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The Role of Intellectual Property Rights in Information and Communication Technologies

C Niranjan Rao

CENTRE FOR ECONOMIC AND SOCIAL STUDIES
Begumpet, Hyderabad-500016

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Abstract

The paper starts by recapitulating the basic arguments provided by economic theory to explain the existence of the patent system. The paper then concentrates on the three important ICT industries viz., telecommunication equipment, computer hardware and semiconductor industries. The issues covered in the discussion on these industries are the technological characteristics; market structure and technology transfer experiences of selected developing countries. Even though there are some differences in these industries, what come out clearly are some similarities. These similarities pertain to concentration by firm as well as country; rapid technological changes; existence of scale economies; rising minimum efficient levels of production; entry barriers to the industries both financial and technological etc. Bresnahan, Stern and Trajtenbert [1997] show that in the computer PC market brand name and being on technological frontier help the firm in appropriating inventions. Taylor and Silberston [1973] observe that in electronics while patents by themselves are not important method of appropriation, it encourages firms to accumulate patents so that they can have an advantage in cross-licensing agreements. This finding was reiterated by Hall and Ham [1999] for semiconductor industry. They name this phenomenon "patent portfolio race". The paper briefly touches upon the issues pertaining to Internet and the problems it raises for copyright; protection of computer software and the discussion on a sui generis protection for databases. The paper concludes that the role of IPRs in ICT seems to be marginal and as prices are falling it does not seem to be attracting negative attention.

Keywords : Intellectual property rights, patents, information and communication technologies.

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*** Centre for Economic and Social Studies (CESS), Hyderabad, India.*

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1. Introduction

The last two decades of the twentieth century saw an intense debate on several intellectual property rights (IPRs) in the international fora. While developing countries were arguing for 'lesser' level of patent protection in the Diplomatic Conference on the Revision of the Paris Convention (1975-86), the developed countries were successful in introducing a move under multilateral trade negotiations of Uruguay Round, which would eventually 'strengthen' patent protection and other intellectual property rights (1986-94). This process resulted in the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS)[1] under World Trade Organization (WTO). Many developing countries are still in the process of implementation of the TRIPS agreement, which required them among others, to strengthen their patent systems as well as introduce new IPRs such as, geographical indications and layout designs.

Be that as it may, the last two decades of the twentieth century also witnessed a remarkable communications revolution. The early 1980s witnessed rapid changes in telecommunications as well as computer industries. While the birth of personal computer started the computer revolution, rapid technological developments took place in telecommunications. The mid 1990s witnessed the growth of the Internet. The century closed with the mobile revolution as well as the bursting of the telecom and Internet bubbles.

How are intellectual property rights and information and communication technologies related? What is the role of IPRs in the technological development of information and communication technologies? This paper seeks to explore these questions.

[1] The seven intellectual property rights covered under this agreement are Copyright and Neighbouring Rights, Designs, Geographical Indications, Layout Designs, Patents, Plant Variety Protection and Trademarks.

Of the seven IPRs covered under the TRIPS agreement, two viz., geographical indications and plant variety protection are not relevant for information and communication technologies (ICTs). Trademarks and designs are relevant in a general way, as in any other business. Patents would be important to foster technological change. Copyright and neighbouring rights are important for computer software and for the Internet. Layout designs are of relevance to semiconductor industry.

The ICT industries cover the following: semiconductors, computer and telecommunications. The computer and telecommunications sectors have two components: hardware and software. While most of technological developments in hardware could be patent protected, technological developments in software are not patentable in all countries. The rapid diffusion of Internet usage worldwide starting in the mid 1990s, posed a particular challenge to traditional copyright and neighbouring rights.

