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Public Access, Private Networks and Closed Membership: Electronic Trading Networks in Europe

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PUBLIC ACCESS, PRIVATE NETWORKS AND CLOSED MEMBERSHIP: ELECTRONIC TRADING NETWORKS IN EUROPE

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I. Introduction[1]

The term *Electronic Trading Network* (ETN) is used to define institutions which combine the *collaborative* aspects of electronic trading with the *competitive* advantages of a network-based market. One established such networks might be open or closed to new users. The diffusion of ETN carries economic and political implications for national, regional and international policy. This is not least because ETN involve the ultimate transfer of all aspects of trade into the electronic sphere. Those responsible for the design and operation of these new modalities of trade are developing innovative ways of using the public and private telecommunication infrastructure.[2]

This paper links assumptions with respect to the emergence of the *telematics* infrastructure to the experiences and conflicting priorities of organisations and institutions engaged in the development of ETN primarily in Europe. It suggests that scenarios for infrastructure development which favour multiple suppliers and agreements among network operators create strong tendencies toward heterogeneity and the continued proliferation of closed communities of users.

The paper draws on the results of a project on *Electronic Trading Networks and*

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1. The research for this paper was supported by the UK Economic and Social Research Council's Programme on Information and Communication Technologies. Michael Jenkins, Research Fellow, SPRU made major contributions to the research on Electronic Trading Networks. The views expressed in this paper are those of the author and do not reflect those of any institution.

2. See for example R. Benjamin (1990) Electronic Links create new Market Dynamics, *Computerworld*, November, p. 22; A. Bressand and K. Nicolaidis (1989) *Strategic Trends in Services: an Inquiry into the Global Service Economy*, Harper and Row, New York; Butler Cox Foundation (1990) *Electronic Marketplaces*, Butler Cox Foundation, London; J. Hootman (1972) 'The Computer Network as a Marketplace', *Datamation*, April, pp. 43-46; P. Keen. (1986) *Competing in Time: Using Telecommunications for Competitive Advantage*, Ballinger, Cambridge, MA; T. Malone, J. Yates and R. Benjamin (1989) 'The Logic of Electronic Markets', *Harvard Business Review*, May-June; Promethee (1990) *Networked Markets* Project Promethee Perspectives No. 13, May; S. Turner, J. Epperson, and I. Fletcher (1983) 'Producer Attitudes towards Multicommodity Electronic Marketing', *American Journal of Agricultural Economics*, No. 65, pp. 818-822.

Interactivity: The Route to Competitive Advantage?[3] This study focused on the factors that create demand for ETN. It considered whether a shift of traditional trading networks into the electronic sphere is likely to encourage a tendency toward greater openness in the trading environment or towards closure with increased barriers to membership.

The study found that as ETN mature and become established, preferences for network configurations change frequently. Some ETN operators migrate their services from the public network to private networks while others take the opposite route. Still others prefer to bring network management functions in-house or to develop systems based on hybrid networks. In the end, however varied the individual network strategies, all the ETN organisations included in the study exhibited a tendency toward the development of *closed* electronic trading environments.

There has been relatively little public debate about the implications of this trend toward closed electronic trading based on a mix of public and private networks. The result of a migration of trade and commerce onto closed networks of trade is that international trade regimes may be tilted still further in favour of those able to access and control both the ETN and the underlying infrastructure.[4]

This paper argues that key issue is not whether the telematics infrastructure is operated under public or private, or even single or multiple ownership. Rather the main issue - as historically - is the terms and conditions of access and membership within different institutional arrangements.

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3. See R. Mansell and M. Jenkins (1992) 'Electronic Trading Networks and Interactivity: The Route to Competitive Advantage?' Case Study Report, SPRU, Brighton.

4. See P. Cowhey (1990) 'The International Telecommunications Regime: the Political Roots of Regimes for High Technology', *International Organisation*, Spring, pp.169-199; B. Woodrow (1991) Tilting towards a Trade Regime: the ITU and the Uruguay Round Services Negotiations, *Telecommunications Policy*, Vol. 15, No. 4, August, pp. 323-342.

II. Designing Infrastructure and Services

The analysis of tends in the development of telecommunication infrastructure and the service applications it supports is based on the concept of *design parameters.* The trade cycle, for example, can be disaggregated into five distinct phases (see **Table 1**). Each phase involves the production and exchange of information. The phases can be regarded as embodying logically separate and coherent sets of *design parameters*. These include, for example, levels of access, data quality, security, speed, network redundancy, application standards, gateway protocols, cross-border regulations and dispute settlement procedures. To achieve network confidence and integrity, different levels of network access are required for each phase.

The five *design parameters* of a trading network can also be treated as three interlocking networks - telecommunication, information and organisation.[5] These are *network domains*. The taxonomy which relates design parameters of the trade cycle to network domains and to policy or network interface issues is shown in **Figure 1**. For example, any subset of network relationships can be examined with respect to the implications of decisions for the strategic advantage of firms, access and network interconnection for users, service applications supported by the telematics infrastructure, and the arrangements for regulation. Each of these aspects can be considered in relation to priorities for the production and use of information, the technical development of the underlying telecommunication infrastructure, and the organisational structure of the industry.

An ETN involves compromises with respect to the primary requirements for each of these elements. These compromises set the constraints for investment, ubiquity, access conditions and regulation. The idea that ETN must embody a series of technical and institutional compromises to support different facets of the trade cycle is based upon insights drawn from Braudel.[6] He suggested that the pace and ease of movement within a trade network (i.e. network integration versus fragmentation, or openness versus closure) is conditioned, not by the

5. See R. Mansell (1992) 'Information, Organisation and Competitiveness: Networking Strategies in the 90s', in C. Antonelli (ed.) *The Economics of Information Networks*, North Holland, Amsterdam, pp. 217-228.

