in each country, and the range of online services currently on offer, through personal interviews.

Chapter III National Information Society Initiatives

11. The final chapter contains a sampling of governmental sites related to Information Technology and Telecommunications, as well as an overview of the various Information Society Initiatives that have currently been launched by several transition economies.

Chapter IV Concluding Remarks

12. Based on the results of the survey, this chapter looks at issues to be considered further and what role the UN/ECE might play in Internet Enterprise Development within the transition economies.

Appendices (TRADE/2000/18/Add.1)

13. We have included several appendices as reference material in document TRADE/2000/18/Add.1. These include a country-by-country summary of legislative actions relevant to the telecommunications sector; a complete list of all the local companies in each country who are Internet registries, along with their respective IP address allocation; a list of the signatories to two international agreements dealing with intellectual property rights; and finally, a summary of the various non-governmental, international and regional organizations that are active in Internet development.

Methodology of the Survey

13. In the present study an attempt was made to provide an overview of the Internet infrastructure on a national level. Most of the data were collected from sources located on the Internet; however, several offline sources were also consulted.

14. The majority of the indicators, therefore, represent the results of our investigations into online sources based in each individual country. The lack of any international centralized system of reporting for many sectors of Internet development has meant that the data presented herein were the best available data that our research was able to locate in websites of both public and private organizations. For example, in trying to determine the degree of Internet use in each country, we were only able to locate statistical surveys in a subset of transition economies, and these surveys often did not clearly define the nature of 'Internet Use' that was measured, nor did they provide a clear description of their methodology. Some surveys defined Internet use as 'used the Internet once within the past month', others as within the past six months, and yet others as weekly. The sometimes ambiguous nature of the sources for these Internet indicators places a limitation on their applicability for cross-country comparison, let alone for rigorous statistical analysis.

15. Finally, the focus on national comparisons does not necessarily present a picture of the potential experience for individual users of Inter services within each country. The variation between subregions, as well as the level of services available to particular users, can offer very different perceptions of the experience of the Internet. Therefore, a more detailed analysis at a micro level, which takes into account general social and economic development, is required if we are to present an overall description and analysis of the factors driving the development of the Internet. However, this is beyond the scope of both this report, and the available data. We have, thus, prepared a Survey of the currently available information for several key factors in the development of the Internet, which might be used as a framework for future research.

I. OVERVIEW OF INTERNET DEVELOPMENT IN TRANSITION ECONOMIES

Introduction

16. The Internet is an international network of networks, made up of a wide variety of technologies and standards, but with an underlying architecture based upon the TCP/IP protocol. We can further distinguish between a core network, composed of data networks, servers and hosts that are permanently devoted to carrying Internet traffic, and the periphery networks and devices which temporarily connect users to the core network, such as analogue and digital phone lines, mobile phones, modems and personal computers.

17. The core network is in a constant state of evolution as it expands further into new regions, as existing segments get upgraded for greater capacity, and as new technological standards for data transmission emerge and co-exist with the IP protocol. The growth of the core network is driven by the demand for easier and faster access from a growing number of producers and consumers of digital data. The impetus for research into new technologies

that lead to faster bandwidth comes from the potential for the Internet to become the underlying data network for a host of applications beyond the world wide web, which could include a significant portion of voice communications, as well as the digital delivery of audio and video products.

18. The widespread public use of the core network is less than ten years old and even the most technologically advanced countries have barely reached a level where 50 % of the population can be classified as Internet users. In several European Union countries, less than 5 % of the population makes regular use of the Internet. Thus, the Internet remains beyond the reach of millions of people even in the high-income nations of the world. Furthermore, the integration of the Internet with the access-providing periphery networks of the telecommunication sectors is unevenly distributed across regions and within countries.

19. It is clear that the Internet is having a huge impact on a broad range of sectors of the global economy. It is also clear that the end of this process of transformation is not yet in sight. The principles of the 'New Economy' are continuously being altered, and there is not, as of yet, a single path of evolution to doing business in the 'wired world'. Given the fact that the development of the Internet is in a rapid process of transformation, it is difficult to produce a simplified set of benchmarks that would yield a definitive overall measure of Internet connectivity.

Regional Overview

20. Our study has shown that, at the macro level, there are significant sub-regional differences in the development of the Internet across transition economies. The Central European and Baltic countries, in particular, Estonia, the Czech Republic and Slovenia, have more Internet hosts, secure servers, percentage of Internet users and a wider range of services available over the Internet than the other sub-regions.

21. In terms of the quality of national backbones and international backbone connectivity, Central Europe has benefited from partnerships with EU programmes to deploy high-speed networks, as well as investments from European-based international Internet service providers. The Baltic countries have increased their Internet connectivity with contributions from the telecommunications sector in their Nordic neighbours, Finland, Sweden and Norway. Finally, Russia has one of the largest networks, in terms of sheer size, which also provides international connectivity to many of the other transition economies, in particular, the CIS.

22. Bulgaria, Croatia and Romania are in the forefront of the Eastern European region with levels approaching those of their central European neighbours in several key factors. However, the region's development is proceeding unevenly, both within individual countries and across the region. In particular, Albania is just beginning to develop its networks and is below the levels of the region for many of the infrastructure indicators.

23. The Black Sea region has largely demonstrated a pattern of growth; however, it has also shown a slight decrease in some elements of the Internet environment compared to other subregion. The Ukraine has a particularly large network, however, when it is considered in terms relative to the size of its population, its network ranks in the lower half of the transition economies. The Caucasus and the Central Asian CIS countries have significantly lower levels of development in comparison to the Central European and Baltic countries.

24. When we consider the Internet indicators of the transition economies in the broader context of other developed countries, we find that there is a significant variation between the leading countries, such as Estonia or Slovenia which rank above many EU countries, and Albania or Tajikistan whose levels represent a small percentage of the level of the leading transition economies.

25. However, when we consider the potential of the Internet on a micro level, we can see that despite the significant barriers to Internet connectivity that remain, there is now the possibility for economic opportunities that were inconceivable ten years ago. There is, at present, in virtually every transition economy, the capability to establish a relatively high-speed Internet connection (128 Kbps, much faster than the widely used 33.6 Kbps connections) either through a leased-line or an ISDN line. Satellite and wireless networks, as well as other forms of high speed data networks (ATM, frame-relay) are also available in most countries which offer SMEs the possibility of even higher speed Internet connections. While there are many remaining social, economic and regulatory barriers to the widespread adoption of high levels of Internet connectivity, the current state of development of Internet

technologies offers increasing possibilities for circumventing these barriers and the creation of a 'wired world'.

26. Therefore, the macro-level indicators of the study reveal significant inequalities in the development of the Internet infrastructure of transition economies on a national level. However, the micro-level analysis of the existing infrastructure shows that a small number of individual users and businesses in nearly every country could experience Internet connectivity via technologies that are equivalent to the average mode of Internet connectivity in the countries with the highest levels of Internet development. The underlining question is how to extend this potential connectivity as widely and evenly as possible, enabling full participation of the transition economies into the 'new economy'.

Sub-regional Trends

Baltics (Estonia, Latvia, Lithuania)

27. *Internet Hosts*¹ The three countries of the region all have sizeable networks with over 14,000 hosts. Estonia's nearly 21,000 hosts per million inhabitants is the leading Internet host density for all of the transition economies and ranks above many western European countries, including Spain, Italy and France. Latvia's 7,500 and Lithuania's 3800 Internet density remain below the bottom range of western European countries but places them in the top third of transition economies. Estonia maintained a growth rate of 25 % despite its already highly developed network, Latvia's 32 % and Lithuania's 45 % also indicate healthy rates of growth.

28. *Secure Servers*² Estonia's 29 secure servers led the region, followed by Latvia's 23 and Lithuania's 17. All three countries had similarly moderate levels of growth in this sector.

29. *Access and Use*³ Statistical data were only located for Estonia, which reported that 21 % of the total population are Internet users, well above the EU average of 8.9 %. Given that the region with the highest levels of network development, central Europe, had complete statistical information, it is safe to conclude that Estonia has the highest level of Internet use of all the transition economies.

30. *Services*⁴ All three countries of the region had statistical data available for online services. National Ministries was the sector with the highest level of online presence with Estonia and Lithuania having 100 % coverage and Latvia having 67 %. Estonia also led all countries with available data in the Local and Regional Authority sector and demonstrated above average levels for both the High School/University and Primary/Secondary School sectors. Latvia had a leading 100 % coverage in the Museum sector and Lithuania led the High School/University sector with 100 %.

