The Rise of China in Technology Standards:

New Norms in Old Institutions

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Executive Summary

China's efforts to develop unique technology standards and its rapidly increasing activities as a participant in international standardization efforts have drawn widespread attention. China does use technology standards as a protectionist tool. However, a complete review of the standardization system reveals that: i) protectionism is not the major focus of Chinese standards development efforts; and ii) it is not the main challenge China poses for American firms. This report addresses six broad areas of interest that are critical to understanding Chinese technology standards efforts and their implications:

- Unique or exclusionary technology standards have neither been commercially successful nor fully exclusionary
- Unique standards efforts are an effective trade tool, particularly in lowering royalty rates for Chinese firms
- The main challenge China poses in standardization is in establishing new norms, particularly advancement of a cheap royalty options to the holders of standards-essential Intellectual Property Rights (IPR)
- China is rapidly increasing its skill and sophistication in global standards organizations and building deep knowledge of their regulations, fostering potential advantages in negotiations
- Technology standardization in China remains legally governed by laws and administrative apparatus developed for, and at the time of, the planned economy
- An expansive role for the state in standardization is the accepted norm in China

Unique Chinese standards development efforts, particularly in information and communication technologies, including TD-SCDMA (Mobile), WAPI (Wireless LAN encryption), and AVD and CBHD (Digital disc players) have attracted attention. Many see these standards as outgrowths of China's "indigenous innovation" policy. The policy of promoting indigenous innovation is not clear-cut, as there is no universal agreement on what constitutes indigenous innovation. Unique Chinese standards have also generally been market failures. None have gained significant market support outside of China and most have limited success even within China. These standards also incorporate significant amounts of foreign intellectual property. For TD-SCDMA, foreign firms' patents constitute the majority of the embedded patents.

On the other hand, unique Chinese standards successfully serve as a trade tool. As export processors, China's firms specialize in the final assembly, packaging, testing, and shipment of completed products. For these goods, Chinese manufacturers are subject to the licensing requirements of different standardized technologies. In commoditized industries such as consumer electronics, licensing fees squeeze already thin profit margins. Development of low cost and potentially competitive standards for similar or identical technology niches pushes foreign standards alliances to lower royalty rates. This has been a great boon to Chinese companies.

The approach to intellectual property embedded in technology standards has been evolving. China's Patent Law permits inclusion of proprietary technologies in standards, but the terms under which firms are obligated to license remain ambiguous. This is an area of great concern and contention for foreign enterprises interested in participating in standards development work

in China. The fear is that proposed changes would mean that the act of participation would obligate firms to license their intellectual property. Under the current ambiguous legal environment, policies for IP in standards are de facto the responsibility of the various standards development organizations and industry alliances. Each of these organizations is developing its own policies. Formally, all groups accept and conform to Reasonable and Non-Discriminatory (RAND) principles. Nonetheless, preference is often given to technologies whose IPR is offered on either a royalty-free or minimal and set-price royalty basis. Similarly, some groups have begun using patent pools that set very low royalty rates for embedded essential IP. Thus, the overall trend in China's policy is toward establishing the norm of a set, low, cash-option (that is nominal cash payment, for example 50 cents, for the licensing of all IPs that are embedded in a standard) on the licensing of essential standards' IP.

It is here – in its potential reshaping of norms for standards-essential IP – that China's ascent poses a real challenge to American firms' practices. The Chinese approach emphasizes IP as another factor of production, not as a source of profit or unique competitive advantage. Accordingly, the aim is to lower its price to the minimum, which would (hopefully) increase the profit margin of equipment producers at the expanse of the IPR holders.

China is rapidly increasing its skill and sophistication in global standards organizations. The China National Institute for Standardization is developing masters-degree programs in technology standardization. These programs train engineers to focus on the legal and policy aspects of technology standards development. Deep understanding of the laws and regulations surrounding standards increasingly make Chinese contributors highly effective in promoting China's interests in international standard setting bodies.

The legal and agency structure for standards dates to the 1980s, when the National People's Congress developed and approved two sets of legislation critical for technology standards: the Patent Law (1984) and the Standardization Law (1989). The Patent Law has since been amended three times, taking into account the growth of the market economy and the increased role of business R&D. The Standardization Law has not been amended since 1989. It places the state – specifically, the Standardization Administration of China (SAC) – at the center of standardization efforts. SAC is to initiate, guide, and approve national standardization efforts. Trade (industry) standards are initiated, guided, and approved by industrial ministries, most notably the Ministry of Industry and Information Technology (MIIT). The law does not address intellectual property, licensing, and the role of industrial standards alliances. These areas are open to interpretation and divergent practices by standards development organizations. The law allows for two types of standards: compulsory and voluntary. Compulsory standards have the force of law and can bar non-compliant products from the market.

Last, but certainly not least, China's strategy for standards is state-centric and regulation-based while the United States insists on market leadership and voluntary standards. There is a major and accepted role for the government in China's technology standards development. Industrial ministries support strong state involvement in standards but also insist that standards be subjected to market forces, not just state dictate. The use of state power in standards-making is intended to give Chinese firms an opportunity to develop and test technologies domestically before seeking their inclusion in international standards.

Introduction

On some measures Chinese advancement in advanced R&D and innovation is striking; starting at practically zero in 1990, by 2012 China annually exported over 548 billion dollars in high technology goods and services (MOST, 2012). R&D expenditure is growing, nearly 22% per year, and reached 136 billion USD, second only to the United States, (BBC, 2011; Xi Wang & Liu, 2012). In patenting, China was ranked third globally by 2008 and surpassed Japan as number two in 2010 (Finance.591hx, 2011). China's scientific publications have also surged, ranking second only to the United States and leading in certain emergent fields such as nanotechnology.[1]

It is no surprise that China has set its sights on achieving what it sees as its due global stature in the technology standards domain. By 2020, according to the Chinese government, China should have an innovation-based economy and be a world-leading R&D power (StateCouncil, 2006). Policy makers see development of technology standards as central to realizing these objectives. Within China, particularly in policy circles and academia, there is a pervasive belief that only companies that make standards can be considered first tier international technology-based companies.[2] Furthermore, it was widely argued that to achieve the goal of establishing standards-setting firms, the government must play an active role in

[1] It should be noted that in these statistics, similarly to many statistics used in the case of technology standards, there is an acute misunderstanding of the meaning and the causes behind this surge. For example, in the case of scientific publications much of the explosion can be explained by means other than a radical qualitative change of the entirety of Chinese research output in less than a decade. Simply looking at the journals themselves, one realizes that almost all the publications are in new ISI indexed scientific journals that have been established and managed by Chinese in China over the last fifteen years after a new incentive system for academics placed emphasis and material rewards on publication in ISI-cited journals. Thus, while the surge is nothing but miraculous, and hints at significant underlying changes, scholars who use aggregate statistics to reach sweeping conclusions on innovation rankings often miss their mark by a wide margin (Murray & Spar, 2006; Porter, Newman, Roessner, Johnson, & Jin, 2009).

[2] A popular Chinese saying states: 三流企业做产品; 二流企业做技术; 一流企业做标准 (Third tier companies make products; second tier companies make technology; first tier companies make standards).

mandating and setting standards. In interviews, many policy makers and academies voiced a similar sentiment as stated by a leading researcher at Tsinghua University:

> "Globalization is all about the move from national markets to a global market. Where there is a single global market, the first mover wins. Standards can create a relatively protected environment to allow indigenous firms and technology to develop. Otherwise the first mover, who comes most often from a developed country, will dominate. Emerging economies are coming from behind and cannot compete on the same terms as established technology players. Thus the state should be more active in providing the necessary protected environment."

With this underlying perception, the Chinese state apparatus has moved strongly to promote new indigenous technologies and standards incorporating them. However, it has done so using a hybrid administrative and institutional system born under the planned economy and developed gradually and without explicit direction throughout the reform era. China's moves to develop unique, and at times mandatory, technology standards have stunned dominant foreign technology companies, yet until now these standards have repeatedly failed when introduced into the market. However, as we argue below, failure to reach success in the market does not mean that these standards have not served a valuable purpose for Chinese firms.

We argue that China's technology standards policy, while ambitious, is far from a monolithic strategic objective. The reader should remember that China is far from a single-minded strategic actor. Its formal organizations and institutions of standardization are still developing and changing, many of them still tied to a legal and agency infrastructure developed for a centrally planned economy. Bureaucratic infighting often undermines the potential market success of Chinese standards, even those which ostensibly present a real technological challenge to the West. The use of embedded formal intellectual property rights – such as patents – in standards is only recently emerging. Most importantly, we contend that, based on the business models of Chinese technology firms, China's real challenge to the West is not in developing

unique alternative technologies and standards; but rather in affecting changes in the norms governing the means by which embedded IP in standards is monetized and licensed.

This white paper is based on the results of archival, statistical and secondary source research, as well as three months of field research conducted in the spring and summer of 2012. Archival research included consulting official Chinese policy and legal documents, standards drafts, and circulars. Statistics were provided by China's standardization administration, the Ministry of Science and Technology, the State Intellectual Property Office, and interviewees. Secondary source research included both media and academic publications and white papers in English and Chinese from foreign and Chinese sources.

The field work involved the use of semi-structured interviews. Each interview utilized a seven-point interview theme instrument; all of the themes were at least partially addressed in each interview. (Using semi-structured interviews as opposed to surveys enabled interviewees to speak more fully on topics of interest to them or areas where they had greater expertise.) Thus some interviews focused heavily on the role of IP in standards and China's evolving IP system while others emphasized strategy and theory for standards in China's economy. Interviewees represented the various stakeholders in China's technology standards bodies, government ministries, technology companies, academia and consulting firms.

In total, we performed over sixty semi-structured interviews. Interviewees included both Chinese and foreigners, providing a wide range of insights and perspectives into China's technology standards system and policies. Meetings were held in Beijing, Jinan, Hong Kong, and Xiamen. As the center of China's political system and home of most standards-making bodies, the majority of interviews were held in Beijing. The interviews were conducted in Chinese or English according to the interviewees' comfort level; the majority were conducted in Chinese.

Wherever possible, we verified the claims of interviewees by triangulating responses with those of other interviewees or published accounts and research.

