Patenting and Voluntary Standards:
Tensions Between the Domains of Proprietary Assets and "Public Goods" in the Innovation of Network Technologies

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This article focuses on the interaction between intellectual property rights (IPRs) regimes and committee-based standards development organisations (SDOs) in terms of the commodification of knowledge. IPRs and SDOs are institutions that are designed to codify technical knowledge with quite different purposes though. The resulting documents describe a private right (patent) or a public good (a standard). The article associates the former with a commodification and the latter with a decommodification process of technical knowledge, and it explores a situation in which these respective purposes have come into conflict. The scope for conflict is examined and analysed in light of the controversy, which emerged during the standardization of GSM telephony in Europe.

Keywords: standardization, knowledge-commodification, GSM

The rapid development of information and communication technologies (ICTs) thrives on the creation and dissemination of new knowledge. Intellectual property rights (IPRs) regimes and standards development organisations (SDOs) are two important elements of the institutional infrastructure that facilitate the generation and diffusion of new technical knowledge and, by so doing, promote technological innovation. These two institutions share a central function: each serves to codify current technical knowledge in detailed and unambiguous terms. The way they do so, however, and their respective rationales involve an essential tension: in the one case, the resulting document essentially describes a private right (patent) while the other arguably describes a public good (a standard).

During the past decade or so, the interplay between these two institutions has become conflict-prone in the field

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of ICTs. Here, the codified knowledge found in patents has come into conflict with that found in individual voluntary standard specifications. This paper explores this relatively new area of controversy from the perspective that it pits the domain of proprietary assets against that of public goods. We do so by exploring a case – the first case – of conflict that emerged on this tension-filled front, that of the standardization of GSM telephony in Europe. The case will allow us a vantage point from which to explore the respective roles IPRs regimes and SDOs play as institutions of commodi-fication and de-commodification, to describe the scope for conflict and to analyse it.

Background

A discussion of knowledge commodification tends to start with a consideration of how the "computerization of society" is affecting the nature of knowledge. Lyotard (1984) points to broad transformations associated with this 'computerization' process and argues that it is pushing towards an "exteriorisation of knowledge." The idea is that knowledge is increasingly being transformed into an informational commodity. This reorientation fundamentally affects the motivation for the creation of new knowledge and the way it is consumed and it has fundamental implications for the advancement of productivity ("productive power") in a political-economic sense.

Much of the analysis based on the commodification argument focuses on the way knowledge is accumulated especially in learning environments. The emphasis of such analysis is placed on the way ICT transforms knowledge into an informational commodity primarily because it facilitates diffusion/distribution via information bits. In this paper we join the discussion from a somewhat different angle. We enter a discussion of the dynamics of knowledge production and consumption as they manifest themselves in the production of information and communication technologies themselves. Instead of focusing on how existing ICTs affect the way knowledge is disseminated to society, we look at how technical knowledge is accumulated for the generation of the technologies themselves. This can be seen as an internal loop in the larger evolution of the computerization process. The idea is that the ways new information and communication technologies are developed ultimately shape the way they spread information and thus promote knowledge accumulation. This knowledge feeds back into the way ICTs are shaped: there is a dynamic interaction between technology and society. There is a complicated argument here, which essentially distinguishes itself from the "linear model of innovation". (See Nelson & Winter, 1982; Dosi *et al.*,1988).

One important locus for studying the interaction between society and technology is the institutional framework of innovation. Institutions such as IPR-regimes and standards development organisations are important in shaping how technical knowledge is accumulated and disseminated during the innovation of ICTs. In economic terms, the first is generally characterized as an "incentive structure" that promotes the production of new knowledge while the latter is generally characterized as a "non-market selection environment" (Nelson & Winter, 1982) that helps facilitate technological diffusion by promoting coordination. In this context, the premise is that (i) IPRs (especially patents) represent in general a fairly clear case in which the codification of technical knowledge leads to commodification, and that (ii) the specifications produced by standards development organisations in general represent an arena where codification leads to the de-commodification of knowledge. Based on this hypothesis, the paper focuses on how the rapid development of the ICT field has brought the two institutions into conflict. We demonstrate the potential for conflict between the commodification and de-commodification of knowledge by looking at the IPR controversy that arose during the standardization of the GSM system.