31. *Teledensity*⁵ Estonia leads the region in both telephone lines and cellular subscribers per 100 inhabitants. With 34.3 lines per 100 inhabitants, Estonia ranks 4th for transition economies and 1st in cellular subscribers with 17 per 100 inhabitants, placing it 33rd in the OECD study. Latvia had 30.2 lines per 100 inhabitants, followed immediately by 30 in Lithuania. For cellular subscribers, Lithuania had 7.2 per 100 inhabitants, followed immediately by Latvia's 6.8.

32. *Backbones*⁶ The development of international connectivity in all three countries of the region has been supported in partnership with Finland, Norway and Sweden, which have provided direct links to their national backbones. Estonia has placed a significant effort into the development of the IT sector in the realm of education, in particular the deployment of its Educational and Research Network (EENet), however Latvia and Lithuania also have

1 Internet hosts are computers with permanent connections to the Internet, see Chapter II.

2 Secure servers are Internet hosts that are employed as website servers and are enabled to provide encryption protection via the Secure Socket Layer (SSL) protocol, see Chapter II.

3 Internet users are usually defined as persons who have accessed the Internet in the past month, see Chapter II.

4 For a list of potential sectors currently available as online services, see Chapter II.

5 Teledensity is the number of telephone lines per 100 inhabitants, see Chapter I, Part II of the Survey (TRADE/2000/19).

6 Backbones are the high-speed data networks that make up the core of the Internet, at both the national and international level, see Chapter I, Part II of the Survey (TRADE/2000/19).

public academic networks. Latvia has been a pioneer in the use of wireless technology for Wide Area Networks (WANs), exporting its expertise in the field to other countries in transition. Latvia also operates the only Internet Exchange in the region.

33. *Internet Registries*⁷. The Baltic countries have almost identical numbers of locally-owned Internet registries, as well as similar percentages of local to total number of Internet registries. However, Estonia leads the region in terms of the number of IP addresses allocated by locally owned registries, with its second overall total of 130,000 per million inhabitants. In terms of foreign-owned Internet registries, the region tilts towards companies based in Finland, Sweden, Norway and Russia, in contrast to the dominance of U.S. and Western European telecommunications companies that dominate the foreign-owned Internet registry sector throughout the other transition economies.

Central Europe (Czech Republic, Hungary, Poland, Slovakia, Slovenia)

34. *Internet Hosts*. Poland, Hungary and the Czech Republic have respectively the second, third and fourth largest networks out of the transition economies, with Slovakia and Slovenia not far behind. Thus, all of the countries in the region fall in, approximately, the top 30 % of the transition economies. In terms of hosts per million inhabitants, the Czech Republic's leading 11900, Slovenia's 11 800, and Hungary's 11 700 for January 2000 place them within the range of their Western European neighbours. Slovakia (over 5000) and Poland (almost 4500) are in the top third of hosts per million for transition economies but remain less than half of the totals of the lower Western European nations. Despite the high levels of their initial development, all of the countries in the region displayed between 25 and 40 % growth, with the exception of Slovenia which grew only by 3 %.

35. *Secure Servers*. The region is the clear overall leader in this sector, occupying the 2nd through 5th positions in terms of the number of secure servers, although Slovakia falls a bit lower. The Czech Republic's 108 secure servers in December 1999 is second only to Russia's 116. It should be noted that the Czech Republic and Russia's leading totals represent only 0.2% of the global total of secure servers, the vast majority of which are located in the United States. The region also demonstrated a growth rate of nearly 100 % for each country in the sector.

36. *Access and Use*. Every country in the region had some form of statistical information available on Internet use. Slovenia led the region with 14 % of the total population reported to be Internet users, or 280,000 Slovenians that are online, which is second only to Estonia in the transition economies where data was available. In Slovakia, there were 510,000 people with Internet access, or 9.5 % of the population. Both Slovakia and Slovenia have levels of Internet use that are above the EU average of 8.9 %. There were 506,000 Internet users in Hungary, or 5.1 % of the total population. In the Czech Republic, one study identified 292,000 Internet users, or 3 % of the total population, however, other estimates put the figure closer to 600,000 users, or approximately 6 % of the total population. In Poland, there were 1.5 million users, or 3.9 % of the total population. Thus, all of the countries in the region are within the range of Internet use by EU countries.

37. *Services*. With the exception of Slovakia, every country in the region had statistical information for Internet services. National Ministries are the sector with the greatest percentage of Internet presence, with 100 % coverage in the Czech Republic, Hungary and Slovenia and 94% coverage in Poland. Hungary led overall for transition economies with available data in the coverage for the hospital/clinics sector, with 23 % having an online presence. Slovenia led all countries in the primary/secondary school sector, as well as for libraries.

38. *Teledensity*. Slovenia is the overall leader amongst the transition economies with 37.5 lines per 100 inhabitants, followed by the Czech Republic's 2nd place 36.4, Hungary's 33.6, Slovakia's 28.6 and then Poland's 22.8. Slovenia ranks 47th out of the 206 nations included in the OECD study and is not far from the levels of teledensity of

7 Internet registries are public or private organizations that have registered with one of the three regional supervisory organizations, to receive an allocation of IP (Internet Protocol) addresses. Internet Registries then distribute IP addresses to Internet hosts on their internal networks, or resell them to downstream networks. Internet Exchanges are centralized nodes where several Internet Service Providers (ISPs) share network resources. See Chapter II, Part II of the Survey (TRADE/2000/19).

some its EU neighbours. In terms of cellular subscribers, Hungary leads the region with 10.5 subscribers per 100 inhabitants, 2nd amongst transition economies, and 45th in the OECD survey. The Czech Republic follows with 9.4, then 8.7 in Slovakia, 8.4 in Slovenia and finally 5.0 in Poland.

39. *Backbones.* The region has benefited from its proximity to EU based networks, such that the Czech Republic and Hungary have participated in the deployment of the European TEN-34 and TEN-155 backbones. Poland increased its international connectivity capacity via a high-speed connection to Sweden. All of the countries of the region have extensive public academic backbone networks, local telecom networks, and private networks from international providers. Internet Exchanges are currently in operation in the Czech Republic, Hungary and Slovakia.

40. *Internet Registries.* The Czech Republic and Poland have the largest number of foreign-owned Internet registries among transition economies. Furthermore, several companies from the region have become foreign-owned Internet registries in other transition economies, including Hungary's Banknet Kft which is a registry in many other countries. In terms of locally-owned Internet registries, Poland's 28 is the third largest, resulting from the large number of regional and municipal networks operating within the country. Slovenia has the highest level of IP address allocation by locally-owned registries of all the transition economies.

Eastern Europe (Albania, Bosnia and Herzegovina⁸, Bulgaria, Croatia, Romania, the former Yugoslav Republic of Macedonia, Yugoslavia)

41. *Internet Hosts.* Four of the countries in the region (Bulgaria, Croatia, Romania and Yugoslavia) have networks that include over 10,000 hosts; the former Yugoslav Republic of Macedonia has just under 1,500 and Albania has the smallest network of the transition economies with approximately 200 hosts in January 2000. In terms of hosts per million inhabitants, all of the countries of the region, except Albania, are grouped closely together in the upper half of the transition economies from the former Yugoslav Republic of Macedonia's 750 in January 2000, Yugoslavia with 1,000, Romania 1,600, Bulgaria 2,000 and Croatia's leading 3,100. Albania remains in the bottom two countries for all transition economies in hosts per million inhabitants as well. The region had one of the strongest overall levels of growth (Bulgaria led with 65 %) and the level of development is approaching that of their Central European neighbours.

42. *Secure Servers.* Croatia led the region with 25 secure servers, followed by Romania with 21, Bulgaria with 10 and Yugoslavia with 7. Albania had no identifiable secure servers. All of the countries, with the exception of Albania, demonstrated some growth in this sector.

43. *Access and Use.* The only country in the region that had any available statistical information was Croatia, which reported that there were approximately 237,000 Internet users, or 5.6 % of the total population, placing it above some of the lower-ranked EU countries.

44. *Services.* Statistical information on Internet services was available for Albania, Bulgaria, the former Yugoslav Republic of Macedonia and Romania, but not for Croatia or Yugoslavia. The sector with the highest level of Internet services in this region was that of 'National Ministries' where 81% of the ministries in Bulgaria had an online presence, followed by 67 % in the former Yugoslav Republic of Macedonia, 41 % in Albania and 25 % in Romania. Bulgaria led every category within this region.