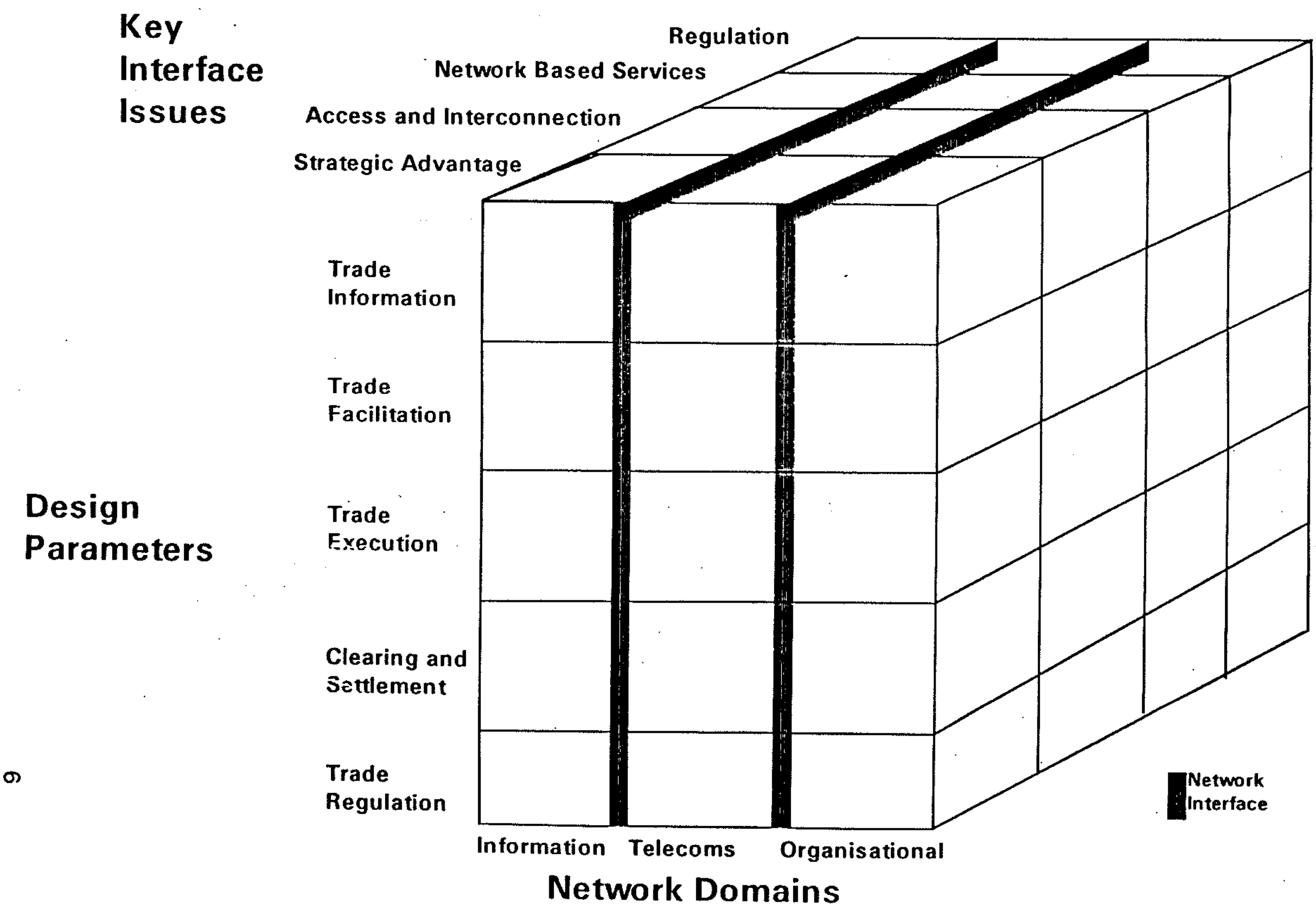
6. See F. Braudel (1984) *Civilization and Capitalism 15-18 Century: Vol.III - The Perspective of the World*, Collins, London.

Table 1 - Design Parameters of Trading Networks

PARAMETER	DEFINITION	EXAMPLES
Trade Information	The dissemination of background information, possibilities and options which provide the knowledge base required to become involved in trade	**Databases** eg.Patents, Standards, Catalogues **Information Feeds** eg. Market Intelligence, News Agency reports
Trade Facilitation	The information and procedures concerning activities, actions and choices necessary to allow the free movement of goods and services	**Legal Procedures** eg. Customs Clearance, Health and Safety **Financial** eg. Insurance, Letters of Credit, **Logistical** eg.tracking and tracing service **Trade Related Tasks** eg. certification, authentication, storage, repackaging **Administrative** eg. electronic movement of information, instructions, documents
Trade Execution	The process of informing the relative parties that a binding contract has been consummated	**Conditions of Trade** eg.Private Treaty Closed Market Open Sale **Mode of Trade** eg. tender, auction, open outcry **Type of Trade** eg. procurement, futures, options
Clearing and Settlement	All information-related actions to move goods, funds etc. triggered by an executed trade	**Information** eg. title transfer, clearing house, documentation **Physical** eg. delivery, testing **Financial** eg. guarantees, margins, funds transfer
Trade Regulation	Information concerning all elements of trade required by voluntary or statutory organisations. May eventually be released as Trade Information	**Telecommunication** eg. transborder data flows, Access nodes **Financial** eg. capital adequacy, settlement periods **Competition** eg. access, biased markets **International Trade** eg. TRIMS, TRIPS quotas, non-tariff barriers

Source: R. Mansell and M, Jenkins, 'Electronic Trading Networks and Interactivity: The Route to Competitive Advantage?' Case Study Report, SPRU, Brighton, 1992.

Figure 1: Network Taxonomy: A Three Dimensional Approach to Policy Research



maximum potential parts of the trading system, but by the *minimum* characteristics of the elements present across the network. Braudel observed that advances in technical systems (e.g. communication, road, rail transport) were subject to uneven development patterns.

This observation can be developed through the analysis of the design parameters and minimum conditions required to support open or closed networked markets. This requires a focus on the bottle-necks or *minimum* characteristics of interlocking technical and institutional networks as shown in Figure 1.[7] We look first at the *design parameters* that predominate in the transformation of the telecommunication infrastructure in Europe since this is the foundation for ETN.

III. Designing the Telematics Infrastructure

A central issue for European Community policy has become the management of the transformation of the traditional telecommunication infrastructure into a *telematics* infrastructure capable of contributing to the development and growth of the Single European Market.[8]

Simple projections of the rate of growth and diffusion of the telecommunication infrastructure give little indication of the underlying costs or benefits of any specific development trajectory. For example, it has been forecasted that by the year 2000, broadband telecommunication services could generate annual

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7. See for example, R. Mansell and M. Jenkins (1992) 'Networks and Policy: Interfaces, Theories and Research', *Communications & Strategies*, 1er Trimestre, No. 5, pp. 31-50; and R. Mansell and M. Jenkins (1992) 'The Policies of Integration: Telecommunication Policy in the Single European Market', forthcoming in *International Review of Comparative Public Policy*, Vol. 5, 1993.

8. The *telematics* infrastructure refers to the substantially greater degree of information processing capability that is beginning to reside within the public network as compared to the more traditional telecommunication infrastructure prior to the advent of software driven 'intelligent' switching capabilities.. The telematics infrastructure offers an 'intelligent' platform which may or may not be used by the owner/operator to supply services which use the network functionality to support services which require information processing often far beyond that needed for the simple conveyance of messages. The boundary between conveyance and processing is increasingly unclear, a fact which has been recognised by regulatory jurisdictions in Canada, the United States, the Commission of the European Communities and most member states. See R. Mansell et al. (1992) 'From Telecommunications to Telematics: Policies for European Infrastructure - Project Outline', SPRU, University of Sussex, July 1992.

public telecommunication operator revenues in Europe of about 10 billion ECU. Over 1 million business sites could be equipped with fibre access to networks by the year 2000. A much smaller number will make use of this capacity for broadband services. Certain services such as high speed non-voice communication, including graphics and digital imaging, are expected to create the demand for growth in higher capacity networks throughout Europe.[9]

However, if the transformation in the telecommunication infrastructure is to result in a *telematics infrastructure* responsive to the full range of economic, political, social and cultural aspirations of public and private users, technological advance will need to be coupled with policy measures. In short, if public access to advanced networks and services is to keep pace with leading edge implementation of technical facilities, and the infrastructure is not to become a platform primarily for private networks offering closed membership to selected communities of users, substantial activity in the public policy domain will be needed.