Preliminary Observations about Institutions and Commodification

We start with a couple of initial observations about the way the institutions "package" new knowledge. A patent and a technical (consensus) standard are essentially documents. They codify the technical details of new economically relevant knowledge. The reason and method for this codification is of course very different in the two cases. In the case of a patent, the codification describes the technical product or process over which the assignee is given defined rights of control (limited geographically and temporally). We will generally illustrate the case of intellectual property rights via the most familiar type of rights, patents. A patent represents a commodification of the underlying knowledge and it acts to create a private good out of knowledge. On the other hand, a standard elaborated through a standards development organisation (SDO) is a set of technical specifications describing a system design that the SDO recommends to the market at large. This is essentially a collective process, where the rationale is to overcome compatibility problems and/or to promote network externalities. In this case the standard becomes a public good (see Samuelson, 1955).

Intellectual Property Rights

The case that patents effectively commodify knowledge is most clear. A given patent will in its claims define the steps necessary to make a particular technology work. The patent system can be said to codify new knowledge in order to assign limited ownership. Through the patent, technical knowledge becomes a commodity that can be bought, sold and leased, or kept for oneself. This has the effect, it is believed, of providing an incentive to invent: the IPR system is therefore associated with the generation of new technical knowledge. As we will illustrate below, patents are in practice also used to promote non-competitive processes as in the context of R&D collaboration. There is, however, another function from a public policy point of view that complicates this picture. In exchange for monopoly protection, the patent holder allows a detailed technical description of his invention to be published and made freely available. When patents lapse (usually after 20 years), anyone can use the invention free of charge. In this sense, the codification also acts in the case of patents as a way to disseminate knowledge. (i.e. bringing it into the public sphere)

Standards Development Organisations

The case that voluntary standards development organisations effectively de-commodify knowledge is a bit more complicated to present. Schmidt & Werle (1998) provide a description of the type of standard we are looking at:

> Standards result from the intricate interaction of company business strategies, standards committee activities, government interventions, and processes of market diffusion, and they are rooted in the perceived technical requirements for developing, manufacturing, operating or using devices that are meant to inter-work with others. (Schmidt & Werle, 1998: 33)

This description indicates that the standardization process brings together commercial, academic and regulatory actors who, through this complex interaction, identify the need for common specifications, who elaborate, develop and ultimately diffuse technical specifications. The standard specifications for a technology will define how the various components of the system should work and – more instrumentally – interwork.

One general economic argument for formal standards-writing is that markets seem to have trouble facilitating a satisfactory cross-over between variety and standardization. Timely selection of standards allows a technology to grow and reap the benefits of economies of scale, network externalities and the cumulative, collective learning process. Another rationale for collective standardization is to promote compatibility between technical systems and between components in systems.

Standards development organisations help to achieve these benefits by codifying technical specifications and distributing the resulting standards. Committee based standards are sold as publications at the price to cover some of the costs represented by the document. On the other hand, the technology is free in the sense that the reader of the standardized technology can then utilize the knowledge freely.

The important institutional aspects of committee standardization is that the process allows for the participation of a wide range of interested actors, including users. This is on the basis of a rule of due-process, and essentially involves a consensual decision process. The collective nature of this codification process indicates the de-commodifying role of standards and its design to promote the spread of the knowledge as broadly as possible. We will demonstrate how the standardization process can be interpreted as de-commodifying in more depth by looking at the GSM case.

The GSM Case

The formalization of the GSM system provides a necessary context about the state of knowledge in this particular technology, the role of the formal process of standardization and how in this process the standard and the patent institutions can come into conflict.

Background

In many social contexts, the GSM[1] system may well be the most widespread avatar of the so-called ICT Revolution. Today this mobile communications system has a pervasive position in a remarkable diversity of societies. GSM handsets are in use in scores of countries, ranging from the Nordic countries, where its use is rife, to Bangladesh, where single handsets are reported to act in lieu of non-available fixed-lined telephony for entire villages.

The ancestry of the GSM system itself is not especially "revolutionary". The first commercial incarnation of a mobile telecom system in fact dates back to the 1940s (in Saint Louis, USA), with other mobile systems for police and more importantly, the army predating that by a couple of decades. The evolution of mobile communications has therefore involved a rather long period of accumulation of knowledge about how to efficiently use energy waves in the remote transmission and reception of information. The technical feasibility of the basic idea was not enough. Great improvements in the total capacity and efficiency of the system had to be made before mobile communications were remotely feasible in market terms. Besides, one could only guess at what the market potential was, and these guesses tended, in retrospect, to be very conservative.