The rest of the paper is structured as follows. In section 2 we will discuss the role of the patent system in fostering inventions. We will also discuss the role of copyright and neighbouring rights in software and the Internet. The next three sections will study particular industries, telecommunications equipment industry in Section 3, the computer hardware industry in Section 4 and semiconductor industry in Section 5. In the ICT industries we study in this paper, we follow a common structure. We will delineate the market structure of the industry; note any country wise or firm wise concentration; look at the technological changes, which have occurred. In the case of computer hardware and semiconductor industries we will also discuss the technological appropriation mechanism observed in these industries. Lastly we will discuss the technology transfer experiences of selected developing countries. The developing countries we selected for this study are India, Republic of Korea and Taiwan Province of China. The reason for their selection is that while India seems to represent a case of failure, Republic of Korea and Taiwan Province of China represent successful cases at least in some areas of ICT. Section 6 will discuss some issues such as: Internet, Computer Software and Database protection. In the last section we will offer some concluding remarks.

2. Intellectual Property Protection and Technological Development

Patent Protection

Patent protection has a history of more than five hundred years. While the patent system developed and evolved when inventors were individuals, it had to adapt itself to the situation of corporate inventors, who became prominent since the middle of the twentieth century. It was only after the corporate inventor became prominent that a reasonably sound economic theory of patents could be developed. Arrow [1962] reasoned that knowledge being a public good, resources for its production will not be forthcoming and hence will have an adverse effect on welfare. To attract investment into knowledge production the patent system, which gives a temporary, legal monopoly to inventers is necessary. It was contrary to the view of Schumpeter (1971) who says that patents are not only unnecessary for encouraging inventions but may also retard technological progress. In Schumpeter's evolutionary model firms struggle to keep their market position by continuous innovations. For a firm an innovation will itself create a temporary monopoly. During this period of monopoly the innovating firm will make extra-normal profits, but such profits will be eroded once other firms catch up by copying the innovation. Hence a firm has to continuously innovate.

The evolution of the inventor from individual inventor to a corporate inventor is very important. While for an individual inventor patents may be the only mechanism of appropriation; for the corporate inventor there are many more avenues such as, being incumbent in the market, being the first mover as well as having trademark recognition for his goods (Scherer [1970]).

There are inter-industry differences in the way they are dependent on the patent system for technological appropriation. This was clearly brought out by Taylor and Silberston [1973][2]. While for some industries such as pharmaceutical and fine chemicals patent protection is very important, for some other industries such as mechanical engineering industries it is not. Taylor and Silberston note that for electronics industry patent system is

[2] This was confirmed by Mansfield [1986] and Levin et al [1987].

perceived to be not important. The reasons for the dependence of the pharmaceutical industry on the patent system are, the technology of production of drugs was easy to copy through reverse engineering and there are no entry barriers to the industry.

The reasons for technological changes not being dependent on the patent system in electronics (in which semiconductors, computers and telecommunication sectors fall) are the following. The rapid pace of technological development: except for some radical and fundamental inventions most of the inventions have a life of a few years, much less than the full term of the patent.[3] The minimum size of break-even point is rising rapidly and making entry difficult in standardized products (it is possible for entry in niche products). There are economies of scale in production of these industries, which creates entry barriers. There are first mover advantages for the firm, which brings the invention to the market. The other important factor is that the real prices of products of these industries are falling over time because of the technological changes.

Copyright Protection

There are two areas in which copyright (and neighbouring rights) protection is crucial in ICT industries. These are computer software (including telecommunications software) and Internet.

The very first reaction to protect software was through copyrights. Many countries including India amended their copyright laws to include computer software under copyright protection in 1984. One of the criticisms of copyright protection for software was that copyright did not protect the idea itself by but only a particular expression of the idea. While copyright protection for mass-market software seems to be quite effective, copyright protection for customized software is not important.

The growth of the Internet has put a lot of pressure on copyright protection. Many countries have strengthened their copyright protection in the digital

[3] "In the case of rapidly developing areas, patent protection may not be useful because inventions quickly become outdated" (Schmoch and Schnoring [1994]).

age. As a result the Internet is not the same as it used to be in the earlier days. Most useful information, which used to be freely available in the earlier days of the Internet, is no longer free.