This research has shown that China's technology standards system is still maturing and has developed several unique and defining characteristics that have an impact on the standards produced, the interests of foreign (and Chinese) firms, and that ability of foreign companies to contribute to technology standard development efforts:

- China's technology standards system, and the active role for the government in pushing standards development, is governed by the 1989 technology standardization law of China. This law was made while China was still largely under the planned economy, and even the nascent reform movement was heavily government led and directed. As the legal basis for China's technology standards system and administration, the leading role for the government – specifically the central government – remains the law in China to this day. Recent attempts to reform the law have not diminished state leadership in standards, and they have not yet been successful in radically changing policies for incorporation of protected IP into standards.
- Voting in Chinese technical committees and working groups is not the source of major decisions or changes in membership or incorporation of technology. US firms should pay closer attention to the actual structure of decision making within each body, instead of focusing on formal procedural mechanisms like voting.
- China's emerging approaches to embedded-IP in standards differ from the US norm and present a challenge to monetized IP-based business strategies. Chinese firms and standards-making bodies increasingly favor low-price or free licensing norms for embedded technology.
- Although interested in using standards as a means of technological upgrading, China's unique or exclusionary standards development efforts have not been commercially successful; neither have they been effective in supplanting foreign embedded intellectual property in ostensible Chinese technologies and standards.
- However, China's unique standards development efforts are very effective as trade and commercial negotiation tools, specifically in lowering royalty rates that Chinese companies pay for licensing.
- China's overall view of technology standards and the role for the state (versus market) in determining their formulation and composition is more akin to a European perspective than that of the United States.
- The Chinese now have a much better understanding of the specific wording of international agreements about standards, to include what practices are allowed, when, and how. As a result, China's international negotiators are becoming more adept than those in the United States. It is, therefore, no longer clear whether the US would prevail against Chinese efforts in cases of standards disputes at the international level.

This white paper develops these arguments as follows. It first introduces the basic principles of technology standards, standards development and embedded intellectual property (IP) as practiced in the West and in international organizations. It then turns to China, introducing the influential 1989 Standardization Law, the legal basis for China's approach to technology standards. With this background, the paper then looks at China's standardization system and the actual workings of China's technical committees and standards bodies, and how these shape the types of standards developed. It then explores how China approaches the incorporation of essential intellectual property into national and industry technology standards. Then, it presents a discussion of the relative success of China's attempts to develop unique Chinese technology standards, highlighting the effective, if unintentional, role these efforts play in the setting of licensing fees for Chinese manufacturers. Finally, the paper presents a brief discussion of the broader implications of China's unique standards development efforts for US firms and the position of China and the United States in the international standardization system.

Technology Standards in Brief

Technology standards are agreed-upon technology platforms for interconnection, operation, or function on which other applications, improvements, and innovations can be made. Like patents, the formal documentation for a standard consists of hundreds of pages of technical specifications defining terminology, outlining protocols and specifying the technologies necessary to make the protocols function. Since the time of the unification and centralized codification of weights in Qin-era China, and medieval Florentine guild-masters checking the length of cloth merchants' meter-sticks, standards have traditionally been the staid domain of government weights and measures officials (Kindleberger, 1983). Even in those early days, however, standards were essential to the smooth operation of trade – hence the Florentine

insistence on controlling against "short sticks." Today, this importance has only increased. Standards of quality facilitate trade through lowered transaction costs and increased efficiency. For example, the difference in standard railroad gauges between Russia and China forces railroad operators to exchange the railcar carriages at the border, slowing trade. Similarly, international travelers know well the irritation of being unable to use different electronic devices due to voltage differences and incompatible plug styles. On the other hand, standardized measures of quality enable potential buyers to acquire goods or services sight unseen with a measure of confidence.

Technology standards are integral to modern life. Information and communication technology (ICT), particularly its ability to communicate with other devices, is reliant upon widely adopted and accepted standards. Whether internationally developed such as the ISO's OSI suite or DARPA's TCP-IP, commonly accepted protocols are necessary for electronic devices to communicate and exchange data. To illustrate, the Universal Serial Bus (USB), developed by a group of US computer firms including Intel, IBM, and Microsoft, has become the global standard for interfacing computer peripherals with the main system. The USB standard has replaced the need for multiple incompatible jacks that had made it difficult to design and market products for any and all types of personal computers. Use of USB has helped alleviate market confusion and increased the market for peripherals as buyers can confidently purchase hardware assured of its compatibility with their computer system, regardless of brand.[3]

While there may be, and often are, competing standards for a given technology – for example GSM and CDMA in second generation wireless telecommunications – technology standards often achieve quasi-monopoly status in world markets. For example, although there are competing software options including free open-source and online tools, Microsoft's Office suite

[3] The market success of USB is such that both Apple and PC-brands all use it as the basic connection interface.

dominates the global market in word processing, spreadsheets, and presentation software. This de facto monopoly enhances Microsoft's brand value and makes it difficult for competing (and even potentially better) technologies to take root in the market.[4] Firms whose technology is incorporated into a dominant standard stand to earn massive returns, while those who supported a losing standard might find their R&D investment wasted.[5]

Technology standards can be either market-based de facto or de jure (formal) standards. De facto standards such as Microsoft Office are set through market competition where the winning standard or format pushes competitors out. An important point, and one sadly much confused in the media, is that a technology standard – even a market determined de facto one – is *not* usually a product by itself. While Microsoft software tools are products, even DVD technology is not actually a product but rather a codified set of technologies which, if adhered to, make a player compatible with the standard. DVD players are products, devices certified as compatible with other devices and media adhering to the same protocols. Technology standards are incorporated into goods and services to make them compatible with, or in compliance with, regulations or even technological necessity (such as how to continue squeezing ever more data transmission into finite amounts of broadcast-worthy spectrum). Only when the standard is incorporated into products does it have an impact. In our research, Chinese enterprises consistently emphasized the importance of standards in products, not the monetary value of the standard – or even embedded IP – by itself. This critical difference will be highlighted in our discussion of Chinese approaches to IP and the challenge this may present to US firms.

[4] Through the "network effect" in which more users adopting a given technology can exponentially increase that technologies' value due to the number of compatible partners. As such standards such as Microsoft Office become deeply entrenched. Known as "Metcalfe's Law", this method of valuation has been used to explain the value of social networks, computer networks and the Internet.

[5] The victory of Sony's Blu Ray over Toshiba's HD-DVD standard led Toshiba to license its technology at very low rates to Chinese firms in order to cut its losses. Chinese firms went on to use this technology as the basis for the indigenous China Brand High Definition violet laser disc standard. Expert analysis estimates 90% of the technology for the Chinese standard came from HD-DVD (Hsu & Hwang, 2008).

Formal or de jure standards are developed, set, and administered by institutionalized technology standards bodies. These can be non-governmental organizations with global membership, such as IEEE, or state membership-based bodies such as the International Telecommunication Union (ITU) and International Organization for Standardization (ISO).[6] The United States considers international market-determined standards and those set by NGOs such as IEEE to be international standards that should be accepted as mandatory under WTO rules. However, European Union members and China insist that only formal inter-governmental bodies can make binding international standards. This has become an area of contention in US-China relations governing standards (AMCHAM, 2012; USITO, 2010).

At the national level, there are non-governmental bodies, such as the American National Standardization Institute (ANSI) or European Technical Standards Institute (ETSI) that define national or regional standards. These are generally not standard-making bodies themselves. Rather, they are administrative bodies and represent their respective states in formal inter-governmental standards organizations (such as the ISO). While able to certify compliance, these actors too lack an independent means of enforcement of their standards. Some national standards bodies (such as the German Institute for Standardization) draft, adopt, and certify national standards. Generally there are not formal government bodies; however their actions, as in the United Kingdom, may be certified as official for the country in question.

To develop standards, specific technical committees are established to draft the protocols for a given technology or area of interest. Technical committees may be organized either by

[6] IEEE is a professional organization made up of experts from electrical and electronics engineering. It sets standards for electronic and local wireless communications technologies. It has no enforcement capability of its own. ISO and ITU are state-based organizations whose membership is limited to representatives of different countries. These bodies set broad ranges of standards – such as ISO – or more narrowly focused ones – such as ITU which only sets long-range telecommunications standards. These organizations also have no formal enforcement capability but do certify products or technologies as compliant with their standards, thus providing consumer confidence about their interoperability.

industry directly, or under government aegis through national standards bodies. Within technical committees, working groups of experts propose, test, debate, and adopt protocols to incorporate into the final standard. Inclusion of technologies or approval of protocols is accomplished through consensus and majority vote.

Binding enforcement of standards set by the IEEE or international organizations such as the ISO is accomplished through the World Trade Organization. In response to the use of technology standards as a trade barrier in the 1970s and 1980s, the Uruguay Round of the GATT, which formally created the WTO, incorporated language regarding technology standards into the Technical Barriers to Trade (TBT) agreement. According to the 1995 TBT agreement text:

> "Where technical regulations are required and relevant international standards exist or their completion is imminent, members shall use them, or the relevant parts of them, as a basis for their technical regulations" (WTO, 1995).

In effect, the TBT agreement requires WTO members to use internationally accepted standards, except where there are significant security or local country challenges. WTO members who adopt non-conforming technology standards may face retaliatory action by offended parties through the WTO's arbitration apparatus. Unique compulsory standards can be used as a trade barrier and are thus banned under TBT rules. However, it is very difficult to prove that a technology standard, compulsory or otherwise, is actually intended to be exclusionary. WTO rules also allow for exceptions based on national conditions, which means that intent to disrupt trade must be proven. While the TBT agreement makes compliance with international standards enforceable, the WTO arbitration mechanism is rarely used. To date, only a single standards-based case has been brought for arbitration, concerning a European attempt to restrict use of the word "sardines" (WTO, 2003). Furthermore, the definition of an "international" standard is itself subject to contention. The United States' official position is that formal standards set by intergovernmental bodies such as the ISO and those set by NGOs such as IEEE are international

standards for TBT purposes. However, European states and China argue that only intergovernmental body-created standards are international, and therefore obligatory.