The technical knowledge needed to improve system capacity took a remarkably long period to accumulate. During several decades, knowledge was accumulated on how to best use dimension cells, (re)use frequency bands, how to "handoff" discrete signals between cells, improve signal transmission and reception and automate the link to the fixed-line network. These technical areas are just hinted at here in order to illustrate the range of technical areas involved (see Mouly & Pautet (1992) for relevant technical issues of mobile-communications). The advent of the transistor was also instrumental. It was only at the end of the seventies and in the early eighties that the first spate of large-scale systems began to emerge, notably AMPS, TACS, C1, and NMT. These few successful and thus visible examples eclipse many other ideas and some other systems (eg. CT-2/Telepoint system) that have perished in the process.

The GSM system began to take shape simultaneously with the launch of these analogue systems. It would take another decade before the GSM system was launched. Its launch was met by the criticism of some (cf. Gilder, 1993) that GSM utilized old-hat technologies. Indeed, the GSM system built on a stock of existing knowledge and this is arguably part of its strength. For example, it relied on known methods for multiple-access (Time Division Multiple Access, TDMA), which were within the design capabilities of the technicians (Bekkers, 2001: 323). Although known, this was a technique that had not been used on a large, commercial scale.

GSM's major achievement was that it coordinated the design for a digital mobile system and that it orchestrated the concerted launch of this large technical system in a large area: i.e. Western Europe at a critical time. In technical terms, the system did provide a design by which relatively high traffic cell technology could be integrated upon a digital platform (for technical details, see Mouly & Pautet, 1992; Bekkers, 2001). It also managed to coordinate the introduction of a new set of services, including Short Message System (SMS) and, more instrumentally, Roaming.

GSM Standards

The fantastic spread of the GSM system was not a case of serendipitous chance. The system involved a multi-layered effort of coordination, ultimately centred on the coordination of technical dimensions in a standards development environment. In fact, the GSM system was in many respects the antithesis of the invention-in-garage-by-individual-genius type often caricatured for the ICT area. Instead of the individual, there were separate groups of technicians who represented partially competitive interests; instead of the garage, there was the large standards development organisation (actually two, since the project was moved in mid-stream); and instead of an invention, there was a hefty document describing how the system should work. And behind the scenes, there was considerable oversight by political interests. In this section we note some of the characteristics of the GSM standardization process.

The standardization of GSM involved the detailed codification of technical know-how. The GSM system is based on 10,000 pages of technical specifications. In this sense, GSM is a document – a standard – that details the GSM900 and DCS1800 technologies, and not a technology itself. This document codifies a total of 280 recommendations that cover two phases of the system's deployment (phase #1 and #2: see Table 1) and that include the specifications for a related PCS network at 1800MHz (DCS1800; "delta specs"). The "specs" cover all aspects of the system, from interfaces, to switching (NSS), to radio transmission and reception, to channel coding, to terminal specifications, to service recommendations etc.

The standardization process was initiated in the committee-based standardization environment of CEPT (Conférence européenne des administrations des postes et télécommunications). This heritage witnesses to sponsorship by European service-providers (the old PTTs of the CEPT system) and regulators. As the deregulation of the European telecoms markets started, however, the GSM was handed over to the new European Telecommunications Standards Institute (ETSI), where the process grew to include a set of vendors from inside and outside Europe. The ETSI was established in line with the recommendations from the Green paper on the development of the common market for telecommunications services and equipment (European Commission, 1987), which signaled the deregulation of the telecom market in Europe. The ETSI included multinationals including companies with their headquarters outside Europe, for example Motorola.

It is interesting to note that the name GSM actually pays tribute to people, specifically the members of Groupe Spécial Mobile (GSM) in the CEPT system who started to explore the potential for a pan-European mobile communications system. The "global" dimension of GSM only came later as political momentum gathered and a larger, more diverse group of collaborators were involved. The standards were elaborated primarily by representatives of vendors and service-providers. The design of the system was negotiated among the participants according to five basic sets of requirements set out by the special committee. These included cost aspects, network aspects, radio-frequency utilization, quality of service and security (Mouly & Pautet, 1992). The standards provide information and guidelines to a wide range of vendors and service-providers about how the system is to be put together,

Table 1. Timeline of mobile-communications.

