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Standards, Patents and National Competitiveness

Michael Murphree and Dan Breznitz

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ABOUT THE GLOBAL COMMISSION ON INTERNET GOVERNANCE

The Global Commission on Internet Governance was established in January 2014 to articulate and advance a strategic vision for the future of Internet governance. The two-year project conducts and supports independent research on Internet-related dimensions of global public policy, culminating in an official commission report that will articulate concrete policy recommendations for the future of Internet governance. These recommendations will address concerns about the stability, interoperability, security and resilience of the Internet ecosystem.

Launched by two independent global think tanks, the Centre for International Governance Innovation (CIGI) and Chatham House, the Global Commission on Internet Governance will help educate the wider public on the most effective ways to promote Internet access, while simultaneously championing the principles of freedom of expression and the free flow of ideas over the Internet.

The Global Commission on Internet Governance will focus on four key themes:

- enhancing governance legitimacy — including regulatory approaches and standards;
- stimulating economic innovation and growth — including critical Internet resources, infrastructure and competition policy;
- ensuring human rights online — including establishing the principle of technological neutrality for human rights, privacy and free expression; and
- avoiding systemic risk — including establishing norms regarding state conduct, cybercrime cooperation and non-proliferation, confidence-building measures and disarmament issues.

The goal of the Global Commission on Internet Governance is two-fold. First, it will encourage globally inclusive public discussions on the future of Internet governance. Second, through its comprehensive policy-oriented report, and the subsequent promotion of this final report, the Global Commission on Internet Governance will communicate its findings with senior stakeholders at key Internet governance events.

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ACRONYMS

3C	content, computers and communications
AVS	Audio Video Standard
CD	compact disc
CDMA	Code Division Multiple Access
DVD	digital video disc
ETSI	European Telecommunications Standards Institute
GSM	Global System for Mobiles
IBM	International Business Machines Corporation
IGRS	Intelligent Grouping and Resource Sharing
IP	intellectual property
JVC	Victor Company of Japan
MIIT	Ministry of Industry and Information Technology (China)
MOU	memorandum of understanding
MPEG	Moving Picture Experts Group
MS-DOS	Microsoft Disk Operating System
PC	personal computer
RAND	reasonable and non-discriminatory
SEPs	standards-essential patents
USB	universal serial bus
VHS	Video Home System

EXECUTIVE SUMMARY

Standards are important but poorly understood. Technology standards in particular enable the modern networked global economy to function. Within these technology standards, however, are hundreds or thousands of separate patent-protected technologies. This paper offers a market-based examination of the impact of these standards-essential patents (SEPs) on the firms and countries adopting technology standards. SEPs within technology standards shape the markets for standards-compliant devices. They determine which actors will be permitted to participate in the markets for these devices and the terms under which they will do so. Through licensing fees and practices, holders of SEPs are able to restrict competition or increase the costs of rival firms. This paper explores two cases of the impact of standards-essential intellectual property (IP). It first considers the cases of the GSM (Global System for Mobiles) and CDMA (Code Division Multiple Access) standards for mobile telecommunications, revealing how firms were able to shape the terms of competition through their control of standards-essential IP. The paper then explores an alternate approach to SEPs as shown through recent standardization efforts in China. In those efforts, the emphasis is less on the monetization of the standards-essential IP and more on the widespread dissemination of technology and sale of standards-compliant devices. This alternate approach, emphasizing free or nominally priced IP, poses a challenge to the current norm of "reasonable and non-discriminatory" (RAND) licensing terms for standards-essential IP.

INTRODUCTION

Technology standards are fascinating. They are inscrutable and dense, accessible only to engineers and IP lawyers, seemingly far outside the realm of daily life. At the same time, they are central to modern daily life. From your morning coffee (graded according to a standardized scale of colour, quality and roast), to your email inbox check (enabled by a dizzying array of protocols set by individual firms and international technology associations), to your commute to work (powered by gasoline rated according to standards set by sovereign governments), life is governed by standards. Were it not for standards, it would be impossible — without extreme costs in terms of time and effort — to compare products, utilize networked technologies or even shop in a grocery store with confidence. Standards ensure product compatibility (essential for the functioning of telecommunications, audio, video and information technology) and facilitate information transfer. When a product is standardized, it is clear to a prospective buyer or user what they are acquiring, as well as its capabilities.