The inclusion of protected intellectual property (IP) in technology standards through IEEE, ISO or other bodies is done in accordance to the good faith disclosure principle. This is the standard norm governing how firms should make their IP known and available for inclusion in the protocols of technology standards. Companies whose representatives are taking part in the development of a standard, or which are active in technology areas covered by a prospective standard, are expected to proactively disclose any patents that may be infringed by the proposed standard. This is usually accomplished by a "patent dump" where firms simply list virtually every potentially relevant patent they have.[7] As the protocols of a standard are refined, it ideally becomes clear which patents may be infringed upon and therefore the standards committee must ensure means of licensing of these technologies. Protected technologies can be incorporated into standards through multiple means of licensing:

1. RAND Licensing: Reasonable and Non-Discriminatory (RAND) licensing, sometimes called FRAND (adding the word "Fair"), obligates the firm to license its relevant protected technologies to any interested firm without bias and to charge a "reasonable" royalty fee for the license.[8]
2. RAND-RF: Where a firm is willing to license all or some of its protected technologies without demanding a licensing fee, they make a RAND-RF (royalty-free) pledge. For firms seeking to build their brand, increase final product sales, develop market allies or steer the direction of a standard committee, this can be an effective licensing strategy.
3. Patent Pool: certain technology standards use patent pools, often administered by incorporated bodies separate from the formal standards development organization. Member companies include their relevant technologies in the pool and all receive a pre-set royalty for each standard-compliant unit sold. Would-be adopters pay a flat rate for all of the relevant technologies in the standard but must accept the full pool, even if they believe some of the patents to be superfluous.
4. No-License: in certain cases, a firm may disclose that it has relevant protected technologies that the proposed standard would infringe upon, but may choose not to license them on any

[7] IP expert interviewees noted that many firms now have such massive patent portfolios that they are unsure of the value or even content of their patents. Since patent mining takes time, special skills and resources, a "patent dump" is used to buy time to examine patents in detail while still conforming to the good faith disclosure principle.
[8] In the U.S., reasonableness is determined by legal precedent from comparable goods. China, however, does not have a common law system and does not have a similarly developed tradition of using precedent to determine reasonableness. This makes reasonableness difficult to define.

terms. Although discouraged, US anti-trust law does not consider refusal to license to constitute anti-competitive behavior (Bohannan & Hovenkamp, 2012). No-License disclosures often force a standard committee to "invent around" the patents in question unless the recalcitrant firm can be convinced to license.

Official policy statements and documents from China's standards development organizations generally follow these international patterns. China does not explicitly seek to develop alternative institutions and organizations or practices concerning standardization. Since the 1980s, China's standardization administration has learned much about how international standards bodies work and the means by which they create and administer standards. However, interviewees noted that while understanding of international practice is much greater than in the past, there is institutional inertia that continues to emphasize the more unique, and particularly state-led, aspects of China's standardization system. The remainder of this paper calls attention to the differences in the Chinese approach to standards versus the current international model, emphasizing the broad similarities but also critical specific differences.

China's Legal and Administrative Standards Systems

China's current technology standards development system dates back to the 1950s with the establishment of China's current standardization administration under the tutelage of experts from the Soviet Union.[9] This system, which governed weights, measures, health, safety and other non-controversial areas for standardization and regulation, endured until the 1980s. Despite various reorganizations and name changes, China's central government technology standards body, now known as the Standardization Administration of China, has existed continuously since the 1950s.

[9] China joined the ITU in 1920 and was an early ISO member under the pre-1949 Republic of China. After the 1949 revolution, China's economic, political, and even standards institutions were realigned and reoriented toward the Soviet Union. China rejoined the ISO in 1978 (CCNA, 2006).

The current formal system of standardization is still strongly influenced by the Soviet-designed planned economy standardization system and the timing of structural and legal reforms in the mid-1980s. This is especially important since the 1980s were a period of mixed practices and expectations regarding planning (hence state leadership) versus the market. China in the 1980s, although undergoing the earliest stages of economic liberalization, was still heavily dominated by the planned economy. State-owned (and then planning-based) enterprises contributed over 70% of industrial output (Naughton, 2007). The countryside was more economically liberal as rural communes were disbanded (with a few exceptions) by 1984; the family responsibility system had been spreading rapidly through communes since 1979. China's first joint venture law was enacted in 1980. Although growing, market-oriented township and village enterprises would not become industrially powerful until the 1990s. During this period there was constant tension between more economically liberal reformers led by Zhao Ziyang and more conservative reformists led by Chen Yun. The most famous metaphor for the Chinese state view of the proper role of the market in the economy was that of the "bird in a cage," coined by Chen Yun: the market sector was to provide vitality within the iron cage of planning, which was to remain present and dominant. Given the political economy of the time, it is clear that laws written regarding standards would include a major role for the state.

The 1989 Technology Standardization Law

The formal technology standardization organizations in China have developed over the past twenty years under the influence of the 1989 Technology Standardization Law, rapidly changing technologies, and high degrees of experimentation and learning. The 1989 Law, which is still the sole legal basis for China's standardization system and *has not been officially*

amended, was drafted starting in 1985 and adopted in 1988. Given the time in which it was developed and adopted, it reflects a view on standards embedded in the now long-passed reality of a government-led planned economy, and a strong top-down approach to reforms. The strong leadership role for the government is formally enshrined in the law. As stated by one interviewee remarking on the differences between standards in the West and China, "What makes standardization special in China is the leadership of the state."

Most of the provisions of the law are uncontroversial. It is formally designed to encourage international trade, technology interoperability, adoption of international standards and development of standards for the protection of health and safety. One interviewee noted that at the time of the law, there were really only standards for health and safety; technology standards in the manner of IEEE or IEC standards for interoperability were not widely discussed or mentioned in the law. Technology standards, and their potentially controversial IP or protectionist implications, were not even envisioned as a possibility by the authors of the law.

However, four articles in the law strongly influence the unique and at times controversial aspects of China's technology standards system:

> **Article 5:** Article 5 assigns responsibility for unified administration of standardization to a body under the State Council. This is the opposite of the situation in the United States, and even Europe, where bodies such as ANSI are non-governmental organizations. While China's SAC is officially a non-governmental body, even in China it is viewed and treated as an extension of the state. Article 5 also permits relevant bodies under different ministries and regional governments to also take responsibility for standardization within their various jurisdictions (whether industrial or geographic). This article (and Article 12) codifies a tendency toward state leadership, for national, industry and regional standards.
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> **Article 6:** This article delineates four legal types of technology standards within China. Where no standards exist and none are proposed for development, enterprises may define their own enterprise standards. Interviewees noted that unlike dominant foreign firms, there are few Chinese companies with enough clout and market gravity to set enterprise standards which could shape the whole industry. Where a regional government sees the necessity of a standard for improving the coordination and functioning of local industry, it may adopt a regional standard. If adopted, this will supersede any existing enterprise standards in that jurisdiction. At a national level, different industrial ministries may promote, set and adopt standards for their different responsible industry or trade areas

(The Ministry of Industry and Information Technology, MIIT, is highly active in this area, pushing standards in ICT and telecommunications). Finally, where a standard will serve the national interest, the State Council appointed body should develop national standards. Revealing the emphasis on health and safety standards, the same article encourages enterprises to set standards even more stringent than national or industry standards.

Article 7: This article officially defines the two classes of Chinese standards, dividing standards into compulsory and voluntary ones. The United States does not use technology standards in this way. All American standards are voluntary and based on market competition. Due to this article in the law, China's authorities have the ability to make a technology standard compulsory and legally enforceable. When a national standard is compulsory, it should be entirely royalty free. Officially, only standards responsible for safety or as otherwise prescribed by law will be compulsory. However, as noted by the United States Information Technology Office (USITO) and the US Chamber of Commerce (AMCHAM), there are other ways of making standards de facto compulsory such as mandating use of a specific standard in a different regulation or where Chinese firms concertedly demand use of a given standard without official state sanction.[10] The ability to make compulsory standards presents the possibility of using standards as a protectionist tool or to promote a given technology or enterprise through a mandated market.

Article 12: This article states that trade associations, scientific research institutions and academia should be involved in the formulation of standards but that "a department engaged in the formulation of standard shall organize a committee on standardization technology". This, again, places a government body at the center of standardization efforts by mandating that a state actor initiates committee formation. The committee, once so created, is responsible for drafting and examining the standard.

Despite its continued status as law, in interviews concerning the status and meaning of the 1989 Law, Chinese business and even standards development bodies noted that the law was quite outdated. A typical response concerning the law stated, "Standardization (in China) is based on the 1989 Law but this law only mentioned health and safety, not ICT. The law is obsolete."

Its obsolescence is also significant for the many issues in modern technology standardization that the 1989 Law fails to address. The law *does not mention intellectual property or the means by which it can be incorporated into technology standards*. The legal

[10] For example, the WAPI encryption standard was first made a de facto compulsory standard when the three telecommunications companies demanded that any phones on their networks use the standard. While not officially a state pronouncement, it forced smart phone companies to ensure their devices could support WAPI in addition to the global 802.11i encryption standard.

status of IPR in standards is thus somewhat ambiguous. The law is not static, however. There have been repeated reforms to China's intellectual property laws as regard patents. China's first patent law was passed in 1984 and entered into force in 1985. Since then, the law has undergone four sets of revisions, with the most recently adopted provisions being proposed in 2008 which attempted to balance private and public interests and national innovation strategy while strengthening IPR protections. A fourth revision is currently undergoing review. When initially made available for comment, the fourth revision included provisions making it possible to demand compulsory licensing of relevant patents for Chinese standards (SIPO, 2012). After receiving 400 comments, it has again undergone revision, particularly regarding mandatory licensing.

Similarly, in 2004, SAC issued a draft policy which formally declared that the state should guide national standards that have "great bearing on industrial development and competitiveness," and address IPR and standard issues "so as to improve the proportion of self-proprietary technologies in Chinese standards" (Slater, 2009). A draft regulation from SAC the same year would have forbidden the use of proprietary technology in mandatory national standards or else mandate royalty-free or RAND licensing, regardless of the patent holder's wishes (SAC, 2009; Willingmyre, 2010). This policy was not adopted but neither was it completely abandoned. Thus, the 1989 Law remains the formal regulation while other related laws and policies continue to be debated, often involving proposals that could significantly lower the returns that foreign IPR could command from Chinese manufactures.

Despite this freedom to adopt differing approaches to incorporating IPR and the multiple, often controversial, new regulatory proposals, it should be noted that interviewees repeatedly mentioned that conforming to international standards and practices with regards to IP protection

was important.[11] Significantly, although considered obsolete, and based on an institutional and administrative climate that has significantly changed, the basic 1989 Law remains largely unchanged. It gives the state the ability to act in seemingly arbitrary ways when it sees it in China's interests to do so. However, while the law provides the legal basis, and hence justification, for Chinese administrative behaviors, outside of this law, a body of administrations and practices with strong impacts on the actuality of Chinese standardization efforts and results, has emerged in China.

