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The Role of ETNO in the Changing European Telecommunications Environment

Harold MANTLE and Pierre-André WENGER, Berne

Zusammenfassung

Die Rolle von ETNO im Wandel des europäischen Telekommunikationsumfeldes

Grosse Veränderungen in der europäischen Telekommunikation werden eine Vielfalt von Organisationen beeinflussen. Die Rolle der Vereinigung europäischer öffentlicher Telekommunikationsnetzbetreiber (ETNO) bezüglich Regulierung, Technik und Markt wird in diesem Artikel dargelegt. Trotz zunehmender Konkurrenz rufen sowohl absehbare, vervollkommnete Techniken als auch die Deregulierung nach Zusammenarbeit unter den Netzbetreibern. ETNO hat sich an die Veränderungen im Telekommunikationsdienstangebot anzupassen und in engem Kontakt mit den EU-Behörden zu bleiben, wenn sie in der neuen Informationsgesellschaft der Jahrhundertwende eine bedeutende Rolle spielen will.

Résumé

Le rôle de l'ETNO face à l'évolution des télécommunications en Europe

Les importantes mutations enregistrées récemment dans le secteur des télécommunications en Europe influencent profondément les activités de nombreuses organisations. Cet article expose le rôle de l'Association européenne des exploitants de réseaux publics de télécommunications (ETNO), eu égard aux aspects réglementaires, techniques et commerciaux. Les développements technologiques ainsi que le phénomène de déréglementation auxquels nous assistons incitent les exploitants de réseaux de télécommunications à coopérer étroitement, malgré la concurrence croissante qui s'installe entre eux. L'ETNO entend participer activement à l'évolution des télécommunications en Europe, en contact étroit avec les autorités de l'Union européenne, de manière à assumer pleinement son rôle primordial dans la nouvelle société de l'information à l'aube de l'an 2000.

Riassunto

Il ruolo dell'ETNO nel settore europeo delle telecomunicazioni in continua evoluzione

Gli importanti cambiamenti che caratterizzano il settore europeo delle telecomunicazioni influiranno su molte organizzazioni. In questo articolo viene presentato il ruolo dell'Associazione europea dei gestori di rete pubblici delle telecomunicazioni (ETNO) per quanto concerne la regolamentazione, la tecnica e il mercato. Malgrado la crescente concorrenza, le tecniche perfezionate emergenti come pure la deregolamentazione richiedono che i gestori di reti collaborino fra di loro. L'ETNO deve adattarsi ai cambiamenti nell'offerta di servizi di telecomunicazione e deve rimanere in stretto contatto con le autorità dell'UE se vuole avere un ruolo importante nella nuova società dell'informazione di fine secolo.

Summary

The Role of ETNO in the Changing European Telecommunications Environment

The important changes now taking place in the European telecommunications environment will influence a variety of organizations. The role of the European Public Telecommunications Network Operators (ETNO) Association is considered in this article in view of regulatory matters, technology and market. Despite the increasing competition, emerging sophisticated technologies as well as deregulation will call for cooperation on the part of the network operators. ETNO has to adapt to the changes in telecommunications service offering and to maintain close contact with the EU authorities, in order to have a significant role to play in the new information society at the turn of the century.

1 An Era of Change

Intense changes are now taking place in the European telecommunications environment which are affecting all of the operators offering telecommunications services. The ability of administrations and companies to adapt rapidly to these changes will probably decide in what form, if at all, these operators will survive at the beginning of the 21st century.

Up until the beginning of the early 1990's in Europe the telecommunications service offering was principally technology-driven. The available technology was implemented by state-owned monopolies who

were also responsible for the regulatory aspects. The dominance of the administrations in controlling these two features meant that the market requirements were not always of prime concern (Fig. 1).