In technology products, standards ensure compatibility across brands and devices (Braunstein and White 1985). Before standardization takes place, there can be multiple protocols for different products, making them incompatible (Besen and Johnson 1986). With standardization, a consumer can purchase a variety of devices from multiple vendors and brands knowing they will work together. The reader may recall a time before the universal serial bus (USB) standard, when computer accessories used many different types of connectors. Not every brand or type of computer on the market included all of the necessary plug types, meaning the user had to either purchase adaptors or carefully check for compatibility before purchasing a computer peripheral. With the USB standard, users know that accessories will always be compatible, whatever brand they purchase.[1]

1 An interesting exception to this trend are Apple products, which frequently use different standards in order to force users to purchase only Apple products. This strategy can increase revenues by locking users in to a given vendor's products but can also backfire if the products are not sufficiently differentiated and valuable to a consumer to encourage them to inhabit this isolated market. Despite the unique hardware standards it adopts, even Apple understands the de facto Microsoft Office standards for word processing and spreadsheets. Accordingly, Apple includes these Microsoft applications with its computers in order to ensure Apple users can easily share documents with personal computer (PC) users.

Despite their ubiquity in our lives, technology standards are still a mystery. Most people neither know what they contain nor how they are created. Yet their importance goes beyond facilitating modern life. Standards create markets for technology goods and services, and set the terms of competition in those markets. This paper specifically looks at one aspect of standardization — the inclusion of essential IP, usually referred to as SEPs. Within the hundreds of pages of documentation for a standard, the clauses concerning SEPs help determine the fate of technologies, markets, firms and even countries in the global economy. This paper examines the intersection of technology standards and IP and explains the impact SEPs have on the development of technology markets and industries in different countries.

SEPs determine the costs for firms to participate in markets for standardized technologies. They do so in two ways. First, firms that own the rights to SEPs have a cost advantage in the market over non-SEP holders (Bekkers, Dysters and Verspagen 2002). Unlike firms on the outside, SEP holders will owe no licensing fees, or lower ones, when they produce standards-compliant products. Second, holders of SEPs have a closer understanding of the specific technical features of a standard and thus a greater advantage in setting the technology trend for the next generation of standards, helping to perpetuate competitive advantage (Correia de Brito and Pelkmans 2012).

At a macro scale, different countries in the world economy have different positions in this system, and hence different perspectives on the normative role for IP in standards. All else equal, developed countries usually support "hard" IP norms in standards. This is an extension of their national laws concerning IP. IP is property and thus the bearer has the right to dispose of it as they see fit, whether by restricting access to it or setting the price at which it may be used (Simpkin 2010). Developing countries, which — thanks to the global fragmentation of production — are major manufacturers of technology products that conform to established technology standards, are in a difficult position. In order to produce goods for which there is global demand, they must produce standards-compliant products. However, doing so exposes the firms to requirements to pay royalties for the SEPs in standardized technologies. This increases their costs and lowers profit margins, thus reducing the resources available to invest in research and development that could, perhaps, contribute to the next generation of technology. Accordingly, emerging economies, most notably China, are increasingly pushing for new norms governing SEPs (Maskus and Merrill 2013). China's approach — setting standards with free or nominally priced IP — is highlighted here.

This paper first defines technology standards and SEPs, and the roles they play in determining markets for technology goods and services. It then turns to two case studies. The first looks at the role that SEPs played in early mobile telecommunications standards in Europe and the United States. This case shows the manner in which hard enforcement of IP rights shaped the markets for these technologies. The second case study examines two standardization efforts in China, highlighting the challenge that licensing fees for SEPs pose to Chinese firms and the efforts made in Chinese standardization to change the norms governing IP in standards. The paper then concludes with implications for the future of SEP norms and public policy-governing standards.

DEFINING TECHNOLOGY STANDARDS AND SEPs

Technology standards are defined as formal written protocols, developed by consensus or a modified consensus principle in a formal or ad hoc body, that serve as a platform for interoperability and comparability and on which other applications and innovations can be built (American National Standards Institute 2013). This somewhat complex definition encompasses both varieties of standards: de jure (set through binding political processes) and de facto (set by enterprises or private bodies that have achieved market dominance that forces competing standards to exit). Both de jure and de facto standards can be set by either individual private parties or alliances, or by government or international organizations. Usually, the drafting of a standard takes place in a working group, is voted on by a technical committee and is finally adopted by the entire standardization body (International Organization for Standardization 2013).

Although standards are usually considered public goods, because the adherence to the standard by one firm does not preclude its adoption or utilization by another, they should actually be considered "semi-public" goods (Kindleberger 1983). All firms are able to benefit from standardization but those actively involved in setting the standard and contributing essential technologies benefit even more than those who simply use the standard. The degree of benefit a firm receives from a standard depends on its position either as a creator/contributor or as an adopter of the standard.

