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Philipp Genschel and Raymund Werle

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From National Hierarchies to International Standardization: Modal Changes in the Governance of Telecommunications

PHILIPP GENSCHER

RAYMUND WERLE, *Max Planck Institute, Cologne*

ABSTRACT

The emergence of large technical systems like railroads, telecommunication networks or power grids was closely associated with hierarchical governance. Despite the success of hierarchical structures in promoting the development of these systems they have recently come under strain. They are suspected of being too slow, too cumbersome, and too unimaginative to deal with the complexity and turbulence of modern technology. Practical people as well as academics look for functional alternatives. One of the alternatives is the decentralisation of technical control via standards. The paper investigates this alternative by analysing the role that standards have achieved in telecommunications after the hierarchical order was eroded by globalisation and deregulation. It discusses how the demise of hierarchy has boosted the 'demand' for standards and how the institutional infrastructure for standardisation was adapted to meet this demand.

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1 Introduction

Modern society is held together by a complex infrastructure of technological systems. Transportation systems, power grids, communication net-

works, and similar technologies provide the means to relate regionally distant but functionally interdependent parts of society. But if technology keeps modern society from falling apart, what keeps technology from falling apart? Large technological systems consist of a multitude of functionally diverse components which are designed, produced, and operated at different places by different people. System integration is not an easy task. How is it achieved?

The evolution of the first large-scale technological systems in the 19th century was associated with the introduction of hierarchical modes of social coordination into industrial organisation (Chandler 1977; Hughes 1983; Mayntz/Hughes 1988). Hierarchical structures enabled actors to make their technologies large for two reasons. First, they provided a framework for decomposing the complex problem of developing and running far-flung, multi-component technological systems into a series of subproblems which could be handled decentrally on the basis of division of labour. Second, by subordinating all activity to a centralised chain of command, they ensured the actors against the risk that the decentralisation of activity might lead to incompatible results.

Hierarchy was an immensely successful means of promoting the development of large technical systems. Nevertheless, hierarchical structures have come under strain. New types of institutions which are 'neither market nor hierarchy' (Powell 1990) have gained in prominence and started to supplant or even substitute for older hierarchical arrangements. The confidence in the superior effectiveness and efficiency of hierarchical coordination has eroded. But what comes after hierarchy? Coordination problems must be taken over by functionally equivalent arrangements in order to maintain order and to develop and extend technical systems. One of the mechanisms is standardisation. Today, standards provide much of the coordination and integration that was previously achieved hierarchically. Having become an important concern for business people, technical experts and politicians, standards attract considerable attention. The number of articles on computer standards, for example, has doubled every year since 1980 (Cargill 1989, 5).

Both the shift away from hierarchical coordination and the growing importance of standards have gained considerable attention in economics, sociology and political science. There is a wide-ranging debate on 'governance', focused on conceptualising and explaining a variety of empirical institutions (Scharpf 1993; Campbell/ Hollingsworth/ Lindberg 1991; Marin/Mayntz 1991; Williamson 1985; 1991), and there is a more specialised debate on how standards work and how they get adopted (David/Greenstein 1990; OECD 1991; Dierkes/ Hoffmann 1992, Ch. 14-17). Strangely enough, the latter debate proceeds in almost

total isolation from the former. Widely ignoring the interdependency between governance type and demand for standards, it simply assumes a certain demand as given, and then discusses how it can be met.

The purpose of this paper is to show how closely the ascendancy of standards and standard-setting institutions is linked with the decline of the hierarchical mode of coordination, using telecommunications as an example. The telecommunications sector used to be organised in a rigid hierarchy. Standards played a residual role, however, in the emergence of an institutional structure for standardisation. During the late 1970s and the 1980s, the hierarchical order of telecommunications came under pressure and had to make way for a more decentralised and normatively less integrated institutional structure. The role standards play in this new institutional context is examined.

2 Large Technical Systems in National Containment: The Old Order in Telecommunications

The institutional structures adopted throughout the world for managing telecommunication networks were based on an encompassing concept of the telecommunications sector and the way it can most efficiently be organised. This traditional concept rests on the basic principle that telecommunications networks are a 'natural monopoly', and that extensive public control of the telecommunications sector is necessary to secure certain functions essential to the public interest.

(1) The theory of natural monopoly states that under certain conditions, which are supposed to prevail in telecommunications, a monopolistic market is likely to emerge (Baumol/Panzar/Willig 1982). Due to technical indivisibilities and related economies of scope, a strong incumbent firm enjoys an enduring competitive advantage. Its market is protected by high barriers to entry for potential competitors. Public control and intervention into such a monopoly is perceived as legitimate in order to prevent the monopolist from abusing his position.

(2) The other argument for public control maintains that certain politically desirable and socially essential functions will be underprovided if allocation decisions in the telecommunications domain are exclusively driven by cost considerations, be it in a monopolistic or in a competitive context. These functions include infrastructural support for military communications purposes and universal public telecommunications services. It is argued that this requires a nationwide provision of telecommunications services on a uniform and equitable basis. Here public regulation is needed to reduce the role of cost considerations in the provision and allocation of services. In a politically influenced system of prices for telecommunications services, cross-subsidisation is

quite common. Services sold in metropolitan areas may subsidise those offered in rural areas, and long-distance lines may subsidise local loops or vice versa. This is only sustainable, however, if there is no competition in the profitable segments of services.