Technology Standards Development Bodies and Administration

From the point of view of official structure, China's technology standards development bodies work much like those in the West. They have similar organizational structures, formal responsibility charts and even use the same terminology. However, the actual practice of different bodies varies significantly from the Western model. As mandated by law, national technology standards are assigned numbers by the SAC. Having a number issued by SAC gives a standards body, and its technical committees and working groups, the legal right to begin development of a national standard.[12] To put it differently, a standard development effort, even if led by major market players or a university is without legal basis unless it receives a standard number.[13] This has complicated the process of developing organizations similar to IEEE in China. For example, groups such as the China Communication Standards Association (CCSA) and China Electronics Standardization Institute (CESI) do not have the authority to make and

[11] As of September 2012, both the SIPO and SAC amendments and regulations are still undergoing revision and review. Neither has entered into force although the latest draft of the SIPO regulation (the fourth) is due at any time.
[12] National standards are identified by numbers beginning with "GB."
[13] Interviewees noted that state sanction was more than just a product of the 1989 Law. It was critical for lending legitimacy to a project and was often necessary to get firms and organizations to participate in standards development efforts.

approve standards on their own. They are under MIIT and can receive industrial standard numbers from the ministry, but require SAC sanction to work on a prospective national standard.

In addition to granting numbers, SAC approves and implements national-level standards. It is also responsible for representing China at international standards bodies such as ISO and IEC. However, in accordance with the 1989 Law, industry standards are the responsibility of different government ministries. Under the 1989 Law, national level standards can be divided into industry (also called "trade") standards and national standards. The difference between the two is the government body with jurisdiction over their development and adoption. For industry standards, SAC is not the most significant player. The responsibility for industry standards belongs to China's industrial ministries, notably the Ministry of Industry and Information Technology. SAC does not directly promote or approve industry standards. It does, however, review, revise and adopt industry standards when they are submitted to become national standards. It also takes responsibility for an erstwhile industry standard when it is to be submitted to an international body such as the ISO. SAC is the arbiter between domestic and international standards.[14]

The most important ministry involved in industrial standards development is MIIT. Most of the unique and controversial standards development projects, such as TD-SCDMA and WAPI, have been developed under MIIT's auspices.[15] MIIT and other industrial ministries assign project numbers for industry or trade standards development efforts by technical committees and their various working groups. MIIT acts through dedicated standardization bodies, most notably

[14] A related body is the China National Institute for Standardization (CNIS). This body is separate from SAC but is likewise under the administrative arm of AQSIQ. CNIS is responsible for conducting studies and policy-relevant research on standardization with the goal of improving the quality of Chinese standards and standards development practices.

[15] A long-time observer of Chinese standards noted that the rather extreme behavior of MIIT in the WAPI case was the result of pressures from parts of former military bureaucracies which had been absorbed into MIIT but not assimilated.

the China Electronic Standardization Institute (CESI), and the China Communications Standards Association (CCSA). These bodies are responsible for electronics and near-field communications standards and telecommunications standards, respectively. CESI and CCSA administer the technical committees and working groups developing standards for projects assigned numbers by MIIT (or SAC when developing a national standard).

This division of authority means that foreign enterprises interested in lobbying or seeking redress of grievances concerning standards need to understand which bureaucratic organ is responsible for their development. For national standards, SAC is the final arbiter. It is also the point of contact for disputes or concerns involving international standards. However, industry standards – often a source of contention between Chinese and foreign enterprises – are not the responsibility of SAC. For these standards, a foreign organization would need to directly contact the industrial ministry and seek changes or information there.

As in the West, there are also industry alliances that develop and promote certain technology standards. Technology standards alliances are not the same as technical committees or working groups (although their memberships overlap).[16] Rather, alliances are corporate or non-profit bodies that exist to promote the development, marketing and monetization of a given standard or suite of standards. These bodies are the acronyms most commonly heard in discussions concerning standards such as IGRS and AVS.[17] Alliances often include many members interested in producing products compliant with the standard, but who have little or no technology, or inclination, to contribute to development of the standard itself.

[16] This is akin to the practice associated with the MPEG standard(s). MPEG's audio-video encoding standards and upgrades are developed, proposed, debated and adopted through IEEE Working Group 11. However, the administration of the patents and commercial interests of contributing firms are managed by the MPEG Licensing Authority which manages MPEG's patent pool. This body sets the rates for the common license for would-be adopters of the standard produced by WG 11.

[17] In the West, standards alliances serve similar purposes and often have similar structures such as the MPEG-LA alliance which promotes the standards, and embedded intellectual property within them, produced by ISO/IEC Joint Technical Committee 1, Subcommittee 29, Working Group 11.

Alliances can also be responsible for setting the IPR policies for the standard they represent, and hence, are very important for understanding how IPR and technology standards work together in China. Under Chinese law, however, the legal status for standards alliances is somewhat murky as they are not mentioned in the 1989 Law. Scientists, research institutions and firms are encouraged to propose standards so these bodies can receive official sanction from SAC or a ministry. Once granted standards numbers, they can develop standards subject to the approval of the organization that granted the number. Unlike groups such as USB, Chinese standards alliances cannot make or codify standards by themselves (except for enterprise standards). Standards alliances remain reliant upon the state for their legal status; however, recognition that China's standardization administration moves too slowly for market and technological advances has led to an increased desire among some experts and officials to empower standards alliances. To date, however, no formal regulations regarding their status have been put forward.

Technical Committee and Working Group Structures and Practices

This section explores the inner workings of technical committees and working groups. Most importantly, there are practices that prevent full and equal participation in standards development by foreign firms, but these are not the proscriptions most commonly considered. Critically, voting rights, while now open to foreign firms, are not the key to influence or participation in Chinese standards development. Thus, if we want to understand who makes decisions, and who wields influence we have to understand the internal working of these bodies, and not just their formal structure. Additionally, an important difference with Western standard

development bodies is that the individuals who serve as the chairmen of Chinese technical committees wield more power and influence than their counterparts abroad.

Technical committees under China's standards bodies such as CESI and CCSA have multiple categories of membership. At the most basic level, there are observing members and voting members. Some foreign enterprises, as well as USITO and the American Chamber of Commerce, have complained that Chinese standards bodies have policies, or practices, that bar foreign members from voting or at least from participating in standards development on an equal footing with Chinese enterprises and research organizations (AMCHAM, 2012; USITO, 2010). Our research shows that this is no longer the case. Foreign firms are not barred from voting membership. However, while able to vote and contribute technology, foreign enterprises still have no direct voice in the final direction and adoption of the standard or selection of individual technologies to incorporate into specific protocols.

In interviews, different technical committee heads stated explicitly that, while in the early 2000s there were formal rules in China barring foreign participation in standards development efforts, these are no longer in force. The only exception is for standards related to national security or information security. These standards, such as the often cited WAPI standard, are also considered opaque and often troublesome for Chinese companies. Kennedy's research in particular has noted that these highly exclusionary standards tend to fare badly even within China's administrative apparatus when seeking broad approval, much less market success (Kennedy, 2008).

However, even where a firm has voting member status, there are other subtleties – such as hierarchical membership structure in industry alliances responsible for standards – which shape patterns of influence within a standards development group and mean that even full voting

membership does not grant equal influence. For example, among voting members, standard alliances often have two higher classes of members: "promoting members" and "core members." Promoting membership is based on active participation in standard group meetings, technology submission, commentary on other submissions, and contributions to the success of the standard through producing goods certified by the standard. The highest and most influential rank of membership is inclusion in a "core members committee." This body controls the direction of the technology standard and may be viewed as an analog for standing committees in China's legislative or Communist Party bodies.[18] While all full members (that is, all voting members) have a vote and an official voice in the development of standard, the core members committee makes most of the major decisions, and thus makes the actual voting process largely symbolic. The core members committee includes the founding members of the alliance (representatives of the first companies or organizations involved) and the largest contributors. To date, for most unique Chinese standards development efforts, the core members committees in the industry alliances are exclusively Chinese.

Voting in technical committees is also quite different from the practice in technology standards development in the U.S. and Europe. Whereas in an ISO committee voting may be highly contentious and competitive between proposals, in Chinese standards groups, voting is mostly a formality. Chinese standards bodies strive to achieve consensus before a vote is held. The core members committee and voting members within the group must generally feel that all parties have been satisfied before the formal vote is held. The result, arguably, is a more readily

[18] The National People's Congress (NPC) is China's highest legislative body and the only body constitutionally allowed to approve laws. However, the NPC only meets in full plenary session once each year. For the rest of the year, a standing committee meets. Similarly, the highest body in the Communist Party, the Politburo does not always meet in plenary session. However, a standing committee meets regularly and wields the most influence. Core members committees work in much the same way by setting the overall direction for a standard and wielding more influence than full or even promoting members.

accepted standard – at least for core members – and one in which the technology has been carefully considered and integrated. However, achieving such broad consensus is often difficult. Interviewees stated that this method is very slow and not ideal for developing standards in rapidly changing industries. Chinese standards development often lags behind market and technological development.

Accordingly, it is not voting in standards that is the critical tool of influence; it is membership in the core members committee. Such membership affords significant influence over the direction and technology content of a standard. For foreign firms, this suggests that there remain obstacles to complete and open participation in Chinese standards, even as old formal prohibitions are removed. Emphasizing voting or non-voting membership is unlikely to result in increasing influence for US firms in Chinese standards bodies. Rather, efforts should highlight the need to advance actively contributing foreign members to the core members committee.

Third, committee (working group and technical committee) chairmen in Chinese standards bodies have greater powers than in the West. Formally, the chairman of a committee is just a chief administrator. However, interviewees from different technical committees noted the powerful role played by committee chairmen. Chairmen, in effect, are the arbiter of disputes over inclusion of technology or new members. In addition to being a final arbiter, *committee members often delegate significant authority to the chairman*. This authority includes decisions on membership or type of membership, as well as – more importantly – deciding on the inclusion of different technologies. This is not to say that committee members or rejected applicants have no recourse. Those who disagree with decisions by the chairman can take their concerns to a vote by the whole committee. However, given the emphasis on influence by core members and the

importance of consensus, a general vote is unlikely to change the result.[19] One official explained the role chairmen play in their committees:

> "In a committee, the chairman has the most power since voting to get consensus is difficult. In my experience, at times the experts in different working groups don't care to contribute or debate so they let the chairman decide and they vote after the fact."

