Chapter 15

The Changing Nature of Technical Regulation in Telecom Networks

Richard Hawkins

1.0 Introduction

Continuing changes in the telecom industry and market structures have exerted many new pressures on regulatory systems. Nowhere have these pressures been more acute than in the area of technical regulation, defined broadly as the process of controlling the technical conditions that enable existing and new network technologies to interconnect and interoperate, both within and between individual networks. The idea has become widely accepted that in a more competitive telecom marketplace, the need for externally imposed technical regulation is diminishing. This is an oversimplification. As the role of the regulatory agency is re-examined with respect to changing market structures, so must its role be reassessed relative to intervention in technological issues.

This chapter examines the transition from analogue technologies in a monopoly paradigm, to digital technologies in a liberalising paradigm, in the context of the nature and function of technical regulation. The objectives are to question some of the current assumptions about the relationship between regulators and technological development in the telecom sector, and to make some strategic observations concerning the evolving role of regulatory agencies in the general area of technical regulation.

2.0 Instruments of Technical Regulation

It is important to make a distinction between 'regulation' as a term signifying a specific kind of regulatory instrument, and the far broader 'function' of regulation. A formal 'regulation', as administered under legislative authority, is only one type of instrument that can be employed in the technical regulation of telecom networks. Indeed, in most of the world's large telecom markets, formal technical regulations are applied only in selected circumstances where broad governing principles are required. Normally, at the local level, they are restricted to technical areas affecting network security and quality, or to areas with policy, legal, and national security implications. Thus, in most countries, issues like radio spectrum use, electromagnetic compatibility and protection, terminal equipment type-approval, and power-supply specifications, all tend to be governed by mandatory regulations. At the international level, the International Telecommunication Union (ITU) issues regulations on sharing the radio spectrum, and the harmonising the operation of international public network services. Once a country agrees to accept these ITU regulations, their use becomes binding under treaty.

By far, the greater part of technical regulation in telecom is effected through technical standardisation, and this will be the primary focus of the discussion to follow. Ideally, standards represent a consensus of views in the industry concerning the kinds of technical issues that should be approached and resolved in a common way, and the technical solutions that should be adopted. Standards development processes can be long and arduous, and lead many to question whether standards are any more responsive than formal regulations to changes in technology. In the past, perhaps the most significant distinction between the two forms of technical regulation is that standards have had a closer affinity to the actual configuration of networks at the operational level.

In the telecom industry, standards have always been regarded as 'voluntary' instruments. In fact, until comparatively recently, the term 'standard' was hardly used at all. The 'standards' of the industry were normally defined in 'recommendations' as issued by Public Telecom Operators (PTOs) at national or sometimes regional levels, and as promulgated internationally through the ITU. In some cases, nevertheless, the application of these recommendations was 'virtually' mandatory in that they might be referred to in formal regulations, or because specific network functionalities could not be provided unless specific standards were applied.

In practice, the principles separating 'regulations' and 'standards' are often obscure. In addition to the practice of referencing standards in regulations, the preparation of the technical content of regulations can be contracted-out to standards development organisations. In Europe, for example, The European Telecommunications Standards Institute (ETSI) has produced several 'Technical Bases for Regulation', funded directly by the European Union, to support regimes of mandatory technical regulations as specified in EU Telecommunication Directives. Most European 'regulations' are confined to traditional areas (such as terminal equipment type-approval), but an expanding range of subjects is also being addressed in this way, including Open Network Provision (ONP), satellite and mobile communications, infrastructure development (including ISDN and ATM), and digital broadcasting (ETSI 1995).

In today's telecom environment, in which the relationship between public and private sector entities is in a state of flux, lack of clarity concerning normally mandatory 'regulations' and nominally voluntary 'standards' can be very troublesome. Although voluntary standards are certainly instruments of technical regulation, they are not simply interchangeable with other regulatory instruments (Reddy 1990). As a process, voluntary standardisation is heir to a range of internal and external pressures that, arguably, are further beyond the immediate control of legislative and regulatory agencies than those applying to other kinds of instruments (more below).