The prevalence of these two basic principles ultimately produced a rather homogeneous 'organizational paradigm' worldwide (Schneider 1991, 25), which remained stable until recently. A single network operator – either owned or tightly regulated by the state – provided all telecommunications services. Whether the operator was a public administration such as a PTT, in most countries, or a private corporation like AT&T in the United States, was of minor importance with respect to corporate behavior.

Another relevant feature of the traditional governance structure in telecommunications was a degree of vertical integration. Research and development, design and manufacturing of telecommunications equipment were directly or indirectly controlled by the PTTs. Where the PTT could not directly influence the decisions of the small circle of national manufacturers, it could secure compliance with technical specifications through its procurement power. In this constellation, national technical coordination was achieved through small groups of technical experts from the manufacturing firms, interested government agencies, large telecommunications users such as banking and insurance companies, and the PTT.

The telecommunications domain was hierarchically structured. This structure produced – and was later reinforced by – a fragmentation of the world into sheltered national markets. The factors discussed above also account for the closed international trading structure in telecommunications technology. National security and social motives favored the production of all vital parts of the telecommunications network by national manufacturers. Labor market and industrial policy concerns provided additional support. As a consequence, the national PTT was obliged to 'buy national' and, if needed, the national market was additionally protected from foreign competition.

The national markets, developing in isolation from each other, proceeded along rather different paths of technical development. Which path a market took was largely determined by the particular problems and concerns, concepts and biases, strategies and interaction sequences that ruled the processes within the national telecommunications domain at certain branching points of technical development. They were embodied in the technical layout of the national network. The result was considerable technical diversity among the networks, which precluded the interchangeability of equipment. Technical components designed to

match the historically developed specific features of one country's network could only be adapted to another network at high costs.

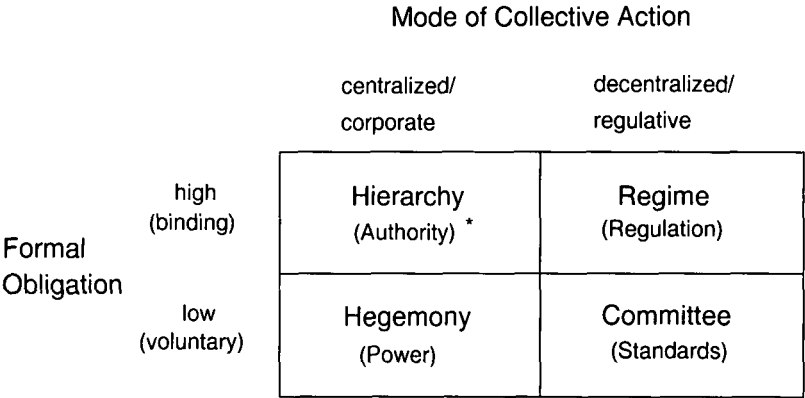
3 From National Isolation to Minimal International Coordination

The only contact between the self-contained national systems was through the conjoint provision of international services arranged upon the basis of bilateral operation agreements between the PTTs. They fixed the administrative and technical conditions of providing a service between the respective countries as well as the administrative rules governing the procedures for collecting and apportioning tariffs. Technical agreements defined the operating procedures and arranged for technical *compatibility of the networks at the network interconnection points*.

Especially in Europe, where many states were crowded into a geographically small area, a multitude of bilateral agreements would have been necessary to establish international traffic including transit procedures. Here it was recognised very early that the application of common rules would greatly enhance the efficiency and diffusion of international services. Thus, in Europe the first attempts were made to coordinate international telecommunications.

Different organisational solutions to the problem of international coordination are available. Commons, one of the founders of institutional economics, distinguishes two general modes of coordinated collective action, the corporative and the regulative (Commons 1961, 342). The corporate mode of international coordination implies that the states empower an agency to act on their behalf. They consent to be legally bound by the decisions of the agency, i.e. the states create a transnational agent and transfer sovereign rights to it. What evolves is a formally legitimised transnational 'hierarchy'. The regulative mode achieves coordination decentrally, creating a system of formally binding norms and rules which set limits to or regulate the states' freedom of action by changing the cost and benefit structure of individual strategies (Stein 1982, 301). Some kind of body or bureau may be commissioned to give assistance and legal advice, but it has no competence to act on behalf of the states. This regulative mode has the form of an international law or treaty and is often called an international 'regime'.¹ Corresponding to the different modes there are different means of coordination. Hierarchies rely on authority; regimes use regulations.

In an international context these two types of *de jure* agreements are often difficult to accomplish. In some areas such as technical coordination, states may hesitate to agree to the imposition of binding norms. Technical change, for example, might be impeded by static legal con-



* Means of Coordination

Diagram 1: Four Modes of International Coordination

ventions. Thus, other forms of coordination evolve which can be called *de facto* solutions. The explicit distinction of *de jure* and *de facto* arrangements provides for a second dimension of corporative and regulative coordination. Diagram 1 shows that in addition to *de jure* hierarchy and regime, two forms of *de facto* coordination can be identified. The *de facto* corporate solution can be designated hegemony. Here the states do not consent to be bound by the decisions of the agent, but have no viable alternative to doing so because of the high opportunity costs involved.² The *de facto* regulative form of coordination takes the form of negotiation systems or what we shall call ‘committees’. Here states and other actors or their delegates congregate on a voluntary basis. Both procedural and membership rules for a specific arena can be provided by a regime, but negotiation systems may also be established *ad hoc*. The decisions of committees usually have the nature of recommendations, the observance of which is voluntary. In the technical domain these recommendations are generally called technical norms or standards. Compliance with standards reduces transaction costs as long as other relevant actors also comply. In contrast to standards in the case of committees, in hegemonies power is the means of coordination.