Thus, committee chairmen have significantly more authority than their counterparts in U.S. or European standards bodies. However, different committees have differing levels of power delegated to the chairman. In cases where the core membership is highly active, they may not vote to give much discretion to the chairman, while other committees' members are "too busy" and thus delegate responsibility to the chairman.

Although the law formally grants directorship and leadership of standards to the state, this power is somewhat circumscribed. In technical committees and working groups, there is an official representative of the government body that initiated the standards making effort by assigning the standard a number (a ministry in the case of an industry standard, or SAC in the case of a national standard). This representative is part of the core membership, but is very rarely the chairperson of the group. Interviewees said that while in the past the state representative once had wielded influence and set the direction of the standard or veto proposals, by now the representatives' role has been greatly diminished. While the government representative may still formally have a quasi-veto, this power is no longer exercised. Further, as one interviewee noted, the government representatives often lack the necessary technology backgrounds to even follow the debates within the standard group and thus remain quiet. Thus, while the state remains firmly entrenched in all levels of standardization activity, its actual influence and direct control is greatly reduced.

[19] In AVS, for example, a 75% affirmative vote is necessary to change a previously accepted protocol.

The power of the state remains significant not in the direct control of standardization efforts but in coordination of the non-technical aspects of standards such as enforcing and codifying the norms for embedded IPR and licensing fees. As we discuss, there have been multiple attempts to formally enshrine inexpensive, free, and/or mandatory licensing of technology in Chinese standards. Without a direct control over the selection of technology or drafting of protocols, the state – or its representatives – can wield great influence in this area. Second, as noted in our discussion about the 1989 Law, standardization efforts can only be formally initiated by the state (either SAC or a ministry). This means that the government has the ability to initiate standards projects, and apportion funding for them, in areas it deems critical or strategic. This ability to direct the initiation of standards efforts has yielded results in helping lower the royalty rates Chinese companies must pay for the embedded IP in foreign standards.

Interviewees noted that Chinese firms increasingly have their own intellectual property (usually in the form of patents and trademarks). As Chinese firms attempt to magnify their profit margins, they increasingly view IP as a business and strategic tool. Indeed, interviewees in China's technology transfer administration noted that as Chinese firms become more sophisticated in terms of technology development, they are coming to resemble US firms in their approach to IP. China's State Intellectual Property Office (SIPO), enterprises, academics and those involved in formal technology transfer organizations all noted that as Chinese enterprises become more sophisticated and possess their own IPR, there is growing pressure to protect and monetize IPR. Like their American counterparts, Chinese firms increasingly turn to the courts to settle disputes. In 2011, Chinese firms filed 66,000 IP cases. Of these, copyrights accounted for nearly half while trademarks and patents accounted for 24% and 12%, respectively. Indeed, China now files more IP infringement cases than the US (including copyright, trademark, patent,

and false advertising). Foreign interviewees noted that it appeared that with time, China's approach to IP, and embedded IP in standards, would converge toward the US norm.

Our overall research, however, suggests that while China is moving towards a much more robust IPR enforcement regime, the motivations behind IP development and protection differ greatly from the United States. While in the US, IPR protection is an accepted norm that permits innovators to extract monopoly rents from their efforts Chinese firms and the Chinese government both see IP quite differently. This means that, while some aspects of the IPR regime and IP for standards system will converge toward the US norm, other aspects will remain quite distinct.

China's recent trend toward tighter IPR protections and pursuit of monetization is tempered by policy experimentation in China's technology standards bodies, and by the broader trends of which actors develop and contribute IP and why. This experimentation has set a new path, followed by most if not all organizations, toward a new set of norms and practices for the incorporation of proprietary technology into Chinese standards. These norms seek to make technology inexpensive through low licensing fees in order to increase the profitability of Chinese high-technology products.

Our research suggests there is a broad trend in China toward a norm of inexpensive licensing for embedded IP in technology standards. This has come about through experimentation and not by central government fiat.[20] Since the 1989 Standardization Law does not address the question of embedded intellectual property and none of the amendments or regulations proposed have yet clarified the status of embedded IP in national or compulsory standards, there is no official position. Thus, questions of how to select, administer and pay for

[20] Central government attempts to mandate cheap or royalty free licensing such as those by SIPO and SAC have failed to be implemented as they face strong resistance as being decidedly not in line with "accepted" international norms concerning technology licensing.

embedded intellectual property are the responsibility of different representative bodies that oversee the development of standards. Different technical committees and standards development bodies or alliances adopt different strategies governing how and under what conditions proprietary technology will be included in their standard. The interests of Chinese enterprises are a major driving force toward a new norm of low licensing fees.

Two major forces influence attitudes and approaches toward the inclusion of IPR in standards. First, the main sources of intellectual property in China are universities and research institutions, rather than enterprises. Second, the competitive strategy and business focus of China's high technology enterprises emphasize the sale of actual products as opposed to monetizing IP; Chinese firms see standards, and any embedded IP, as a means toward this goal rather than an end in itself. To that end, Chinese enterprises and standards bodies appear to be pushing for a new norm of low prices for embedded IPR in standards.

Interviewees noted that unlike in the West, many of China's technology standards are led not by enterprises but rather by university researchers or scientists and engineers in major research institutions such as the Chinese Academy of Sciences. For example, the AVS standard for audio and video encryption began as a pooling of the various initiatives of multiple university labs. When the standard effort was initiated in 2002, the major contributing members were all university labs or research institutes, all of whom had existing projects in audio and video encoding technologies. Chinese firms, while active in the production of equipment using similar encoding technologies such as those in AVS, had only weak research capabilities. As a result, they did not contribute much technology to the standard.[21] This is not to say that Chinese firms do not possess IP or R&D capabilities. Indeed, many firms possess increasingly sophisticated

[21] Although not the major initial contributors of technology, companies have joined the AVS working group and industry alliance. Today, the AVS group has 91 members of which 20% are universities.

capabilities and are developing competitive patent portfolios.[22] However, as yet in many standards groups, the submission of core technology remains dominated by universities and research institutes.

For research laboratories and university researchers, there is a strong incentive to participate in technology standards development. Active participation and submission of technology into Chinese standards – particularly getting the technology included in standards – affords bonuses, travel permissions, or credits toward promotions and tenure. Academics also need to secure funding in order to continue conducting research. Participating in standards development provides access to funds from MOST, MIIT, NDRC and other bodies, as well as local government funds. Contributing to standards provides access to grants ranging from a few thousand to tens of millions of RMB. These benefits strongly encourage participation in standards development work. As a result, university professors and labs tend to be highly active in the development of standards, in contrast to Western working groups where company representatives tend to dominate.

Second, and more critically for long term trends, China's high technology enterprises themselves hold a different view of intellectual property and technology standards. There are two competing business models for IP. One sees IPR as a potential gold mine, a source of revenue through licensing or patent sales.[23] This model emphasizes the intrinsic value of IPR (and is the source of the growing international industry in patent mining and "patent trolls"). We describe this model as "IPR as a source of profit." It is the perspective and business model of firms like

[22] The widely reported surge in "junk" patents since 2008 may appear to belie the capabilities of Chinese firms. Nonetheless, many larger firms are filing for and receiving invention patents, as opposed to design or utility model patents, and attempting to use these in and for their products.

[23] The recent multibillion dollar deals and valuations for patent portfolios suggest there is potentially great wealth in a patent portfolio if it can be leveraged correctly. However, IP experts note that the vast majority of IPR can be transferred for tens of thousands to several million dollars per patent as opposed to the tens or hundreds of millions in recent widely publicized cases.

Qualcomm that rely heavily or entirely on monetizing IPR for revenues. Companies following this business model seek to develop and protect or acquire as much potentially valuable intellectual property as possible and then license it to other firms which will actually use the information in that IP to produce goods or services. While common in the United States, this model is not widely seen in China.[24]

The second approach to IP could be called "IPR as a factor of production." Here, IPR is not a direct source of revenue but rather a means to improving products. A way to think about these differences is to think how Apple changed where value is created in the music distribution industry. When Apple released the iPod in 2001, it revolutionized the music industry by turning the prevailing logic on its head. Hitherto IP (songs and content) were expensive - $20 or more for a CD – while music players (the hardware) were increasingly commoditized and cheap. Apple made the hardware expensive, sleek and highly desirable, while charging a nominal price for the IP. This model argues that profit is derived from maximizing the sales of pricey hardware, and hence, prefers to lower the price of all factors of production, IP included.[25]

Both of these models can be found in China. Although interviewees from standards working groups and IPR transfer exchanges said that monetization of IP was an increasingly important goal for Chinese enterprises, most Chinese enterprises see IP through the lens of the "IPR as a factor of production" model. Like their counterparts in Korea, Chinese high technology firms do not consider licensing of technology to be a major potential source of profits.[26] Even

[24] An exception is IWNComm, the creator of the WAPI wireless encryption standard. According to interviews, fifty percent of its revenues are based on licensing its approximately 600 patents in the WAPI standard.

[25] This is not to suggest that Apple does not have an extensive and highly valuable IP portfolio. Its recent purchase of 6000 Nortel patents shows its commitment to keeping a valuable, if often defensive, patent portfolio. Apple also jealously guards IP related to the success of its hardware such as its interface and style, for which it successfully sued Samsung for infringement.

[26] According an IP representative of LG, "The value of patents is determined by their contribution to a product and thus our overall business. The value of patents is in how they strengthen the technology in our products and hence

interviewees in IPR exchanges, whose job is to help firms monetize IP through arranging licensing or IPR transfers, stressed that Chinese firms strongly hope to keep their production capabilities even as they develop and protect more and more IP. A representative of a standards research body noted that keeping production capabilities was an important strategy for Chinese firms. In his opinion, the "IPR as a source of profit" business model would "have at best a fifty percent chance of success in China," while a strategy that includes the actual production and sale of goods and services using that IP has a much greater chance of success.

The "IPR as a factor of production" approach means that Chinese firms are interested in developing self-owned intellectual property (patented technologies) and incorporating them into standards in order to increase the value of their products and the prices they can command in the market. Even at prevailing prices, incorporating more self-owned IPR could help lower factor costs by alleviating the strain of paying royalties to foreign IPR holders, should their technology be successful in supplanting the foreign one. As we discuss at length below, Chinese enterprises place great value on lowering the price of IPR as a production input; developing their own and having it incorporated into standards is a means of lowering the royalties necessary to license embedded or essential foreign IP.