The mid-1990's will be characterized by a separation of the regulatory function and service provision aspects, as imposed by national governments and/or the European Union, and an increasingly market-driven service offering. With the convergence of the information, entertainment and telecommunications industries increasing competition will occur, so that, following liberalization of the telecommunications

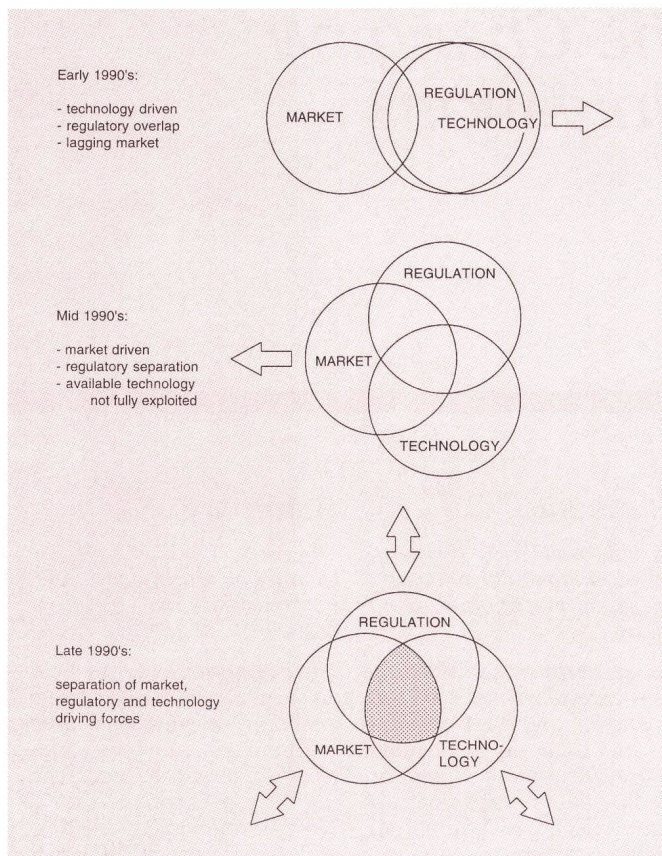


Fig.1 Changing telecommunications driving forces

market in the European Union in 1998, the three driving factors market demand, regulatory requirements, and technology availability will have similar significance to service providers. Interaction between these three forces will take place depending upon the specific developments in each domain.

2 Cooperation and Competition

Increasing globalization and liberalization, together with multimedia, combined technology trends, will force service providers to critically review in which areas they compete with each other and in which areas it is advantageous to cooperate.

When approaching the *market*, individual actions will predominate or alliances will be made in certain areas, where a combined action is thought to bring more benefits (Fig. 2).

In front of emerging sophisticated *technologies*, cooperation will be required at various levels, such as joint research and development programs, standards establishment and coordinated service launching. Several European projects (e.g. RACE, METRAN, Euro-ISDN, GSM, etc.) and organizations (e.g. EURES-COM, ETSI, etc.) exist for coordinating such technological aspects. One of the two objectives of the European Public Telecommunications Network Operators' Association (ETNO) is also to promote the cooperation and coordination of its Members in developing harmonized fixed public telecommunications networks and basic services.

Concerning *regulation* within Europe, the main driving force now and in the near future is the European Union. Faced with such a large and significant body, the operators have a common motive to combine their efforts in order to develop their positions. ETNO provides this common platform with its first objective, which is the development and representation of common views to third parties, especially to the institutions of the European Union and other European organizations.

3 The ETNO Association now

Following the European Commission's 1987 Green Paper on Telecommunications, which, among other things, advocated the separation of regulatory and operational functions, CEPT became an organization of national regulatory authorities in September 1992. ETNO was founded on 12 May 1992 as the general policy association of the majority of the European public telecommunications operators. The structure of ETNO can be understood in terms of a sequence of information transfer, organization and actions.

Receival and distribution of *information* is the responsibility of the Secretariat based in Brussels. The *organization* of all internal matters is determined by the General Assembly made up of the participating Members. The procedures are enacted either via the General Assembly meetings, held twice yearly, or by written approval or by special fora (e.g. the Senior Executive Conference on Network Evolution, the Workshop on Central and Eastern Europe and the Seminar on the ETSI 1995 Work Program). *Actions* are initiated or approved by the Steering Committee, with detailed studies being made by Working Groups and liaison being undertaken by Special Rapporteurs (Fig. 3). The