45. *Teledensity.* There is a wide range of levels of teledensity within the region, from Albania's 2nd last position in the transition economies, with 4 lines per 100 inhabitants, up to 30 in Bulgaria and 35 in Croatia which rank in the top 60 of over 200 OECD surveyed countries. In terms of cellular subscribers, the region is more closely grouped together with Albania's 0.18 per 100 inhabitants ranked 18th among the 26 transition economies, and the other countries of the region occupying the 9th through 13th positions, with Croatia again leading the region with 4.1 subscribers per 100 inhabitants.

46. *Backbones.* Croatia has one of the most extensive academic backbones of the transition economies, with especially high-speed connectivity possible in the Zagreb region. Romania also benefits from the deployment of

8 Detailed information not available at the time of the research.

public networks, the Romanian Education Network and the Romanian National Computer Network. Bulgaria has several private international providers that have established networks across the country, as well as the national ATM data network developed by the Bulgarian Telecommunications Company. In terms of international connectivity, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia and Romania all have direct fibre optic links to European backbones; however, Albania and Yugoslavia are limited to satellite connections. Romania also operates the only Internet Exchange in the region, based in Bucharest.

47. *Internet Registries.* Romania and Bulgaria lead the region in terms of the total number of Internet registries, and Bulgaria with 18 has the largest number of locally owned Internet registries, whereas Albania has no locally owned registry. In terms of the total IP address allocation from locally-owned Internet registries, all of the countries in the region are grouped together behind the Baltic and Central European regions, although Croatia leads the region with 34,000 IP addresses per million inhabitants. The number of foreign-owned Internet registries does not vary much across the region and many of the same companies are registered in each country.

Black Sea and Russia (Belarus, the Republic of Moldova, Ukraine, Russia)

48. *Internet Hosts.* The information for this region is somewhat incomplete with no data available for the Republic of Moldova from the July 1999, October 1999 and January 2000 surveys⁹, as well as a problem with the reporting system for the Russian results from the January 2000 survey. In terms of sheer size, Russia has the largest network (excluding the results from January 2000) of all the transition economies. However, the Russian networks are concentrated in the major urban areas such that its number of hosts per million inhabitants (over 1000 in January 1999) remains around 10% of that found in the lowest Western European nations. Similarly, the Ukraine has a fairly extensive network of almost 29,000 hosts, which places it in the top third of transition economies, but when measured in terms of hosts per million inhabitants it ranks in the lower half with under 600. The Ukraine also showed strong growth over the course of 1999. Both Belarus and the Republic of Moldova have low levels of development with Belarus declining by 15% over the period. Because of the data collection problems for the Republic of Moldova, and Russia, no accurate results were available for their respective growth rates.

49. *Secure Servers.* Belarus and the Republic of Moldova each had only 3 identifiable secure servers by the end of 1999. However, there was some growth in Ukraine, which went from having 8 in March 1999 to 25 by year's end. Russia had the largest number of secure servers of all transition economies with nearly 120 in December 1999, representing an increase of over 100% from March 1999. However, Russia's leading number of secure servers represents only 0.2 % of the global total of secure servers.

50. *Access and Use.* Statistical information was only available for Russia and Ukraine. In Russia, it was reported that there are 5.4 million Internet users, or 3.7% of the population. The very general definition of Internet use in Ukraine found 200,000 users, or 0.4% of the population. For the transition economies where data was available, Russia and Ukraine had the lowest levels of Internet use as a percentage of the population; however, Russia does have a greater Internet density than the lower EU countries such as Greece's 2.9%.

51. *Services.* No statistical information on Internet services was available for any of the countries in the region.

52. *Teledensity.* Belarus leads the region with over 24 telephone lines per 100 inhabitants, followed by Russia's 20, Ukraine's 19, and 15 in the Republic of Moldova. Russia leads the region in terms of cellular subscribers with 0.51 per 100 inhabitants, Ukraine has 0.28, Republic of Moldova has 0.16, and Belarus follows with 0.12 subscribers.

53. *Backbones.* There is significant activity in the development of backbones in the region, with the most extensive networks deployed in Russia. Academic backbone networks are currently being developed in Belarus and already exist in Russia. There are also two Internet Exchanges operating in Moscow and St. Petersburg that provide efficient connectivity across the Russia's public and private networks. In the Republic of Moldova, the national telecom also acts as an unofficial Internet exchange through its peering relationships with several other ISPs. The Russian backbone networks are themselves a central point of connectivity for ISPs throughout the region, as well as among the other regions of the transition economies. Russia's international connectivity will be greatly enhanced by

9 RIPE Internet host count survey, see Chapter II.

the recent announcement of a 2.4 Gigabit per second connection to backbones located in Sweden.

54. *Internet Registries.* Russia and the Ukraine have the top two positions in terms of the number of locally-owned Internet registries, as well as the total number of Internet registries. Both countries locally-owned Internet registries make up a significantly larger than average proportion of the total number of registries. When we look at the number of IP addresses allocated by locally-owned Internet registries in the region, Russia leads the region with over 9 thousand addresses per million inhabitants, however, this falls below the overall average for transition economies. Belarus has the third lowest overall number of IP addresses per million inhabitants. The state of Internet registries in the region indicates that there is a fairly large diversity of activity in the Internet sector. However, the quantity of activity, from the perspective of the overall size of the potential market in the region, falls some distance below that of the Central and Eastern European, and the Baltic countries.

Caucasus (Armenia, Azerbaijan, Georgia)

55. *Internet Hosts.* Azerbaijan had the third lowest overall number of Internet hosts in January 2000 with approximately 600, Georgia fared slightly better with around 900, and Armenia led the region with 2,300. Armenia's total number of hosts increased by almost 150% over the period of January 1999 to January 2000, with the significant majority of the increase taking place in the last quarter of 1999. Azerbaijan and Georgia also demonstrated growth over the period, but given the low levels of their initial number of Internet hosts, the increases were not significant. In terms of the number of hosts per million inhabitants, Armenia is once again the leader in the region (with over 600) although its numbers remain a small fraction of those found in leading transition economies.

56. *Secure Servers.* No secure servers were located in Armenia, only one was found in Azerbaijan and there were 5 located in Georgia. There is also very little activity in this sector in the region and no significant growth was detected during 1999.

57. *Access and Use.* No statistical information was located for any of the countries in the region.

58. *Services.* No statistical information on Internet services was available for any of the countries in the region.

59. *Teledensity.* The second least developed region in terms of teledensity has nearly 16 lines per 100 inhabitants in Armenia, 12 in Georgia, and just under 9 in Azerbaijan. In terms of cellular subscribers, Georgia leads the region with 1.1 subscribers per 100 inhabitants, followed by 0.85 in Azerbaijan, and 0.2 in Armenia.

60. *Backbones.* In a situation similar to the Central Asian CIS countries, the geographical isolation of the region from the main international backbones has meant that the ISPs in the region have relied on satellite connections, however, the construction of the Trans-Asia-Europe fibre optic line should enable further development in this sector. No significant national backbones were identified in the region.

61. *Internet Registries.* The region does not have significant numbers of locally-owned Internet registries. Armenia leads the region with three. Georgia stands out in the number of foreign-owned Internet registries, with a similar level (10) to the Eastern European and Black Sea countries.

Central Asian CIS (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan)

62. *Internet Hosts.* In terms of the number of computers permanently connected to the Internet, this region is only slightly more developed than the Caucasus. In January of 1999, Tajikistan had the least number of Internet hosts (130) of any country but had surpassed Albania for second-last place in the January 2000 RIPE Host count survey. Kazakhstan leads the region in terms of the raw number of hosts (over 2000), however, Kyrgyzstan leads the number of hosts per million inhabitants (just under 800). Tajikistan, Kazakhstan and Kyrgyzstan all showed significant growth rates for the period from January 1999 to January 2000 with over 100% increases in the number of hosts. However, the totals for Turkmenistan and Uzbekistan both decreased slightly over the same period. By comparison, the number of hosts per million for the region's leading country, Kyrgyzstan (800), remains little more than 6% of Spain (12,400).