The European Communities policy framework for the *telematics infrastructure* has been taking shape since the mid 1980s. By 1988 the Commission of the European Communities (CEC) had observed that 'to flourish, telecommunication has to have the optimum environmental conditions'. One aspect of Commission has activity has been a drive to promote the development of telematics services in support of the competitiveness and cohesion of the Single European Market.[10] Programmes have been aimed at promoting the competitiveness of manufacturing industry and at changing the structure and operation of the European telecommunication infrastructure.[11] This has been accomplished through policies directed at areas such as standards, services, equipment and

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9. Commission of the European Communities (1991) 'Perspectives for Advanced Communications in Europe: 1990', Volume 1, Summary Report, Commission of the European Communities, Brussels, February.

10. See S. Bruno et al. (1991) 'Modes of Usage and Diffusion of New Technologies and New Knowledge: A Synthesis Report', vol. 2 (no 1) FAST Monitor, FOP 227, Commission of the European Communities, June.

11. See R. Mansell, P. Holmes, and K. Morgan (1990) 'European Integration and Telecommunications: Restructuring Markets and Institutions', *Prometheus*, Vol. 8, No. 1, pp. 50-66; R. Mansell, B. Holbrook and T. Darmaros (1992) 'Telematics Services for the Less Favoured Regions of the European Communities: A Political Economy of Development', forthcoming in B. Mody (ed) *Planning Communication Technology Development: Alternatives for the Periphery*. New York: Sage Publications.

network access.[12] The Community's Framework Programmes has supported pre-competitive research on technologies and applications, e.g. RACE, STAR, Telematique, etc.[13]

Much attention has focused upon corporate requirements for the *telematics infrastructure*. By the early 1990s it was clear that these would need to include European-wide access to wide area networks; matching data functionality with the performance of local area networks; accommodating voice, image, video and data applications within networks comprised of a mix of technologies; offering services that contain increases in telecommunication-related expenditure and which, at the same time, create conditions for experimentation with new applications.[14]

Attention has also been given to the consumer's interest in the *telematics infrastructure*. The lead time and riskiness of investment in the provision of consumer oriented services, the current and latent demand for interactive and other types of communication services and the need for a redefinition of concepts of public (universal) service have all been considered.

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12. See Commission of the European Communities (1987) 'Towards a Dynamic European Economy: Green Paper on the Development of the Common Market for Telecommunications Services and Equipment', COM(87) 290 final. Since 1987 EC Legislation in the form of Directives has included: Commission Directive, 16 May 1988 on competition in the markets for telecommunication terminal equipment (88/301/EEC); Commission Directive, 28 June 1990 on competition in the markets for telecommunication services (90/388/EEC); Council Directive 28 June 1990 on the establishment of the internal market for telecommunications services through the implementation of open network provision (ONP)(90/387/EEC).

13. RACE Phase I - Council Decision of 14 December 1987 on a Community Programme in the field of Telecommunications Technologies - Research and Development (R&D) in Advanced Technologies in Europe, 88/28/EEC. OJC 16, Vol. 31, 21 January 1988; RACE Phase II - Council Decision of 7 June 1991 adopting a specific research and technological development programme in the field of communication technologies (1990-1994), 91/352/EEC, OJC 192, Vol. 34, 16 July 1991; Telematics Systems of General Interest, Council Decision of 7 June 1991 adopting a specific programme of research and technological development in the field of telematics systems in areas of general interest (1990-1994), 91/353/EEC, OJL 192, Vol. 34, 16 July 1991; Commission of the European Communities (1986), 'Council Regulation instituting a community programme for the development of certain less-favoured regions of the Community by improving access to advanced telecommunications services (STAR programme)', 3300/86, OJ L305/1, 31 October 1986.

14. Commission of the European Communities (1992) *Perspectives on Advanced Communications for Europe,* PACE 92, Brussels.

Public policy decisions are being devised to influence the balance which develops between publicly accessible and private closed networks. The scenario that seems to underlie the European Community's programme for change is one that seeks to strengthen the coherence and integrity of the pan-European telematics infrastructure by bridging - or at least filling the gaps - in what is now an extremely heterogeneous and unevenly developed infrastructure. Yet the predominant vision for the underlying infrastructure is one which seems to favour continuing heterogeneity and complexity.

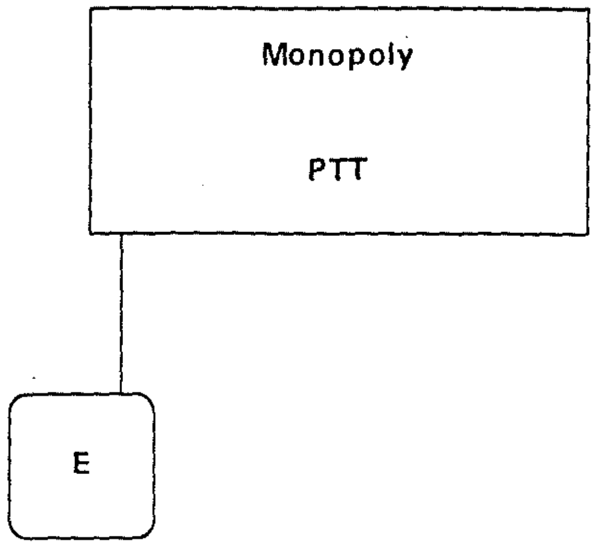
In Europe, as elsewhere, the key *infrastructure* institution in the early days of telecommunication development was the universal monopoly PTT. Figure 2 shows the PTT with its associated equipment manufacturer (E). The PTT had little competence in fields such as computing or software development and relied upon closely linked equipment manufacturers. Services and applications beyond telephone, telex and simple data transmission were left to others within the information technology field.

The vision of a transition to a *telematics* infrastructure in Europe is one which includes assumptions about the level of complexity, standardisation, and scope for new entry that will emerge in the future. A 'stage-oriented' scenario is influential among those with primary responsibility for technical development. The scenario carries implications for investment in advanced technologies as well as for the structure, organisation and regulation of the industry. Whether such a scenario is optimal in the light of the Commission's objectives of stimulating accessible advanced infrastructure services has been a source of considerable disagreement among those with responsibility for policies with respect to market liberalisation and competitive entry.

The main features of the essentially linear metamorphasis of the infrastructure are schematically presented below. Figure 3 suggests a configuration in which the national PTT remains dominant and the terminal equipment (Te) market is liberalised bringing associated entry opportunities for peripheral equipment manufactuers (E). At this stage, competitive tendering is also required of the PTTs and two or perhaps three major public switch manufacturers become the preferred suppliers of the PTT (Es). At the same time, mobile service providers are licensed (M) and their equipment manufacturers see their markets expand. In some of the member states there are also moves to license satellite operators (S) to engage in a broader range of service provision, e.g the UK and Germany.