In telecommunications a transfer of the hierarchical model of coordination as it had evolved in the national systems to the international sphere would have made it necessary to assign the provision of international services to a transnational agency. This, however, would have undermined national sovereignty and was therefore highly unlikely. Especially in the 19th century, such a solution was without precedent

in any international policy domain. In the 1920s, a suggestion to entrust the monopoly of European international telephone communications to a single company with sufficient capital to assume full responsibility was rejected (Chapuis 1976).

For the very reason that a transnational agency was unacceptable, the hegemonic solution was not available. Public control in telegraphy and in the early decades of telephony had produced fairly self-sufficient national telecommunications systems. There were no exchange relationships, therefore, which could have created power inequalities and constituted a hegemony. One exception can be found in the old British Empire. Intercontinental traffic within the Empire was dominated by Cable & Wireless, which had end-to-end ownership of the international facilities. Ergas and Paterson (1991, 31) call Cable & Wireless a 'hegemonic power' in the British Commonwealth.

Regulative solutions to the coordination problem were more likely to emerge than corporate ones. Drafting international treaties as a mode of coordination was the routine approach in the 'sovereign state system' of the 19th century. International treaties do not impede state sovereignty, since they only provide a framework of contractual rules, a regime that leaves concrete decisions to the discretion of the contracting parties. Yet for this very reason international regimes are quite inflexible. It normally proves difficult and time-consuming to adapt to changes. Thus, in domains where change is the rule rather than the exception, the establishment of committees which issue standards may be the more appropriate mode of coordination, although problems of implementation and compliance may arise.

The official history of treaty-based international coordination in telecommunications can be traced back to the year 1865, when delegates of twenty European countries attended a conference on the harmonisation of the provision of international telegraph services. The meeting proceeded along established routines, deciding to base coordination on an international treaty, the International Telegraph Convention. This convention fixed rules that governed legal, commercial, operational and technical aspects of an international telegraph service.

In two points, however, the conference transcended established routines. Firstly, it decided to meet periodically to review the terms of the treaty. This would remain entirely at its own discretion. The conference secondly decided to complement the treaty by an international organisation, the International Telegraph Union (ITU), which is supposed to be the modern world's very first international organisation (Coddington/Rutkowski 1982). In 1868 a permanent 'International Bureau' was set up in Berne, Switzerland. Its purpose was to ease communications

between governments with respect to telecommunication affairs and to help prepare periodic conferences. But very soon the smooth adaptation of the treaty's rules and norms to technical and administrative developments within the new ITU framework proved to be incompatible with comprehensive political control demanded by the member states. Furthermore, the international conferences, whose delegates were recruited from the diplomatic corps and the national bureaucracy, lacked the time and expertise to consider all the technical and administrative difficulties involved in arranging for international connections.

Therefore the St Petersburg conference of 1875 decided to group together technical and administrative details in a separate document entitled 'Regulations' and leave its periodic revision to an 'Administrative Conference' of specialists from the ranks of the network. That changed the role of the 'political' Conferences, shifting most of the continuous workload to the Administrative Conferences, in which governments were not directly represented (Mili 1973, 289).

As long as telephony remained chiefly a domestic issue with minimal interconnection between countries and almost no international trade of telecommunications equipment, the mode of coordination did not change. It was only challenged in the 1920s with an attempt to arrange for an international telephone service. The first steps were taken outside the ITU, which considered telephony 'a mere appendage to the telegraph service' (Chapuis 1976a, 203). In 1923 a meeting of delegates from six European PTTs initiated by France proposed to set up a permanent International Consultative Committee on Long-Distance Telephony (CCIF) to support and coordinate the administrations in their efforts to establish long-distance and international connections. The CCIF was established in 1924 with twenty member-administrations (Chapuis 1976; see also Savage 1989, 168–184).

The purpose of the CCIF was to study technical, operational and tariff questions in order to 'propose standards for long-distance telephony with which the various European countries, in their own interest as well as in the general interest, are invited to conform as strictly as possible' (cf Chapuis 1976, 186). Emphasising the voluntary character of the standards the Committee called them 'Recommendations'. Thus, in contrast to the ITU, the CCIF aimed at international coordination through standards instead of treaties and regulations. Suggesting focal solutions, standards were supposed to help achieve the necessary international technical uniformity without having to rely on the type of formally negotiated rigid administrative rules prevailing in the ITU.