63. *Secure Servers.* The only secure servers in the entire region are located in Kazakhstan, which had 6 in December of 1999. There appears to be very little activity involving secure servers and no growth was detected in this sector across 1999.
64. *Access and Use.* No statistical information was located for any of the countries in the region.
65. *Services.* No statistical information on Internet services was available for any of the countries in the region.
66. *Teledensity.* The region has the lowest levels of teledensity for transition economies in 1998, ranging from less than 4 telephone lines per 100 inhabitants in Tajikistan to just over 10 in Kazakhstan. In terms of cellular mobile subscriber density per 100 inhabitants, the region is once again the least developed, with Kazakhstan's leading 0.17 subscribers per 100 inhabitants to Tajikistan's 0.01 subscribers.
67. *Backbones.* The geographical isolation of the region from the main international backbones has meant that the ISPs in the region have relied on satellite connections; however, the construction of the Trans-Asia-Europe fibre optic line should enable further development in this sector. The only currently deployed national backbones, which were identified in the study, were located in Kazakhstan, where both private and public sectors are deploying national data networks.
68. *Internet Registries.* The region has very few locally based Internet registries, with Kazakhstan and Kyrgyzstan each having four local registries, Uzbekistan having one, and Tajikistan and Turkmenistan having none at all. Kazakhstan, therefore, leads the region with over 100,000 possible locally allocated IP addresses. Kazakhstan also leads the region in terms of the number of foreign owned Internet registries, with the presence of several Russian ISPs in addition to the several international providers that are present throughout the region. Tajikistan had the lowest level of foreign-owned Internet registries of all the transition economies.

II. INTERNET USE

Measuring Internet Use

69. Internet use is notoriously difficult to measure, given the significant network resources that would be required to continually follow and record the minutiae of Internet traffic patterns. There are, however, two widely used sources for information on Internet use that rely on software technology in order to produce data on the number of computers with permanent connections to the Internet, or 'hosts', and what type of server software supports each host's site.
- The Network Wizards' Internet Domain Survey, sponsored by the Internet Software Consortium, (<http://www.isc.org/ds/>), attempts to discover every host on the Internet through a systematic search of all registered domain names.
 - Netcraft's Secure Server Survey (<http://www.netcraft.com/ssl/>) identifies those hosts connected to the Internet that contain the security software protocols, such as Netscape's Secure Socket Layer (SSL), that enable the use of encrypted transactions.
70. In addition to technological solutions for measuring Internet use, a primary benefit of which is their cross-national and cross-platform comparability, the traditional alternative remains the use of statistical surveys. Internet Service Providers are notoriously reticent to publicly provide information on their client/customer base and the lack of licensing requirements in most countries means that government agencies have few resources in place for monitoring their growth. However, several local marketing and consulting companies have begun to produce studies based on survey data on local Internet use, such as the BMF Gallup Media company in Estonia (<http://www.bmf.ee>) and Carnation Consulting in Hungary (<http://www.carnation.hu>). In addition, several international research and consulting agencies, such as IDC and Andersen Consulting, have increasingly expanded the regional content of their studies to include transition economies. Finally, the European Survey of Information Society (ESIS), a project of the Information Society Project Office (ISPO) of the European Commission, has recently expanded the focus of its study

to include Central and Eastern Europe and the Mediterranean areas.

Internet Hosts

71. Using a methodology similar to Network Wizard's Internet Domain Survey, RIPE (the Réseaux IP Européens) produces a monthly host count survey, which includes information on all the transition economies. The information is broken down according to each country's Top Level Domain (TLD – see section for more information on the Domain Name System) and then the number of 'real hosts' are identified by eliminating duplicate entries. The result is a monthly survey of the number of real hosts that are connected to the Internet, and listed in the Domain Name System as falling under each country's Top Level Domain. This survey provides us with a useful indication of the relative size and growth of each country's network. It should be noted, however, that users in each country might have their websites hosted on servers that are not physically located in the country, or that might be registered under one of the generic Top Level Domains (e.g. '.com' or '.net'). The cross-country comparison will still be valid unless it can be shown that a particular country has an exceptionally large percentage of sites hosted or registered outside of the country¹⁰.

Number of Hosts in Each Country per QTR from January 1999 to January 2000
Countries Ordered by January 1999 Data

Country	Hosts Jan 1999	Hosts Apr 1999	Hosts Jul 1999	Hosts Oct 1999	Hosts Jan 2000
Tajikistan	131	236	330	399	511
Albania	142	117	210	220	215
Azerbaijan	435	392	376	531	603
Uzbekistan	454	388	359	377	N/A
Republic of Moldova	613	1022	N/A	N/A	N/A
Georgia	738	751	945	960	898
Armenia	951	1077	1241	1210	2313
Belarus	1052	1049	1135	830	883
Bosnia and Herzegovina	N/A	N/A	N/A	N/A	N/A
Former Yugoslav Republic of Macedonia	1130	1382	1561	1431	1487
Turkmenistan	1171	1125	1248	844	852
Kyrgyzstan	1527	1652	1076	1439	3535
Kazakhstan	2250	2470	2668	4224	5715
Yugoslavia	7712	8801	8390	10424	10544
Croatia	9507	13154	13520	14308	14535
Lithuania	9802	11121	11880	12704	14193
Bulgaria	10250	13530	15170	15997	16832
Latvia	14332	15862	15980	16921	18877
Ukraine	19775	21830	24437	26539	28973
Slovakia	22064	24446	26092	26464	28183
Slovenia	22932	22146	22845	21622	23599
Romania	23508	27436	28529	31765	36294
Estonia	24158	25705	27154	28031	30103
Czech Republic	86482	92588	102186	112339	122253
Hungary	95931	100173	105464	101518	119642
Poland	130554	152212	142051	170134	171217
Russia	156678	184381	201578	213174	N/A

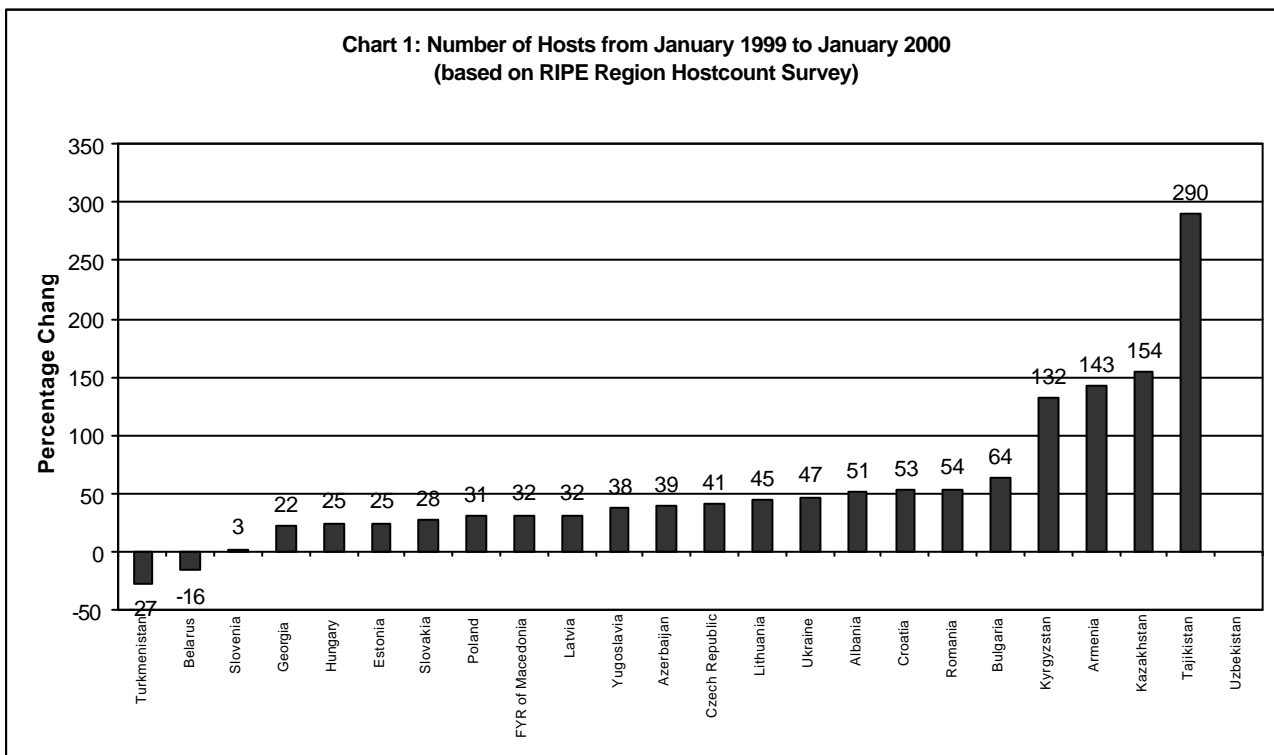
¹⁰ In 1997, Russia accounted for 0.04 % of the gTLDs, which would have added approximately 8,300 hosts to its total of 156,000, a change of approximately 5 %. Percentages were available for the Czech Republic (0.02%), Poland (0.02%) and Slovakia (0.00%).