There are two non-exclusive approaches to lowering royalty rates:

1. Encourage market acceptance of Chinese technologies (and IP) by charging as little as possible in order to entice other firms to support or adopt these technologies in lieu of foreign alternatives.
2. Develop a competitive alternative technology, especially one offered at a low price, to force foreign IPR holders to lower their rates for Chinese manufacturers.

In the case of the AVS standard, Chinese enterprises have utilized both strategies to try and secure lower rates, and hence higher profits. In AVS, the working group policy is to include essential technologies in a patent pool that will charge a low flat rate (initially about $0.12 per

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the value of those products in the marketplace." The preferred use of IP is to improve actual products, not provide a source of direct revenue.

device) for adopters. The standard itself, for digital audio and video encoding, is also designed to be technologically competitive with global standards. The technology is twice as efficient as the MPEG-2 standard, which makes it comparable to MPEG-2's successor, AVC (AVS, 2012). Unlike MPEG-2, however, AVC faces competition from AVS and a new lower royalty rate. While MPEG-2 charged $2.50 per device, AVC set a rate of $0.15. Interviewees agreed this was in response to the competitive challenge from the Chinese standard. By setting a low royalty rate, the Chinese were able to force a foreign competitor to lower their rates as well. Thus, whether a manufacturer uses AVS or AVC, they will pay significantly less than they would have otherwise.

Even China's leading technology firms, Huawei and ZTE, take a similar perspective on intellectual property and standards. The value of intellectual property is in its ability to increase the quality and price (or lower input costs) of their physical products. They have a strong incentive to seek low royalty rates on technologies they need to access. In working with other Chinese firms, they set low royalty rates to encourage others to do the same. Interviewees stressed that for Chinese companies, technology was seen as a costly input and one that should be accessed as cheaply as possible, whether through negotiations with foreign IPR holders or by setting new norms.

Chinese enterprises may be initiating a new norm for IPR in technology standards. So long as Chinese firms remain committed to manufacturing, they will pursue technology access at low prices. Chinese standards bodies respond by making the technologies embedded in their standards as inexpensive as possible. Indeed, patent pools with low rates per unit are now the officially preferred method for IPR licensing in standards according to MIIT's CESI. Standards groups such as IGRS officially conform to the RAND principle but also stress that setting low rates is in the best interest of its members. As Chinese firms become more important in global

technology markets, this new norm – cheap technology – may threaten the business model of companies that rely on the intrinsic value of their IP as a means of earning returns.

Unique Technology Standards as a Trade Tool

Our research has found that China's motivation for continuing to pursue unique standards lies not in seeking market success, nor in freeing China from reliance on foreign core technologies, nor even in attempting to secure a new revenue stream from licensing fees. Rather, China's unique standards development efforts are an extremely effective trade tool that has been used to reduce the royalty rates Chinese manufacturers must pay for using foreign intellectual property. Chinese firms pursue standards development as it affords them a strong competitive tool in seeking to lower the prices they must pay to license foreign technologies in the goods they produce.

We should note, however, that the vast majority of China's development of technology standards, both nationally and internationally, has not been intended to supplant foreign technology or force concessions from foreign IP holders. Although China has developed tens of thousands of new standards since the 1990s, most of them are uncontroversial and many are comparable or identical with international standards. Spreadsheets of standards development efforts within China note where the standard in question is identical or based upon an international or foreign (German or Russian, for example) standard.[27] Chinese firms, especially those heavily reliant on foreign markets, tend to support international standards – as doing so attests to the compatibility and quality of their products, which helps them to win overseas orders.

[27] To illustrate: the 2011 National Standards Revision Projects document lists one effort, to be completed by 2013, as a revision to the national standard governing the standard terminology for electro-technical equipment, specifically related to telephony. The national standard, number GB/T 14733.8-1993 is to be based on the IEC standard, IEC 60050-722:1992. The revisions will bring the official Chinese standards for these terms in line with the latest IEC revisions. Such standards development efforts are very common and generally uncontroversial. Nearly half of all standards revisions in this document were based upon or identical to international or foreign standards.

Nonetheless, where development of unique standards has occurred, it has most notably been prevalent in the ICT industry.[28] Chart 1.1 outlines the various unique standards development efforts through 2010. These have been the subject of significant controversy, scholarly research, and media attention (AMCHAM, 2012; Ernst, 2009; Kennedy, 2006a, 2006b; Kennedy et al., 2008; Linden, 2004; Liu, 2006; PeoplesDaily, 2004, 2007, 2009; Suttmeier & Yao, 2004; Suttmeier, Yao, & Tan, 2006; USITO, 2010; Yoshida, 2003; Yoshida & Carroll, 1997). These standard efforts have been both primarily state-driven (TD-SCDMA, WAPI) and market driven (EVD, IGRS, AVS). However, whether primarily state or market driven, all have been subject to the final arbitration of market acceptance or rejection.

[28] In interviews, it was stressed that the vast majority of Chinese standards are identical or essentially identical to those developed and adopted at the international level. Hence, while China develops large numbers of standards (generally catching up to the rest of the world), the only area of major contention has been in ICT. According to Kennedy, Suttmeier and Su's research, in the last fifteen years to 2010, there were only twenty controversial or unique standards, all in ICT (Kennedy, Suttmeier, & Su, 2008).

Chart 1.1 Unique Chinese Standard Development Efforts (1993-2010)		
Technology	**Chinese Standard(s)**	**International Standards**
Digital Video Players	VCD 3.0, CVD, EVD, HDV, HVD, CBHD	SVCD, DVD, Blu-Ray, HD-DVD
Mobile Telephony	TD-SCDMA, TD-LTE	WCDMA, CDMA2000, LTE
Wireless Local Area Network Encryption	WAPI	IEEE 802.11i
Audio-Visual Encoding/Decoding	AVS	MPEG2, MPEG4-3 (AAC), MPEG 4-10(H.264), VC-1
Digital Trunking	GoTa, GT800	TETRA, iDEN
Document Formatting	UOF	ODF, OOXML
Home Networking	IGRS, ITopHome	DLNA, UPnP, KNX, ECHONET
Mobile Phone Charger	YD/T 1591-2006	None
Mobile TV	CMMB, T-MMB, CDMB, DMB-T, CMB	DVB-H, T-DMB, MediaFLO
Radio Frequency Identification	NPC	ISO 18000 and others, EPC/GS1, Uid
Security Computer Chip	TCM	TPM
Wireless Metro Area Network	McWill	WiMAX
Source: Kennedy, Suttmeier & Su, 2008; Authors' Research		

Since the 1990s, China has developed such unique technology standards to accomplish three goals:

1. Develop indigenous innovation capabilities (free of foreign technology).
2. Free China from reliance upon, and paying for, foreign technology standards (eliminate royalty payments).
3. Earn revenues for Chinese companies as foreign firms are forced to sell compliant products, or as products utilizing Chinese standards and technology develop overseas markets.[29]

[29] See, for example, Segal, 2011; Linden, 2004; Kennedy et. al, 2008; Kroeber, 2007.

If accomplished, each of these goals would significantly increase China's stature as a technology standards setter and would advance the goal of turning China into an "innovation society" by 2020. However, generally speaking, these goals have not been achieved.

- In terms of building indigenous innovation capabilities and freeing Chinese firms from reliance on foreign IP, even the most strategic of China's unique standards include large amounts of foreign intellectual property. TD-SCDMA is heavily reliant on foreign technologies: of the 148 Time Division Duplex patents filed with SIPO, over seventy percent are held by foreign companies (most notably Siemens and Qualcomm) (Ernst, 2011).[30] Nokia, Ericsson, and Siemens provided thirty-two, twenty-three and eleven percent, respectively, of the patents for the standard. The leading Chinese developer of TD-SCDMA, Datang Telecom, only contributed 9% of the patents to the standard (Breznitz & Murphree, 2011a; Sinocast, 2006; Stewart, 2009; Stewart & Wang, 2009). Other indigenous efforts such as EVD and CBHD also include significant amounts of foreign technology (Hsu & Hwang, 2008).
- Research has shown that Chinese standards have not been widely adopted outside of China, or adopted at all in many cases (Breznitz & Murphree, 2011a, 2011b; Kennedy et al., 2008; Linden, 2004; PeoplesDaily, 2004). Standards such as EVD (a high definition red laser-based alternative to DVD) failed to attract consumer interest. TD-SCDMA, despite performing arguably better than competing standards in simulations, has similarly struggled in the market. Implementation of TD-SCDMA actually hurt the relative market position of China Mobile.[31] China's standards similarly have failed to find interested overseas markets and thus appear to have been mostly costly diversions.[32] There have been few if any significant revenues accruing to Chinese firms from developing unique standards.

If the standards are unsuccessful, why would Chinese firms bother to participate in technology standards development? For many Chinese firms, participation in standards development is less about furthering the development or monetization of their technology than about strategic positioning and marketing. For small firms in particular, participation in standards development affords similar benefits to those sought by university professors or researchers: state grants. For small firms, the grant amounts are sufficient and provide an opportunity to

[30] As a standard based on time division multiplexing, as opposed to code or frequency division, the TDD patents are essential to the standard and among the most critical.

[31] China Mobile's market share in smart phone services is far lower than its extremely dominant position in 2G voice mobile telephony. Although China Mobile still has the largest number of 3G subscribers (27 million to China Unicom's 18.5 million in March 2011), its lead is greatly narrowed when compared to its profound dominance in 2G (Kumar, 2011). Chinese consumers have noted that the 3G services offered by China Mobile's competitors are more reliable and less prone to bugs. This perception of weaker technology has hurt adoption of TD-SCDMA.

[32] One interviewee put it bluntly and rather undiplomatically when summarizing the efforts in 3G standard development: "China has huge sunk costs with TD-SCDMA, and this was the only reason it got pushed through. They launched it but are trying to get away from it as fast as possible, since even the officials who pushed it in the first place now see these efforts as a huge waste of time and resources when China moves to 4G next year."

conduct research without having to pay for it out of pocket. As many firms frequently note that a lack of capital constrains their ability to conduct R&D, this is a significant incentive to participate in standards. For large firms, the grants from the state are usually insignificant (the very large grants and loans made available to Datang Telecom and China Mobile for development and rollout of TD-SCDMA are a major exception). However, participation in standards enables large firms to curry state favor by participating in government selected projects. It also provides an opportunity to keep abreast of the R&D actions and capabilities of their potential partners or rivals. According to interviewed managers, firms of all sizes see strategic benefit in participating in standards work, since approval of standards is a sign of technology sophistication with government approval. This is beneficial for firms seeking to win new customers since government approval provides powerful advertising.