If a technical issue with regulatory implications is given over to a voluntary industry standardisation process that, in the end, does not deliver optimal results in terms of regulatory objectives, options for subsequent positive intervention by a regulatory agency may be especially restricted (Baggott 1986). Once applied in the public telecom network, for example, and particularly if applied at key interfaces, standards can affect the subsequent development trajectories of technologies and service markets throughout the whole network. Furthermore, uncertainty over the regulatory status (voluntary or mandatory) of proposed standards can influence the nature of industry input into standards development projects, leading to uncertainty about the eventual form, content, and technical quality of the standards produced (Hawkins 1993).

3.0 Technical Regulations and Standards in the 'Old' and 'New' Regimes

Still very much evident in most national telecom markets, the 'old' regulatory regime is geared toward preserving monopoly structures. Under this kind of regime, most 'standards' are little more than the internal procurement specifications of national PTOs, supplemented and/or supported by ITU 'Recommendations' usually as applied in national 'versions'. Under the Post, Telegraph and Telecommunication (PTT) system, still a dominant paradigm in much of the world, commercial, regulatory and technological functions are combined in a single public administration. In this scenario, the PTT can develop a virtual monopoly over national technological acumen in telecom, usually operationalised in conjunction with preferred or exclusive arrangements with selected equipment manufacturers. Where PTOs are regulated by independent authorities, however, as in Canada, Britain, and the US, there is generally less precedent for the regulatory agency to be directly involved in technological matters of an operational nature. Independent regulators monitor the planning and implementation of new technology, but they do so mainly in terms of the implications for tariffing and 'term-of-licence' requirements, and in order to avoid conflicts between standards, regulations and general policy objectives.

Historically, in the major economies, both PTTs and independently regulated PTOs took part in extensive R&D programs, usually under vertically integrated arrangements with subsidiaries or preferred outside suppliers. The understanding, of course, was that the results of an R&D program would be applied primarily in the networks of the PTO financing the program. The immediate benefits of internally generated R&D for the PTOs were (a) that they could control the direction and pace of the network design process, thus regulating directly the flow of new technology into the network; and (b) that they could achieve relatively efficient co-ordination between service planning and technical change. The whole process encompassed the development and application of standards, and afforded PTOs the maximum possible degree of influence over the content of national and international technical regulations.

3.1 Digitisation, Liberalisation and the 'New' Regulatory Regime

The degree to which digitisation and liberalisation have proven to be mutually reinforcing factors in the reshaping of telecom networks and markets is still the subject of intense debate. Certainly one of the most important implications of digitisation for telecom market structure is the increased modularity of digital systems. Regardless of the procurement structure within individual PTOs, the possibilities for procuring public network equipment economically in a multi-vendor environment are, arguably, far greater in a digital than in an analogue environment. Moreover, the scope of technical choices is increasing rapidly as non-traditional actors enter formerly closed public network markets. Computer and software firms are rapidly expanding their range of networking and related products. IBM, for example, is now ranked among the top ten communication equipment vendors world-wide.

In a digital environment, liberalisation of equipment supply markets has benefits for incumbents as well as new entrants. Incumbent PTOs can reduce the costs of service upgrades by deploying localised, computer-controlled service modules, acquired from specialised, competing suppliers (Mansell 1993). For public network equipment manufacturers, the escalating R&D costs of digital technologies means that new markets

must be found to supplement revenues from their established vertical relationships with selected national PTOs. The question, of course, concerns the extent to which these advantages might outweigh, or be outweighed by, the residual advantages of established, vertically oriented relationships. The nature of this balance has considerable implications for the function of technical regulation in liberalising markets.

The dominant political and economic philosophy of the 'new' regulatory regime is oriented towards facilitating rather than restricting entry into telecom equipment and service markets. It advocates the break-up of 'public administration' structures through separation of operational and regulatory functions. As a result, many countries are now involved in disestablishing their PTTs, and setting up independent telecom regulatory agencies for the first time. This raises new questions, however, about the R&D structure, its relationship to the development of technical regulations and standards, and the position that regulatory agencies should adopt with respect to technology.