In 1925 the CCIF was officially recognised and attached to the ITU, but retained autonomy concerning its structure and working procedure. The statutes of the CCIF remained basically unchanged until the follow-

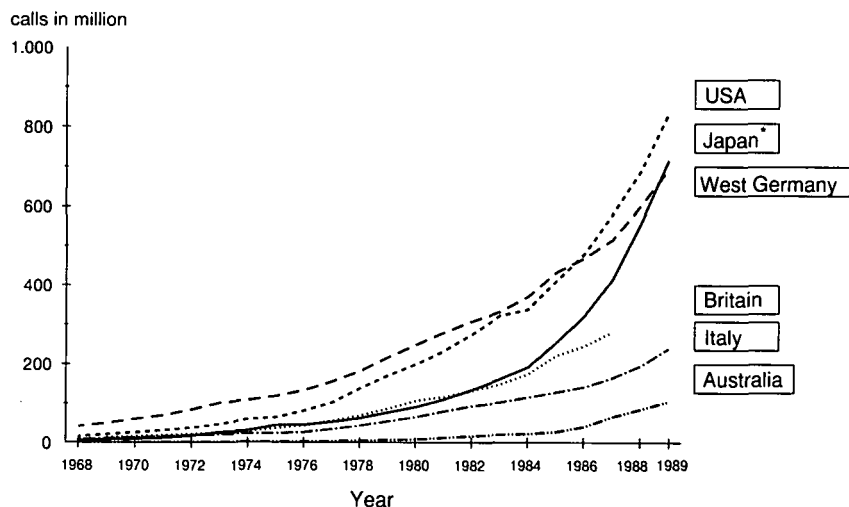
up organisation, the International Telegraph and Telephone Consultative Committee (CCITT) was set up in 1956 by the merger of the CCIF with the International Telegraph Consultative Committee (CCIT).³

The CCITT is open to the PTTs of the members of the ITU and to so-called recognised private operating agencies (RPOAs) which have been approved for participation by a member state (Coddington/Rutkowski 1982, 93). The working projects are issued and results are finalised by a Plenary Assembly of all members of the CCITT. This Conference identifies technical, operational or administrative areas where clarification and perhaps standardisation are desired, formulates these desires as questions and issues them to the Study Groups for consideration. The Study Groups consist of experts of the member administrations and in an advisory capacity of specialists from private industry and academia. While they are allowed to take part in the deliberations, they are not allowed to vote, and their contributions have to be authorised by the respective national administration.⁴

From the outset of telegraph and telephone services, it took about 100 years to establish an institutional setting which provided minimal coordination of international telecommunications. Any corporate types of institutions which might have infringed upon national sovereign rights were rejected by the nation states. Most of the states, especially in Europe, operated the telecommunications system through public administration. The systems were similar in general architecture but differed considerably in specific details. From a technical point of view these differences would have called for early international coordination in order to reduce costs of transborder communication. But coordination remained on a low level and was almost exclusively based on the regulative mode. Here, a gradual shift from *de jure* systems of international regulations to *de facto* standardisation could be observed. But even when the CCITT was founded, the 'production' of standards was still negligible. However, the CCITT provided the arena in which technology- and service-related coordination activities could be concentrated.

4 Transborder Expansion of Telecommunications and the Erosion of the Old Order

Since the late 1960s several technical, economic and political factors have contributed to the weakening of the old nation-based hierarchies in telecommunications. The *internationalisation* or *globalisation* of the sector could be considered a common denominator. This trend may have been technology driven, but it was channelled by corporate actors with partly complementary and partly competing interests.



* Minutes in million

Sources: ITU 1978, ITU 1987, ITU 1989, Siemens 1991.

Diagram 2: Telephone Service: Outgoing International Traffic

If we exclude telegraphy, the first highly visible indicator of the general trend is international telephony. In the 1950s and 1960s, the inherent tendency of the telephone systems to expand reached national borders, and gradually crossed these frontiers. Automated signalling and switching in combination with an international numbering and routing scheme provided by the CCITT were the crucial innovations on the long road to a comfortable international telephone service. But tariffs remained high, especially for overseas communications. They have been slowly reduced since traffic seemed to have reached a 'critical mass', which has induced an exponential growth of transportation capacity via copper and optical fibre cables as well as satellites. Therefore, the OECD stated in 1990 that 'international calls have long been one of the most profitable parts of the business of public telecommunications operators and they are growing in importance as international trade and travel grow' (OECD 1990, 12/13). Diagram 2 gives an impression of the development of international telephone traffic from 1968 to 1989 measured by the number of outgoing calls from a selection of highly industrialised countries.

Growing transmission capacity and a high global density as well as an almost completely automated operation of networks in all industrialised countries have reinforced what Collin Cherry twenty years ago called 'the communication explosion' (Cherry 1978, 57-102). In the field of telephony the monopolistic PTTs have for a long time defended their complete control of international traffic.

An exception has been the International Telecommunications Satellite Organisation (Intelsat), a non-profit consortium based on an inter-governmental agreement. This agency was charged with the installation and operation of a global satellite system. It was controlled by national PTTs and similar common carriers holding shares based on their use of the system.⁵ The originally small circle of shareholders has developed into a rather large group of about 120 members (Komiya 1990). Intelsat coordinates utilisation and technical functioning of satellites providing transmission capacities for telephone, telegraph and data communication as well as radio and television broadcast services. Here Intelsat has the general authority to establish standards for approval of earth stations for access to the space segment (Levy 1975, 658). In terms of its organisational form and internal decision rules, Intelsat, on the one hand, departed significantly from the existing practices in international telephony. On the other hand, however, as a common carrier for common carriers it was designed and functioned to reinforce the international telecommunications regime (Krasner 1991, 357).