Standards have several impacts on technology development and marketing once they are set. First, standards will "freeze" the development of technology. This does not mean innovation or technology development stops. Rather, the freeze means the standard codifies the state of the art at that point, amalgamating knowledge into a platform on which other peripheral and related innovations can be built (ibid.; Besen and Johnson 1986; Ernst 2009; Ernst 2011). Second, the setting of a standard effectively precludes the development of alternative technologies — whatever their technical or commercial merit. Once a standard is set, firms must ensure their products conform to the standard, lest they face a declining market share. The third impact of standards is to shift the basis of market competition. Once a standard is set and all firms are able to utilize it, competition no longer involves novelty or difference but rather becomes based on price (Farrell and Saloner 1985; Berg 1988; Berg 1990; Berg and Schummy 1990; Özsomer and Cavusgil 2000; Yoo, Lyytinen and Yang 2005).

All three of these principles can be seen in the case of the de facto standard for video cassettes in the 1980s and 1990s (Cusumano, Mylonadis and Rosenbloom 1992). In the 1970s, Sony first introduced a video recording cassette under the brand name Betamax. Within a year, a competing standard format, Video Home System — VHS — was offered by the Victor Company of Japan (JVC). Although Betamax enjoyed first-mover advantage and arguably offered better picture quality, by the early 1980s, VHS had emerged as the dominant standard. VHS won the competition over Betamax because its creator — JVC — was willing to widely and inexpensively license the technology. As more firms offered VHS players, there were lower prices and more content available. Users increasingly adopted VHS. Once VHS achieved critical mass, Betamax users became "orphans," with limited choice of content (Özsomer and Cavusgil 2000). Once VHS won the standards competition, the technology was essentially frozen. Firms were able to produce the technology — utilize the standard — and make improvements on it, such as higher-quality or longer-running cassettes. However, the standardized technology would remain largely unchanged until it was supplanted by an entirely different technology 20 years later — the digital video disc (DVD). Competition among VHS-player manufacturers shifted to price. Since all devices performed the same function, consumer interest shifted to price and away from unique features. The same trend would occur with DVD players once they emerged from competition among advanced VHS and video compact disc players.

The market impact of standards — and by extension the broader impact on firms and national economies — is often a feature of the embedded IP. An SEP is a patent whose technological scope must be violated if a user creates a standards-compliant technology (American National Standards Institute 2016). The European Telecommunications Standards Institute (ETSI) further clarifies that essentiality means it is impossible on technical — as opposed to commercial — grounds, given the current state of technology, to make or use standards-compliant technology without infringing on that particular IP (ETSI 2016). Similarly, Jay P. Kesan and Carol M. Hayes (2014) define SEPs as technologically essential patents, where essentiality is tightly bound with the interoperability focus inherent in a standard. To illustrate, consider an electric plug. If all — or most — of the firms in a given industry opt to use a specific type of plug for charging devices, the plug shape is a de facto standard. If the design of this plug is covered by a patent, any firm making products compatible with that plug would be violating this proprietary technology. Thus, the patent in question would be essential to the de facto standard.

While early technological standards often had dozens or hundreds of patents considered essential, today standards often list thousands of essential patents. SEPs are intended to be so basic to the technology in a standard that it is impossible to "innovate around" the patents to produce a roughly compatible or equivalent product that does not violate the patent (Dolmans 2002; ETSI 2016). Rather than violate IP, which would undermine the incentive to invent, standards bodies provide options for holders of SEPs to declare and benefit from widespread adoption of their technology.

Any actor wishing to adopt a standard or make standards-compliant products will have to license the patents in question. This process poses several potential risks in standardization. First, an IP holder might declare that it has essential IP but refuse to license the technology (Bekkers and West 2009). If this occurs while a standard is being developed, the developers must attempt to find a way around the patent or else the entire standard can be blocked. Second, an IP holder might wait until after a standard has been developed to declare that the standard as proposed actually infringes on their patents. If the firm again refuses to license their IP, this is called "patent holdup" and can prevent the implementation of a standard (ETSI 2016). A firm under the same circumstances can offer to license but only under highly restrictive or expensive terms with negative effects on standard adoption and the profitability of firms making standards-compliant products. A third threat is that an IP holder will transfer the patents to a third party that refuses to acknowledge or accept the licensing agreements made by the previous owner (Arthur 2012). This last occurrence has sparked numerous lawsuits as new IP holders — such as Google after purchasing Motorola Mobility's patents — change the agreed-upon licensing terms and increase fees.

In almost all cases, standards-development bodies and national governments enforce IP law in the case of technology standards. Patents are IP, and must be protected or else, proponents argue, there would be no incentive for firms or individuals to innovate (Simpkin 2010). Patents are necessary to offer a reward for taking the risk of invention — even if those patents can determine the fate of a technology standard. Since standards offer so many advantages to consumers in clarity of choice and lower prices, it stands to reason that they should be developed. If a standard involves SEPs, then a licensing arrangement must be made. The general norm is known as RAND: reasonable and non-discriminatory (Van Eecke and Truyens 2009). SEP holders are expected to license their patents on a non-discriminatory basis — all users have a right to license the technology — and in exchange for a reasonable royalty. This norm is broadly upheld in the United States and Europe (ibid.; American National Standards Institute 2008).