3. Telecommunication Equipment Industry

Technological characteristics

The telecommunications equipment industry at the end of the twentieth century can be divided into three segments: fixed line, mobile and Internet related equipment. The fixed line telecommunications equipment industry consists of switching equipment, transmission equipment and terminal equipment. Even though both transmission and terminal equipment sectors witnessed technological changes, the change in the switching equipment industry in the 1970s because of the use of microelectronics was outstanding. This led to digital switching equipment, which increased the capacity of switches and also made the delivery of value added services possible.[4]

Digitization has increased the cost of Research and Development (R&D) of new switching generation. Interestingly digitization has also decreased the product life cycles of a switching system (see Neu, Neumann and Schnoring [1987], Grupp and Schnoring [1992], Hicks and O'Brien [1997]). Digitisation also resulted in software becoming more prominent in total costs over time. While the ratio of software to hardware costs in 1970 was 20:80, it was reversed by 1990. According to Rao [1999] future innovations will be coming from software segment of the industry (also see Lera [2000]).

The 1990s witnessed a remarkable growth in mobile telecommunications. Mobile telecommunications equipment industry consists of: base stations, switching systems and handsets. Allocation of frequency spectrum by the governments as well as inventions increasing the efficiency of spectrum use made mobile telecommunications a success. Now the situation is that mobile telephone connections are about to exceed fixed line phones. This is creating

[4] Koski [2002] makes a very interesting comparison between analog and digital technologies, while analog technologies can be embodied in physical assets, digital technologies lead to intangible assets.

problems for fixed line telecommunications equipment manufacturers, who are witnessing a drop in orders for fixed line telecommunications equipment.

The growth of Internet in the mid-1990s also increased the demand for Internet equipment such as routers, etc.

Market structure

In the pre-1985 era many developed countries had a fixed line telecommunications equipment manufacturer and this manufacturer had a monopoly of supply to the national telecommunications carrier. There was a gradual liberalisation of the telecommunication carriers' world wide in the mid-1980s, which took the form of privatising of state owned carriers, easing of entry, and removal of restrictions on procurement of equipment. The impetus for this was the break-up of AT&T in the US in 1984, which led to competition in this sector in the US market.

According to Koski [2002] privatisation of telecommunication carriers resulted in the growing importance of intellectual property rights in this sector. The liberalisation of the condition that the national carrier should procure equipment from the national equipment manufacturer, resulted in an enormous growth in international trade in telecommunication equipment. While earlier the international trade was between developed countries as suppliers of telecommunications equipment and developing countries as purchasers of this equipment, the intra-developed country trade in telecommunications equipment increased (see Neu, Neumann and Schnoring [1987] and Neu and Schnoring [1989]).

The world fixed line telecommunication equipment market is oligopolistic. There are a small number of large fixed line telecommunications equipment manufacturers. The top four firms in 1998 viz., Lucent (US), Ericsson (Sweden), Alcatel (France) and Nortel (Canada) accounted for three quarters of total switching equipment sales in the world (see Mani [2003]). Most of the dominant fixed line telecommunications equipment companies are based in the US. Many European countries have a strong presence in fixed line telecommunications equipment manufacturing. Japan is another country, which has a strong fixed line telecommunications equipment industry.

Rapid technological change and the resultant sharply declining product life cycles increased the minimum efficient level of production, leading to concentration. According to estimates, between 8 percent and 12 percent of the world market is needed to assure viability of a firm in this sector (see Neu, Neumann and Schnoring [1987], Grupp and Schnoring [1992]).

The mobile telecommunications equipment sector is divided because of the deferring mobile communications standards prevalent in different countries. There is no world wide standard yet. Some leading wireless communications equipment manufacturers are: Ericsson (Sweden), Motorola (US), Nokia (Finland) and Siemens (Germany).

There is an interesting case of an interaction between patents and standards setting in this industry in Europe, which actually led to an oligopolistic market structure.[5] The European Telecommunications Standards Institute (ESTI) established the standards for GSM in mobile telecommunications. ESTI tried to develop a standard with out any patented technology but this was not possible. Eventually when the standard was developed and the essential patent list for the standard was published a number of firms had considerable share of these essential patents. While the European firms, which held some of these patents, agreed to pool the patents and licence it to other firms on reasonable terms, the US firm Motorola refused to participate in any such scheme.[6] It agreed to only cross licence its patents to four other firms, Ericsson, Nokia, Siemens and Alcatel. Now these five firms dominate the industry in an oligopolistic market structure.