With the deregulation of the telecommunications sector in the US in the early 1980s and the 'challenge of the monolith' AT&T (Galambos 1988), the old international order came under pressure. AT&T had to restrict its activities to the operation of trunk calls within the United States and overseas. Competitors, the most prominent being MCI and US Sprint, were allowed to enter the market and offer long-distance telephone services nationally and internationally. Jumping on the deregulation bandwagon rather early, Japan and the United Kingdom allowed for competition in the telephone domain on separate networks as well as on leased lines to be provided under fair conditions by the old dominant network operators. The Commission of the European Community pushed the liberalisation of the telecommunications market by means of a Green Paper in 1987 and subsequent directives to the member states (see Dang-Nguyen/Schneider/Werle 1993).

Outside the market of telephone or telephone-based services such as facsimile transmission, a wide range of services in the field of transborder computer- and data-communication has emerged. Since these services are usually not confined to the transmission of information, but offer functions such as storage, multiple distribution, conversion of formats, codes and transmission speed or encoding and decoding, they are called *value-added services* (VAS). Frequently they are performed in dedicated networks, so called *value-added networks* (VAN). Many VAN have evolved either as industry-specific solutions in the banking and financial information services business or as in-house networks of multi-national corporations, which have a high need of internal communication and data exchange among their headquarters and their branches all over

TABLE 1: *World Market for Value-Added Network Services*

	1988	1989 (US \$bn)	1990	1995
UK	0.83	1.12	1.41	2.50
France	0.32	0.42	0.57	2.07
West Germany	0.31	0.42	0.56	1.55
Rest of Europe	0.61	1.86	1.39	3.70
USA	5.96	8.48	11.24	20.27
Japan	1.70	2.75	4.00	9.15
World	9.74	14.04	19.25	39.17

Source: PACE (1989)

the world. In particular distributed design and manufacturing processes in a multinational context demand high-capacity telecommunications networks.

The world market for VAS is rapidly growing. Table 1 gives an impression of the growth perspectives in the area of information processing, messaging and some other services typically defined as VAS. Unfortunately, the problem of delineating VAS contrasted to basic services has led to differing evaluations of the present and future market for VAS. But most researchers agree that information processing and messaging services constitute the core of VAS and that they grow at high rates (see Werle 1993). The amount of transborder activities in VAN and VAS is difficult to assess, but it is much higher than transborder telephony.

On the one hand, the improving and expanding opportunity structure for transborder communications constitutes an attractive market not only for users and service providers but also for equipment-manufacturing firms. The manufacturers, on the other hand, are confronted with sharply increasing research and development costs for the technical components of the networks. Growing complexity of multi-functional telecommunications networks and terminals requires high-speed and high-capacity transmission and switching devices as well as intelligent network management tools. Microprocessors and computers have become the backbone of network operation and management. The knowledge base of data processing and that of technical communication overlaps more and more. Manufacturers of telecommunications equipment try to enter the market for data processing, as producers of data processing devices fight for a share of the market for telecommunications technology. This market is growing and becoming more international (Schnöring 1992). High costs in research and development and low unit costs in production forced producers into 'an intense struggle for market

entry into foreign markets' (Neu/Schnöring 1989, 25). Indeed, in the 1980s international trade with telecommunications equipment increased rather fast (see OECD 1988, 94–111; OECD 1990), though trade patterns varied considerably with regard to the different components of telecommunications systems (transmission technology, switching devices, customer premises equipment). The general impression is that the countries that liberalised their markets first had the highest import rates and a disadvantage concerning their balance of trade (Neu/Schnöring 1989). From a user's point of view, however, high imports may have been an advantage.

The liberal countries could have retaliated by raising their import barriers. But protectionism remained an unused weapon. Instead the United States and the United Kingdom tried to convince other countries to liberalise their telecommunication sectors as well. Likewise they pushed for a liberalisation of the ITU-dominated international telecommunications regime (Cowhey 1990). They wanted not only the markets for telecommunications equipment to be opened but also those for all kinds of telecommunications services. One of the levers used to achieve this goal was putting telecommunication services on the agenda of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) (Aronson/Cowhey 1988, 233–276; see also Woodrow 1991).

Internationalisation and globalisation of telecommunications have been triggered by political and economic as well as technical factors, especially the partial convergence of data processing and telecommunications technology. As a result the two basic principles legitimising the old order have been damaged. The conception of telecommunications as a natural monopoly proved to be highly static and more or less inappropriate for periods of rapid technological change. The justification of public control in order to secure universal service and compensate or prevent disadvantages of users in peripheral regions can not easily be transferred from the 'plain old telephone service (Pots)' to highly specialised VAS for business users. General infrastructural considerations beyond Pots are no longer perceived as having a higher significance in telecommunications than in other policy domains. The demand for political intervention and control shifted from the emphasis of classical welfare aspects to concerns for fair competition and efficiency. The old PTTs, though they are no longer public agencies in the large industrialised countries, are suspected of taking advantage of their still privileged and protected situation when they must compete with smaller firms.

One consequence of the internationalisation and globalisation of telecommunications was a growing demand for international coordination.

In national markets, where technical components networks were traditionally co-ordinated through a hierarchical mode, new modes were required. National borders no longer correspond with technical borders for interactive communication, and coordination cannot be reached by concertation of national hierarchies in order to connect their networks. Users of telecommunications equipment and services want to mix or combine different technical devices and services offered in the world market. What they wish to mix must match, and this can only be achieved through some form of international coordination.