(Source: RIPE Network Coordination Centre < <http://www.ripe.net/> >)

72. In January of 1999, there were seven countries among the transition economies that had less than 1000 Internet hosts and twelve countries that had less than 5000. According to the Network Wizards' Internet Domain Survey for January 1999 (<http://www.isc.org/ds/WWW-9901/report.html>), there were 43,230,000 in the world and 12,140,747 registered under the '.com' generic Top Level Domain. It should be noted that the Network Wizards survey generally returns a slightly lower number of hosts per top level domain in comparison with the RIPE survey.

73. Other countries with less than 1,000 hosts, according to the Network Wizards data, from outside of the transition economies include: Malta (966), El Salvador (815), Nicaragua (715), Faroe Islands (621), Andorra (517), Nigeria (410), Gibraltar (316), Islamic Republic of Iran (244), Nepal (153) and Afghanistan (1). Therefore, four of the countries in the study – Tajikistan, Albania, Azerbaijan and Uzbekistan – had fewer Internet hosts than the Principality of Andorra with its population of 65,000 inhabitants.

74. We must also take note of a few aberrations in the RIPE hostcount survey. No information was available on the number of hosts under the Republic of Moldova's Top Level Domain (.MD) after April 1999. There was also no data available for the hostcount for Uzbekistan in the January 2000 survey. Finally, we have indicated "Not available" for the Russian Federation as they show a dramatic drop in the number of hosts in Russia from approximately 213,000 in October 1999 to less than 64,000 in January 2000. In response to a request for clarification, RIPE indicated that problems with to the Moldovan and Uzbek DNS servers prevented their automated survey from gaining access to their respective Top Level Domain information. The drop in the number of Russian hosts was due to a change in the equipment used by RIPE to conduct the Russian survey, which was then unable to access large sections of the Russian network.



75. The figure above clearly indicates the overall trend of strong growth in the number of Internet hosts with the large majority of countries witnessing an increase from 22 to 64 % over the period of January 1999 to January 2000.

Internet Host by Country: per million

Country	Hosts per million Jan 99	Hosts per million Jan 2000
Uzbekistan	20	N/A
Tajikistan	22	87
Albania	46	69
Azerbaijan	57	79
Belarus	101	85
Kazakhstan	137	349
Republic of Moldova	139	N/A
Georgia	145	176
Armenia	264	643
Turkmenistan	279	203
Kyrgyzstan	332	769
Ukraine	387	567
The FYR of Macedonia	565	744
Bosnia and Herzegovina	N/A	N/A
Yugoslavia	728	995
Romania	1045	1613
Russia	1061	N/A
Bulgaria	1220	2004
Croatia	2067	3160
Lithuania	2649	3836
Poland	3374	4424
Slovakia	4086	5219
Latvia	5733	7551
Czech Republic	8396	11869
Hungary	9405	11730
Slovenia	11466	11800
Estonia	16661	20761

(Calculations based on data from RIPE Network Coordination Centre < <http://www.ripe.net/> >)

76. The significance of the dramatic increase in the number of hosts in Tajikistan is diminished when we consider the extremely low initial level in January 1999. However, both Armenia and Tajikistan have shown a significantly larger rate of development in comparison with the group of countries that had less than 1,000 hosts in January of 1999.

77. In the group of countries with between 1,000 and 5,000 hosts in January 1999, Kazakhstan and Kyrgyzstan more than doubled their number of Internet hosts, which stands in dramatic contrast to Belarus and Turkmenistan who both witnessed a slight decrease.

78. If we extrapolate Russian growth from its previous quarters, where growth went from 18% to 9% and then to 6%, then we should expect that the overall growth from January 1999 to January 2000 would fall within the range of 40 to 45%.

79. In order to more closely establish the patterns of development for the rest of the countries, most of whom fall within the growth rate of 22 to 64 %, let us first consider the relative strength of the level of Internet development based upon the number of hosts per million inhabitants.

80. A consideration of the number of hosts per million inhabitants clearly indicates the greater Internet density in the Baltics and central Europe in comparison with the other regions under study.

81. When we consider the rate of development from January 1999 to January 2000 (see previous Number of Hosts from Jan 99 to Jan 00 table), Estonia and Hungary's 25 % increase in the number of hosts places them at the lower end of the mid-range (22 to 64% increase) of countries. However, despite their much higher initial starting point, both countries exhibited a dynamic increase in their Internet sector. The Czech Republic also began the period with one of the highest levels of Internet density and still maintained an increase of 41% over the course of the year. By contrast, Slovenia's second highest level of density in January 1999 risked falling into fourth place behind Hungary and the Czech Republic when the number of hosts increased by only 3 %.

82. Finally, the East European countries all produced between 32 and 64 % increases in the number of Internet hosts. Bulgaria's 64 % increase, Romania's 54% and Croatia's 53% increase all indicate levels of development that are approaching their Central European and Baltic neighbours. However, Bulgaria's 2,004 hosts per million in January 2000 remains less than 1/10th of Estonia's leading 20,761 hosts per million inhabitants.

83. The OECD report, 'Communications Outlook 1999', provides the July 1999 Internet host density, also based on RIPE data, for most of the world's countries. The United States, Canada, Iceland and Finland had the highest levels of Internet host density with over 1,000 per 10,000 inhabitants, i.e. 1 Internet host for every 10 persons. Estonia's 20,761 per million, or 208 per 10,000, is higher than Spain (124), Italy (138), Japan (147) and France (174).

Secure Servers

84. In order to make use of the Internet for commercial purposes, there must be a technological framework that can ensure the security of any transaction that passes through the public networks. Encryption software is the technological solution that is the foundation for e-commerce. The Secure Socket Layer (SSL) is a protocol for encrypted transmissions over TCP/IP networks which establishes a secure end-to-end link between the host site's web server application and the end user's browser application¹¹. The verification of the SSL encrypted transaction is based upon the exchange of digital certificates that are then authenticated by a 'trustworthy' third party, i.e. a certification authority (CA)¹². In the December 1999 Secure Server Survey, Netcraft¹³ identified 58,685 sites with valid third-party certificates, a 77% increase from the January 1999 total of 33,091 secure sites. Netcraft also discovered that the rate of growth in Europe surpassed that of North America. However, the United States remains, by far, the dominant player in the secure server marketplace with over 68% of the total number of secure servers¹⁴.

85. The leading countries for secure servers in transition economies are Russia and the Czech Republic, which each represent less than 0.2% of the global total. The following table indicates the number of secure servers identified by Netcraft in their March, June, September and December 1999 survey:

11 The Universal Resource Locator (URL) for a secure server, enabled with the SSL protocol, would then include 'https' rather than the standard 'http' identifier.

12 Both browser software (Netscape Navigator, Internet Explorer) and server software (Microsoft IIS, Apache SSL) interact with the certificate authority, which in 99% of the secure transaction market, after the acquisition of its competitor Thawte in December 1999, is the U.S. corporation, Verisign (<http://www.verisign.com>).

13 The British Internet consultancy, Netcraft, performs a monthly survey of web servers, based upon all hosts identified in Domain Name Registries, which is then used to identify any web servers that are enabled with the SSL protocol, to produce the Secure Server Survey. By requesting the public certificate, Netcraft are able to identify the identity, geographical location, and legal jurisdiction of the owners of each SSL enabled site. It should be noted, then, that the geographical location of each secure server is not based upon the ccTLD of the domain name, but rather from the information provided by the owners of the site to the certification authority, as contained in each site's public certificate.

14 One potential explanation for the dominance of the United States and Canada is the widespread use of credit card by consumers in North America, as well as the reluctance of credit cards companies outside of North America to permit merchants to engage in online credit card transactions. See, Cybercash (<http://www.cybercash.com>).