May be because the origin of the Internet was the US, this country's firms dominate the Internet equipment industry. Cisco Systems, 3Com, Bay Networks and Cabletron Systems are the leading Internet equipment manufacturers (see Rao [1999]).

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[5] This paragraph is based on Bekkers, Verspagen and Smits [2002].

[6] Some of the initiatives of ESTI to get the firms to share their patents concerning GSM is reminiscent of compulsory licensing provisions in patents (See Bekkers, Verspagen and Smits [2002].

Technology transfer

Some large developed countries tried to set up fixed line telecommunications equipment manufacturing facilities within their countries emulating the system of many European countries. While in some countries this was in private sector, in India it was in the public sector.

A public sector company, ITI was set up in 1949 to manufacture fixed line telephone equipment. Initially this firm had a collaboration agreement with the UK company ATE to produce strowger switching equipment. According to Mani [1989] this technological collaboration did not achieve its purpose because even production efficiency was not achieved, let alone technology absorption and then technological capability to invent. Later in the 1960s when the crossbar technology was developed this public sector firm entered into another technical collaboration agreement with the US company ISEC for the production of crossbar switches. The experience with transfer of crossbar technology was unsuccessful, so much so that a plant, which was set up did not even reach its envisaged production capacity by the time it was decided to phase out crossbar technology. The same company entered into another technical collaboration agreement with the French company Alcatel for the production of electronic switches.

Meanwhile in 1984 a public sector laboratory C-DOT (Centre for Development of Telematics) was created to develop indigenous technological capabilities in the production of electronic switching equipment. By end 2001 the switches whose technology was developed by C-DOT and were indigenously produced by both the sole public sector and some private sector firms accounted for 50 percent of equipment capacity. But the import content of these switches is about 45 to 50 percent and goes up along with the capacity of the switch (see Mani [1989] and Mani [2003]).[7]

The liberalisation of 1991 saw telecommunications equipment industry being thrown open to foreign direct investment. Seven firms, which supplied switching equipment to India prior to 1994, invested in India either for assembly or

[7] The reasons given are “uneconomic production volumes, higher startup costs, and fast changing technology” (Mani [2003])..

manufacturing. But later liberalisation of trade in telecommunications equipment reduced this investment, (see Mani [2003]).

There is a case of an indigenous development of WLL access technology known as CorDECT developed by one university - Indian Institute of Technology, Chennai; a private sector laboratory - Midas Communications Technologies, Chennai; a US semiconductor manufacturer - Analog Devices and four private sector manufacturers. In spite of being a low cost and efficient technology this is not being used extensively.[8]

The experience of the Republic of Korea with mobile telecommunications equipment was much more successful. With the active help of the government and a model of cooperative R&D and technological collaboration agreement with the US firm Qualcomm, firms from the Republic of Korea could develop production efficiency, technology absorption and technological capability to innovate. Some interesting features of this technological collaboration agreement was that it ran for 15 years, and the royalty rates were 'high'. These firms did so well that they were the first to introduce CDMA based commercial mobile telecommunication services in 1995, and occupy a dominant position in the supply of CDMA mobile handsets in the world market. Companies from the Republic of Korea, account for 53.7 percent of CDMA handsets worldwide.[9]

4. Computer Hardware Industry

Technological characteristics

The product profile of the computer hardware industry by decreasing level of technological complexity is: mainframes, work stations/servers and personal computers (PCs). The user profile of these products is: government and business, which have massive data processing requirements, or as web servers, generally use mainframes. Workstations/servers are for technical uses and PCs are used by individuals and small and medium businesses. It was the introduction of PC in 1981, which led to the computer revolution, as we know

[8] For a study of this technology see Mani [2003] pp. 38-40.