Figure 2

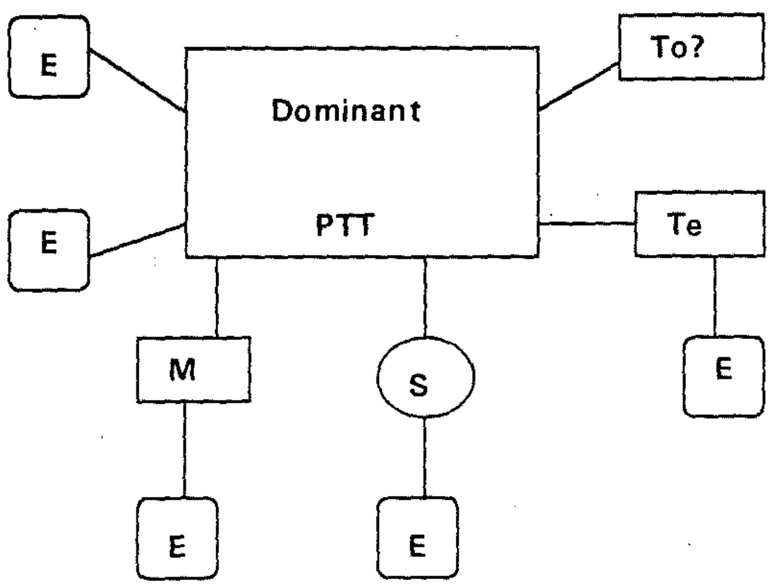
From Telecoms to Telematics Infrastructure



Source: SPRU, 1992

Figure 3

From Telecoms to Telematics Infrastructure



Source: SPRU, 1992

Figure 4 shows that gradually the market position of the PTT becomes less dominant and the interconnection of facilities and services begins to become a priority issue. In addition, service providers seek opportunities to use the facilities of several different infrastructure providers to support applications (A).

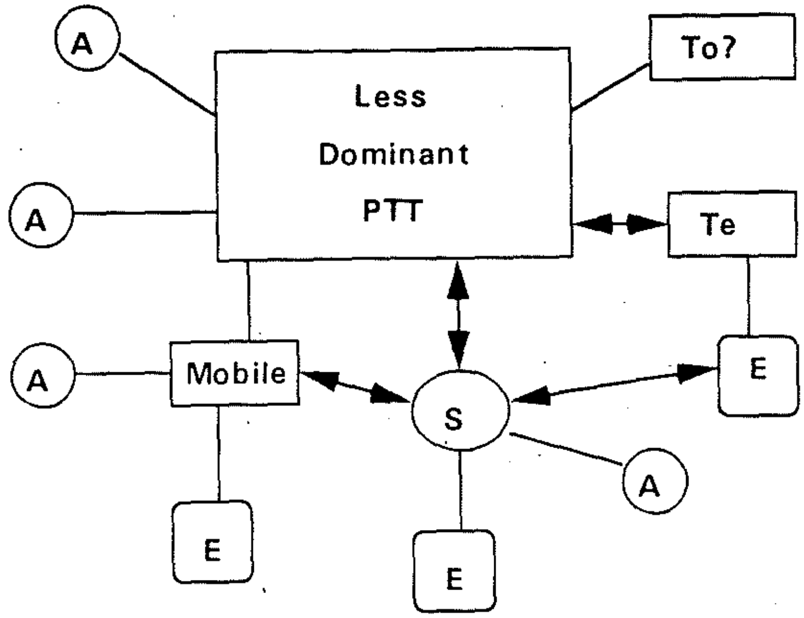
In a subsequent configuration shown in Figure 5, the PTT is no longer regarded as the monopoly provider. The public telecommunication operator (TO1) must now contend with one (TO2) or more operators who are given the right to provide service to the public. Ultimately, the scenario is one in which many different TOs provide intelligent telematics platforms supporting numerous different applications (A). Whether each TO will have the same service obligations with respect to the public and/or private closed user groups is a question that has been raised directly only in the UK. The answer has been ambiguous insofar as no public service obligations have been imposed upon new entrants following the liberalisation of the market in 1992. Whether the scenario suggested by Figure 5 is technically, economically or politically feasible is a question that has only begun to be addressed. In addition, the fact that there are many possible departures from the technical configuration suggested by this scenario and that these may require parallel differentiation among regulatory regimes has not been considered in detail.

From the perspective of public and private users the *telematics infrastructure* scenario shown in Figure 5 is only one of may possible configurations that might be responsive to their needs. For many infrastructure users the main questions concern the access and usage conditions which enable them to make use of the functionality that is embedded within the infrastructure or that is located at the periphery of the network. Users are no longer relatively homogeneous in their demand structure.

One class of users which places extremely heterogeneous demands on the telematics infrastructure is comprised of those engaged in electronic trading. The following section focuses on electronic trading as a specific example of infrastructure use. The analysis focuses on key aspects of Electronic Trading Network development that illustrate conflicting trends toward open or closed network environments.

Figure 4

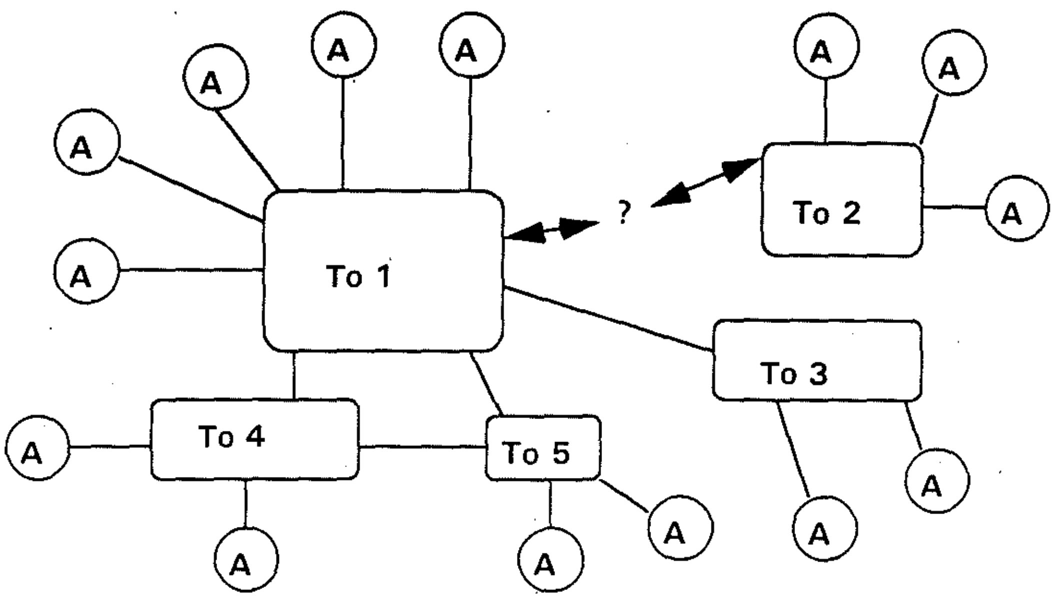
From Telecoms to Telematics Infrastructure



Source: SPRU, 1992

Figure 5

From Telecoms to Telematics Infrastructure



Intelligent Telematic Platforms

Source: SPRU, 1992

IV. Designing Electronic Trading Networks

The study on Electronic Trading Networks (ETN) covered six initiatives in the Netherlands, Sweden, the United Kingdom and the United States.[15] These encompassed some of the largest firms in the telematics sector as well as organisations with little prior experience in managing or operating telecommunication services. The sectors covered included financial services, transport and distribution, and agriculture and horticulture.