Mobile communications highlights	
1946	First civilian mobile system launched in Missouri
1979	900 MHZ band reserved by the World Administrative Radio Conference (WARC of the International Telecommunications Union). This substantively laid the basis for the development of mobile communications.
	AMPS launched (Bell Labs)
1981	NMT (cooperation between Scandinavian PTTS and some manufacturers)
1982	First meeting of Groupe Spécial Mobile (GSM) in Stockholm
1985	TACS (AMP- based)
1986	Validations Systems tested
1987	GSM opted for 'the broad-avenue' digital approach
	GSM Memorandum of Understanding (MOU)
1988	ETSI instituted
	IPR conflict commences with refusal of MOU terms
1989	GSM transferred to ETSI
1991	GSM phase I standards

operated and maintained.

The GSM standards represent a comprehensive codification of the mobile network system. They were in fact deliberately over- detailed in order to reduce uncertainty in the launch of the system throughout the different contexts of the European telecom markets. A high degree of codification was also desirable so that new actors (not only the incumbents) and other markets could implement the system with minimal difficulty.

The high degree of codification was therefore part of a strategy to promote world-wide diffusion of the system, an intention that the name "global systems for mobile communications" amply implies. This strategy is also suggested by the high degree of coordination that took place on other planes than just the technical: considerable activity in industrial policy spheres was involved internally (principally involving France, Germany and Sweden), and externally. (cf. Cattaneo, 1994; Iversen, 1999b) The technical standardization process was one part of a more comprehensive systems-building project in which technical, political and institutional aspects of the GSM system were engineered in great detail (Bender, 1999).

De-Commodification and Public Good

The important point about the standardization of GSM to emphasize in our context is that the extensive codification of the GSM standards had the effect, if not the primary motivation, to spread this particular technological system widely. The codification of the standards, and their regulatory sponsorship, encouraged the broad implementation of the standards. This broad implementation has brought with it apparent welfare benefits, some evidence for which is found in the decreasing cost to the individual user over time.

The standards themselves served to contextualise knowledge already accumulated, to package it in a system that served a practical (and as it turns out, important) role, and to transmit it to a wide audience. In this sense, GSM standards served to de-commodify technical know-how and place it into a (quasi-) public sphere.

In more economic terms, the GSM case demonstrates several welfare-benefits that distinguish it from a private-good and that associate it with a public good. One aspect of this is that the standard renders the know-how into an "information good". Off the top, the GSM standards are expandable (or "non-rival") in the sense that one's use doesn't per se exclude or negatively affect the use of others: everyone in the world could, at marginal cost, own their own set of GSM standards (given shelf- space) and this would not reduce their inherent value. In fact the more consumers that ultimately utilize the system described by those standards, the greater the utility has become for each individual user: in this sense they have successfully generated positive network-externalities. The politically sponsored set of standards codifying a single technology further reduced the search costs by becoming a *de facto* standard (a market standard, like Windows), and it avoided further orphaning effects among subscribers to losing technologies like Telepoint (see Grindley & Toker, 1993). There is also a great deal of literature on the economic rationale of consensus standards (see Iversen (2001) for one overview).

The more substantial aspect of the public good argument is, however, that it puts the know-how in the public domain. This does not rule out making profits with the technology. Codification in the standards-writing process allows knowledge about the set of techniques to be exchanged and ultimately implemented which is definitely guided by profit motives. Nonetheless, there are aspects indicating that standards like the GSM standards also have a role in de-commodifying technical knowledge. Although profits ultimately motivate participants, all the profits were not captured by the developers themselves. Some of the advantages from the resource allocation can be said to spread to society at large. This set of welfare benefits is itself facilitated by the government sponsorship of the standards. This opens a considerable debate over the de jure versus de facto standardization, particularly the ability of regulators to promote technology standards responsibly and effectively (cf. David & Shurmer, 1996).

Another way to look at GSM standards as an exercise in de-commodifying knowledge is to consider what would have happened to underlying technical knowledge without them. We recall that the standards-process like that of the GSM essentially involves the design of a new system based on available technology. The process adds to our total knowledge in at least two ways. First, the process uses technologies that might otherwise not have found their way into the greater social setting. We recall that mobile technology has some roots in military technology, and that its diffusion in civil spheres has been limited. GSM effectively changed that. The GSM standards also used newer technologies with military origins (like the TDMA) that had not reached wide-scale commercial markets, and which might have been consigned to the junk heap without the standards.