[9] This paragraph is based on Lee and Han [2002], see also Grupp and Schnoring [1992].

it today. While the earlier mainframes were based on proprietary[10] architecture and software, the PC was based on open architecture.[11] One feature of the industry is its rapid pace of technological development and the fall in real prices. This meant a constant increase in the minimum scale of production.

Market structure

The market structure of the computer hardware industry has to be looked at according to the product. In mainframe computers the market is dominated by a few firms from the US and Japan. European firms are conspicuous by their absence. Some major mainframe firms are IBM, Hitachi and Fujitsu.

In the workstation/server market while the number of firms is much larger than mainframe firms it is much smaller than PC manufacturing firms. Here also firms from the US and Japan dominate the industry. Some important firms in this segment are Silicon Graphics and Sun Microsystems. There is some presence of firms from the Republic of Korea and Taiwan Province of China at the lower end of the market.

The PC manufacturing industry is the most competitive among these three product groups of the computer hardware industry. There are a small number of large firms, which dominate the industry but there are, a large number of small firms, making this industry long tailed. As it is a consumer product (dominant buyers are individuals or small businesses) brand names[12] are very important. But the presence of non-branded PCs is an important feature of the industry. The prices of non-branded PCs are lower and helped in diffusion of computer usage. Rapid technological progress in both hardware and software are a feature of this market. Fall in real prices also helped in the diffusion of computers. While firms from the US and Japan still dominate the branded and frontier technology high end of the PC market, firms from the Republic of Korea and Taiwan Province of China have a strong presence

[10] While the meaning of this term is not defined in intellectual property law it seems to be covered by trade secrets.

[11] "The standard governing interfaces were open, which meant that they were not owned by any single firm", Bresnahan and Greenstein [1999].

[12] Brand names are defined as valuable trademarks.

both in branded but standardized PC market and component market which are used to make non-branded PCs.

Technology transfer

In India, the technology transfer experience for the production of PCs was not very successful. The pre-1991 policy regime did not allow foreign direct investment in this sector and there were protective tariff walls. This helped the industry to develop rudimentary skills. But allowance of foreign direct investment (FDI) in this sector after 1991 and removal of high tariffs did not help indigenous industry to flourish. Moreover the PC market was very competitive, witnessing rapid technological changes and price declines. The Indian PC market was served by, component imports and their assembly in India. Even when some computers were produced in India their import content was high (see Heeks [1995]).

Interestingly between 1978 and 1991 there developed a semblance of private sector Indian computer hardware industry. About 6 firms (HCL, DCM DP; ORG; WITL; Zenith and Minicomp) had set up strong manufacturing capabilities; set up R&D facilities and spent considerable amounts on R&D. They tested latest computer chips, produced some latest computers and exported them to developed countries. But the 1991 liberalisation resulted in their withdrawing from hardware production and later they entered into collaboration agreements with foreign firms or turned their attention to software (Heeks [1995] pp.M86-M88).

On the other hand the Republic of Korea and Taiwan Province of China have succeeded in acquiring technology, absorbing the imported technology and also acquired technological capability to introduce minor innovations at least in the standardized but highly competitive PC market.

Technological appropriation

Many studies based on firm level surveys have shown that patents do not provide the mechanism for appropriating the benefits of invention in electronics industries in which ICT industries fall (see Taylor and Silberston [1973]; Mansfield [1986] and Levin et al [1987]). How do firms in an industry where

technological developments are very rapid and there is a fall in real prices of products appropriate technology?

Bresnahan, Stern and Trajtenberg [1997] analyse this problem by proposing the principles of differentiation. They argue that the PC market was highly segmented. The principles of differentiation they propose were Frontier/Non-Frontier as far as technology is concerned and Branded/Non-branded. According to these authors these two dimensions afforded these firms a temporary monopoly power during which these firms generated rents, which in turn induced innovation.

Bresnahan, Stern and Trajtenberg [1997] also observe that patent protection played only a minor role in technological appropriation in the PC market of the late 1980s. One reason for this according to the authors is that as the PC was based on open technical standards it did not substantially delay the entry of imitators.

