Уфа: УГАТУ, 2004 Вестник УГАТУ Т. 5, № 1 (9). С. 197–203



УДК 681.324

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# THE "DIGITAL DIVIDE" RAISED FROM THE INTERNATIONAL INTERCONNECTION IN INTERNET TIMES

The available data in this paper illustrates that both the speeding development of Internet and the widening digital divide in Internet times is surprising the world. It is the cause that the special economic characteristics of Internet, that is, the economies of scale and the distinct externality of Internet, lead a monopoly and unfair charges in Internet interconnection between countries. Then we point out that the "digital divide" reflects the seriously unbalanced distribution of Internet in the world, which damages both developing and developed countries and further aggravates the disequilibria of global economy. Finally, we present the principle of Internet interconnection and suggest that bridge "digital divide" needs international communities paying a close attention to and participating in setting up a fair and reasonable Internet settlement system. *Internet; settlement of interconnection; digital divides; global economic; international communities*

## 1. THE PROBLEM WITH THE INTERNATIONAL INTERCONNECTION OF INTERNET

Internet originally commenced in America and the United States has kept the absolute leading position in the Internet field since that time. Currently, There only are two methods of the Internet settlement between countries. One is peering and the other is transit. Usually, developed countries and regions adopt the peering method for each other, in which both sides offer the half circuit separately, exchange the traffics without payment and need no settlement at all. Contrarily, most of the developing countries

From the project supported by the National Natural Science Foundation of China: Study of the pricing mechanism, principle and pattern of the Internet services, 70271057/G011204, Zheng Huisong, Jia Danhua, 2003,01.

***От редакции.*** Деловые контакты между учеными УГАТУ и ведущих технических университетов г. Нанкина, одного из крупнейших промышленных и научных центров Китайской Народной Республики, успешно развиваются с начала 90-х гг. Накоплен большой опыт совместных работ в рамках действующего Договора о сотрудничестве с Нанкинским университетом аэронавтики и астронавтики (НУАА), ведутся совместные исследования с Нанкинским университетом науки и технологий (НУНТ), достигнута договоренность о выполнении совместных научных и образовательных проектов с Нанкинским университетом почты и телекоммуникаций (НУПТ).

Предлагаемая вниманию читателей статья доцента НУПТ г-жи Джа Данхуа посвящена одной из наиболее острых для современного Интернет-сообщества проблем, связанной с так называемым «цифровым неравенством», сложившимся между наиболее развитыми в технологическом отношении странами (и в первую очередь, США) и развивающимися странами Азии, Африки и Латинской Америки, в которых сегодня проживает подавляющая часть населения земного шара, в силу экономических причин оторванного от преимуществ доступа к глобальной сети.

На примере реальных статических данных в статье показано, как ускорение темпов развития Интернет сопровождается углублением «цифрового неравенства» в мире. Причиной этого является экономическая специфика Интернет, поскольку глобальный характер и распределенность Интернет неминуемо ведут к монополизму одних стран и несправедливым ценам в установлении Интернет-коммуникаций между другими странами. Подчеркивается, что «цифровое неравенство» отражает сложившийся сегодня серьезный дисбаланс мировой аудитории Интернет, что пагубно сказывается как на развивающихся, так и на развитых странах и подрывает равновесие глобальной экономики в целом. И наконец, в статье предлагается новый подход к организации взаимодействия в среде Интернет; отмечается, что для преодоления «цифрового неравенства» международное сообщество должно уделять больше внимания становлению и упрочению справедливого и взаимовыгодного партнерства всех участников Интернет.

Редколлегия журнала сочла возможным опубликовать данную статью в оригинальном виде, сохранив стиль и язык изложения автора. Хочется надеяться, что обсуждаемые в статье идеи (несмотря на их очевидную дискуссионность) найдут интерес у читателя журнала.