A second aspect is that the standards process itself helps accumulate new knowledge. During the standardization process knowledge is generated by using and adapting extant technologies and by encouraging their combination. It becomes a locus for the coordination of technical ideas and their articulation to non-technical conditions as perceived by the participating agents. These condition the range of new applications that subsequently emerge.

Intellectual Property Rights and Emerging Controversy

When the specifications for the GSM standards were being articulated, the technical committees were working in an field where research had already been conducted during previous decades. Some were areas, which were heavily protected especially by patents, but also by software copyrights. Even though the committees were not attempting to reinvent the wheel but to lay functional guidelines, it became clear that there was a risk for conflict between the technical specifications being codified and the codex of relevant IPRs, especially given the comprehensiveness of the system. Let us look at the emergence of the conflict and its implications.

In 1988, the main technical dimensions of the GSM system had begun to take form. At this stage, the first commercial contacts began taking place between customers (the Telecom Operators, TOs) and vendors (equipment suppliers) for the provision of equipment based on the GSM specifications. This took place at the same time that vendors were being co-opted into the standardization process, during its transition to ETSI. It was in the associated round of bidding that the IPR conflict began to emerge.

At this stage, concerns were raised that the implementation of *essential* aspects of the GSM specifications would implicate a number of IPRs (in the form of patents). This is to say, that the vendors who followed the specifications would, by doing so, infringe existing patents. The “essentialness” of the patents is important to emphasize: it entails that vendors could not avoid the technology described in IPRs and at the same time build the technology specified by the standards. Thus essential IPRs could effectively block the standards and stop the implementation of the technology.

This posed a fundamental paradox: following the one guideline (the standards) meant breaking another (the rights of the patent holders). In the GSM case this was especially delicate because the GSM standards were mandatory standards and therefore had to be used to participate in the EU market for mobile communications. This style of regulatory standard was used in this case to promote the harmonization objectives in the common economic area. The codified technical specifications were more than guidelines, they had the force of a regulation. One set of rules was on a collision course with a set of internationally recognized laws (intellectual property rights), and since there was no clear redress to the problem, the EU attempted to clarify its position without intervening via another layer of codification: the Communication of the Commission on *Intellectual property rights and standardisation.* (European Commission, 1992)

Touchstone for Inter-Institutional Conflict

In general it should be noted that the potential for "blocking IPRs" had always been a theoretic possibility in the drafting of technical specifications. The theoretical possibility, however, was for the first time in the GSM case perceived to be a real threat. The GSM case was also said to presage a rash of such conflicts (see Iversen, 1999a). We will look at the circumstances of the conflict and draw out some of factors that were specific to it, as well as others that support the hypothesis that the risk for such controversy would grow.

Memorandum of Misunderstanding

In the GSM case, the confrontation between IPRs and the standardization process was provoked by another layer of codification, an agreement called the GSM Memorandum of Understanding (MoU)[2]. This document was entered into by the network administrators and operators of 15 CEPT countries in 1987, and it put into place the logistics of a coordinated launch from the public network operators' point of view. In it, the signatories committed themselves to a common organisational line on the deployment of the GSM system.

The MoU was designed by the public network operators (PNOs) to minimize coordination risks associated with the orchestrated launch of a complex technical system. It was imperative to the success of the GSM system that the launch be synchronized, that equipment-type be proved compatible and that there was a rolling commitment to the future development of the system. Another important area of risk was IPRs. Approaches to this area were to be harmonized. This included the terms governing bidders' freedom to exercise their IPRs that were employed unilaterally by the 17 participating PNOs.

What was contentious for equipment makers with relevant IPR portfolios was that the contracts specified that equipment suppliers were to undertake to license any patents "essential" to manufacturing for the GSM system: there was an obligation to license all essential IPRs within the CEPT-area royalty-free and there was an obligation to license IPRs to all-comers outside the CEPT area at "fair, reasonable and non-discriminatory terms."