5. Semiconductor Industry

Technological characteristics

The manufacturing stages of a semiconductor device are: design, fabrication, assembly and testing. Fabrication is the most difficult stage[13]. It is also a very capital intensive and scale intensive process. It is also a very R&D intensive industry[14]. Technological developments in the semiconductor industry especially integrated circuits (ICs) and their miniaturization led to microelectronics revolution, which are widely used in ICT industries. The 1980s saw the evolution of 'Application Specific Integrated Circuits' (ASICs), which led to the 'disintegration' of the industry into design and fabrication.

Market structure

The market structure of the worldwide semiconductor industry is highly competitive but the entry barriers, both financial and technological are

[13] For a description of the process see Dick [1991] p.137.

[14] Megna and Klock [1993] observe that while R&D as a percentage of sales is generally 3 percent across industries, it accounts for as much as 10 percent of sales in semiconductors.

formidable. The manufacturing process is a highly capital and technology intensive activity. The cost of setting up a modern fabrication facility has increased and the useful lifetime of these facilities shortened over time. Another feature of this industry, which puts up entry barriers, is learning by doing (see Hobday [1991], Irwin [1994], Flaharty [1984]).

Firms from the US and Japan dominate the industry, firms from Europe which were present in the initial stages of the industry have witnessed a decline. Some dominant US firms are Texas Instruments, Motorola and National Semiconductor. Some dominant Japanese firms include NEC, Mitsubishi, Toshiba, Fujitsu and Hitachi.

Technology transfer

In India efforts were made to manufacture ICs through the pubic sector firm Semiconductors India Ltd. But after about two decades this firm makes only small and medium ICs, while large and very large ICs continue to be imported (Mani [2003]).

Production in the Republic of Korea and Taiwan Province of China started with foreign direct investment by US firms for the labour intensive assembly operations of IC manufacturing in the 1970s. Later with government help and technology transfer agreements with foreign firms. the Republic of Korea established a domestic semiconductor industry. Firms from the Republic of Korea benefited from the US-Japan Semiconductor Agreement of 1986, which resulted in increase in prices of memory chips (Irwin [1994]). The semiconductor industry of the Republic of Korea does not develop any new technology on their own, but concentrate on achieving efficiency in production and on good quality high volume semiconductors. The semiconductor manufactures from the Republic of Korea are Samsung, Hyundai and Goldstar.

In Taiwan Province of China earlier efforts to transfer and assimilate technology failed (see Chen-Fen and Sewell [1996]). But it established TSMC in 1987, which is today the largest dedicated independent semiconductor producer in the world.

Lay-out design protection

Design of the integrated circuit is a skill intensive and very expensive process. It is said that while it is very expensive to design an IC it is very easy to copy. The US in 1984 introduced a sui generis form of protection for semiconductors called 'Semiconductor Chip Protection Act'.

A sui generis treaty to protect lay-out designs 'Treaty on Intellectual Property in Respect of Integrated Circuits' administered by World Intellectual Property Organization (WIPO) was concluded in 1989 but it is yet to come into force. The developed countries were successful in introducing a sui generis form of protection for lay-out designs in the TRIPS agreement. It contains a section on 'Layout-Designs (Topographies) of Integrated Circuits'.

Critics of this measure argued that while it may be expensive to design an IC or it is very easy to copy, entry barriers to the industry are such that setting up fabrication facilities to manufacture that design will not be easy. The entry barriers to the industry give protection to the incumbents. Of late the design of ICs has become so complicated that it is no longer a low cost affair.

With the advent and introduction automation (Electronic Design Automation (EDA)) into IC design itself, the costs of design fell drastically. The development of ASICs led to the design part of IC production to be done by purely design firms. Lay-out design protection would have been very useful for these design firms. But Hobday [1991] observes, "ASICs offer users a greater degree of design security – they are intrinsically harder to copy". There is a general consensus that lay-out design protection has been quite ineffective (see Hall and Ham [1999] p.41).