Under the new regime, it is expected that regulators will issue mandatory technical regulations from time-to-time, but that these regulations will be minimal in scope, leaving most aspects of technical regulation to the voluntary industry standardisation process. However, reflecting the increased need for co-ordination among diverse competing entities in the development of advanced new digital technologies with considerable network externalities, standards have been moving steadily upstream from their traditional place in the switching and routing hierarchies of public networks, to the position of defining the technical configurations necessary for the provision of advanced electronic services. In this environment, PTOs now question the terms under which they should finance internal R&D programs and the development of standards, when the outcomes must be shared with independent equipment supply firms that, increasingly, operate in international markets.

In that PTOs derive their operating revenues from subscribers, there is clearly a public interest for regulators to uphold the way technology development expenditures are shared between PTOs and manufacturers. Standards have become an especially important factor in this development. As the range and complexity of standardisation activity increases, however, and the number of standards projects and organisations escalates, the scope for regulatory agencies to become directly involved in standards-making at the technical level is normally very limited. The important considerations for regulators are to ensure that the standards-making process operates equitably in the public interest, and that standards are produced and implemented in a way that is compatible with regulatory objectives as set out in national policy. To do this, it is necessary for them to consider some basic characteristics of the contemporary standardisation system.

4.0 Expanding Rationales and Institutional Change

The problem of determining how regulators might or ought to interact in the standards development process is greatly compounded by the scope of industry rationales for participating in the standardisation process. This has become much larger than it was in the era before liberalisation pressures, and by the convergence of computer and telecom technologies. Figure 1 illustrates that standards development now occurs with at least as much reference to the 'business' dimension at strategic levels, as to the 'technology' dimension at operational levels. In technological terms, standards activities can be initiated with reference to 'upstream' design and production phases as well as

'downstream' implementation phases. In business terms also, the scope ranges from relatively straightforward cost containment and reduction rationales oriented to improving the efficiency of manufacturing and implementation processes, to complex design and market development rationales oriented to commercial strategies. Figure 1 illustrates the upstream-downstream orientations of five key types of standardisation rationale, along with an indication of the relative scale of the activities pursued by stakeholders under each rationale.

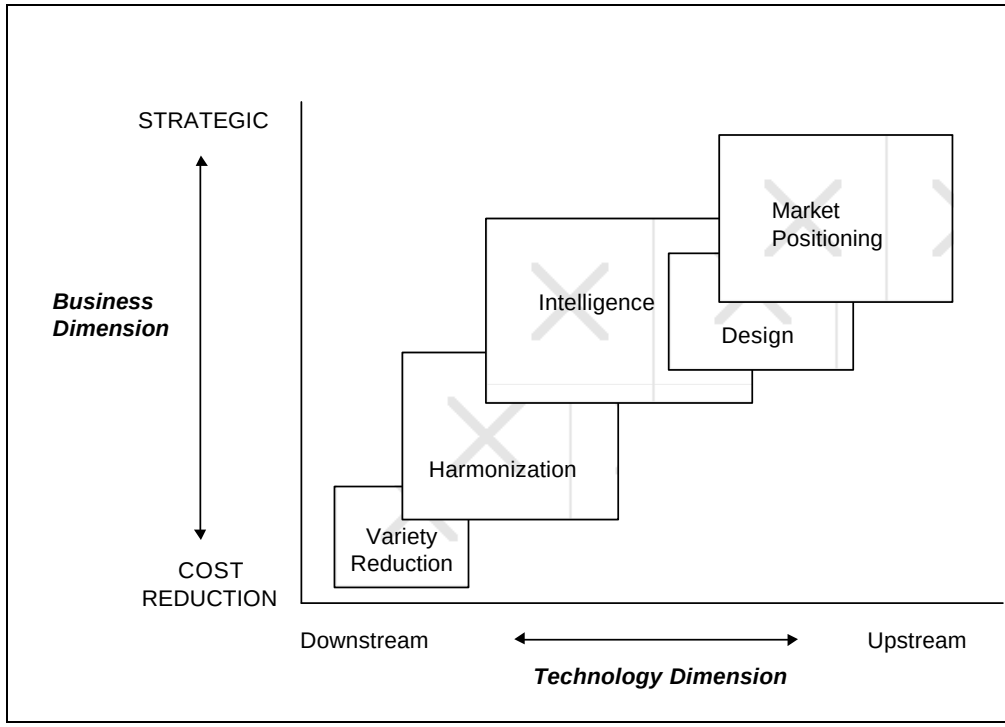

Figure 1 **– Standardisation rationales**[1]