The characteristics of the networks chosen for the detailed study are shown in **Table 2.** They included the following examples in the financial services, transport and distribution, and agricultural sectors:

NORDEX	The Transvik Electronic Market System, Sweden and United Kingdom
GLOBEX	Globex Corporation, United Kingdom and United States
PRODEX	Prodex: Product Exchange Reconciliation, UK Oil and Gas Industry
MCP	Maritime Cargo Processing PLC., Felixstowe UK
VABA	Tele-Auctions, The Netherlands
Westland	Video-Auction System, The Netherlands

A. Telecommunication Infrastructure Use

The **NORDEX** ETN membership is open to users who are professional brokers rather than to institutional investors. Users are provided with a dedicated telephone line which connects a workstation to the Transvik Market System's central computer in London. Connections are established using private leased circuits in the UK, GEIS Co. connections to Oslo, Stockholm, Copenhagen, New York and Amsterdam, and the 3C Communications (a Kinnevik subsidiary) pan-European network. Member firms must be engaged in a sufficient volume of trade in shares to justify the use of telecommunication networks in addition to the Public Switched Telecommunication Network (PSTN). Operators of the underlying telecommunication infrastructure for the system have established connections using conventional available facilities. There is evidence of a moderate degree of technical innovation. First GEIS Co. have configured their network to handle the traffic generated by the Transvik system and 3C Communications has incorporated a transLAN bridge to connect the Transvik

15. The case studies involved desk based research; industry and government representatives involved in Electronic Trading Networks via a 'Call for Expressions of Interest', selected interviews (November 1991 to February 1992) based on a structured questionnaire; and workshops with academic, industry and government participants.

Table 2: Electronic Trading Network Organisations

Organisation	Functional Description	Ownership and Control
Transvik **(Nordex)** **Case Study No. 1**	Nordex is a London based, cross-border electronic marketplace for global professional investors who trade in shares of companies based in the four Nordic Countries Nordex operates via a central counterparty mechanism offered by Citibank and linked to the bank's Clearing and Settlement Services Planned to extend the service to Holland and Budapest	Subsidiary of Kinnevik (privately controlled Swedish Holding Company) which has national and international interests in the Information Distribution Industry eg. Telecom (fixed and mobile), Credit Card Phones, Cable and Satellite TV, Home Shopping Services.
Chicago Mercantile Exchange (CME) Chicago Board of Trade (CBOT) and Reuters **(Globex)** **Case Study No. 2**	'After Hours' 24 Global Trading Network linking Members of National Exchanges to buy and sell Futures and Options Financial Instruments eg. Stocks, Currencies (using CME/CBOT structures) Global Networking/Facilities Management to be provided by Reuters	Will operate as an accumulated structure -the three principals (CME, CBOT,Reuters) -the National Futures Association (USA) -the national exchanges (eg. Paris MATIF) -the members NB. The fees paid by the users will be split between the above parties
UK EDI Association Oil Industry Interest Section **(Prodex)** **Case Study No. 3**	Inter-firm Product Exchange Reconciliation Scheme Based on EDI messages developed by UK group for submission to UN/EDIFACT	Part of pan-European EDI user Group - The European Oil and Gas EDI Group - involves both EC and EFTA countries
Maritime Cargo Processing Plc. (MCP) **Case Study No. 4**	A trade facilitation organisation which allows users direct access to UK Customs data and inventory control system (DEPS)	Service Company jointly owned by the founder members of the Port Community Port of Felixstowe majority owned by Hutchison (Hong Kong) who also own Hutchison Communications
Dutch Tele-auctions **(VABA)** **Case Study No. 5A**	VABA is a computer bureau and consultancy to provide network based services over leased lines to fruit and vegetable auctions	Wholly owned subsidiary company of CBT (Central Bureau of Fruit and Vegetable Auctions) CBT owned by the provincial auctions
Dutch Video auctions **(Westland)** **Case Study No.5B**	Westland is a trading centre for buyers and an auction complex for flowers and pot plants. Provides grading, certification, packaging and other trade related services to its members The video auction is a local initiative which may be offered to other auctions	Grower owned cooperative with 3000 members

Source: R. Mansell and M, Jenkins, 'Electronic Trading Networks and Interactivity: The Route to Competitive Advantage?' Case Study Report, SPRU, Brighton, 1992.

Ethernet system. From the perspective of the telecommunication equipment and network suppliers, innovations were required to meet the technical requirements of the telecommunication operators in the form of an interoperable cross-border network based on proprietary standards and protocols.

An ETN requires a network operator to *select* appropriate technical configurations and to take responsibility for combining telecommunication and computing functions. The analysis showed that telecommunication infrastructure, service attributes, computing facilities and software capabilities had been *designed* to meet a range of trade parameters with varying degrees of success.

For example, each parameter for the network was associated with specifications for peak volumes of traffic, access, speed, reliability, security, cost, etc. The selection process reflected the variable skills present in the user community, the availability of computer processing power and suitable forms of underlying infrastructure capacity.

Table 3 provides an indication the degree of innovative activity that was needed to implement each ETN. Some made relatively conventional use of existing telecommunication and other information technology components. Others had been involved in a substantial degree of innovation. In Table 3 users, operators and equipment suppliers are assigned to a continuum ranging from the conventional (low) to the highly (high) innovative use of telecommunication, computer processing facilities and software. The results suggests that innovations in the use of computer processing power are present to a greater degree than for telecommunication or software development.

For **GLOBEX** users, network operators and equipment suppliers, a much greater degree of innovation has been required to make the system operational. The network must connect Reuters' subscribers worldwide and hub traffic in Hong Kong, London, Paris and New York. In order to meet the stringent requirements for security, speed and reliability it has been necessary to create a network with less than 3 second response time and 99.5 per cent availability.

Table 3: Innovation in ETN Configuration

	Low Innovation		Medium Innovation		High Innovation
Telecommunication					
Users		P M	N V	W	
Operators	P V	W M		N G	
Equip. Suppliers	M V	W	N	G	P
Computing					
Users	P	N M	V W	G	
Operators	P	M N	V W	G	
Equip. Suppliers	P	N	V W	M G	
Software					
Users	N G	M	V W	P	
Operators	P	V	W M	N G	
Equip. Suppliers	P	V W	N	G M	

Key to Case Study Organisations

Nordex	N
Globex	G
Prodex	P
MCP	M
VABA	V
Westland	W

NOTE: Organisations are assigned a position based upon assessment by the authors. The case studies provide relevant information on organisational structures, technical systems, user perspectives and policy issues. R. Mansell and M. Jenkins, Electronic Trading Networks and Interactivity: The Route to Competitive Advantage? Case Study Report, SPRU, Brighton, 1992.

In contrast, a working party of users responsible for developing **PRODEX** failed to innovate in the use of the telecommunication network. To do so would have required telecommunication equipment suppliers to upgrade the existing infrastructure network. This would have involved TOs and third party service operators agreeing standards to support X.500 directories and databases. At the time there was no commercial incentive to do so.