The MoU functioned as an agreement among purchasers in which 100% of the market was represented. Such an agreement was not unfamiliar to companies working in EU countries in what can be termed the "monopoly provider's paradigm", ie. before the effect of the 1987 Green Paper towards deregulation and liberalization began to be felt. During this paradigm, each country had its own PTT which was at once the regulator and the operator. Beneath them, there was generally a primary equipment provider that was groomed as the national champion. In this situation, it was the operator who codified the technical specifications and then passed these to their national champions, who were expected to clear any IPR problem. As telecoms markets started to be deregulated (or re-regulated) and new equipment suppliers moved in the assumption appeared to be heroic that the equipment suppliers would accept the IPR terms although the regulatory context was changing.

It is clear that the terms were meant

to defuse the risk that IPRs could pose to the collective launch of this "over specified system." At first the "national champions" did not seem inclined to challenge these terms, despite the fact that they found them "unfair". The individual situation of the different suppliers must however be seen in terms of a set of factors that includes: The number of patents that could be construed as "essential" to the GSM standard; their technical area and, related, the orientation of the company IPR strategy including how to enter opening markets elsewhere on the globe.

The Controversy

The IPR controversy was set off when the US based Motorola signalled that it was not going to accept the MoU terms (see Iversen, 1995). Motorola claimed to have a large number of patents – between two dozen and 30 – that were essential (3 times as many as the nearest rival); Motorola's patented technologies were in areas of once-off investments, in which royalty income was seen as important supplement; Motorola lacked market shares in Europe and Motorola had an in-house IPR policy that was much more aggressive than that of most Europeans. These factors contributed to its unwillingness to accept the IPR terms on offer.

The controversy emerged in the context of a relatively inactive patenting culture in Europe. In this context, Motorola's refusal was seen as an "aggressive use of patents", and it can be said that as a result Motorola's behavior triggered a new era of awareness of IPRs in telecommunications. Given the ongoing changing market situation especially in Europe, Motorola's IPR strategy to gain market share was actively adopted by all other players (Miselbach & Nicholson, 1994).

The European PNOs found themselves in a vulnerable position when the range and number of intellectual property rights reputed to be implicated by the GSM system they had sponsored began to emerge. Motorola was by no means alone. As this information became available, it must have increasingly seemed that the successful launch of GSM depended on the IPR holders' willingness to enter the MoU stipulation of royalty-free licensing. One concern was the risk that "cumulative" licensing costs[3] would price GSM out of the market or that IPRs would not be licensed.

The system was indeed perceived to be extremely vulnerable. Therefore when Motorola[4] refused the terms of the MoU undertaking, demanding separate individual contracts, the systems builders' concerns reached a pitch. A series of accusations and recriminations was sparked between 1988-89, that called into question Motorola's strategy and the fate of the GSM system. Was this US based manufacturer refusing to license its patents? Would the terms it demanded give it such an advantage that it would take de facto control of the European market? Against a background where the system was more vulnerable than expected, rumours emerged that Motorola was trying to use its "essential" intellectual property rights in order to hold the GSM standards process to ransom. Motorola argued, with the tacit support of some of the suppliers, that the PNOs were abusing their position in CEPT like a cartel to dictate licensing conditions. A consensus was not achieved with the exception that the MoU was generally regarded as a “failure”.

So what happened? De-commodification did not occur. But the licensing practices of Motorola and the other companies did not result in prohibitively high royalties in the EU. GSM could bear the royalty costs, has proven competitive and spread to many countries.

Increasing Scope for Conflict: the Legacy of the GSM Case

The lasting legacy of the GSM case is that the IPR conflict went from being a theoretic possibility to becoming a factor that could fundamentally shape technological development in this field. As market stakes rise, the “essential patent” controversy will create more serious problems. Several more recent cases illustrate that the tense relationship between Intellectual Property Rights and standardization has spread. It has since grown to include both different types of IPRs (patents and software) and different levels of standardization: regional (ETSI), international (ISO) and industrial level (Video-Electronics Standards Association, VESA). In the latter case, the conflict was involved in a formal regulatory decision (the Federal Trade Commission vs. Dell computers: Decision C-3658, consent order, May 20, 1996)

The indication is that the IPR problem signalled by the GSM standards has indeed gained scope (Iversen, 1999b). This has caused growing concern. In a recent article, a former policy director at the Federal Trade Commission complained that increasing patent litigation is making it harder for technology standards groups to operate, not least in the semiconductors industry. (Balto, 2001: 8)

IPRs in the Changing ICT Field

There are several factors about the current markets for information and communication technologies that augment the importance of IPRs as a means of commodifying new knowledge. Several observations on the level and nature of IPR use in the field of ICTs are therefore in order, as these issues condition how IPRs can be, and are being exercised, in the context of ICT standardization.