Firms also participate in standards development for the marketing benefits. Small firms in particular note that participation in working groups affords them the opportunity to meet with technology team leaders and managers from large companies. This direct connection can be leveraged into potential contracts or sourcing agreements. Without participation in standards, these firms argue, it would be difficult or impossible to catch the attention of major companies. Participating in standards makes it possible for small firms to directly grow their business.

Trade Benefits from Standards Development

For firms participating in standards development, our research has uncovered an even more important motivation for getting and remaining involved. Firms that participate in standards development are able to lower the royalties they must pay to foreign IP holders. By what mechanism does standards development result in lower royalties? In the name of

developing indigenous innovation capabilities, freeing China from reliance upon foreign technology standards, and earning royalties for Chinese companies, SAC or an industrial ministry such as MIIT begins promoting a specific technology standard development effort. Once initiated, rational firms seize the opportunity to receive state support and began working on different standards development projects.

The publicity accompanying the announcement and beginning of standards development draws the attention of foreign standards bearers (holders of essential IP in those standards). In response to the Chinese challenge, foreign standards bearers may preemptively lower their royalty rates for Chinese manufacturers, thus making production of goods compliant with international standards more profitable.

Lower royalty rates lead both firms and the state to see the advantage of continuing to promote development of technology standards. As a result, the government continues standards promotion, even as it fails to accomplish other stated goals. The process then begins again. It should be noted that with each standards development effort, the formal justification by the state remains the same even though the goals are unmet. Therefore, it is the benefit of lower royalty rates that ensures the continuation of standards development policies.

This mechanism can be seen as illustrated in two case studies. These were selected to represent the ideal match and a least likely case. The ideal match is the case of digital optical media storage standards. These have closely followed the mechanism of development of relatively or completely unsuccessful standards followed by royalty reductions and increased research ability. The least likely case is that of the TD-SCDMA 3G standard. TD-SCDMA received the near-maximum amount of state support and is in a sector considered crucial for national development and security. It was also protected for an extended period by the state. If

any standard was to achieve at least domestic success in accomplishing the three goals, it would be TD-SCDMA.

By the late 1990s the DVD standard, developed by an alliance of Japanese, American and European companies, became established. Although initially an expensive luxury, hundreds of Chinese manufacturers established production lines, causing a rapid decline in price. This further fueled mass market demand for DVD players, particularly overseas but increasingly within China as well. While the potential markets were enormous, the more-or-less fully developed technology DVD left little room for Chinese firms to alter the standard or provide alternatives to foreign mandated patents and their associated royalties.

High demand caused production of DVD players in China to explode: from 3.5 million DVD players in 2000, to 70 million – seventy five percent of world output – by 2003 (Linden, 2004). Nevertheless, despite their production capabilities and exports, profit margins for Chinese manufacturers remained thin, falling to one dollar per unit in 2004 (Kanellos, 2004). High royalty rates became a source of constant friction with overseas brand and patent holders. Chinese manufacturers attempted to take action to protect their profit margins, including filing a lawsuit in the United States accusing DVD patent holders of abusing their monopoly power (ChinaDaily, 2005; Pyyny, 2005). None of these efforts proved successful at significantly lowering the royalty rates for the Chinese manufacturers; the case and appeal were dismissed in 2006 and 2008, respectively (Meisner & Lewis, 2008).

In 1999, China's government proposed development of a Chinese standard as an alternative approach to alleviating the financial trouble of its manufacturers (Clendenin, 2006; Zhang, 2008). Under the Ministry of Information Industry (MII, the former name of the current MIIT), several government research institutes and DVD manufacturers formed an industry

alliance under an incorporated entity called Beijing E-World Technology (Clendenin, 2006; PeoplesDaily, 2003). MII and the State Trade and Economic Commission then provided $1.2 million USD to begin development of an indigenous Chinese red-laser based standard (Smith, 2003). In 2001, E-world released the Advanced High Density Disc System (AVD). To further development and refinement of the new standard, the alliance paired the AVD system with a "basically compatible" Taiwanese system called Enhanced Versatile Disc. The Taiwanese partners, for reasons never fully disclosed, backed out of the arrangement shortly thereafter.

Although not a market success, the EVD standard effort had a highly significant positive impact on Chinese electronics manufacturers. By bringing China's challenge to global standards into the spotlight, the standards effort quickly led to a substantial reduction in the royalties Chinese manufacturers had to pay (Einhorn, 2003). The announcement (but not yet official approval) of the EVD standard was soon followed by a royalty-rate concession from DVD's standard bearers. The major patent holders for DVD players agreed to only charge full royalties (then twenty-one dollars) for exported DVD players whereas domestic market DVD players were only charged about twelve dollars (Linden, 2004). Further, in 2004, while broadly announcing intentions to replace DVD players in China with AVD, the Chinese government pushed for a further reduction in royalties paid by Chinese companies per DVD player. Within a few months royalty fees were reduced again. The rate decreased from over twenty dollars per unit for Toshiba, Matsushita, JVC, Mitsubishi, Hitachi, Time Warner, Philips, Sony, and Pioneer technologies to $13.80 USD, (Linden, 2004; PeoplesDaily, 2004).

In the high-definition era, the process has repeated itself. Development of a Chinese standard has forced the hand of foreign IP holders. China's answer to Sony's Blu-Ray plan, the

China Brand High Definition (CBHD) disc player, entered the market in 2009. Introduction of this competing standard had immediate positive results for Chinese firms.

While CBHD enjoyed direct state support, it was not the only locally developed standard in optical storage media. A noteworthy project was Guangzhou Digital Rise Technology's development of an audio-video codec – DRA – for Blu-ray. China's government was then able to force the Blu-ray Disc Alliance to adopt the Chinese DRA audio-video codec as part of the Blu-ray 2.3 package (CDRInfo, 2009; ChinaSourcingNews, 2008).[33] Adding the Chinese standard to the international standard was a quid pro quo for permitting the sales of Blu-Ray products in China. In this case, in addition to demonstrating and improving technology development capabilities, developing an alternative standard greatly enhanced China's negotiating position for incorporating its technology into the dominant foreign standard. Development of CBHD as an alternative was sufficient threat to force the Blu-Ray Alliance to incorporate Chinese actors.

More significantly, the development of CBHD, like EVD, forced a reduction in royalties for the dominant foreign standard. Blu-Ray reduced the mandatory royalties for its embedded patents. For manufacturers, royalties fell to $9.50 per player, a significant reduction even over the royalties for DVD players (Ding, 2009; GlobalSources, 2009).

The evidence is similarly compelling in the case of TD-SCDMA. In 1995, the Ministry of Science and Technology (MOST), the Ministry of Posts and Telecommunications (MPT – today's MIIT) and the State Planning Commission (today's National Development and Reform Commission) made development of a Chinese 3G mobile standard a key project of the Ninth Five Year Plan (Zhou, 2004). Seeing the success of European firms with the globally popular GSM standard and the royalties earned by Qualcomm's CDMA standard in the United States and

[33] In March 2009 Warner Entertainment group agreed to begin offering content for the CBHD standard (ChinaDaily, 2009; Xing Wang, 2009). This was the first time a foreign content provider offered to support a Chinese standard, suggesting the increasing effectiveness of China's standard-making as a trading tool tactic.

Korea, China's leadership sought to repeat these technological and economic successes through development of an indigenous standard that would showcase independent Chinese technology (freeing Chinese firms from reliance on expensive foreign standards and their embedded patents) and potentially earn overseas revenues as a globally competitive standard. The standard was jointly developed by the Chinese Academy of Telecommunication Technology and Siemens and commercialized by Datang Telecom. After being successfully approved as an international standard by the ITU in 1999, the standard took another 8 years of development before being formally launched on December 31, 2008, six or seven years after 3G mobile became available in other countries.

If the main commercial outcome of the TD-SCDMA effort was delaying the roll-out of 3G networks in China by eight years, it did prove very beneficial to China's telecommunication equipment industry as the ultimate tool with which to reduce royalty payments on the other two standards. After China developed the TD-SCDMA standard, nine companies in the WCDMA alliance capped the royalty rate they asked from Chinese companies at less than five percent of the sales price for hardware (Fan, 2006). This rate was far lower than for non-Chinese producers and represented a clear China-tailored boon. As the royalty fee was re-set as a percentage of the sale price and not as a constant sum, it ensured that the royalties paid fall in tandem with other costs. In a similar fashion Huawei used the threat of TD-SCDMA to negotiate lower royalty payments for domestic and international CDMA products with Qualcomm technologies, the American holder of the standard (Sinocast, 2006).

As can be seen, participation in unique standards development affords Chinese enterprises benefits that are wholly unrelated to the market success of the standard. Indeed, the lowering of royalty rates may be the primary objective since many export oriented firms only

produce goods that conform to foreign technology standards. The repeated success of this method in encouraging foreign companies to lower their rates for Chinese manufacturers suggests that this may be the primary driving force behind continued efforts to develop unique standards.

State Justification for Standards and the Limits of State Power

There are powerful state interests at work as well. Since the 1990s, there has been strong academic and political support within China for unique standards development. In our research, interviewees stressed that China needed to use technology standards as a promotional tool – both for encouraging the development of indigenous innovation capabilities, and to strengthen the market position of Chinese technologies. Interviewees stressed the difficulty China faces in pushing its own technologies into an already crowded marketplace. This is particularly the case where alternative Chinese technologies exist but international standards have already ossified. Using standards to potentially mandate the use of Chinese technology is seen as a means of providing space for Chinese technologies to receive attention and fair testing in the market. Without such assistance, academics and officials in the standards bureaucracy believe that Chinese firms will be unable to push their technologies into the market, as they will simply be ignored. As summarized by one interviewee, "In a given technology, there are already dominant foreign technologies which China must overcome. Standards are a means of protecting infant technologies."

However, the reader must recall that Chinese standards, despite this level of rhetorical support and even state sponsorship, must compete in the market. Standards are not ends in themselves; they only have value if they are incorporated into technologies used in goods and

services. Even staunch supporters of unique Chinese standards development argue that having a successful standard, one that is adopted domestically or internationally, is meaningless if it fails to gain market traction. As one interviewee put it:

> "The market is god. Even if the government adopts a standard, we must sell our products in the market so market acceptance of a standard is the ultimate goal."