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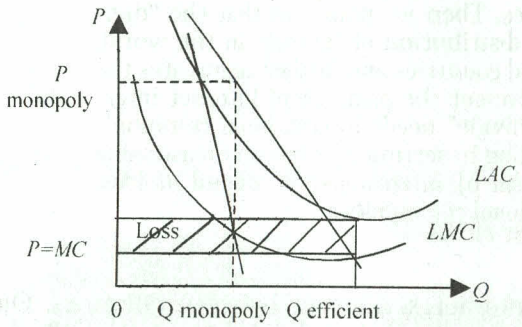
have connected their own backbone-networks to the Internet by the method of transit since the time of Internet introduced. In this way, the United States makes no payment, while the connected countries have to pay two half-circuit rents plus information flow fee. (Chen Kai, 2001) It may be rational only in the initial phase when information was mainly flowing from developed countries to the developing one, but not these days. Because of this way against the principle of balanced cost and income, it is to be proved more and more irrationalities when the information flows on the Internet tend to a balance bilaterally.




**Graph 1.** Internet externality. From: Qu Futian, Progress in Resource & Environmental Economics, Nanjing Agricultural University, February 2000, Nnajin

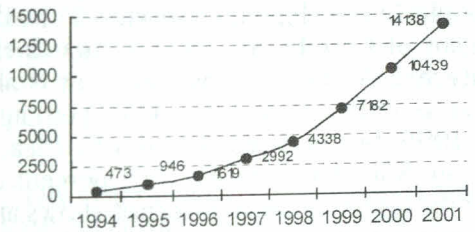
The outstanding economics of scale makes the marginal benefit increase and the marginal cost decrease greatly with the progressively growing of the Internet scales, so that Internet has a distinct externality which results whenever the long-run average cost (*LAC*) curve falls over the relevant range of output-to the point where all demand is satisfied and indicates that there are economies of scale in production. This is illustrated in Graph 1, where the demand function intersects the LAC curve before the LAC turns upward. In the case of Internet, as is shown in the diagram, the long-run marginal cost (*LMC*) function lies everywhere below LAC, because large amounts of investment needed for a network infrastructure construction forms very high fixed cost initially, which forms the relatively high common cost when Internet interconnected and is far greater than the variable cost on the Internet operation with large scale. Efficient allocation of resources occurs whenever marginal social valuation of a good or service is equal to the marginal social cost of providing that good or service. But the situation where price is equal to marginal cost (P=*LMC*) results in losses as the shaded area in the Graph 1, because the average cost of Internet services lies above the average return or competition market price. Thus, firms will lose the shaded area in Graph 1 if they set price equal to marginal cost. The situation led to a natural monopoly in Internet operation and services providing. Since a monopolist determines the price, the unreasonable charges for Internet interconnection have been paid by most of developing countries and inefficient allocation results.

Internet behavior follows the Metcalfe theorem that a network value grows in the proportion of the square of the number of its users (Yang Peifang, 2000), that is, the increase of each user means much more increase of the network value so that the greater scale of and more unit's access to the network, the more benefits getting from the network, which shows the Internet settlement system of interconnection should be under the prerequisite of satisfying the more possible demands of the Internet interconnection. In fact, to reduce the barriers to the Internet interconnection is equal to increase the number of user accessed to the Internet and thus to increase the value of the Internet. On one hand, the common cost of the Internet is so high that it should be share-out, because the more network users, the less expense of share-out cost for each one. Generally the "totally share-out way" would be employed to apportion the total expenses of the network operation by relative enterprises. And on the other hand, as the average cost per unit for each user decreases with the expanse of the user's scale quickly, it proves that to the connected countries, the charges for the Internet settlement of interconnection can decrease close to the fair cost that can be borne. Meanwhile, the benefit of each interconnected unit of the Internet grows with the addition of each connection. In a word, the charges for current Internet settlement of interconnection have the necessity and possibility to depreciate in a great extent.

As the Internet develops into today and the flows of the network services among the operating enterprises basically keep equilibrium, it is obviously irrational to still have one side pay for all the cost of the Internet settlement of interconnection while the other side got "a free ride" to gain information from the opposite. The developing countries have paid, however reluctantly, a large sum for the Internet interconnection for a long time and the heavy settlement cost becomes a bottleneck and hinders Internet development in their countries, which causes the worldwide imbalance in the Internet development and therefore intensifies the "digital divide" [15].