5 The Proliferation of International Standardisation

The erosion of the old nation-based telecommunications order and its transformation into a more heterogeneous and less hierarchical constellation of actors and telecom systems has affected the processes and the institutions of international coordination. As long as international communications predominantly relied on public networks, coordination remained under control of the PTTs. We already mentioned that some standards recommended by the CCITT in the late 1950s and the 1960s opened the way toward fully automated international telephone service. This trend of internationalisation within public networks stabilised the position of the just (1956) founded CCITT as the central institution of international coordination and standardisation in telecommunications. This is clearly expressed by increasing attendance to the Plenary Conferences. The second plenary of the CCITT in 1961 was attended by 58 and the third conference in 1965 by 114 member countries. At that time, however, the first challenges of CCITT's position could be observed, ironically, because standards became more and more important as a means of international technical coordination.

Internationalisation and globalisation of telecommunications did not accidentally coincide with the blurring of borderlines between data processing and telecommunications. The well-established CCITT experienced first effects of this development more than 30 years ago, when it started to standardise data modems (Wallenstein 1990, xiii). It soon became evident that there was a growing need for compatibility of technical components which a few years earlier would not have been expected to become attractive candidates for operation within the same encompassing network. The interconnection of data terminals with a central data processing unit through an analogue public telephone network might not have been beyond imagination, but it was not business as usual. To render such an interconnection possible, compatibility was required.

How can compatibility be achieved? In the old order the hierarchy secured compatibility within its domain. Between the domains of different hierarchies a few standards and all kinds of gateways, converters and transformers were employed. The development of modern software-based systems and components installed as dedicated private networks across national borderlines, as well as intelligent terminals connected to old and new networks have increased rather than reduced complexity and heterogeneity. Technical *ex post* solutions, emerging outside collectively coordinated procedures, have continued to be one – and rather frequently the only – option to reach compatibility in today's heterogeneous technical configurations. But the standardisation of interface specifications would obviously be a less costly solution to the coordination problem. Thus, standardisation appears to be attractive, but it is not always easy to achieve.

International organisations such as the CCITT, committed to the basic principle that standard setting is the best solution to the compatibility problem, heavily engage in standardisation. Participation in the study groups and their working parties is voluntary and is not remunerated. Though not *de jure* imposed, *de facto* unanimity is required when standards have to be decided upon. CCITT standards have the formal status of recommendations and are not binding, but in general the probability of compliance is considerable.

The growing importance of international compatibility standards has not automatically enhanced the standing of the CCITT and the other traditional international standardisation organisations such as ISO and IEC, which by the convergence of information and communications technologies have gained a say in the standardisation of telecommunications. It had rather the reverse effect of destabilising their position. The traditional bodies were accused of lagging behind the actual demand and being incapable of producing the standards that were really needed. At the same time the number of organisations producing standards increased. Both developments were perceived by the traditional bodies with a sense of alarm. They conceded difficulties, but attributed them to the quantitative overload and not to an incapacity to cope with the new challenge. The increased demand for standards could not be met by the usual time-consuming working procedures. It was argued that a combination of office automation, tighter time schedules and better funding would alleviate this problem considerably. That the workload has grown is clearly indicated by the output of the CCITT, which increased from 6,360 pages in 1980 to 18,000 pages in 1988 (Drake 1989, 36). The more fundamental problem, however, lies in the diversified demand for international standards. The traditional organisations are structurally ill equipped to cope with this diversity.

In the process of internationalisation of the production of telecommunications equipment and the provision of specialised telecommunications services (VAN), the PTTs have lost their comprehensive vertical and horizontal control of the telecommunications sector. Today, companies produce equipment or provide services whose sphere of action transcend national confines. This applies most prominently to the equipment and services which were added to the traditional telegraph, telephone and telex canon of telecommunications by the data-processing sector. The resulting problems of international coordination differ to a great extent from those encountered in the segmentarily differentiated old order. They do not entail harmonisation of national but of organisational positions.

Since the application of standards is voluntary, their development does not depend on any specific formal procedure. As a result, there are hardly any restrictions to the formation of standardisation organisations. 'Effectively, any two or more parties can agree on anything, and then claim the agreement is 'available' to the market' (Reynolds 1990, 433). Thus, the organisations which felt that their coordination needs were not aptly represented and considered by the traditional incumbent organisations could form their own standardisation bodies.⁶ But this single motive cannot account for the surge of international standards bodies with company-based membership during the early and mid-1980s. It definitely does not explain the pattern of these bodies, the structure of their membership and the field of technical specifications they are involved in. Clues to explanation can be provided by the strategic plans that companies have pursued by forming standardisation bodies. The Standards Promotion and Application Group (SPAG), for example, was established in 1983 by the leading 12 European information technology manufacturers. They intended to strengthen their position vis à vis the American and Japanese producers by developing common European standards for data communication. This intention led to the decision to base these standards on the Open System Interconnection (OSI) reference model – a seven-layer frame of reference for systems of standards – which was conceived at that time as a competitive project to an IBM proprietary network architecture (Collins 1987).

Also, deregulation of telecommunications motivated the establishment of new standardisation organisations. The PTTs' control over telecommunications was heavily challenged by political initiatives to cut back their monopoly in the provision of mass services. Competing network operators or service providers were chartered or at least envisaged. That eroded the PTTs' ability to ensure compatibility by hierarchical coordination. The resulting coordination problems were approached by new standardisation bodies: T1 in the United States in 1984, TTC in

Japan in 1985 and ETSI in Europe in 1988. All these organisations are regional in scope, with participants coming from more than just one country. T₁'s and TTC's membership structure is company-based, while ETSI has a mixed system with some decisions taken by company-based voting and others taken by nation-based weighted voting (Besen 1990; Lifchus 1985).