The **MCP** network began as a highly innovative use of telecommunication facilities but is now quite conventional. The system was originally designed as a method of direct data input using dumb terminals connected to a mainframe computer via the PSTN and leased lines. The system was focused on the UK

Customs and there was no requirement for cross-border interoperability. The network operator has been moderately innovative throughout the implementation phase. To retain users MCP has added features and services. It has also reacted to the trend towards PC-based computing by enhancing the functionality of the network. Given its lack of prior expertise and because of the high financial costs of such developments, MCP has relied on external suppliers. This has increased operational costs without necessarily generating revenues. For example, MCP has borne the cost of establishing gateways into its mainframe for users already established on other networks despite the fact that the amount of additional traffic generated has not warranted the cost.

In the case of **VABA**, the tele-auction users, network operators and telecommunication suppliers were involved in a moderate degree of innovation. The auction system operates on a centrally configured network based on leased digital circuits for the tele-auction element and the Dutch PTT Packet Switched Data Network for the market information elements. Voice circuits have been made available for buyers in the auction halls. In the case of **Westland** a slightly greater degree of innovation was needed since the video-auction required an on-site fibre-based Local Area Network. There is currently no interworking between the Dutch cable operators and the Dutch PTT, but the operator is seeking to expand to a national system. This would integrate the PTT's packet switched network with the cable network facilities for image transmission.

B. Computing (Information Processing) and Software (Writing)

Table 3 also shows that considerable innovation was required on the part of users, network operators and suppliers to provide computer processing power. The degree of innovation is even greater with respect to software writing.

At the heart of the Transvik Market System (**NORDEX**) is a central electronic order book into which dealers place offers to buy and sell. The Transvik Market System is based on software written in-house between 1984 and 1987 in a DEC environment. DEC workstations are configured to support open systems and X/Windows. The system involves a moderately complex configuration of computer processing capability. A Network Access Node (NAN) coordinates the start up of remote workstations, handles and routes messages, and polls the workstations. Housekeeping of audits, updating databases, tracking limits, timestamping, etc., is handled by the System Coordinator Processor. A Trading Engine receives data, organises the queues of messages and runs the order book. The system constantly scans open orders for matches and broadcasts prices. There is also a Back Office System which archives relevant data about customer positions, runs an interface to Citibank's settlement system and organises invoices and billing information. From the user's perspective the software is user-friendly. This has required a considerable degree of innovation on the part of the network operator, and the computer workstation and mainframe suppliers.

In contrast to NORDEX, the degree of innovation required of the **GLOBEX** computing system has been considerable. GLOBEX has been designed to support order entries using terminals consisting of a keyboard, monitor and printer located in the offices of clearing members and individual members. Administrative terminals in the offices of clearing members receive confirmation of trades. Terminals display the 10 best bid and 10 best offer prices together with the quantity bid or offered, the last sale price and other data. Since the system was introduced in June 1992, it has provided more real-time screen-based information on its contracts to traders than does the NORDEX system. Reuters, the network operator, has absorbed the development costs of the software.

PRODEX's reliance on the application of computer processing power and software is relatively low. A greater degree of innovation was required of the software developers. The software required for PRODEX involved a set of rolling files for each company. These contain unreconciled previous and pending transactions left over from a matching of one oil company's internal transaction files with those of another. There are no plans to do this on-line. The amount of processing power required is not significant. A moderate degree of innovative activity was required of computer users to ensure that agreement was reached on data formats, etc. Since users have participated in working groups assigned the task of developing all the facets of the PRODEX system, they gained competence across a spectrum of software and computing issues. This was necessary in order to make recommendations for the introduction of the system, (e.g. by in-house development and/or third party suppliers).

The **MCP** application of computing and software to support the data entry system also ensured that software development would be as user friendly as possible. The MCP system was developed using VIP, a Honeywell product. The software resides on the Port company's computers and the Port's Computer Services Division provides the computer capacity. The network is star shaped offering dumb terminal type tele-emulation. No sophisticated front end features are available to end users. As a result, the system has encouraged innovative software and systems development on the part of specialist software houses who have produced off-line report generators, menu systems, etc.

The two TN in the Netherlands (**VABA, Westland**) required more innovation in the use of computer processing capacity than in software development. In the case of VABA, the computers occupy a central position in a number of star shaped networks. Ultimately a Universal System for Auction Administration is to be integrated into a common framework for the actions of the leading 10 or 12 Dutch vegetable and fruit auction centres. The central VABA computer runs each tele-auction. At the centre, the clocks are controlled by a Digital micro-computer based system. VABA's development of computerised auctioning involved first, a local (stand alone) auction system based on computer controlled clocks; and later, a more complex system based on an Intel platform. Despite a relatively lengthy computer and software development process, the tele-auction runs more slowly than the physical auction. At Westland, computers link together over 400 terminals and printers via a Local Area Network which is 3.5 kilometres long. Two video-walls made by Philips were installed in 1990. To keep pace with the auction the network capacity must be sufficient to allow the video screen to be refreshed in under a second.

IV. Design Constraints and Minimum Conditions

The technical constraints encountered during the design of these ETN have been largely resolved. Some of the problems faced by users, network operators and equipment suppliers are highlighted in **Figure 7.** As each of the networks has evolved there have been a further set of constraints to overcome requiring cooperation among disparate in-house and external network operators (See **Figure 8**).

These technical problems have not required insurmountable innovations in technology. Instead the main design constraints have been: a) the uneven availability, cost and access conditions for telecommunication infrastructure and services in different geographical areas; b) the need for coordination across spheres of traditional competence within the telecommunication industry (PTOs, cable operators, third party network operators) and across technology fields (telecommunication, computing and software development), and c) the need to agree certain *minimum* standards without which network-based systems cannot be extended to the range of members desired by the network operators.

The use of private networks to support ETN is most advanced in the *Financial Services* sector. For example, Transvik has found that the optimum technical solution would be to use a network of leased circuits. However, its users will not invest in, or bear the cost of a high overhead system. The value of trade and the volume of traffic do not justify this investment. As a result Transvik has compromised with a mixture of public and private telecommunication network strategies. This has made network optimisation difficult to achieve.

Some of the larger overseas users use a leased line from Transvik to their London offices and dedicated leased line networks the rest of the way. Others make use of Transvik's agreement with GEIS Co. Transvik has the advantage of a sister company, 3C Communications, which already has a pan-European network.

The profile of the operator of the **GLOBEX** initiative differs from NORDEX. The GLOBEX profile is distinguished by the substantial size of its principle participants. Although they have chosen to collaborate in the Globex Corporation, their strategies are to compete in their respective sectors, e.g. Reuters as a global financial information network operator and the Chicago exchanges in relation to other US exchanges and those in London, Tokyo, etc. Globex Corporation's strategy is subject to direct influence by its investor/owners. Reuters' agreement to absorb the up-front development costs has provided GLOBEX with easy access to capital and the physical location of the corporation is not presently tied to any specific market. Nevertheless GLOBEX must satisfy regulatory provisions which exist in the US. It is unclear how far whether the company is bound by regulations in other jurisdictions.