In general, the use of IPRs is high and the modes of use diverse in the ICT field. One indication of the high patent intensity is that the large ICT companies (such as IBM) top the list for the greatest numbers of applications in the US. But the activity is not limited to large multi-national corporations: high patent propensity is found pretty well across the board. This special patent-intensity may reflect several things. It suggests a high degree of exploration in an area undergoing “revolutionary” development. But, it also suggests that this is an area where there is a high propensity to patent, an area where the competition environment promotes active patenting strategies. One aspect is that the high level of activity (reputedly) promotes a constantly changing pattern of collaboration and competition in the ICT area. Companies collaborate and compete alternately or even simultaneously in developing new products and markets. This so-called “co-opetive” climate invites a diversity of IPR strategies. More generally however, we should expect to find high degree of use and a diversity of usages of the intellectual property rights in a field that defines itself according to its “knowledge assets”.

As indicated earlier, patents are not exclusively – perhaps not evenly mainly – used to extract monopoly rents from knowledge in the ICT area. Among other uses, patents can act as a signal to potential collaborators and a means to facilitate such collaborations. They are also used defensively to a large degree, to prevent others from claiming rights to technology. In many cases the rights are not actually exercised, but maintained as a bargaining chip (in collaborative R&D, in mergers and acquisitions) or a cloaked warning against litigation.

In short, IPR protection of technological knowledge is an active area characterized by changing rules, practices and strategies. These changes combined with those we find in formal standards-setting bodies bring the two institutions into conflict with each other.

Standards Development Organisations in the Changing ICT Field

The formal standardization process is likewise an area of intense activity and of changing patterns. The ways standard-setting is changing as an institution reflect especially a confluence of changes in the technology (e.g. the pace of change, rising complexity) with changes in the regulatory framework (e.g. deregulation and new markets). Although an anomaly in some senses, the GSM case illustrates some of the trends that are important in the standardization process and that, directly and indirectly, influence the potential for conflict with intellectual property rights.

Move Towards Anticipatory Standards

One current tendency is to move the standardization process in front of the market. Originally the voluntary standards that were elaborated by standards development organisations reflected market preference: standard specifications codified how market-standards work and how they might inter-work with other systems. (Cargill, 1989) More recently, there has been a push to standardize *a priori* market introduction. This *anticipatory* standardization moves in the direction of development. Collaborative R&D takes place to a certain degree within the SDO's working groups.

The GSM standards can be seen as a combination of post-market and pre-market standardization. As noted, much of the system was based on existing technology. At the same time it was the first digital cellular communication system. The likelihood of encountering active IPRs is visibly increased because the technology is more recent and because a certain measure of development becomes involved.

Proliferation of Standards-Setting Bodies

As with the technology itself, the institutional framework of standards-setting bodies is diversifying and proliferating. Standards-setting bodies are mushrooming not only in number but also in type. There is a growing number of voluntary standards development organisations which reflect the emergence of new markets in both technological and geographical terms. Alongside the broadening network of SDOs, a distinct system of consortia has grown up. Consortia involve market-players on a technology-to-technology basis. The system of consortia is composed of cross-membership of mostly multinational firms, which link producers of ICT goods and services with suppliers of complementary products. Sometimes consortia submit their specifications for approval by recognized SDOs.

The GSM standards emerged during an institutional transition. The standardization process was begun in the CEPT (a European PTT organ) and continued in ETSI, where service providers and manufacturers including multinational companies were involved. This move towards more diversified membership affects the IPR question. Different actors traditionally have different propensities to amass patent portfolios – the classic example being between PNOs with relatively few patents and manufacturers with many patents. There have been differences in attitudes towards patenting, with American companies renown for more active patenting strategies than Europeans. Further, different actors have different interests, different perspectives, and different expectations which condition how they are likely to utilize their patent portfolios in a given situation. Bringing different actors together who have not worked together before therefore opens for new areas of friction and greater uncertainty.