A major exception, however, has occurred in the case of China. There, the government has attempted to set rules for technology standardization that weaken the norm of hard IP protection (Breznitz and Murphree 2013). China's government does not suggest that patents are unimportant or that they should be invalidated. Instead, standards-development organizations are encouraged to include SEPs offered on a royalty-free or nominal basis before considering patented technologies or SEP-relevant protocol submissions from firms interested in maximizing the returns from licensing (ibid). The objective is to encourage firms to offer their IP inexpensively in exchange for broad promotion of the technology standard — with the idea that a larger user base would ensure both licensing revenues and income from sales of standards-compliant products.

HOW STANDARDS AND SEPs SHAPE MARKETS

With this understanding of standards and SEPs, it is possible to go into greater depth on how these shape markets. Standardization research argues that there are three stages of competition in standardized technologies: pre-standardization, standardization and post-standardization (Besen and Johnson 1986). In the pre-standardization era, a variety of competing technologies or formats arise. In this stage, competition is between the technologies themselves over which offers the best quality, greatest ease of use or other features. The development of the modern PC industry illustrates this stage. Until 1984, there were at least four major PC standards: International Business Machines Corporation (IBM), Apple, UNIX and CSIS. All four competed to offer the most satisfactory user experience (Apple) or the greatest utility (IBM). All were incompatible, because the software for one PC system could not run on another. Each also used unique peripheral hardware, thus making shopping difficult. Users of one firm's system were effectively locked into a closed monopoly market — with the accompanying higher prices.

The standard was set when the impasse between the four technology platforms was broken open through the combination of IBM's decision to use a third-party's operating system — Microsoft Disk Operating System (MS-DOS) — and the piracy of IBM's Basic Input/Output System by Taiwanese computer hardware manufacturing firms. With "PC clones" available — computing hardware with similar capabilities, and all able to run the same software, thanks to MS-DOS — consumers were able to choose among competing brands without worrying about incompatible software. As more and more users adopted the IBM PC standard, it achieved critical mass in the market, forcing out the competing standards — except Apple, which retained a niche market.

Once the standard was established, PC manufacturers and brands now had to compete on price. Increased competition for users and the availability of standardized components drove down prices, further encouraging adoption. The PC industry, to this day, is mostly a highly price-sensitive competitive environment in which makers of general use PCs must produce as inexpensively as possible to support sales. Most users no longer care about the brand of the PC because they are largely interchangeable.

While standardization changes the overall dynamics of market competition from features to price, the rewards of that competition are heavily influenced by SEPs. Once a standard is adopted and the list of SEPs determined, the firms that contributed them are able to demand royalties. While this is normally done in accordance with the RAND principle, there is no clear definition of a reasonable royalty. In the DVD standard, the SEPs were held by a group of European, American and Japanese firms including Toshiba, Matsushita, JVC, Mitsubishi, Hitachi, Time Warner, Philips, Sony and Pioneer. As with VHS, DVD was an open standard in that any firm wishing to do so could produce DVD players and discs. However, they would be required to pay royalties to these firms, set at roughly US$20 per DVD player in 2004 (*People's Daily* 2004; Linden 2004). When DVD players were first produced, this seemed a reasonable amount. However, as the wholesale price of DVD players fell in the early 2000s, the royalty became the single largest cost in production, severely limiting the profits for manufacturers while providing a steady source of income to SEP holders. For firms hoping to leapfrog technologies or catch up through advanced manufacturing, the cost of royalties limited the ability to marshal capital. For firms hoping to secure their position in the next generation of standards, the royalties offered a source of income for investment in research and development.

Further, it is common practice for SEP holders to share their IP with other SEP holders through cross-licensing (Bekkers and West 2009). Cross-licensing grants SEP holders largely royalty-free access to the standard. Effectively, SEP holders can thus produce standards-compliant goods at a far lower price than firms without SEPs. This cost advantage can be used to undercut the prices of non-SEP-holding competitors or to provide an even greater source of profits. It can thus be seen that SEPs significantly impact the distribution of gains from standardization.