The proliferation of standards bodies did not lead to competition between them, although competitive concerns were the very motive for the establishment of some of the new organisations like SPAG. The established organisations, because of their specific incapacities, seemed to have good reasons to expect competition. But only in very rare cases were really competing standards issued by the new standardisation organisations. The small number of technical experts capable of drafting standards did not become a problem either, although at the time when T₁, TTC and ETSI were established there was some concern in the CCITT that they would constitute a 'brain drain' on the reservoir of experts working for it (Irmer 1990, 5).

Instead of competition, cooperative relations between the various organisations in the field of international standardisation evolved (see Diagram 3), because the activities were complementary rather than substitutive. In 1990, for example, the CCITT and the three regional organisations ETSI, TTC and T₁ decided at a conference in Fredericksburg, Virginia, to coordinate their activities with the aim of developing a division of work which would be acceptable to all of them. The emerging design seems to be that the regional organisations take over large parts of the technical work. They provide the CCITT with consolidated input. This input is then discussed and finalised by the CCITT with the participation of countries and organisations which are not members of the regional organisations. While the regional organisations have no guarantee that their input is finalised by the CCITT unchanged, they are compensated by the endorsement of their ideas by the large CCITT membership. Thus, the technical expertise and superior decision capacity of the regional organisations is traded for the generality that the CCITT can offer with its membership coming from all over the world.

Very similar arrangements have been established in the standardisation of functional profiles between the three regional workshops EWOS from Europe, NIST-OIW from North America, AOW from Asia and the ISO/IEC Joint Technical Committee 1 (JTC 1) (Macpherson 1990, 263–265) and also in the field of conformance testing between SPAG, COS and POSI (SPAG Standard 2, 1990). This network of formal cooperation agreements is supported by an extensive network of informal contacts and technical experts' multiple membership in the various standardisation bodies.

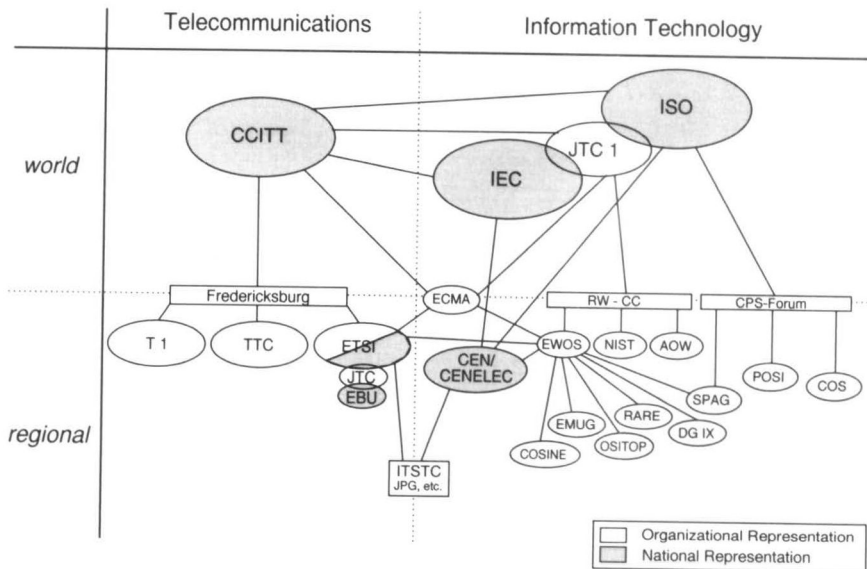


Diagram 3: The Ecology of Standardisation Organisation

The rising number of standardisation bodies and the cooperative relations between them is due in part to the high workload in international standardisation bodies. The sheer quantity and complexity of the coordination problems that came hand in hand with the use of computers in telecommunications and the use of telecommunications for computer applications in liberalised global markets with many heterogeneous actors might, therefore, very well prove to be a precondition of the coexistence of the various standardisation bodies which deal with these problems (Rutkowski 1991, 295).

Cooperation in the area of international standardisation does not generally preclude competition with regard to specific standardisation domains or particular standards. But the incentives and means of the organisations to enter active competition are limited, and direct confrontation is the exception, especially as long as newly issued standards are 'located' within the OSI architecture. In this cognitive frame of reference, different standards on the same layer can be seen as options, the selection of which is up to the 'market', i.e. outside direct control of any standardisation organisation.

6 Conclusion

In its early decades, telecommunications was contained in national systems. Technical, economic and political factors advanced the develop-

ment of national hierarchies, which settled problems of coordination internally. Formally binding decisions concerning features of technical parts to be installed in the network or modalities of utilisation were issued, if necessary, as administrative decrees. Concertation was achieved by authority. Hierarchy proved rather efficient as long as 'hard-wired' technology dominated and system growth was restricted to national territory.