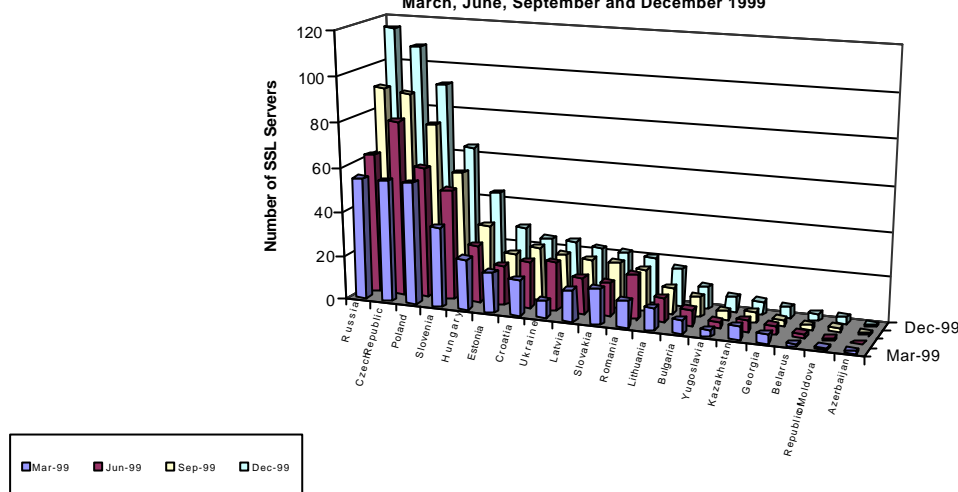
Secure Servers by Country

Country	March 1999	June 1999	September 1999	December 1999
Russia	55	63	91	116
Czech Republic	55	79	89	108
Poland	55	59	76	92
Slovenia	36	50	55	64
Hungary	23	26	32	44
Estonia	18	18	20	29
Croatia	16	21	24	25
Ukraine	8	22	22	25
Latvia	14	16	21	23
Slovakia	16	15	21	22
Romania	12	20	19	21
Lithuania	10	11	12	17
Bulgaria	6	7	9	10
Yugoslavia	3	3	4	7
Kazakhstan	6	5	5	6
Georgia	4	4	3	5
Belarus	1	2	2	3
Republic of Moldova	1	1	2	3
Bosnia and Herzegovina	N/A	N/A	N/A	N/A
Azerbaijan	1	0	1	1

Source: Netcraft Secure Server Survey, <http://www.netcraft.com>

86. As shown in the table the first five countries, Russia, Czech Republic, Poland, Slovenia and Hungary have shown an increase of over 100% from March to December 1999, followed by other eastern European countries which registered a growth of 50-100%.

Chart 2: Secure Socket Layer (SSL) Server Survey Data from Netcraft for March, June, September and December 1999



Internet Access and Usage Patterns

87. A recent survey, 'Measuring Information Society' (<http://www.ispo.cec.be/polls/Welcome.htm>), published in March 1999 by the European Commission, reported that 8.3% of Europeans surveyed had access to the Internet, or had an Internet connection. There was, however, a rather large divergence from 39.6% of individuals in Sweden having Internet access, to 2.9% in Greece; in particular, the Northern European countries, i.e. Sweden, Denmark and the Netherlands, had the highest connectivity rates and the Southern countries, i.e. Greece, Spain and Portugal, had the lowest levels.

88. The quality of the data available on access and usage patterns for the transition economies varies widely, depending primarily on the existence of privately produced surveys, as there are very few statistical data being produced in this area by national Governments.

89. The following information on Internet usage and access patterns is drawn from available reports produced by local research and consulting agencies. At the time of writing information for Bosnia and Herzegovina was not available:

Croatia: Based upon a sample of 1,100 citizens older than 12 years of age in May 1999 conducted in 131 different settlements, the Czech research agency IPSA (<http://www.ipsa.hr/Internet.html>) estimates that:

- 12% of Croatian households have a personal computer, or 170,000 households.
- 5.6% of Croatians are active Internet users, i.e. used the Internet in the past month, or 237,000 active Internet users.
- The five major ISPs in Croatia report a total of 90,000 subscribers.
- 52% of Internet users live in the four major cities, 40% in smaller towns and 1% in more remote settlements.
- 50% of Internet users are younger than 26, 33% are between 26 and 35 and 20% are between 36 and 55. Less than 3% are older than 55.
- 58% of Internet users are male.

Czech Republic: The US-based research group, International Data Corp (<http://www.idc.com/>) produced a report in November 1999 that estimated:

- There were approximately 292,000 Internet users, i.e. persons who have been connected to the Internet in the last six months, or approximately 3% of the population.
- Students (college, university and high schools) make up 47.6% of all users.

- The number of Internet users is growing by 30.7 % every year.

There was some controversy over the results of this report in the Czech IT industry whose leaders claimed between 500,000 and 700,000 Internet users based upon local public opinion surveys. (For an article on the controversy, see http://www.Internetnews.com/intl-news/print/0,1089,6_253361,00.html)

Estonia: The Estonian market and media research company, BMF Gallup Media (<http://www.bmf.ee>), conducted a survey of 'Usage of Computers and Internet among the Population of Estonia' in late-1998 / early-1999.

- The total number of Internet users was approximately 168,000 for persons between 15 and 74 who used the Internet once in the past six months.
- 62 % of users accessed the Internet from the workplace, 33 % from school and 22 % from home.
- 120,000 Internet users (72 % of the total) used the Internet frequently, i.e. at least once in the past week.
- 11 % of Internet users, almost 19,000 people have their own homepage.
- In a more recent study (unpublished figures), BMF announced in a press release that the number of Internet users in Estonia had reached 21 % of the population with 58% of 15 to 19 year olds being Internet users and 94 % of them having used a computer at least once in their lifetime.

Hungary: The Hungarian 'New Economy' consulting company, Carnation Internet Consulting (<http://www.carnation.hu>) regularly publishes results of their research into Internet use. The latest information is based upon their June 1999 survey.

- There were 506,000 regular users of the Internet in Hungary, or 5.1 % of the total population.
- 60 % of Internet users go online from school, 25 % from work and 25 % from home.
- Their profile of an 'average user' is someone aged 20-25, a student or young business person, lives in an urban setting, well educated with a high disposable income.

Poland: The Polish 'interactive media agency', AMG:Net (<http://www.amg.net.pl/indexe.shtml>), surveyed over 100 Polish medium to large companies and multinational subsidiaries with Internet access. The November 1999 report concluded that:

- All of the respondents used e-mail and 88 % of the companies had a website.
- 94 % of the companies used the Internet for general communication purposes.
- 86 % used the Internet for online research; 79 % for marketing and 39 % for competitive intelligence.
- Only 17 % used the Internet for P.O.S. (Sales) and 19 % for After Sales Services.
- 17 % used the Internet for Business to business (B2B) purchasing.

The Warsaw Voice online news magazine (<http://www.warsawvoice.com.pl>) reported in December 1999 that a study by the International Data Corp. (IDC) estimated approximately 1.5 million Internet users in Poland which would be approximately 3.9 % of the total population.

Russian Federation: Several media sources reported that a study produced by the Russian National Institute of Social and Psychological Research identified:

- 5.4 million Internet users in Russia which would represent approximately 3.7 % of the total population.
- White-collar workers and students were reported to make up the largest proportion of Internet users.
- Over 50 % of those surveyed are online more than one hour per week.
- The most popular type of websites visited are news sites, cited by 42 % of those surveyed, followed by science and education sites, then business and finance sites.

Slovakia: The Slovak research companies, Focus and Webner, collaborated on the 'NetProjekt' survey of computer and Internet use in the Slovakia (<http://www.prieskum.sk/eng/DEFAULT.asp>).

- There are 510,000 people with Internet access, although it is not specified whether they are regular users, or when they last accessed the Internet.
- This represents 9.5 % of the population, a large increase from their 1997 study which reported 5.5 %.

Slovenia: The academic research centre, 'Research on Internet in Slovenia (RIS)' (<http://www.ris.org>) produces a number of studies on the Internet, including studies of e-commerce, regulation and case law pertaining to the Internet, as well as surveys of websites and ISPs. Their most recent survey (from September 1998) concluded that:

- There were 280,000 Slovenians who had used the Internet in the past three months, or 14 % of the total population.
- There were 180,000 persons who use the Internet on a monthly basis.
- 44 % of Internet users reported their main access point as the workplace, 38 % from home, and 13 % from school.

Ukraine: The United States' Department of Commerce operates BISNIS (<http://www.bisnis.doc.gov>), a resource centre on economic opportunities in Russia and the 'Newly Independent States'. They have produced a report in June 1999 on the Internet in Ukraine (<http://www.bisnis.doc.gov/bisnis/country/9906intuk.htm>).

- The report estimates the number of Internet users (undefined) in the Ukraine at 200,000, or 0.4% of the population.
- 30 % of Internet users live in Kiev.
- Marketing research indicated that there were approximately 100,000 regular Internet users.
- 20 % of Internet users are government employees, 30 to 40 % are corporate customers, 10 to 18 % are medium and small businesses, 22 to 30 % are miscellaneous customers.

90. Although the uncertain statistical significance of the data raises problems for cross-country comparisons, in particular the definition of a user and the differing dates of the surveys, we may make the following observations based upon the data as rough estimates of the number of Internet users in each country.