To illustrate the principles of technology standards and SEPs in market creation, consider the examples of two standards: first, the setting and performance of mobile telephony standards in Europe and the United States in the 1980s and 1990s, and second, more recent Chinese attempts at standardization. In these examples, the role of SEPs was quite different, greatly shaping the outcomes for the standards. In the case of mobile telephony, limited licensing of SEPs helped determine the eligible players in the market — thus determining winners and losers before market competition had even begun. For Chinese standards, a bitter lesson in the costs of SEPs would lead to attempts to change the norms governing IP. Given the vested interests of established technology players, Chinese standards makers came to believe the only means of improving their competitive situation would be to create technologically competitive Chinese standards as an alternative to global standards with "expensive" IP. The idea was to force a change in the norms governing valuation of IP without violating the norm of IP itself. In effect, SEPs would still be accepted but the pricing norm would switch from an arbitrarily defined RAND licence to nominally priced sharing of IP to encourage adoption and dissemination of a standard and standards-compliant technologies.

MOBILE TELEPHONY STANDARDS

The world's first truly global telecommunications standard was GSM, developed by a consortium of European firms under the aegis of two bodies: the Groupe Speciale Mobile and (later) ETSI (Bekkers, Verspagen and Smits 2002). In the 1980s, the Scandinavian countries, Germany, France and Italy had developed four individual and incompatible mobile telephony systems, creating highly fragmented national markets (Funk 2002). As a result, French mobile handsets, for example, became useless once a user crossed the border into Germany. To solve the problem of incompatibility, in 1982, telecommunications operators across Europe signed a memorandum of understanding (MOU) pushing for a single pan-European standard to replace the incompatible national standards. This MOU would form the basis of the Groupe Speciale Mobile that would later develop the GSM standard.

Rather than allow firms to develop competing standards, ETSI would use national-level representation for voting on protocols and IP policies (Brenton 1990). This system was to ensure that all of the member states would feel included in the development effort and encourage their national firms to adopt the standard. It was also to provide a means for smaller member states to air their concerns before the standard would be completed. However, as the voting only required a supermajority, it was possible to override the concerns of resistant countries in order to facilitate moving forward with development and adoption of the standard.

Once a single pan-European standard was in place, global adoption quickly followed (Funk 1998, 2002; Funk and Methe 2001). National telecommunications ministries and phone companies chose the technology because there were many participants (all of the major European telecommunications firms) offering compatible infrastructure and handset technologies. The competition on a common platform meant devices were less expensive. It also meant there was already a large user base, further encouraging adoption. At GSM's peak in 2005, 75 percent of the worldwide mobile industry used the standard (Bekkers and Updegrove 2012).

For IP, utopian ideals of a completely royalty-free standard initially struggled. Although the 1982 MOU recommended all SEPs be made available on a royalty-free basis, the French and German governments pushed for GSM to adopt their technologies based on the RAND policy for SEP inclusion (Bekkers, Dysters and Verspagen 2002). In contrast, Ericsson of Sweden offered another approach to mobile telephony on a royalty-free basis — one using non-proprietary technology. Once it was adopted, this royalty-free core helped to keep overall royalty rates low. The lower rates, in addition to the the advantages of the large user base, would further encourage worldwide adoption of the standard.

By 1998, GSM would only list 380 SEPs, some of which were duplicates due to their being filed in multiple jurisdictions (Bekkers and Updegrove 2012). Ericsson had very little proprietary technology in GSM. It chose instead to seek revenues by selling its equipment and handsets. Having created the technology core, Ericsson would enjoy a competitive advantage in making compliant technologies.

The single largest SEP holder would be Motorola (ibid.). Unlike Ericsson, which sought to earn revenues through sale of hardware — a pattern common among Chinese firms, as discussed below — Motorola sought to maximize its royalty returns. Motorola's technology was essential to the GSM protocols, but the company refused to even accept RAND principles. Motorola demanded the right to set royalty rates on a bilateral basis with any firm adopting GSM and to be able to discriminate among the firms that would be allowed to license its technology. Some European firms would be unable to produce GSM equipment when Motorola refused to license. For those that did secure a licence, Motorola's royalty rates ranged from 10 to 13 percent of the wholesale price of GSM products (Bekkers and West 2009). This and other licensing fees increased costs to non-favoured firms. Motorola and other leading GSM developers entered into cross-licensing agreements, giving themselves largely royalty-free access to the standard (Bekkers, Dysters and Verspagen 2002).

In the competing CDMA standard, the lead developer, Qualcomm, adopted a very different approach from Ericsson's. By the mid-1990s, Qualcomm was aggressively seeking to exit the infrastructure and handset industries. Without a competitive advantage in producing hardware, Qualcomm sought to maximize revenues through licensing its technology. The CDMA standard was based heavily on SEPs held by Qualcomm. While emphasizing licensing revenues, Qualcomm's approach to IP was quite open when it was approached by representatives from Korea's Samsung (Yoo, Lyytinen and Yang 2005). Whereas the GSM standard's leadership had not allowed Samsung to participate in developing or adjusting protocols or including new SEPs, Qualcomm welcomed Samsung's assistance. Samsung was able to include its IP in the CDMA standard. The market result was adoption of CDMA, rather than GSM, in Korea.