Figure 7 - Design Phase Technical Constraints

NORDEX:	At the time the Transvik system was designed in early 1980s the ways in which software should be written to emulate electronic trading were little understood. Transvik responded by attracting developers from a local rival company (Instinet) who had done the early pioneering. By importing competences some of the risks associated with software development were reduced. This decision created other problems. The inherited software development platform became the basis for the trading communication network for which it was not ideally suited. Additional time and effort had to be spent tuning the technical system to match the communication and processing requirements of the market.
GLOBEX:	The design parameters for GLOBEX as a global market are demanding. Ensuring there is no degradation of the market service caused by technical problems has been difficult. There were numerous delays as network designers struggled to ensure the software algorithm could cope with surges in network traffic as members were trading.
PRODEX:	The preferred technical strategy for PRODEX was to use an X.400 system based on the PSTN. This approach would have needed the provision of an X.500 type central directory containing addresses of all potential users of the system. This service was not available.
MCP:	The design for the original system was set by the need to interconnect to the UK Customs Computer system. This was a videotex system with ports on the computer reserved for MCP's user base. This technical constraint set the tone for the whole MCP development. Being a small technically inexperienced company they contracted out the software development to programmers linked to a hardware company who used its own proprietary operating systems. Responsibility for network management was given to a sister company. They too had preferred technical strategies. The main technical constraint for MCP was to optimise the technical preferences of competing suppliers. This shaped the development of message standards, user interfaces, etc., in ways that have made further progress difficult.
VABA:	Initially this scheme was started by a group of users who tried to work with an independent software company. Once VABA became involved, software development was brought in-house and most of the problems were resolved. As originally designed the system had one major short coming. For technical reasons it was slower than the existing system. The average number of lots completed per minute decreased by 25%.
Westland:	Developing an analogue video system to run on a LAN was not difficult. The main technical problem was to transfer the system on to external off-site networks. Currently the Dutch PTT cannot provide the capacity. Even if capacity were available electronic auctioning requires images to be refreshed in less than a second. For telephone networks this requires high bandwidth and the use of digital technologies. Cable operators might be a possibility, but interworking telecommunication and cable networks raises regulatory which have yet to be overcome.

Figure 8 - Implementation Phase Technical Constraints

NORDEX:	Transvik faced the problem of how to coordinate the activities of several different telecommunication suppliers, national PTOs, GEIS Co. and its sister company, 3C Communications.
GLOBEX:	Reuters faced the problem of effectively upgrading of its global telecommunication network to overcome degradation of the electronic trading system and to ensure even response times in the conditions of access experienced by professional investors. Reuters must also ensure that costs of transmission do not increase inordinately.
PRODEX:	The oil and gas industry has yet to resolve the question of whether the PSTN could be used to support its proposed electronic reconciliation scheme. The problem is whether standards in support of electronic messaging (e.g. X.400; X.500) can be used to interconnect existing systems for information exchange based on proprietary standards.
MCP:	MCP is now being confronted with the need to upgrade its system which is being superseded by competitor's networks supporting more flexible configurations and data entry procedures. Substantial investment in software and upgraded computing facilities are needed together with enhanced user workstations.
VABA	The main technical problems confronting the tele-auction system are the need to extend the telecommunication network to support a growing range of functions with little consultation with the domestic PTO.
Westland	Problems concern how the video-auction can be extended to provide a global hub for trade in cut flowers and pot plants if consultations are infrequent with the Dutch PTO, foreign carriers, and value added network service suppliers. Another is the need to develop a cost effective network that supports voice, data and image communication in an environment where interworking between the cable television and PTO networks is currently not permitted.

In terms of competence and prior experience, GLOBEX could not be better positioned. Although it faces a very steep learning curve it clearly has the assets required to initiate a new venture. The steepness of the learning curve is attributable to the fact that no other venture has succeeded in devising an electronic network for buying and selling futures and options that can cope with '24 hour' trading. Whether the learning curve flattens in time will depend upon whether Reuters has been able to upgrade its telecommunication network to meet stringent technical requirements needed to assure investors of the integrity and fairness of the system. A degree of scepticism has already been reported in the press and at least one GLOBEX partner (Chicago Board of Trade) argued previously that no guarantees against insider deals could be put in place.

The profiles of the users trading on NORDEX and GLOBEX mirror those of the network operators themselves. There are two exceptions to this. For example, the professional investors who become members of the GLOBEX service have been seeking to obtain the best buying and selling prices for their clients in a global financial market. They are more *footloose* than the network operator. They are less constrained by their national environments and will use any electronic trading system which offers the better deal. The financial intermediaries who are members of the NORDEX system also have a high degree of flexibility. They seek optimum deals for their clients in any market environment, e.g. Stockholm, London or other stock exchanges. The learning curves faced by users of the NORDEX and GLOBEX networks are steeper than those for the network operator. Although most users have become familiar with screen-based financial information systems, they need to learn new techniques to interpret market signals in an electronic environment.

In the *Transport* and *Distribution* sector there is a different approach. The PRODEX network operatos has a profile that is closely linked to the national environment. For example, the PRODEX development process was led by collaborating individuals representing a small group of major oil and gas producers in the UK. The initiators had considerable autonomy in defining their development strategy and in reaching consensus on standards and requirements for an interactive electronic reconciliation system. Access to capital was relatively difficult despite the fact that the individuals were representatives of major multinational oil companies. The network would have required investment in equipment, software and telecommunication services for a system that could have drawn attention from the UK Monopolies and Mergers Commission. As a result financing was not forthcoming. If the original PRODEX system had been implemented its location would have been irrelevant to the success of the project.

The user firms (i.e. the major oil producers) operate in a global market. The function of information exchange concerning product reconciliation could be located in virtually any geographical milieu. The profile of these users is close to that of firms in the financial services industry. Companies are large, though they see the need to collaborate on systems development in areas that are not within their core area of business (i.e. exploration, petrochemicals and refining, product distribution). Their decisions to opt for a new electronic service are informed by parent company decisions. Access to capital needed to support equipment purchases and data transmission costs is relatively easy once a decision has been taken. The oil and gas industry has implemented sophisticated information and communication technology-based services in support of their intra and inter-firm information needs in most other areas of their business. This has giving them prior experience in the implementation and use of new services.

In contrast to PRODEX, **MCP** is embedded in its local environment. Not only is it owned by its original local users, but the facilities management services for the network are provided locally by the computer division of the Felixstowe Port Authority. All the personnel are local and an active information network has been established by the customer services team. Local users are likely to influence decision-making and take part in trials for system enhancements. Although it is marketed as a national system, there is an implicit understanding that this is merely to improve the service and reduce development costs for the benefit of the local users.

In the *agricultural* and *horticultural sector* national agricultural marketing boards and large exporting companies have established overseas networks of local agents and representatives to promote the produce of the home industry. The distances between buyers and sellers has meant that traditionally growers were often production-driven rather than marketing-led. However the network operator and user profiles for both **VABA** and **Westland** suggest growing tensions arising from local policies, regulations and market characteristics. They are becoming part of regional and global markets and the physical marketing systems are becoming less embedded in loca' institutions. VABA's reaction has been to restrict access to the network to local producers and users. Paradoxically, Westland has decided that control and operation of electronic trading networks will allow a local system of operators and users to impose standards on a much wider geographical market.