- **Variety reduction** – This is the most basic objective of any standardisation project, and is thus a contributing factor to most other standardisation rationales. As a rationale in its own right, however, variety reduction comes into play most directly at downstream levels whenever there is a high incentive to deploy identical (mostly physical) components, and little or no commercial advantage to be gained by deploying dissimilar components.
- **Harmonisation** – In telecom, this refers to the major on-going task of ensuring that levels of compatibility among new and existing network technologies are sufficient to allow different networks to exchange telecom traffic. Technologically, this remains primarily a 'downstream' process, but the increasing range of new service possibilities is increasing industry awareness of the more 'upstream' strategic implications of harmonisation.

- **Intelligence** – This is now perhaps the pivotal rationale for participating in standards development processes. In an increasingly competitive industry, the standardisation process provides firms with a vehicle for assessing general directions in technology development over time, and for assessing their own evolving technology and commercial strategies, relative to those of their competitors and customers. The intelligence-sharing rationale is the bridge between downstream costs orientations, and upstream, strategic orientations.

- **Design** – The standardisation process can be used as a mechanism for the collaborative development of new 'pre-competitive' technologies among otherwise competing firms. At this level, standards committees can function as *quasi* design consortia. The design rationale is in some respects the downstream end of the market positioning rationale, and there have been several notable successes with this approach GSM being a notable example.

- **Market positioning** – There is now a much greater awareness in firms that standardisation should be linked directly to marketing and R&D strategies for the introduction of new product lines and services. 'What' and 'when' to standardise can be a critical decision area for positioning new products and developing new markets.

4.1 Adjusting the Standardisation Mechanism

In the early 1980s, at the beginning of the era of digital telecom technologies and liberalising market pressures, the standardisation mechanism was oriented primarily toward variety reduction and harmonisation, in a very homogeneous institutional environment. As the governing principles of the 'new regime' began to assume a dominant position in the policy debate, the initial concern for policymakers and regulators was that the existing standardisation system would be unable to produce a sufficient number of standards quickly enough to keep pace with changes in either the technical or policy arenas. Thus, significant new initiatives were supported to 'adjust' the system, and to make it responsive to the needs of a more competitive marketplace for technology.

Much has been written in recent years about the many institutional and procedural changes in the international standards-making mechanism for telecom (Besen 1995; Besen and Farrell 1991; Hawkins 1992; Cowhey 1990; Codding 1991). Suffice it to say here that the old structure, dominated by national PTOs and centred in the international consultative committees of the ITU, has now clearly given way to a more decentralised structure revolving around three major regional standards bodies – T1 in the US, the Telecommunication Technology Committee (TTC) in Japan, and ETSI in Europe. In response, the ITU itself has undergone quite a startling, and far reaching transformation (MacLean 1995).

The most important general effect of these changes is that the orientation and participatory criteria of the process have opened up to the extent that there are now few prima facie reasons – short of the traditionally intractable problems of technological capabilities, and financial resources – to preclude participation by any materially interested entity. Telecom standards are now developed in an environment that is much

more heterogeneous in terms of types and sources of participants, participatory rationales, and technical subject matter. Internationally, furthermore, standards are now determined less on a basis of 'nationally co-ordinated' positions', and more on the basis of industry consensus with respect to developing international markets.

4.2 De facto Standards and Industry Consortia

Institutional adjustment has not led to contentment, however, and yet further pressures are being exerted for change. There are two main contributing factors. First, the market structures of the computer and telecom industries remain largely separate, even though the technological environments have largely converged. Many computer and software firms are now emerging as potential competitors to the PTOs in many markets for network services. Both computer firms, and some telecom equipment suppliers, often see the telecom standards system as preserving needless distinctions between 'public' voice-centred networks and 'private' data-centred networks. The second factor is that telecom and computer companies alike are constantly looking for better fast-track mechanisms to pursue strategic 'upstream' standardisation goals. Both of these factors can lead to inter-sector rivalry and to increased uncertainty as to the pace and outcome of standardisation initiatives undertaken in the regional bodies or in the ITU.