In the case of GSM, rules governing SEPs determined the market in two ways. Thanks to Ericsson's offer of royalty-free technology, overall costs were kept lower than they would have been had the German and French proposals — based on licensing patents — been adopted. However, Motorola's insistence on discriminating among licensees and controlling the rates for each licensee raised costs for all but the core developers of the standard. Those who contributed to the development of GSM stood to benefit far more than others, helping them earn greater profits and setting the stage for the next generation of telephony standards. In the case of CDMA, the willingness of Qualcomm to open the standard to Samsung led to the adoption of a CDMA monopoly in Korea and to helping Samsung develop core innovation capabilities it would use in future generations of mobile telephony. Both the GSM and the CDMA standard involved the use of SEPs. In both cases, not all firms from all countries were allowed to participate in standards development or to produce technology on the same terms. Firms that had not contributed to the development of either standard — for example, other Chinese telecommunications equipment firms such as Julong or Potevio — would have to pay the required SEP licensing fees to those standards' SEP holders. Unlike Samsung (which enjoyed preferential IP access) or the GSM developers (with their patent-sharing agreements), such firms were at a cost disadvantage — one that would limit their abilities to invest in technology and create an unequal distribution of opportunity in the global economy.

CHINESE TECHNOLOGY STANDARDS AND SEPs

Developing-country firms face a very different environment than do established technology giants in Western and Organisation for Economic Co-operation and Development member countries. They often have weaker technology development capabilities and are attempting to engage in technology catch-up or leapfrogging. In some circumstances, the openness of technology standards with RAND-based licensing enables firms to make rapid increases in their technology capabilities (Blind and Jungmittag 2005). So long as a firm has sufficient capital to pay the licensing fees, it is able to access and utilize the technology and the patents embedded in a standard — not only to make the standards-compliant products but also to study and improve upon them. This access is an enormous advantage. Non-standardized technologies containing proprietary technology are not so open. Outside a standard with the RAND norms, an IP holder is free to fully block access to a technology, thus creating a true monopoly. When firms cannot access a technology in order to study, reverse engineer or improve upon it, any attempts they might make to technologically upgrade or catch up will be stymied.

Standards are more open, thanks to the RAND norm. Nonetheless, the opening of standards on its own is no panacea. As noted above, the conditions under which SEPs are licensed determines the structure and terms of competitive markets for standardized technologies. The licensing fees for developing compliant technologies can be onerous to manufacturing firms forced to pay full price. In the first decade of the 2000s, Chinese DVD manufacturers noted that the royalty costs were by far the largest single-cost item in production (Cai 2006; Chen 2008; Ding 2009). Even as the wholesale price of DVD players fell, and the prices of many components as well, the licensing fees remained constant, cutting into the already-thin margins of Chinese manufacturers.

One way to address this competitive disadvantage is to change the norms governing SEPs. Rather than allowing firms to restrict access — as Motorola did with GSM, in the case above — or to maximize unit profits through licensing — as happened with Qualcomm's CDMA standard — SEP policy can be designed to favour the Ericsson approach. Here, technology is licensed on a royalty-free basis and firms compete through manufacturing and sales of products, rather than through IP. For emerging economies, this approach complements their existing competitive strengths as manufacturers. It would lower their input costs while still offering the large consumer base advantages of standardized technologies.

To illustrate this effect, consider the case of audio-video encoding standards. One of the licence items in DVD players was for the MPEG-2 audio-video encoding standard. AV encoding standards convert analogue sound or light waves into digital format (1s and 0s) and convert the digital format into analogue for playback. The MPEG standards are created by the Moving Pictures Experts Group, a committee established in 1988 to coordinate the development of standards for audio and video (MPEG 2010).

The MPEG-2 standard was the de facto industry standard for all digital media in the 1990s and first few years of the 2000s until it was replaced by MPEG-4, also known as H.264, in March 2003. The standard was used for compact disc (CD) and DVD players, and early Internet video and music file and transmission formats. Under the terms of MPEG's SEP licensing arrangement, all devices compatible with MPEG-2 owed US$2.50 in licensing fees (Kanellos 2004). Fees were also owed for producers of CDs and DVDs. Chinese manufacturers, who by the early 2000s were producing over 70 percent of the world's

DVD players, were heavily squeezed by these and other SEP licensing fees (Linden 2004). Chinese manufacturers and researchers studying MPEG-2 and H.264 claimed that of the hundreds of SEPs in the standards, most were technologically unnecessary. The Chinese claimed many of the patents were only incrementally different from other patents in the pool or entirely unnecessary for producing technologies that complied with the standard. Accordingly — the Chinese firms argued — the patent pool contained a large number of patents that they were obliged to license but which were unnecessarily raising their costs.