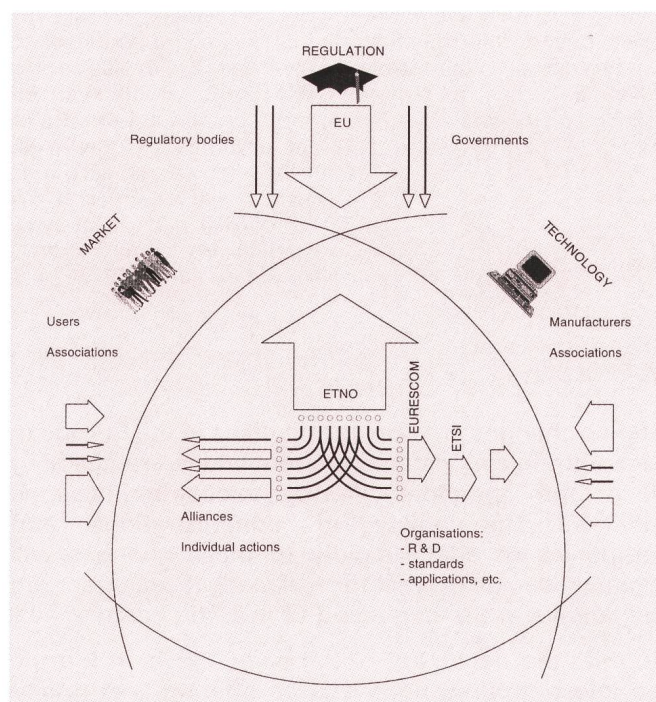


Fig. 2 When to cooperate and when to compete?

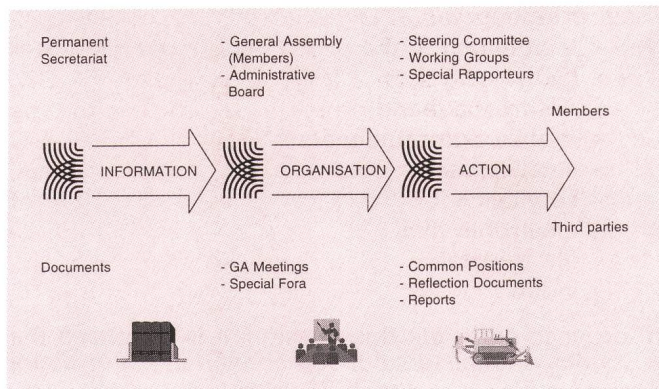


Fig. 3 The ETNO process

principal outputs of the association (*Appendix 1*) are documents having the form of:

- *Common Positions*, which represent the unanimous approval of all Members
- *Reflection Documents*, which are issued in preparatory evaluation phases, but which do not have unanimous approval
 - *Reports*, which are of an informative nature and provide an overview of matters of common interest to the Members

In compliance with Belgian law an Administrative Board is responsible for the legal aspects of the association (*Fig. 4*).

Membership now stands at 32 operators from 27 countries covering the major part of geographical Europe (*Fig. 5*).

All of the ETNO Members together represent an aggregate turnover of more than 100 billion ECU, more than 200 million access lines and more than 1 million employees. More important, but less exploited, is the wealth of combined technological, regulatory and organizational knowledge and experience available

within ETNO. The association is a potentially powerful lobbying and coordinating force. However, when faced in the future with rapid deregulation, alternative information technologies, and an increasingly aggressive and new market environment, ETNO will be tested to the extreme. A common single focus of ETNO activities, as typified by the EU policies in the past, will change to a multitude of different goals, where Members will have diverging interests.

4 Regulation Revision

With the acceptance of the Report of the 'Bangeman Group' concerning Europe and the global information society at the European Council Meeting in Corfu, 24/25 June 1994, the scene for telecommunications deregulation in Europe over the next few years has been set. The effects of the policies to be adopted will extend outside of the EU and encompass the whole of Europe.

Europe, together with the other industrially advanced regions of the world, is moving into the information society (*Fig. 6*). Telecommunications will play a vital role in this society, and a safeguarding common regulatory approach is advocated by the EU. In order to ensure that the market is the driving force, the EU will endeavour to

- end monopolies:
 - liberalize infrastructures and services
 - remove political and budgetary constraints
 - set timetables and deadlines
- open the market:
 - promote the interconnection and interoperability of services and applications
 - speed up and improve the standardization process
 - adjust tariffs to be cost-based and internationally comparable