## 2. SURPRISING THE WORLD IS THE WIDENING DIGITAL DIVIDE WITH THE SPEEDING DEVELOPMENT OF INTERNET

It is surprising the world that supported by the fast changing innovation of information technology, the development of Internet has been speeding so quick, expanding so wide and reached so large scale. Only in no more than ten years, Internet has been expanding to connect 46 thousand computer networks and 141 million host computers close together. (See Graph 2) Since Clinton's government brought up the "Information Highway Plan" in 1993, Internet has greatly changed from a computer network for exchanges of scientist thought and research outcome to a enormous network for telecommunication, information and trade. It has formed the most compute-information network in the world and became a global network.

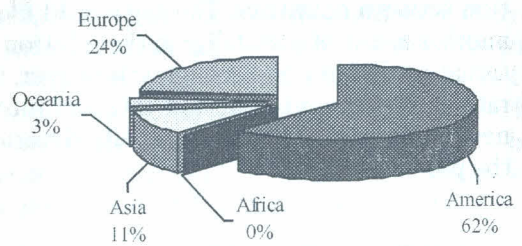



**Graph 2.** Internet Hosts of The World (10 Thousands). The Data From: OECD Communications Outlook 1997 & Mike Jensen, Challenge Internet–Internet and Development, ITU, Geneva 1999 and World Telecommunication Development Report 2002, ITU Geneva 2002

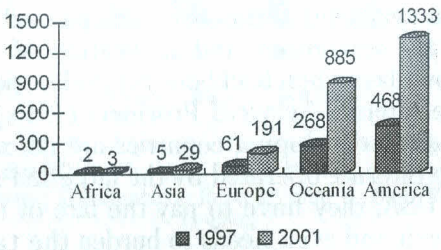
However, the development of Internet is very unbalanced in the world, which has worsened the digital divide. The term, "digital divide", presented in 1998 in America, is used to emphasize the great disparity between or within countries in the obtaining and applying of information because of the differences in their income, region and education. According to the paper of Organization for Economic Co-operation and Development (OECD), the term "digital divide" refers to the gap between individuals, households, and geographic areas at different socioeconomic levels with regard both to their opportunities to access information and communication technologies and to their use of the Internet for a wide variety of activities. The digital divide reflects various differences among and within countries, and formed and enlarged by the global development and application of the Internet in world.

The digital divide raised in Internet times is so wide and so deep that it is also surprising the world. The following data from the ITU[1] or the OECD have somewhat reflected the digital divide among countries.

- Until October of 2000, the number of internet users has already come to 332 million in the whole world. Among them, however, the number of whole mainland in Africa has only reached 3.11 million which less than 1% of the population of African. While in USA the number of Internet users is 148 million.
- People in the rich areas only occupy 16% of global population but possess more than 80% of Internet host computers and personal computers of the world. The number of computers in New York is even larger than that in the whole Africa, while less than 15% of the total computers connected to Internet belong to developing countries. (See Graph 3)
- About 75% of investment in IT industry of the whole world is from the developed countries in 2000.




**Graph 3.** Distribiution of Internet Host, 2000. The Data From: World Telecommunication Development Report 2002, ITU Geneva 2002




**Graph 4.** Internet Host of 10000 Inhabitants. The Data From: World Telecommunication Development Report 2002, ITU Geneva 2002

If the data above show the international digital divide from the angle of the quantity comparison in the static way, on the following Graph 4, Internet hosts per 10000 inhabitants, as a fair index to the rate of Internet permeation, is shown from the angle of quality comparison and in the dynamic way. We can see the trend of the international digital divide is not only very wider but also growing rapidly for the unbalanced development of the Internet. The digital divide, if we

[1] International Telecommunication Union (ITU)