Technological appropriation

Flaharty [1984] notes that patents did not afford protection in the semiconductor industry. Flaharty says significant breakthroughs did not confer any appropriable benefits because these could be easily copied. Hence there was fast diffusion of basic research. According to Flaharty it was the know-how segment of the technological knowledge, which afforded the firms to extract rents and not the fast diffusing basic discoveries. The other source of rents

for firms is being a market leader and introducer of new technology, which offers leadtime during which firms can extract rents. According to Irwin and Klenow [1994], "the first producer of a new generation enjoys a monopoly position and a large price-cost markup; as competitors begin production, that firm's market share and its markup decline".

It is a generally held notion that patents do not provide sufficient protection to appropriate rents from technological developments in industries other than fine chemicals. One reason put forward by Taylor and Silberston [1973] is as follows. While a patented product is easily identifiable in fine chemicals, it is not the case in electronics. An electronic product may be the subject of a number of patents. Hence it has been the practice of firms in electronics to just "licence patents in large clusters". They note a decline in the quality of patents issued in electronics field. This finding has been reconfirmed by Hall and Ham [1999] in the case of semiconductors. They note that any semiconductor product may involve many patents. Hence firms in this industry indulge in cross licensing of patents. For bargaining strength during these negotiations the number of patents held by each firm becomes very important, hence patenting has been on the rise. They characterise this as "patent portfolio races". They also note a decline in the quality of semiconductor patents issued in the US.[15] In this scenario technology transfer between developed and developing country firms becomes problematic, as the developing country firms do not have any patents to cross license.

6. Other Issues

Internet

The worldwide growth of the Internet since 1995 has put a lot of pressure on intellectual property rights. Copyright and neighbouring rights saw an immediate impact of the Internet on the rights they cover. Many areas of protection covered by copyrights viz., literary works, audio, video, etc came to be displayed and exchanged on the Internet causing loss to the right holders. While the copying of literary works seem to have subsided, there were some

[15] See also Koski [2002] p.30.

important cases involving distribution of musical works. The other area of immediate concern is the conflict between trademarks and domain names. WIPO has evolved a mechanism to resolve these disputes (see Eugui [2001]).

Computer software

Computer Software is protected by copyrights in almost all countries. Only the US and Japan give patent protection.[16] The experience in the US has been mixed. The main problem seems to be the quality of patents issued in software. The other problem is non-inclusion of non-patent prior art, which is very important in this field. Rapid change in technology makes patent protection unimportant. On the other hand, copyright protection seems to be inadequate. Indian companies are not active in seeking copyright protection in India or patent or copyright protection in the US. Piracy of packaged software in developing countries is because of high prices and discriminatory pricing not being possible because of leakages.

Database protection

While databases, which are original compilations, are protected under copyright laws, the demand for a *sui generis* law to protect unoriginal databases is disturbing. The criteria seem to dilute the contribution required for obtaining protection. Denmark, Finland, Iceland, Mexico, Norway and Sweden have *sui generis* laws to protect unoriginal databases. While the EU has a directive to protect databases since 1998, the US congress is considering a data base protection bill. The WIPO started a process for database protection in 1996 and rejected a draft treaty and does not have any active proposal at the present time.

7. Concluding Remarks

The unimportance of intellectual property in information and communication technologies seems to the reason for the rapid diffusion of the technology in developing countries. The technological progress in this field seems to

[16] According to Koski [2002] “Software as a class is not patentable in the US, but non-obvious software related inventions, ‘processes’ and ‘machines’ can be patented” (emphasis in original).

be the result of technology push factors, rather than whether intellectual property protection is available or not or whether such intellectual property protection is strong or not. The rapid technological developments themselves are the reason why intellectual property may not be important. The other reason why intellectual property is not leading to any conflicts between developed and developing countries, seems to be the rather disinterest in technology transfer shown by the developing countries in this sector in recent times. The fact that intellectual property protection is not leading to a discernible rise in prices, while technological advances are resulting in falling prices, which in turn lead to imports and rapid diffusion of these technologies in developing countries makes these technologies very uncontroversial.

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