When telecommunications systems slowly began to grow beyond national borders, national hierarchies remained stable at first. The sovereign states rejected plans to establish a transnational hierarchy. Thus, only minimal international coordination on the basis of international treaties was achieved. These treaties, in the tradition of international diplomacy, were rather rigid and abstract. Formal decision-making procedures were ruled by political rationality. Each nation, irrespective of technical competence or vested economic interests, had a vote in this regime. Coordination of international telecommunications concentrated on agreements regarding investments in cables or accounting and served to protect the national domains. Interconnections of national networks were usually designed as gateways providing ex post compatibility.

Problems of compatibility increased with the beginning of globalisation of networks and services in the 1960s. Data processing and data communication outside the traditional telecom networks was coordinated to a considerable extent through the hegemony of IBM. This corporation dictated compatibility rules, which had to be accepted by mostly smaller manufacturers and users. In telecommunications, however, the lack of ex ante compatibility threatened to hamper transnational expansion. The sovereign states, just transforming their national telecommunications hierarchies into more pluralist and competitive structures, would accept neither a transnational hierarchy nor any form of hegemony.

Enlargement and globalisation could therefore only be accomplished because the problems of compatibility could be mastered without centralisation through compatibility standards. These standards provide an infrastructure for coordination which allows telecommunication systems to expand without hierarchical or hegemonic assistance. They allow for the technical integration of networks without organisational integration.

Hierarchies are no longer highly regarded. They are suspected of being overstrained by the complexity and turbulence of current affairs – too slow, too cumbersome, too unimaginative – and it is assumed that they will, therefore, increasingly fall into disuse. Our case does not confirm this assumption. The problem with hierarchical coordination in telecommunications was not that it reached some inherent limit of functionality but that the range of hierarchical coordination was delimit-

ited territorially. The reach of the PTTs extended to national borders. That was sufficient as long as the telecommunication systems they tried to control ended at national borders as well. It became a problem when the systems started to take on a transnational character. The national hierarchies could not fully control transnational systems and, therefore, more decentralised modes of coordination had to be found. The obsolescence of national hierarchical coordination in telecommunications does not imply, however, that there is no space for any form of hierarchical coordination. It is perfectly possible that new transnational hierarchies will emerge, for example in the guise of global carriers, which will re-internalise much of the coordination that is right now achieved decentrally via standards.

List of Abbreviations

AOW	Asia Oceania Workshop
CCIF	International Consultative Committee on Long-Distance Telephony
CCIT	International Telegraph Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CEN/CENELEC	European Committee for Standardization/ European Committee for Electrotechnical Standardization
COS	Corporation for Open Systems
COSINE	Cooperation for Open Systems
CPS-Forum	COS/POSI/SPAG-Forum
DG IX	Directorate General (European Commission) (Personnel and Administration)
EBU	European Broadcasting Union
ECMA	European Computer Manufacturers Association
EMUG	European MAP-User Group
ETSI	European Telecommunications Standard Institute
EWOS	European Workshop for Open Systems
GATT	General Agreement on Tariffs and Trade
IEC	International Electrotechnical Committee
Intelsat	International Telecommunications Satellite Organization
ISO	International Organization for Standardization
ITSTC	Joint Information Technology Steering Committee
ITU	International Telecommunication Union
JTC 1	Joint Technical Committee

NIST-OIW	National Institute for Science and Technology – OIW
OSI	Open System Interconnection
OSITOP	European Group on Technical and Office Protocols
POSI	Promoting Conference for Open Systems Inter- connection
PTT	State Administration for Telephone and Telegraph
RW-CC	Regional Workshop – Coordinating Committee
SPAG	Standards Promotion and Application Group
T ₁	Standard Committee for Telecommunications (ANSI)
TTC	Telecommunications Technology Council
VAN	Value Added Network
VAS	Value Added Services

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NOTES

1. In contrast to Krasner's (1982, 186) definition of regimes as 'sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations' we favor a more restricted definition treating regimes as 'multilateral agreements among states which aim to regulate national actions within an issue area'. This definition addresses regimes as 'examples' of cooperative behavior. They 'facilitate' cooperation, but cooperation can also take place in the absence of regimes (Haggard/Simmons 1987, 495). Regimes presume interdependence of autonomous actors, who voluntarily eschew independent decisionmaking in certain issue areas (Stein 1982; see also Schneider/Werle 1990).
2. This agent, in fact, may be a multinational business enterprise, which is a genuine transnational organisation. Multinational business enterprises existed at the beginning of this century, but on a small scale and with less important effects compared to today's large conglomerates like IBM (see for this type of transnational organisations Huntington 1973).
3. The CCIT had been established by the International Telegraph Conference in Paris in 1925. It had operated under quite different conditions from those of the CCIF (Chapuis 1976). Since 1932, the ITU calls itself International Telecommunication (instead of Telegraph) Union. After World War II, the ITU achieved the status of a UN treaty organisation.
4. Improvements of the status of these two groups, achieved in the 1989 Plenipotentiary Conference in Nice, can be neglected in our argument.
5. The US shares of Intelsat, however, were held by COMSAT, founded in 1962, which in turn was owned in equal parts by the established telecommunications carriers and the general public.
6. Not every coordinated effort to come to a standardisation agreement led to the establishment of a new organisation, especially when the efforts failed. One example is an effort of more than 30 companies from all over the world to reach consensus on a standard for digital audio sound. Three competing proposals were discussed between February 1978 and April 1981, but no decision was made. Then in late 1982 Sony introduced its compact disc (CD) technology in Japan (Stalk/Hout 1990: 133–148).