Table 1

**A Month Charge for Internet Access of OECD in 1996 & of AFRICA in 1998, USD**

| OECD | Australia | United Stats | Finland | Japan | Turkey | Mexico |
|---|---|---|---|---|---|---|
| Charge for Access | 24 | 29 | 33 | 50 | 65 | 94 |
| The Charge / Per Capita GDP | 11.5% | 1.2% | 2.2% | 2.6% | 12.8% | 14.8% |
| AFRICA | Senegal | Mozambique | Ethiopia | Sierra Leone | Guinea | Uganda |
| Charge for Access | 24 | 29 | 33 | 50 | 65 | 92 |
| The Charge / Per Capita GDP | 17.6% | 69.6% | 76.8% | 118% | 45.3% | 107% |

Note: Include the Charge for telephone.
The Data From: OECD Communications Outlook 1997 &
Mike Jensen, Challenge Internet–Internet and Development, ITU Geneva 1999.

could measure it by this index, was even widened from 234 times between Africa (2) and America (468) in October 1997 to 444 times between Africa (3) and North America (1333) in October 2001. The developing countries lags behind developed regions in the Internet development seriously, indeed, because of the differences of technique, funds, culture and the level of education between countries. The gap would likely be another factor of instability in the relation of international polity and economy; however, the irrational settlement system of Internet interconnection between countries actually deteriorates the problems.

### 3. THE IMPACTS OF THE DIGITAL DIVIDE ON DEVELOPING COUNTRIES AND AREAS

The present system of Internet is distorted. In fact, it leans to the advantages of developed countries and forms the monopolized markets of the technology and application of Internet. Nowadays when backbone networks operated by the Internet Services Providers (ISPs) located in some developing countries are connected to the Internet operated by the large ISPs located in USA, they have to pay the fare of two half-circuit and even needs to burden the tax of foreign operators for USA. Clearly, the developing countries not only undertake the heavy expenses of equipments but also the large cost of the Internet settlement of interconnection. Such obviously adds the running cost of non-American ISPs or ICPs (the Internet Contents Providers) in developing countries and make them cannot run in large scale and have few competition advantages. On one hand, they are unlikely to increase the investing capital so as to beget the insufficient supply, which eventually retard the development of Internet in developing countries. On the other hand, the users must share the added cost finally. In fact, the charges for Internet access is more expansive in development countries than in developed ones. Even if the charges seem equal as appearing in the absolute values, there is a wide gap between the relative values indeed.

This is illustrated in table 1. Although the charges paid for Internet access are similar to the comparing countries, it is too high to bear, compared with the expense competency of most people in developing countries. For example, in Japan of OECD, An average month charge for Internet Access paid by one user is about $50 that is only 2.6 percent of its per capita GDP in 1996; but in Sierra Leone of Africa, it is also about $50 that is nearly 118 percent of its per capita GDP. Because Internet shows an evident scale-efficiency and the more users access the more cheap access fees are, in the rich developed countries or areas the access fees are affordable and Internet is available for most of people, on the contrary, in the less-developed countries or areas most of people are refused to the Internet for the unaffordable access fees, which results in the deficient demand of Internet access and application and makes the Internet development very difficult into the virtuous cycle in the globe. Hereby, it has already become the bottleneck and greatly obstructed the pervasion of Internet throughout the world.

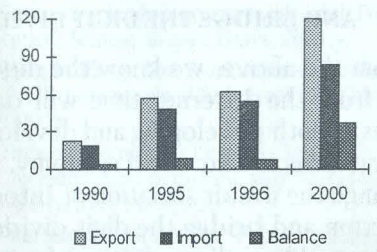
Such evident unfairness brings about the Matthew effect in the Internet development of the world. Matthew effect is originally used to describe the polarization of groups, forces, or interests in the field of social economy. Generally speaking, the countries leading in markets and technologies would accumulate the advantages during the course of Internet development and have more opportunities to achieve greater progress and go beyond others. Ultimately in developing countries not only the development of IT industry would be deferred but also the competition strength of traditional corporations would be weakened. Therefore the development of human resources engaged in the application, research and development of information technology would also be affected.