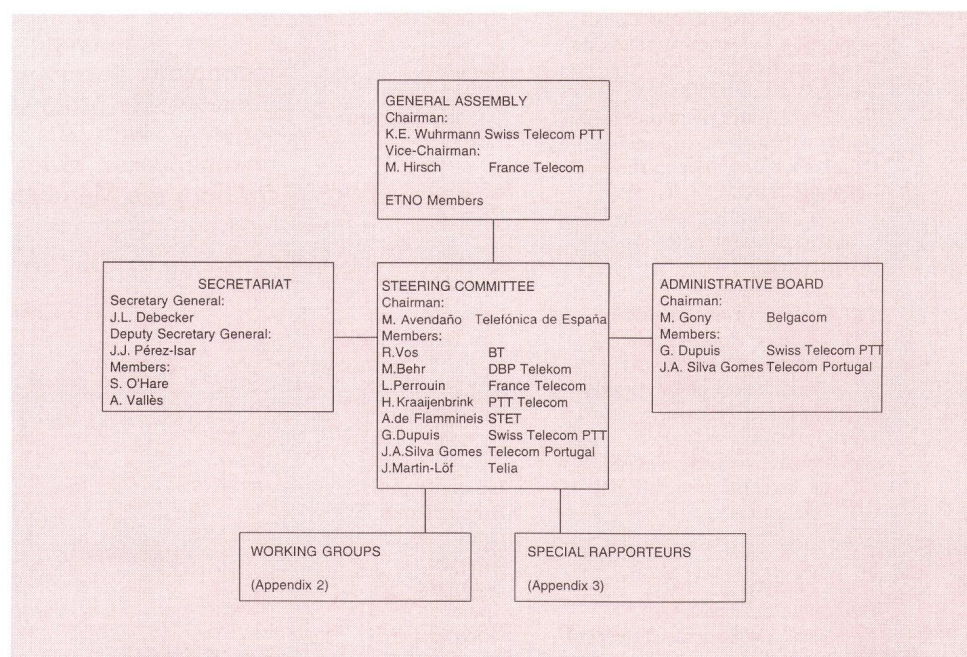


Fig. 4 Organs and Members of ETNO for 1994

- promote public relations
- ensure global access and reciprocity
- protect intellectual property rights, privacy and security of information on a global scale

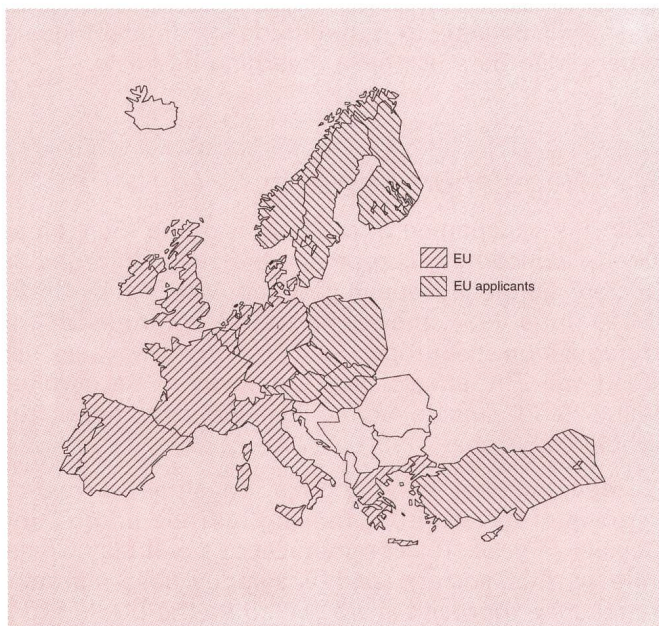


Fig. 5 The ETNO Members

| | |
|---|-----------------|
| Belgacom | Belgium |
| Bord Telecom Eireann | Ireland |
| BT | United Kingdom |
| Bulgarian Telecommunications Company | Bulgaria |
| Companhia Portuguesa Rádio Marconi | Portugal |
| Croatian Post and Telecommunications | Croatia |
| Cyprus Telecommunications Authority | Cyprus |
| Deutsche Bundespost TELEKOM | Germany |
| Entreprise des postes et télécommunications | Luxembourg |
| Entreprise des PTT suisses (Swiss Telecom PTT) | Switzerland |
| France Telecom | France |
| General Directorate of PTT | Turkey |
| Hungarian Telecommunications Company (HTC) | Hungary |
| IRITEL | Italy |
| Mercury Communications (MCL) | United Kingdom |
| Österreichische Post und Telegraph | Austria |
| Organisme des télécommunications helléniques (OTE) | Greece |
| Posti-ja Telelaitos (Telecom Finland) | Finland |
| Posti-Og Simamalasstofnun (PTT Iceland) | Iceland |
| Portugal Telecom | Portugal |
| PTT Enterprise of Slovenia | Slovenia |
| PTT Telecom Netherlands | The Netherlands |
| Puhelinlaitosten Liitto (The Association of Telephone Companies in Finland) | Finland |
| Rom Telecom | Romania |
| Slovenské Telekomunikácie (Slovak Telecommunications) | Slovak Republic |
| SPT Telecom | Czech Republic |
| STET | Italy |
| Tele 2 | Sweden |
| Tele Danmark | Denmark |
| Telefónica de España | Spain |
| Televerket (Norwegian Telecom) | Norway |
| Telia | Sweden |