91. Compared with Western European countries which ranged from 2.9% in Greece to 39.6% in Sweden in terms of user population, transition economies have shown, where data was available, a user population ranging between 0.4% - 21%: Ukraine – 0.4%; Russia – 3.7%; Poland – 3.9%; Czech Republic – between 3 and 6%; Hungary – 5.1%; Croatia – 5.6%; Slovakia – 9.5%; Slovenia – 14%; and Estonia – 21%.

92. Therefore, with the exception of Ukraine, all of the above countries fall within the range of Western European nations. Given that the countries for which data was available are all from Central and Eastern Europe, the regions with the highest levels of Internet infrastructure development, it would be reasonable to conclude that the remaining countries from Central and Eastern Europe would have a similar range of Internet access levels, and that the countries from the other regions would likely have lower levels of Internet access.

Internet-based Services by Institutions

93. A significant portion of the content of the data traffic on the Internet is the provision of services via the World Wide Web. Services that are potentially offered over the Internet include:

- ◆ Government documents / legislation / contact information
- ◆ Travel resources (train schedules, hotel bookings)
- ◆ Medical Information (diagnoses, pharmaceutical products)
- ◆ Employment resources (job listings, job training programs)
- ◆ Consumer goods (groceries, books, music)
- ◆ Financial resources (banking, stock markets, insurance, personal management)
- ◆ Media (newspapers, magazines, news agencies, radio)
- ◆ Culture (museums, libraries, electronic collections of books, art)
- ◆ Entertainment (online music, streaming video, online games)

94. Thus, another potential indicator of the use of the Internet is the range of services available in a given country. One method of measuring this indicator would be to identify all the domain names registered under every

country's Top Level Domain and systematically categorize the nature of each website. This method immediately raises the problem of websites run by local companies but which are either registered to a generic, or other country's, top level domain, or are hosted on a server that is not physically located within the country. Finally, it should be noted that not all content that flows over the Internet infrastructure is available via the World Wide Web. High speed data networks now employ frame-relay, X.25 and ATM technological protocols for data transmission, enabling voice communications and video transmission over the Internet backbones. Therefore, a comprehensive account of services employing the Internet would have to include banking and other financial networks, voice telephony offerings, and other specialized tasks deployed via data networks.

95. However, the European Survey of the Information Society (ESIS), which expanded its coverage to include central and eastern European countries, includes an October 1999 survey of WWW indicators. (<http://www.ispo.cec.be/esis/esis2www/esis2www.htm>) Through surveys and local reporting agencies, they have compiled the number of websites offered by local organizations in the following categories:

- Primary / Secondary Schools
- High Schools / Universities
- National Ministries
- Local and Regional Authorities
- Hospitals / Clinics
- Libraries
- Museums

96. The survey identifies the number of institutions that exist in each category, then the number of websites produced by these organizations and then offers a percentage of websites to the total population. Based on this method, we must presume that they would exclude from the survey and websites that fall under the above service categories, but which does not have any real world (bricks-and-mortar) form, i.e. an online museum or learning institution.

Percentage of Service Organizations Having Websites

Country	Primary/ Secondary Schools	High Schools/ University	National Ministries	Local and Regional Authorit y	Hospitals/ Clinics	Museums	Librarie s
Albania	0.05	63.6	41	0	0	0	0
Bulgaria	1.9	88.1	81.3	13.1	0.6	4.4	0.3
Czech Republic	12.4	44.9	100	3.2	20.6	30.4	4.1
Estonia	14.3	56.8	100	31.6	14.1	31.6	2.6
Hungary	18	75	100	17	23	19.8	5
Latvia	4.1	48.5	66.7	6	3.2	100	1.4
Lithuania	9	100	100	13	9	45	14
Former Yugoslav Republic of Macedonia	0	28	67	2	N/A	7	N/A
Poland	2	70	94	30	8	1	3.3
Romania	0.9	8.5	25	N/A	N/A	N/A	N/A
Slovenia	40.6	72.2	100	29.4	11.5	35.3	41.5

(Source: <http://www.ispo.cec.be/esis/esis2www/esis2www.htm>)

97. A further difficulty with the methodology of the ESIS survey is the reliance on local agencies for data collection, which raises questions about the cross-country compatibility of the results. For example, Slovenia has the highest percentage of libraries with websites at 41.5 %, however, the total number of libraries included in the results for Slovenia was 65, whereas most of the other countries in the study had a much larger total number of libraries. This raises the question of how institutions are defined, i.e. are small municipal library collections included under the category of 'libraries', because if they are excluded then the major collections in urban centres who are more likely to have websites will be unfairly over represented in the final percentage.

98. In a few cases, the country data were broken down further into subcategories, which often revealed a disparity between institutions located in the principal urban centres and the broader regions of the country. Finally, the quantitative nature of the survey does not take into account the qualitative differences between the various websites within each category. For example, it does not distinguish between a website that merely provides basic biographical and contact information for government personnel, in contrast to a website that offers a complete legal database and an updated parliamentary agenda.

99. However, we may make a few simple observations based on the available data.

- The sector with the highest level of website development is that of national government administration and ministries.
- High schools and universities are the second most developed sector, and when broken down further, universities are clearly the more dominant subsector.
- Primary and secondary schools are unsurprisingly the least developed sector in the education field of services. Slovenia has an exceptionally high level (40.6 %) in this sector, with nearly three times the percentage than second place Estonia (14.3 %). Albania, the former Yugoslav Republic of Macedonia and Romania have less than 1 %.
- Local and regional authorities reveal unequal levels of development with Estonia, Poland and Slovenia demonstrating above average levels; however there is clearly overall room for further development in this sector.
- Hospitals and medical clinics also demonstrate an overall low level of website development and Hungary's leading 23 % is not extremely significant.
- The lowest overall development is to be found in the library sector. Every country, except for Slovenia and Lithuania, has less than 5 % penetration in this sector.
- The country with the lowest levels of development is Albania. Romania also seems to show very low levels; however, the data from Romania are incomplete.

III. NATIONAL INFORMATION SOCIETY INITIATIVES IN TRANSITION ECONOMIES

100. National information society initiatives are not, for the most part, detailed legislative agendas, but rather they are general statements of national strategies for the development of the Internet and its effects on society. The following countries have taken some form of an Information Society initiative :

Reference List of the Governmental sites related to Information and Communication Development and Related Bodies in Transition Economies

Country	Governmental sites related to Information and Communication Development	Governmental responsible bodies
Albania	http://www.mininf.gov.al/english/Default.htm	<ul style="list-style-type: none"> • Ministry of Information
Armenia	http://www.amnic.net/cgi/engine/db/government.html	<ul style="list-style-type: none"> • Armenian Internet Users Group
Azerbaijan	http://www.president.az/azerbaijan.htm	
Belarus	http://www.president.gov/eng/index.htm http://www.ac.by/country/industry.html	<ul style="list-style-type: none"> • Information Resources Section • National Academy of Sciences
Bosnia and Herzegovina	http://www.ohr.int/links.htm	<ul style="list-style-type: none"> • Office of the High Representatives
Bulgaria	http://www.president.bg/engl/services/index.html http://www.iccs.bas.bg/iccs/iccs.html	<ul style="list-style-type: none"> • Information and Public Relations • Institute of Computer and Communication systems • National Strategy for IS Development – part of ‘Bulgaria 2001’ government programme.
Croatia	http://www.hr http://www.carnet.hr http://www.croatia.hr/media.html	<ul style="list-style-type: none"> • Department of Telecommunication & Faculty of Electrical Engineering and Computing (Univ. Of Zagreb) • Croatian Academic & Research Network (CARNet) • Croatian Institute for Culture and Information
Czech Republic	http://www.czech.cz http://www.president.cz/predreg.html http://www.usisr.cz/EN/index.html	<ul style="list-style-type: none"> • Czech Information Center • The State Information Policy (SIP) administered by the Office of the State Information System
Estonia	http://www.riik.ee/riso http://www.eif.ee/English/ http://www.gov.ee/government http://www.eik.ee/english/policy/plan.htm http://www.ciesin.ee/UNDP/tigerleap/foreword.html	<ul style="list-style-type: none"> • Estonian Government • Department of State Information Systems • Estonian Informatics Centre • Information Policy Action Plan • Tiger Leap National Education Program
Georgia	http:// www.parliament.ge/gotoGeorgia.htm	<ul style="list-style-type: none"> • Georgian Parliament
Hungary	http://www.itb.hu http:// www.iif.hu http://www.mtesz.hu/nis/corenis.htm	<ul style="list-style-type: none"> • Interministerial Committee for Informatics • National Information Infrastructure Development Program(NIIDP) • National Informatics Strategy for Hungary