In recent years, a large number of industry standards consortia have emerged. Typically, these are oriented to a specific technological problem or market opportunity, and they commit to producing de facto standards quickly, in order to facilitate the introduction of new networking products. The membership of many consortia tends to be restricted to actors with a direct commercial stake in the technical area under development, and there is normally no requirement (as there is in the rules of standards development organisations) to reflect a balance of corporate, sectoral or national interests. Most consortia have roots in the computer and software industries, and began life oriented primarily to data networking. Of the more than fifty major existing consortia, however, most now deal with public as well as private network environments (TTC 1995). Consortia are especially significant in that they have taken the initiative in bridging the historical gap that has persisted between the computer standards community, centred in the International Standards Organization (ISO), and the telecom standards community, centred in the regional bodies and the ITU. In many cases, standards developed in consortia are then injected into the work programs of the regional telecom standards organisations, and/or the ITU.

4.3 The Standards Problem in the 'New' Regime

In the end, the standards problem turned out to be quite different than the early supporters of institutional re-organisation had supposed. Far from being reticent, the telecom and computer industries began producing standards in great profusion, and in an expanding array of organisations. Eventually, the problem of standards production was overtaken by the problems of standards planning, evaluation and co-ordination.

The significance for regulators of this very diffuse structure is twofold. First, it intensifies the existing difficulties of monitoring and/or influencing the standards development process for regulatory purposes. Second, the structure is now so complex that it can likely be influenced on a broad scale only by a small number of very large multinational equipment vendors and service providers. Under the new paradigm,

regulators are presented with a fresh challenge in ensuring that technology provided to the network under competitive conditions, does not contain the seeds of new barriers to market entry. The proprietary (de facto) or non-proprietary nature of many key standards in public network applications may become increasingly more difficult to determine.

5.0 Why Regulators Need to be Concerned about Standards

From the above discussion, there are at least three fundamental rationales for regulators to monitor and/or make selective interventions in the standardisation process. Figure 2 illustrates these rationales according to their policy and technology dimensions, using a diagram similar in aspect to the one given above to illustrate the standardisation rationales of firms.