Interviewees often took a rather cavalier attitude toward foreign, and particularly US, objections to Chinese development of unique standards. Their argument is that if foreign standards and their embedded technologies have superior performance at a given factor cost then foreign companies and IP holders have nothing to fear from unique Chinese standards. Even if a Chinese standard is created and approved domestically or internationally, if it is technologically inferior, it will fail in the market and thus pose no threat.

Complicating the role of the state in standards development, despite formal plans and pronouncements, China's central government – including SAC and standards-developing industrial ministries – has almost never unequivocally committed to exclusively promoting a Chinese standard. One interviewee active in telecommunication standardization noted further that, for all of the talk about the need for protection to benefit Chinese enterprises and technologies, China's government has almost never barred foreign standards. Even in 3G mobile telecommunications, China's carriers use all three accepted international standards. As China has never given unqualified commitment to exclusive use of its own standards, there is always the opportunity for a foreign standard and its technologies to compete in China. When this occurs, even though a Chinese standard may be far more cost effective, the Chinese standard typically loses. Despite nationalistic rhetoric, foreign or internationally accepted standards tend to dominate Chinese developed ones, even in the Chinese market.

Policy proposals such as the fourth revision to the Patent Law and the SAC amendments concerning IP in standards, as well as the "indigenous innovation" policy itself, suggest that the central government has techno-nationalistic designs.[34] Existing concerns regarding China's technology standards development efforts have emphasized techno-nationalism, bias against foreign companies, and trade protectionism (AMCHAM, 2012; Suttmeier & Yao, 2004; Suttmeier et al., 2006; USITO, 2010). However, while these motivations are certainly present among certain actors within the Chinese standards development ecosystem, there is no unified consensus on the desirability of using standards to create a hothouse environment for Chinese technologies. Observers of China's technology standards development ecosystem must remember that China's political system is highly fragmented and internally competitive. While one unit of the bureaucracy may favor a given standard and endorse protectionist measures to ensure its success, other segments of the state may undermine these initiatives in order to preserve their own authority. These competitive games, and their impact on standards, are best viewed through the lens of bureaucratic politics. As one interviewee put it:

> "China is a bureaucratic system, not a political one. Different ministries are constantly competing for influence and budget. Wars over standards are fought in the bureaucracy over power and fiscal turf."[35]

Bureaucratic politics argues that government action should be viewed as the result of internal negotiations and conflict among bureaucratic units (Allison, 1969, 1971). Each unit has predictable and relatively uniform interests, and actors from different organizations act on behalf of their organizations' interests. These interests are most commonly the concrete objectives of

[34] Techno-nationalists treat national interests as paramount, even where this contravenes domestic companies' desires or established international standards practice. Technology standards should be used to free China from reliance on foreign technology (Kennedy, 2006b; Kennedy et al., 2008; Lee & Oh, 2008; Linden, 2004; Qu & Polley, 2005; Suttmeier & Yao, 2004; Suttmeier et al., 2006; Yoshida & Carroll, 1997).

[35] Another interviewee noted similarly that part of the slowness of Chinese national standards efforts was the result of SAC needing to balance the interests of different ministries. Seeking such broad compromise was often difficult especially when different ministries such as MOST and MIIT have different favored standards or protocols.

increased authority and budget. In China, promotion of or support for a given standard depends on whether or not it advances the interests of the bureaucratic unit. Taking a bureaucratic politics perspective is useful for explaining outcomes of certain standardization efforts. For example, the AVS standards for digital media became a battle between the Ministry of Industry and Information Technology (MIIT) and the State Administration of Radio, Film and Television (SARFT). Developed in an MIIT-affiliated research center, AVS was a potential successor technology to the ISO-based MPEG-2 standard and its expensive licenses.[36] As no international standard had yet been established, AVS might have been able to compete with the newly released international MPEG-4 standard. However, SARFT, which has final authority over media content, reduced AVS's chances of domestic success by announcing China would also use MPEG-4 rather than establish a protected market for AVS. SARFT preferred to preserve its authority rather than allow MIIT to encroach on its jurisdiction (Kennedy et al., 2008; Suttmeier et al., 2006). Bureaucratic competition reduces the ability of the Chinese state to act in a unified manner. Thus, even where a standard appears to have strong government support, that support is likely to be fragmented.

A final factor limiting the ability of the Chinese government to use standards as a technology development or protectionist tool is the general lack of enthusiasm for unique standards development by much of China's industry. For Chinese technology firms, government procurement may be an important and coveted market, but it is not the only or even the most important market for the vast majority of firms. China's export-intensive companies, including leaders such as Huawei and ZTE in telecommunications hardware, are strongly incentivized to implement established foreign standards rather than attempt to develop unique indigenous ones.

[36] MPEG-2 licenses cost $2.50 for encoding and decoding devices while AVS only cost 1 RMB (approximately 12 cents) per unit. MPEG-4 is only fifteen cents per license.

Both firms are active contributors to international technology standards working groups and technical committees. While the goal of providing a forum for their unique technologies may be laudable, these firms are primarily interested in increasing their success in the market. Hence, they favor standards that will enable them to sell more products. As a result, they tend to support international standards. This means China's most capable innovators are not necessarily backing or significantly contributing to China's domestic unique standards.

Thus, it may be concluded that while standards development efforts are widespread, the ability of the state to direct and control them is limited. Emphasis on the techno-nationalistic and protectionist impulse behind China's state-led technology standards development efforts is arguably misplaced.[37] Our research suggests that the fragmentation of the Chinese bureaucracy and resistance from Chinese industry means that techno-nationalism will not result in unified or effectively implemented policies, particularly if the policies attempt to mandate a closed protected market.

Conclusions

The situation for technology standards in China paints a challenging picture for US firms. To summarize, this white paper has called attention to the legal underpinnings and the formal and de facto structure of China's technology standardization system. Of particular importance is the centrality of the government – whether SAC or an industrial ministry – to the initiation of technology standards development. The government has pushed for unique standards and so won concessions from foreign IP holders on royalty rates for Chinese firms. As Chinese firms develop their own proprietary intellectual property, they have begun pursuing means of

[37] Both Chinese and foreign interviewees noted that continued emphasis on the WAPI case as evidence for Chinese government control or lack of respect for international norms of standardization is particularly outdated and should be dropped.

incorporating it into standards. However, rather than seek maximum returns from monetization of their IP through licensing, Chinese firms seek to establish a new norm of low-priced intellectual property. While the central government (SAC and SIPO in particular) has attempted to enshrine low-priced or free licensing of embedded IP in new laws or amendments, thus far these efforts have not succeeded. Nonetheless, standards bodies continue to develop their own IP approaches that increasingly favor inexpensive IP licensing. As stated by one IP owner:

> "We never really maximized returns from our patent portfolio. In the standard, we have embedded patents but for partnering companies like LG, Nokia or Samsung, we have signed agreements setting very low royalty rates: 80,000 RMB up front and one RMB per unit thereafter. This has helped us grow the market for our technology by getting partners on board. If any company is willing to support our standard and use our technology, we will work with them and sign an agreement for inexpensive licensing. We will not chase high revenues."

This norm of inexpensive intellectual property is the first major challenge that Chinese firms present to US companies.

Second, rather than attempting to overturn global norms directly or through dropping out of the system, China's firms and standards development bodies – including sponsoring state organizations – have become intimately familiar with the rules of international standardization. The United States would prefer that China adopt the American approach to de facto international standards set by market forces or in non-governmental bodies such as IEEE. From the US perspective, these standards are legitimate international standards and should be given the same treatment as formal standards from intergovernmental bodies. Under the WTO, such standards should be mandatory for member states. However, China is following the European example and only officially recognizes UN or ISO-based standards as international under WTO rules. So long as there is no formal international agreement on what officially constitutes an international standard, China will be able to continue developing unique, even mandatory, standards in areas

where there are IEEE or other de facto standards – but where no ISO or other intergovernmental standard has yet been adopted.

Third, the Chinese are becoming bolder in their willingness to stand up to US firms and practices. No longer willing to be standards takers or to accept US norms at face value, Chinese firms are beginning to challenge accepted US practices and leadership in technology standards. In this emerging competition, China has learned much in the last decade. The first attempts to bring Chinese interests to bear in international standards bodies (or through domestic regulations, most notably in the WAPI case) ended badly for the Chinese. However, they have continued to study the international system and increased their participation in technical committees and working groups even while performing parallel domestic standardization efforts. This experience means the Chinese increasingly know the formal rules of the standardization game intimately. Today, the Chinese may have an advantage over the US (and US firms) in international and domestic standards bodies – not because of favoritism, but because of their understanding of the system and the laws that govern it.

Indeed, on that front the latest initiatives by China's National Institute for Standardization (CNIS) to create graduate level programs in standardization, which would train engineers and managers to excel in standards development both domestically and internationally, is especially telling. Domestically, China's standardization system remains ad hoc in nature. Chinese firms keenly understand how to interpret international practice, which gives them the upper hand when facing challenges from US firms. In any dispute, the winning side will be the one that most completely understands the system in which they are trying to operate. As a result, US trade policy should focus on paying closer attention to differences in international approaches to standardization as these become increasingly institutionalized. It behooves the US to train more

standards experts who can work in and with firms in standards negotiations in China, so that US firms will be less disadvantaged.

Finally, as the Chinese central government looks at the international system for technology standards, it sees two approaches: the American market-dominant approach, and Europe's more state-directed approach. Owing to the legacy of state involvement in the economy, planning, and the continued normative importance of government sanction, China increasingly shows that it is converging more toward the European perspective than the American. Indeed, relying on market forces is broadly distrusted, as these are seen as favoring incumbents and not allowing the Chinese new room to operate or offer technological alternatives with a chance of success. Hence, there is a strong inclination toward state-leadership and guidance as a means of counteracting market inertia. The Chinese affinity for government involvement (and the normative stance that only formal intergovernmental bodies can set international standards) means there will be increasing concord between European standards bodies/governments and those in China. When disagreements arise over international standards, legitimacy, or policy, the United States should be prepared for and expect the European Union and China to present a united front.

China's standardization system is state-led, but it is not completely state controlled. It favors Chinese firms and technologies yet also welcomes foreign participation. It has a legal basis and ongoing reforms, yet remains highly ad hoc – and, especially for IPR practices, dependent on the specific group developing standards. More research is needed to understand which of the patterns discussed in this white paper are passing conditions – and which are becoming institutionalized features of China's standardization landscape.

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