Country	Governmental sites related to Information and Communication Development	Governmental responsible bodies
Kazakhstan	http://www.president.kz/main/mainframe.asp?Ing=en http://www.kazakhstan.kz/w3kaz_e.html	<ul style="list-style-type: none"> AS RC of the Administration of the President
Kyrgyzstan	http://www.kg http://www.kabar.gov.kg/english/all.html	<ul style="list-style-type: none"> kg– Kyrgyz Republic kabar – Kyrgyz Republic
Latvia	http://www.mfa.gov.lv/eng/policy/Hrights/Integration/Information.htm http://www.gov.lv	<ul style="list-style-type: none"> National Programme « The Integration of Society in Latvia » Valsts Informācijas Tīkla Agentūra
Lithuania	http://www.iid.lt/eng/index.htm http://www.smm.infocentras.lt/index_en.html http://www.iid.lt/eng/eng_docs/pro0.htm	<ul style="list-style-type: none"> Ministry of Public Administration and Local Authorities Ministry of Education and Science State Communications and Informatics Development Programme
The former Yugoslav Republic of Macedonia	http://www.sinf.gov.mk	<ul style="list-style-type: none"> Ministry of Informatics
Republic of Moldova	http://www.the Republic of Moldova.md http://www.md/	<ul style="list-style-type: none"> National Informatics Center
Poland	http://www.poland.pl http://www.uci.agh.edu.pl/PTI/summ.html	<ul style="list-style-type: none"> Polska Strona Główna Strategy of Information Technology Development in Poland
Romania	http://domino.kappa.ro/guvern/ehome.nsf http://info.cni.ro/strategy.htm	<ul style="list-style-type: none"> Department for Public Information National Strategy for Informatisation and Fast Implementation of the Information Society
Russian Federation	http://www.rags.ru http://www.gov.ru:8102/index.html http://www.gosorgan.amursk.ru	<ul style="list-style-type: none"> Russian Academy of Public Administration Russian Government Internet Network Home Page
Slovakia	http://www.government.gov.sk/LISTA/sk_frame_govnet.html http://nic.savba.sk/list-e.html	<ul style="list-style-type: none"> Úradu vlády Slovenskej republiky Computing Center of Slovak Academy of Science
Slovenia	http://www.gov.si http://www.uvi.si/uvj	<ul style="list-style-type: none"> Government centre for Informatics Public relations and media office
Tajikistan	http://www.tjns.tj	<ul style="list-style-type: none"> TJ Network Services
Turkmenistan	N/A	N/A
Ukraine	http://www.mia.gov.ua	<ul style="list-style-type: none"> Ministry for Internal Affairs of Ukraine
Uzbekistan	http://www.uznet.net/frame2.html	<ul style="list-style-type: none"> Uznet
Yugoslavia	http://www.gov.yu http://www.mfa.gov.yu/Related/ekonomija/index_e.html http://www.gov.yu/informatics/documents/infostrategy.htm	<ul style="list-style-type: none"> Ministry of Information Ministry of Foreign Affairs Strategy of Development of Informatics in the Federal Republic of Yugoslavia

IV. CONCLUDING REMARKS

- We have observed considerable regional differences in the development of the Internet across transition economies. The Central European and Baltic countries hold a significant lead over the rest of the transition economies in terms of the number of hosts per million inhabitants, the number of secure servers in operation, the percentage of the population using the Internet, and the range of services available over the Internet. Estonia, the Czech Republic and Slovenia emerged as the overall leaders in Internet development.
- The Black Sea region also suffers from uneven development, in the Internet environment. Ukraine has a particularly large network. However, in relation to the size of the population, its network ranks in the lower half of the transition economies. The Caucasus and Central Asian CIS countries are considerably less developed than the Central European and Baltic countries.
- At the micro level of Internet development, it is clear that despite the significant barriers to Internet connectivity that are still present new potential exists for economic opportunities. In most of the transition economies, there is an increasing effort to tap the potential of a relatively high-speed Internet connection at lower cost.
- Whereas the macro-level indicators of the study reveal significant inequalities in the development of the Internet infrastructure of transition economies at the national level, the micro-level analysis shows that individual users and businesses in nearly every country could experience Internet connectivity via technologies that are equivalent to, or above, the average mode of Internet connectivity in the countries with the highest levels of Internet development. The task at hand, therefore, is to extend this potential connectivity as widely and evenly as possible, enabling full participation in the transition to the 'New Economy'.

Issues to be considered further

- *Correlation between economic development and Internet development:* One of the preliminary findings of the Survey has been the considerable correlation between economic development and Internet development. It was confirmed that Internet development depends in large part on economic growth and development. However, there are a few exceptions to this conventional wisdom. The Estonian case illustrates that proactive governmental policy can accelerate Internet development. An issue to be further explored is which governmental tools and policies to promote the use of the Internet would stimulate economic growth and job creation in the region.
- *Competition, Economic efficiency and Telecommunication pricing:* In the West, the competitive market structure has created economic efficiency by lowering tariffs and cost for telecommunications. Over the last few years, the average cost for domestic and international calls has decreased by more than a double-digit percentage. By comparison, many of the transition economies' telecommunication infrastructures are outdated and the modernization of these legacy networks requires heavy new investment which, in return, require new foreign direct investment. The standstill situation that persists in most of these countries generates a paradox of pricing in which the cost for the same communication in the region is three to five times more than the average cost in developed countries. The question then is can the liberalization of the telecommunications sector accelerate and to what extent can this process be linked to enterprise development and local economic growth in the region.

- *Internet-based convergence of new business services*: In OECD economies over 60-70 percent of the GDP is being generated by the services sector. Some transition economies are moving quickly towards this level. In recent years, the convergence process - in which technology, trade and investment increasingly interact in the Internet-based market place - has been seen in a large part of the services sector. However, to what degree and depth this new convergence will be visible in transition economies in the near future remains unclear. It should therefore be explored whether a highly developed network infrastructure will be sufficient to create the environment for new competitive services and whether the networked workforce could generate the same level of productivity as in OECD economies.
- *New transition approach needed?* : The Survey pointed out that in a number of transition economies there is increasing recognition of the importance of the 'New Economy'. Whereas many Governments in the region have previously tended to focus mainly on the traditional economic dimensions of this transition, they are now facing the need for seamless interaction with the digital economy. Unless the transition economies develop linkages with the global networked economy, and unless wealth and jobs are created from this linkage, the economic situation of transition economies may not attain its full potential. There is thus a need for a substantial paradigm shift from this conventional approach to economic transition. The overriding question is what will be the best policies and instruments available to further the development of Information Society and the Internet-based enterprise development in the region. The translation of these objectives into real economic growth in the region will remain an integral part of the new transition approach.

The Role the UN/ECE can play in Internet Enterprise Development in transition economies.

101. The issues surrounding the development of the Information Society are so far-reaching that neither government nor industry nor individuals can hope to tackle them alone. Building the Information Society has become the agenda of Governments across the region. In the past three years, some Governments in the region have created Information Society advisory groups, as listed in this Survey. The UN/ECE secretariat strongly supports concerted action of this kind and encourages Ministers to cooperate in pressing forward measures that address the many matters of common concern to all transition economies

102. The June 2000 Forum on E-commerce for Transition Economies in the Digital Age will be a platform for initiating the work towards a common approach in areas of importance to transition economies such as promoting access to the Information Highway, expediting the electronic delivery of government services and developing a "critical mass of digital products and services" for the Internet and other new media.

103. The UN/ECE, in keeping with its institutional focus, has been intensifying its work to involve the transition economies as full participants in the global information society by organizing this Forum.

104. The UN/ECE is also ready to do its part in helping to increase the momentum of these efforts in order to ensure the successful transition to a knowledge-based society and economy throughout the region. The Committee may wish to consider a work programme for the Information Society and Internet Enterprise Development in transition economies including recommendations and setting out action plans (e.g. establishing Teams of Specialists) which could contribute a forum for discussions and advice on major areas of unfinished and new business, which would concern both national governments, regional international organizations, as well as the enterprise sector should be developed further to achieve the aforementioned goals in an effective way.

105. This Survey has confirmed that that the region has enormous potential for trade and enterprise development based on the innovative power of the Internet. It is to be hoped that this potential will rapidly be achieved for the benefit of all the countries with economies in transition.