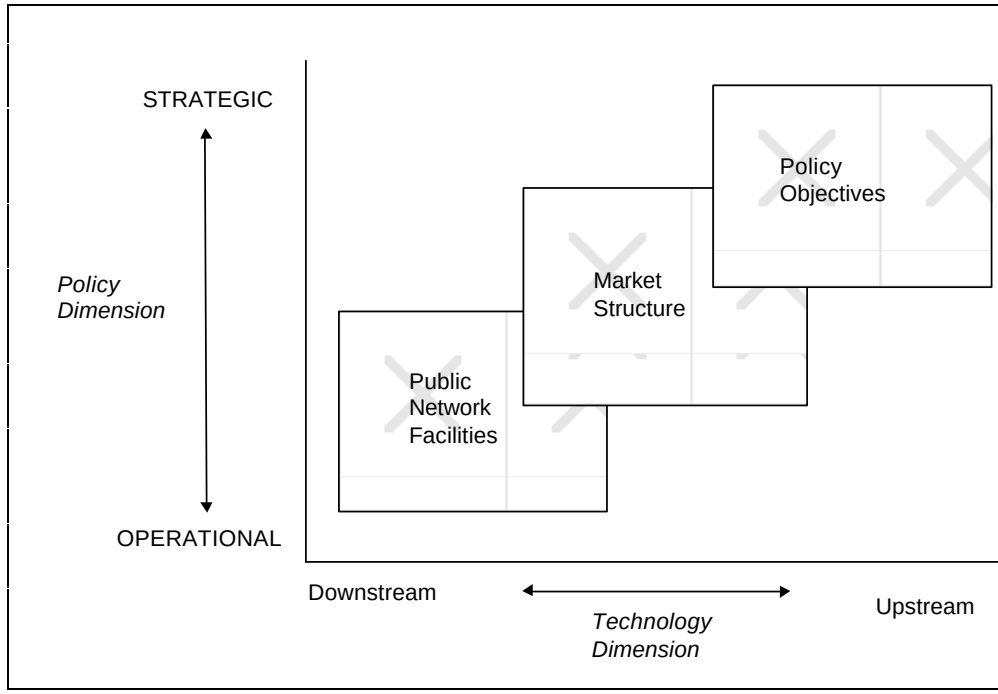

Figure 2 **– Regulatory rationales**

- **Oversight of 'public' network facilities** – A primary responsibility of a telecom regulator is to ensure the provision of 'public network services' – i.e. services that are intended to be accessible by all potential users on a reasonably equitable basis. Under the 'new' regulatory regime, there is an expectation that regulators will confine themselves to issuing broad guidance in the form of mandatory regulations. Given the challenge of rapid of technical change, however, regulators can not perform this function unless they maintain contact with the evolving technical parameters of different kinds of network services at the operational level. Many, if not most of these parameters are defined in standards. Indeed, the 'public' network,

as an entity, may eventually be definable only as a specific set of services and technologies, set out by regulators, and supported by specific standards.

- **Market structure** – One of the key issues for regulators (under the 'old' as well as the 'new' regulatory regimes, although in different ways) is how to control the market power of incumbent firms. Regulators must ensure that the standards applied at key interfaces in the public network do not act to erect barriers to market entry, or to create technological path dependencies that favour certain forms of service development over others. This rationale bridges the responsibility to keep in touch with the changing operational parameters of the public network, with more strategically oriented responsibilities.

- **Support for policy objectives** – Standards are a critical factor in the development of national information and communication infrastructures. Policies with respect to these infrastructures are in turn linked frequently to the broader social and economic policy goals of national governments. The regulatory structure can be expected to support this policy structure, and, at times, to contribute to its development.

6.0 Conclusions

In the 'old' regime, mandatory regulations and voluntary standards are virtually two sides of the same coin. In the 'new' regime, regulators face many uncertainties and pitfalls in approaching the subject of technical regulation. In particular, they must approach the subject of standards with an understanding of their expanded functions as integral parts of the R&D, manufacturing, marketing, and service planning processes for telecom.

In this new environment, careful distinctions must be made as to which instruments of technical regulation will be most appropriate to each context. Technical regulation in the contemporary telecom network can employ: (a) formal regulations that are mandatory in the sense that compliance will be enforced by an independent regulator; (b) standards that are virtually mandatory in the sense that there is an exceptionally high incentive for compliance by all actors exclusive of external enforcement; or (c) standards that are voluntary in the sense that actors can choose compliance or non-compliance without prejudicing their own positions or those of other actors. With specific reference to 'voluntary' standards, furthermore, regulators must distinguish between (a) industry agreements of a non-proprietary nature, and (b) proprietary specifications that may restrict the subsequent technology choices of adopting actors to the products specific firms.

Although convergence between computer and telecom technologies is proceeding at a rapid rate, the respective rates of technology implementation are often not synchronous, and the commercial structures surrounding each sector remain very different. It is imperative, therefore, that standards activities in the two areas be assessed in a co-ordinated way for regulatory purposes. Moreover, all standards issues must now be approached in terms of the increasingly regional and international frameworks in which they must operate.

Ultimately, there are three dangers for regulators to avoid in approaching the subject of technical regulation. The first is to link the function of technical regulation too closely to specific kinds of regulatory instruments. The second is to assume that

voluntary instruments, like standards, will be sufficient to address the kinds of broad technical issues that have general policy implications. The third is to try to address narrow and perhaps transitory technical problems with mandatory regulations or with ambiguous references to voluntary standards. If these dangers are to be avoided, disengagement from the standardisation process on the part of a national regulatory authority is clearly not an option. Given the scale, scope and complexity of the process, however, regulators will have to develop selective monitoring and participatory approaches. These must be aimed at 'keystone' standardisation initiatives that have implications for those broad areas of technological development that relate directly to specific policy goals for the national telecom system.

[1] This diagram is based upon the consolidated results of a long-term, in-depth study of telecommunication standardisation processes, funded by the UK Economic and Social Research Council, Program on Information and Communication Technologies (PICT), and carried out between October 1991 and March 1995 at the SPRU Centre for Information and Communication Technologies. For an overview of the results of this research program see Hawkins (1996).