V. Public Access versus Private Membership

A major concern in any environment in which elements of both public and privately operated telecommunication infrastructure are integrated is the organisational and regulatory constraints. In the case of ETN these problems have arisen, not because of the absence of solutions, but because of difficulties in gaining agreement among the major network users. **Table 9** shows the issues confronted by these ETN during the design phase. The organisational constraints have been resolved by the principal firms/organisations depending upon their perspective on whether cooperation threatens their competitive position in the marketplace. The importance of the wider policy environment is also evident.

The ETN illustrate the salience of policies and regulations that have been designed to ensure that electronic trading does not exacerbate market distortions or jeopardise existing market relationships.

VI. Conclusion

The way in which ETN are developed can be instrumental in strengthening trends toward openness or closure in electronic markets. The ETN *design parameters* have implications for the ways in which the underlying infrastructure is used. If the primary design feature of an ETN is to achieve security, trading integrity and closure, then there will be pressures to adopt a closed infrastructure solution in support of this goal. Proprietary standards which tend to restrict access to a limited community of traders are likely to be regarded as a positive development.

The ETN reviewed in this paper show that by forging new clusters of interfirm relationships, often across the borders of national states, opportunities for policy intervention can become increasingly limited. ETN users and operators can opt to locate in the most favourable economic and regulatory environment. The heterogeneity and fragmentation of institutions, regulations and the telecommunication infrastructure become tools that can be applied to exert *regulatory arbitrage.*

Where coordination has occurred in the development of ETN, this has been where existing organisations are unlikely to face *direct* competition in the market. Where competition is likely, technical and institutional barriers have been erected to control the flow of information and to restrict membership.

Table 9 Design Phase Organisational Constraints

NORDEX was launched in 1989. The reaction of brokers to the technical aspects of the system was positive but there was reluctance to accept the risk of trading on an anonymous system. The absence of a known counterparty stalled the launch for six months. Citibank agreed to act as the universal central counterparty. Each participating broker needed to agree to contractual obligations. Within the European Community there are variations in national conventions concerning trading methods and capital adequacy requirements. There are substantial differences in the procedures between countries and differences in the procedures for trading the same instruments. As a result membership of the network is *closed*. Since NORDEX has faced competition it has considered the balance between competitive differentiation of the market system and the level of standardisation in system features necessary to encourage the diffusion of the electronic market to new members. Although financial intermediaries frequently are subscribers to more than one ETN, the network operators do not permit interconnection between their systems.
The main organisational challenge to **GLOBEX** has been to attract major exchanges to the system. For example, French MATIF contracts are listed on GLOBEX. The US Commodity Futures Trade Commission has adopted a rule limiting the liability of parties involved in GLOBEX. This rule disclaims the Chicago Mercantile Exchange from liability related to the development of GLOBEX and losses arising from failures and malfunctions in the system. The total liability in a single day for all claims is limited to US$ 100,000. The ruling requires members to supply clients with customer information and risk disclosure statements. Members must therefore belong to a *closed* 'club' of traders.
PRODEX has needed to agree standards and procedures. Wide inter-company variations existed in the time dates were changed at depots and the ways in which the same product or location was described. Companies also differed in methods for converting and normalising measurements to account for temperature differences, etc. The resolution was the result of the initiative of the UK Petroleum Industry's EDI committee's work on Standard Data Interchange and Electronic Data Interchange. By 1991, when a new EDI User Group (The European Oil & Gass EDI Group) was launched, the **PRODEX** standards were among the first to be discussed by the new group. In March 1992, PRODEX was submitted to the UN for approval. However, only those using the PRODEX standard can effectively utilise the system and it is effectively *closed*.
The challenge to the Dutch tele-auction (**VABA**) is to modify the attitudes of user organisations. The auctions insist that *only* Dutch produce be sold on the system and that only Dutch buyers may access it. The objective is to use the technology to reduce transaction costs and to raise returns to the growers using the system. The technology is being used as a barrier to competition and market access. Problems that normally confront the design of a new network based service were reduced by the central role that **VABA** (tele-auctions) already had in the industry. Individual auctions were used to competing. They were concerned about the implications of electronic collaboration. Some auctions resisted and stayed outside the system. Others cooperated because the saw tele-auctioning as a way to counteract a trend toward concentration of auctions. Still others regarded the network as a way of combining the benefits of local market presence with access to remote buyers.
The Dutch video-auction (**Westland**) operator has understood the benefits of logistical and trading networks. The *intention* is to *open* the network to non-Dutch users. Currently eight per cent of produce traded in the physical auction hall is from overseas and much is re-exported. Use of an electronic trading environment may increase the produce traded to 20 per cent or more. The company is set up so that members profit from using the market, not from sharing surpluses generated centrally. This may affect their willingness to let Westland mangers push the company in the direction of a network operator for outsiders and membership may not be extended beyond the existing *closed* group.

The ETN examples have shown that the multiple *design parameters* that are embedded in the networks involve compromises which favour some participants over others. The trends toward *closed* ETN achieved using a combination of technical and membership criteria are strong. This is the case even where there is economic justification for the extension of the network to new members to build critical mass.

ETN that rely on mixed public and private telematics infrastructure and that succeed in moving all facets of the trading cycle into the electronic sphere will take time to become the predominant mode of trade. As they diffuse more widely, the evidence suggests that they will do so unevenly. There will continue to be strong arguments favouring the development of *closed* and proprietary networks. As a result the new generation of electronic markets will offer no panacea to the existing biases in markets or to disparities in network access.

Coupled with the predominant European view favouring a *telematics* infrastructure development scenario which seeks to mix and match disparate components of the infrastructure in support of advanced applications such as ETN, the tendency toward heterogeneity is likely to be strengthened rather than reduced. The minimum conditions for development are set by priorities in the trading environment and the requirements of ETN members. As the tendencies toware *closure* are strong it is unlikely that the priorities of ETN members will be identical to those required for open access to all users.

As Braudel has observed,

> The division of labour on a world-economy scale cannot be described as a concerted agreement made between equal parties and always open to review. It became established progressively as a chain of subordinations, each conditioning the other. Unequal exchange, the origin of inequality in the world, and by the same token, the invariable generator of trade, are long-standing realities.[16]

The examples of ETN shows the importance of linking the strategic and competitiveness goals of firms to the development of private and public electronic markets and to the development of the underlying telematics

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16. Braudel (1984), op. cit., p. 48.

infrastructure. The reality is one of conflicting priorities for network design with strong incentives toward closure and heterogeneity at the least among those who promote the emergence of electronic networked markets.

In the Commission of the European Communities, the Directorates responsible for information technology and telecommunication (DGXIII) and competition policy (DG-IV) have yet to address the full spectrum of ETN issues (although considerable attention has been given to EDI, information markets and telecommunication regulatory issues). Policies with respect to infrastructure development continue to promote a heterogeneous network scenario which relies on pressures in the policy and user community to ensure that open access to the infrastructure emerges.

This analysis points to growing need on the part of European Community policy to address more explicitly the contradictions in the design parameters at work as a variety of telematics services become more pervasive. this paper has illustrated clear tensions with regard to conditions of access and membership. The parallel trend toward heterogeneity in the underlying telematics infrastructure is likely to exacerbate these tensions - and the bias seems clearly toward network closure.