Internet has been penetrated into various aspects of social and economic life deeply, improves the development of productivity enormously, and expedites the process of economy globalization. Any country that is not connected with others by the Internet access would face the embarrassments of inferior position in the intense competition of the world. New information technologies would have been bring the prosperity and benefit to each country in the world. However, we have noticed that the boom has not been shared equally in different countries, areas or social levels. Obviously, it is the current unfair charging policies of Internet connecting that is one of the roles despoiled the development right of developing countries in the Internet times, which has made the laggard countries harder to their economic constructions of informationization and difficult to take part in the economic globalization and enlarged the digital divide between developed and developing countries. But only the less-developed countries themselves cannot span it by the utilities of traditional resources.

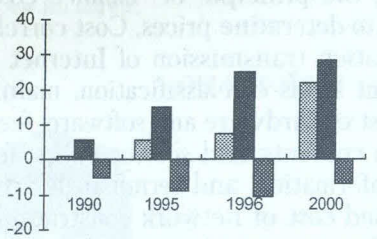
## 4. THE IMPACTS OF THE DIGIT DIVIDE ON DEVELOPED COUNTRIES AND AREAS

The digit divide formed during the transferring from industrialization age to informationization age is not something new but just a problem accompanying with the existent dualistic economy in the Internet time. Although it is a new appearance of an old economic phenomenon, the digital divide still has some differences from the problems of duality. Firstly, it means a crisis not only to developing countries but also to develop ones. Secondly, it directly results in the unequal informationization. Thirdly, it must then deteriorate the disequilibria of the world economic development. Since the Internet economy and globalization trend is growing rapidly, the relationships between countries become closer and closer, the economic development and prosperity of any country are depending on the exchanges of information and resource with other countries, so that the digit divide between rich ones and poor ones becomes more sever and more danger than any before.

The digital divide enlarged by the unfair policies also means a hidden danger to developed countries and may violate their long-run economic benefits, despite the temporary benefits and large-scale capital from the monopolization of Internet by developed countries. Because of the integrative influence of global economy, the increase of international trades and the strong relevancies between counties, the higher degree correlativity is very important to the local industries of a country with more advanced productivity in the age of information and Internet. Continuous development of its economy must depend on more harmony of the social cooperation and any section should not be neglected. So the U.S. was the first to be watchful of the problem of the digit divide and has commenced to resolve it. As another point of view, in an efficient market system the demands always prefer ones with high quality and low price, but in a monopoly market such function is lost. Thus, developed countries would suffer from the stress of network transfers so that frequent Internet clogs are inevitable and their operational risks of the Internet would gradually become more intensified since Internet cannot be developed symmetrically over the world. Still, the corporations in developed areas desire to cultivate or widen the markets of developing countries for the domestic markets of their traditional products tend to be in saturation and many IT products need to look for large-scale markets over through the world. We can see it clearly with the Graph 5 & 6 that the developed area is an absolute exporter while the developing area is an undoubted importer in the international Tele-Equipment trades.




**Graph 5.** Tele-Equipment Tread of Developed Area, Billion USD. The data from: World Telecommunication Development Report, 1998 & 2002, ITU Geneva




**Graph 6.** Tele-Equipment Tread of Developing Area, Billion USD. The data from: World Telecommunication Development Report, 1998 & 2002, ITU Geneva

The trend not only is still going on but also expanding in knowledge and technology service trades so that it is important for making developed countries obtain more opportunities of

global markets to give equal rights of Internet interconnection to any country and to help the economic development of developing countries. Such was also the reason for the Clinton Administration has virtually eliminated tariffs on information technology goods such as semiconductors, computers and related equipment by the global Information Technology Agreement, begun the opening of world services markets through the global agreements on Basic Telecommunications and Financial Services, and preserved the Internet as a duty-free zone and begun the work of adapting trade policy to the digital era through the WTO's commitment.[1]

Unfortunately, the current unfair charging policies of Internet interconnection have badly blocked the Internet development in developing countries and areas and enlarged the gap of digit divide in the world. Certainly, to make the main networks of each county interconnect with Internet possible and available is a very important way to bridge the digit divide for the sustainable development of the global economy and the peace of the world.