Detailed Versus Minimal Specifications

The GSM standards again involve a very comprehensive set of specifications. The high degree of specification raises several issues. On the one hand, detailed and unambiguous specifications can help ensure compatibility and interoperability within and between technologies that are becoming increasingly complex. On the other, increased detail reduces the scope for individual providers to do much more than implement the standards. In the GSM case, "the latitude left to manufacturers consists of the possibility to group canonical entities in a single machine (in which case canonical interfaces disappear) or to split the entity into several distinct, possibly distant machines (thus creating 'proprietary' interfaces" (Mouly & Pautet, 1992: 83).

More to the point in our discussion, greater detail raises the risk that the specifications might involve proprietary technologies that are protected by intellectual property rights. The greater the detail of the standards, the more they resemble the formulation of patents and thus the greater the scope for the two to come into conflict. In the GSM case, the "over- specification" was to a degree deliberate, owing to the overriding concern that the system must connect with existing analog networks as well as proactively to ISDN networks. Not only must the GSM system connect; it must be interoperable despite the idiosyncrasies built into the dissimilar national networks. As an indicator of how formidable such a task is, the GSM system as laid out in the 10,000 pages still needs to be tweaked in order to interoperate properly. In general, the trade- off between insuring interoperability among complicated technologies and maintaining a tradition of 'minimal, voluntary performance objectives' is becoming more intricate.

The Time-Frame

A common complaint about formal standardization processes is that it takes too long to produce the specifications. The timeframe of the standardization process is seen as increasingly important in markets characterized by shortening product horizons and general uncertainty. In broad terms, the standardization of GSM took some ten years. This is indeed a lengthy time-period especially given the rapid pace of technical change in telecommunications and adjoining information technologies. The duration is proof of the extent of standardization, as well as to the complexity and coordination problems involved.

In terms of the IPR question, the length of time it takes to arrive at standard specifications increasingly becomes an issue. While standardization is under way, active research which might be patented continues and perhaps is even augmented by the knowledge that a standard is under development in a certain area. Thus, while a standard is under development for a longer time period, it risks duplicating patents that are being created outside this process. The longer a standard takes to be developed the greater the chance that the standard will become the victim of a "multiple discovery" or that the trajectory of the standard will be leaked from the Working Parties to "carpet-bagger" companies who then start developing patents in the hope of winding up with an essential patent. This is specifically a problem with relation to standards that cover a wide breadth of technical functions, such as the GSM standards. In addition to the individual technical areas covered, the wide breadth of the GSM standards also risked implicating so-called "system patents" which cover concepts that pervade the system such as those claimed for TDMA (Time Division Multiple Access).

This is making for an increasingly densely-packed "IPR Mine- field" through which a standard must navigate. While R&D intensifies and the numbers of intellectual property rights increase, patents can live for up to 20 years. This means a growing pool of patents, which might block standards.

Conclusions

An important area of potential conflict has emerged in the interaction between two central institutional components of the innovation infrastructure: intellectual property rights regimes and standards development organisations. We linked the codification of knowledge in the case of IPRs to a commodification process and in that of standard specifications to a de-commodification process, and demonstrated how the former has started to collide with the latter in the ICT field. The case of GSM standardization illustrated how the scope for conflict first emerged as telecommunications moved from the traditional market situation based on stable collaboration patterns to a market situation, which was considerably less fixed. Factors associated with the emerging competitive climate were considered that lead to conflicts. As GSM was seen to lay the basis for a new market individual actors used their patents in order to position themselves in this market rather than conceding the patents for the sake of the public good (the standard).

The conflict between standards and patents has wider implications for the interaction between technology and society because it ultimately affects the paths technological change can take and the ways applications can be shaped.

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Notes

1 "Global System for Mobile-communications" includes a family of technologies comprised of GSM (900), DCS-1800, PCS-1900 and GSM-400.

2 This contractual agreement has in turn become a governing body composed of signatories. See http://www.cellular.co.za/gsm- mou.htm for details.

3 The price of all IPR royalties. Even in a situation in which all IPR holders accept 'fair terms', the cost of all royalties might still exceed market realities. In the case in which one actor alone claims over twenty patents and several patent holders are involved, one can understand this concern.

4 Other suppliers who called the MoU terms *unacceptable* and *unfair* also had substantial claims to patents in the GSM system.

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