Once a standard is set, however, it is extremely difficult to replace, due to the power of the network effect. When a critical mass of users and suppliers exists for the standard, little space remains for a competing standard at the same level of technology. To help overcome the cost difficulties facing Chinese manufacturers, China's Ministry of Industry and Information Technology (MIIT) initiated a program to create an inexpensive next-generation audio-video-encoding standard.[2] Using contributions from government research institutes, university and industry labs, a Chinese alternative called AVS (Audio Video Standard) was published in 2005. Using a different approach — and hence not infringing on foreign patents — AVS was able to achieve encoding and compression efficiencies comparable to H.264 (AVS 2012). Unlike the development of H.264, universities and government research institutes played a more significant role in AVS, contributing roughly half of the SEPs.

AVS's development alliance claimed adherence to basic RAND principles. However, the group in practice favoured royalty-free SEPs or submissions from firms that agreed to include patents in its patent pool rather than to negotiate licences on a bilateral basis (AVS 2004).[3] The AVS alliance strictly examined claims of essentiality, eventually including only 50 patents in its patent pool, versus nearly 1,000 for H.264. The patent pool was designed to reduce SEP licensing costs. The AVS alliance had also announced the licensing fee in advance — US$0.12 per device. Firms with SEPs were unlikely to make large amounts of money from licensing fees. The intention was to encourage widespread adoption of the standard and for the contributing firms to make revenues by producing and selling products rather than by licensing IP. Although the causal relationship is unclear, Chinese industry representatives and academics claim that the low price for AVS forced the MPEG-Licensing Authority to set a far lower royalty rate for H.264. Even with more SEPs than MPEG-2, the licence rate fell to US$0.15 from $2.50.[4] With lower licensing fees — whether for AVS or H.264 — Chinese manufacturers could produce standards-compliant products on terms far less onerous than demanded in the past. This would improve their profitability and ability to save and invest in future technologies.

Apart from creating alternatives to established technology standards in order to encourage lower licensing fees, Chinese firms and research institutions are actively seeking to set technology standards both domestically and worldwide for technologies that are still in the pre-standardization phase. One such initiative is the Intelligent Grouping and Resource Sharing (IGRS) standard being developed for the Internet of Things (IGRS 2012a). The IGRS standard's first form enables resource sharing among mobile phones, computers, televisions and cable receivers over short distances. Later developments have expanded the capabilities and range of IGRS to enable resource sharing and seamless communication among compatible devices at the metropolitan level. While today's telecommunications standards differ from those of wireless information-processing devices, such as laptops operating on Wi-Fi, IGRS hopes all devices can use the same protocols and communicate smoothly and efficiently. IGRS device networks are designed to be automatic, integrating new devices without needing intervention from service managers or information technology departments. Whenever IGRS devices are within range of one another, they will automatically connect and begin resource sharing as needed. Thus a phone's processing power could be greatly enhanced by resource sharing with a nearby computer. IGRS is not a dream of the Chinese alone; its protocols formed the basis for the international 3C convergence standard[5] adopted in 2012.

Showing the extent to which Chinese firms hope to change norms governing IP in standards to better their revenue and profit margins, IGRS was started by Chinese manufacturers, not research institutes. Although the IGRS working group was officially created by MIIT in 2003, the technology development had begun in leading firms such as Lenovo. After the working group convened, Lenovo and several other firms worked for 18 months on the protocols for the standard, presenting the results to MIIT in 2005. Participation in the working group remained limited, however, as it was widely seen as Lenovo's standard.[6] Other firms involved in development, including Great Wall, Konka, TCL and Hisense, were reluctant to declare or share their potential SEPs for fear of giving them away to their main competitors. To encourage further participation in the standard, Lenovo was formally removed from official leadership of the working group and a new IGRS corporate entity — similar to the legally separate licensing authorities of many other global standards —

2 In-person interviews conducted by authors, Beijing, June and July 2012.

3 Ibid.

4 Ibid.

5 The 3 Cs of convergence are content, computers and communications.

6 In-person interviews conducted by authors, Beijing, March 2012.

would be responsible for licensing and certification of standards-compliant products. Membership grew from 59 to 170 members by June 2012 (IGRS 2012b).