### 5. CONCLUSION AND SUGGESTION: CHANGE THE UNFAIR SITUATION OF INTERNET INTERCONNECTION AND BRIDGE THE DIGIT DIVIDE

From the above, we know the digital divide raised from the Internet time will damage the benefits of both developing and developed countries and areas in the world economy. So we call for change the unfair situation of Internet interconnection and bridge the digit divide and suggest some public policy selections for it as following:

Firstly, a fair charging methods for settlement of Internet interconnection should be following the principle of "balance cost and income" to determine prices. Cost correlated with information transmission of Internet has many different kinds of classification, mainly including: cost of hardware and software; fees of information contents and service offers; fees of service, information and terminal devices paid by users and cost of network construction and information transmission assumed by ISPs, etc. Because the Internet settlement of interconnection involves both sides interconnected, the two ISPs, the cost mainly considered include fixed cost due to the relevant equipments, in which the common cost takes a relatively large proportion, and variable cost produced by flows of information, that is, transmit cost and settlement fees. These cost has a relationship with the realization of the Internet communication as well as the bulk of the communication flows it conveys. We can weigh the income of the Internet settlement of interconnection with the flow of information. So it is scientific to calculate average unit cost according to traffic flow volume.

Secondly, diversification should be employed in the settlement system of Internet interconnection. There are currently thousands of ISPs globally, with more and more diverse forms of interrelationships, and the network interconnection environment becoming more complicated day by day, but the current interconnection settlement system is too uniform, mainly only the two methods of peering and transit, which obviously cannot adapt to the changing demands, so we should consider the establishment of diversification in the settlement system to resolve the problems in Internet interconnection as soon as possible is a fundamental and relatively practical gateway to the solution of the digit divide.

Thirdly, a reasonable settlement system of Internet interconnection should be on the basis of equality, mutual benefit, cooperation and joint development. Efforts must be taken to create favorable international circumstance to give people the developing right in the information-ization age by no matter developing or developed countries. The key is to make all people in the world have access and utilize the Internet in order that new technologies and information could be available and affordable to ordinary peoples. The extensive participation of all countries together and the healthy situations of competitions based on mutual benefits between countries are necessary. Developing countries should unite together and strive actively for an equal and healthy developing circumstance. And restricting the negative influences of economic globalization and dwindling the gap between the south and the north is also beneficial to developed countries. Especially, considering that the Internet is a global network, in order to guarantee global interconnection, to prevent global Internet development appearing polarized and to promote Internet interconnection and widespread use, the connection between various countries and the world's least developed countries may use no-fee settlement method.

Fourthly, the regulation systems of the Internet development should be established by the international society. The current unfair poli-

[1]President William J. Clinton – Eight Years of Peace, Progress and Prosperity. http: // clinton5.nara.gov / WH / Accomplishments

cies reflect the lack of regulation systems of the Internet development in the international organizations of the world. So the challenge faced by development of Internet is not to liberate from some regulations, but to set up an effective international new order and to form a circumstance for the pervasion of Internet as soon as possible at present. International regulations are necessary to prohibit the actions of opportunism, reduce the cost of transactions and guarantee the essential orders of international markets and protect the fair competition so that a unified and open international market can be built to reject some unreasonable behaviors in the monopoly system. For example, the establishment of WTO is the outcome of the development of international trade, which has been the powerful drive to improve global economy. Although it should be pointed out that ISCIA has done much and deserves great achievements to it, the ITU may furthered assume the responsibility to formulate the regulations of the Internet development. Meanwhile it requires much more attention of and the coordination and cooperation among governments, industries and international organizations around the world.

What urgent is to set up a new and rational interconnection settlement system based on traffic volume and cost so as to reflect the true cost on gaining information, to protect the equal right to development of the developing countries in the Internet time and to guarantee a sound development of the Internet throughout the world. Considering that the Internet is a global network, in order to guarantee global interconnection, to prevent global Internet development appearing polarized and to promote Internet interconnection and widespread use, the connection between various countries and the world's least developed countries may use no-fee settlement method. In a word, it requires much work to rebuild the fair policies of Internet connecting. Only in this way could there be a healthy and fair Internet development environment for the developing countries, which has a great significance for attaining a sustainable development of the globe economy in the world. Without a priority construction of a new settlement system, reducing "digital divide"stands no chance.

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