The SEP rules for the IGRS standard are much like those in AVS — built upon Chinese manufacturers' experience with the licensing of SEPs for earlier global standards. First, to prevent bilateral negotiations in which one party might be at significant disadvantage, SEPs included in IGRS must be licensed on a non-discriminatory basis (IGRS 2005). Firms unwilling to accept this condition cannot have their patents included in the standard. Further, any firm wishing to include technology in IGRS must fully disclose all potentially relevant patents. They are not permitted to declare essential patents *ex post.*

Further, similar to AVS, IGRS created a patent pool to facilitate both the licensing of the SEPs and the sharing of SEPs among participating firms. Firms whose patents are included in the pool enjoy "preferential treatment in using other units' patents" (IGRS 2015). Further, the patent pool's single licence is to be inexpensive. While there is no formal rule mandating nominal pricing, IGRS's members see it as in their interest to keep licensing rates low. Doing so is to encourage other Chinese firms — and manufacturers worldwide — to adopt this standard, in the hopes of building critical mass and ensuring lock-in. However, the emphasis for the member firms remains on increasing their market size for compliant products — not on maximizing licensing revenues.

CONCLUSION

The development of globally accepted technology standards has been a boon for firms and consumers in developed and developing countries alike. However, the gains of these advantages are distributed unevenly thanks to the influence of SEPs and the varying terms under which they are licensed. Even when SEPs are licensed on a non-discriminatory basis, the rewards are unevenly distributed. Firms with large collections of SEPs enjoy royalty-free access to the standard due to their ability to enter patent-sharing agreements with other SEP holders. In contrast, those on the outside face a cost disadvantage because they must pay royalties for each standards-compatible product they produce.

In response, some emerging country governments, most notably China, have begun challenging the norms of independently determined "reasonableness" in licensing rates. Since technology standards effectively prevent the emergence of competing products — at a given level of technology — would-be market participants are obligated to compete on the terms set by the holders of SEPs. In China, standardization efforts over the past 15 years have emphasized a narrow definition of essentiality in the interest of limiting the size of the patent pool involved in a standard. By keeping the number of SEPs to a minimum, licensing arrangements should be simpler to navigate.

More importantly, standardization efforts in China have attempted to reshape norms concerning the licensing of SEPs. In principle, as with Ericsson's decision concerning GSM, IP should be licensed on a royalty-free basis. When firms submit proposals for the protocols of a standard, the terms under which they intend to license the technology are considered alongside technical merit. Where the best technology is not available on a royalty-free basis, the standards-development working groups attempt to create licensing patent pools available at nominal rates. This compromise approach is intended to reward innovative effort by allowing firms to receive royalties for their IP but also to encourage earnings through production of standards-compliant products. Ideally, the low royalty rates and widespread production will reduce costs for the technology, facilitating wide adoption.

Writ large, the Chinese approach is intended to show it is possible to protect and honour IP without making it a primary source of revenue. The challenge for foreign firms interested in pushing their technologies as part of Chinese standards is that these norms conflict with Western principles of hard IP rights in which IP holders are free to dispose of their property as they see fit. There is also a challenge and question as to whether leading Western multinationals will accept these terms for SEPs. To date, many firms have been reluctant to participate in Chinese standards-development efforts for fear of losing control over their IP. At the same time, however, some Western firms — most famously Apple — have publicly come out in favour of at least compulsory licensing for patents that might be used to obstruct the rollout or dissemination of a standard. This support shows there is potential for broader acceptance of the "Chinese" approach to SEPs.

Should Chinese standards prove their technological merit and competitiveness with foreign alternatives in the pre-standardization phase, it is possible that these new norms of less expensive IP may take root. This would benefit manufacturers and producers of standards-compliant goods and services. Those firms with production capability and cost controls will be better suited to benefit from this system than firms accustomed to partial, or full, reliance on licensing as a means of revenue generation.

Policy makers in different countries naturally act in the interest of their national economies. These differing visions have now spilled over into technology standardization. In international trade agreements, US negotiators push for protection of IP because this benefits US firms. In contrast, Chinese firms — which specialize in production — emphasize that IP should be widely available on favourable terms. In other emerging economies, this perspective might be welcomed. In India, for instance, there is a thriving generic pharmaceuticals industry. These firms compete not on licensing or technology but rather on production efficiency. As manufacturing and dissemination are the source of value, rather than licensing fees, such firms might be more open to the inexpensive IP approach. Smaller emerging economies with strong manufacturing sectors, such as Vietnam or Indonesia, would also stand to benefit from the lower costs created through an alternate SEP-valuation regime. For countries that utilize, rather than produce, standards-compliant products, the lower licensing fees could mean wider availability of and lower prices for these products.

While the Chinese approach is far from universally accepted, it does provide an alternative perspective on SEPs. Without rushing to make judgments, business leaders and policy makers in both emerging and developed countries should consider the developments in international standardization coming from China. Such consideration will allow negotiators to speak more frankly and clearly, thereby helping to foster more productive negotiations in which both sides understand the other and are thus better able to reach accommodation.

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