- set priorities:
 - technology
 - ISDN
 - ATM broadband
 - mobile communications
 - satellite usage
 - services
 - electronic mail
 - file transfer
 - video

In order to carry out this mission, it is proposed that a Council of Ministers concerned with the information society is set up and that attention is focussed on the following applications:

- Teleworking ('More jobs, new jobs for a mobile society')
- Distance learning ('Life-long learning for a changing society')
- A network for universities and research centers ('Networking Europe's brain power')
- Telematic services for SMEs ('Relaunching a main engine for growth and employment in Europe')
- Road traffic management ('Electronic roads for a better quality of life')
- Air traffic control ('An electronic airway for Europe')
- Healthcare networks ('Less costly and more effective healthcare systems for Europe's citizens')
- Electronic tendering ('More effective administrations at lower cost')
- Trans-European administration network ('Better government, cheaper government')
- City information highways ('Bringing the information society into the home')

The message is clear, and the role that ETNO has to play is equally apparent. In the face of general industrial competition from the USA and Asia, the EU is demanding a fast change from a regulated to a deregulated telecommunications market. However, due to the large investments made by telecommunications operators and the time scales involved in technology developments, this rapid transition poses considerable problems. The role of ETNO is to work together with the regulatory bodies during this changeover in order to ensure stability and benefits for both the Members of ETNO and their customers.

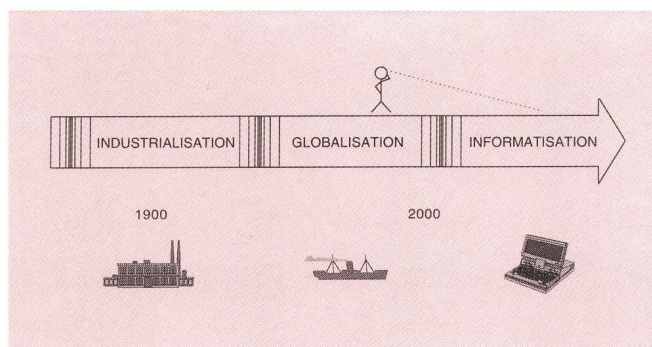


Fig. 6 At the start of a new revolution

The ETNO response will have to come in various forms, involving:

- consideration and actions concerning the implications of the far-reaching issues such as universal service obligation and infrastructure liberalization
- collaboration with other associations when treating matters such as standards and development
- coordination between its Members when approaching joint network development and, in particular, when addressing the implementation of the proposed EU applications

If approached in a proactive manner and with the emphasis on the key issues, the chances of success and the importance of the role that ETNO can play are large.

In parallel to the EU developments another regulatory influence will come from the implementation of the GATT Uruguay Round on Multilateral Trade Negotiations due to become effective in 1995. With the agreement on trade in services (GATS) of the forthcoming World Trade Organization (WTO) new aspects will be brought into multilateral service trade, such as:

- no discrimination of service providers from other countries
- publication of transparent laws, regulations and bilateral agreements
- liberalization commitments have to be extended to all other GATS signatories as for those of the most favoured nation

Continuing globalization of service offering will also require a global regulatory body. This task could be taken up in the future by the WTO in line with the present global policy of trade activities carried out by GATT. The definition of regional agreements (reciprocity arrangements) could be an area for ETNO activity, such as negotiating entrance conditions for service providers from other global regions.

Another source of liberalization pressure will be the OECD, which has been studying the case for infrastructure competition and is making the following claims for liberalization:

- increased benefits to users (choice, innovation, quality and price)
- market growth
- universal service is complemented and enhanced
- efficiency of public telecommunications operators is improved, and new employment opportunities are created

Thus it can be expected that the OECD will also press for early liberalization of the telecommunications markets of its Members.

Close collaboration with the regulatory bodies and a joint approach of the Members are required from ETNO when considering these fundamental issues.

The EU and WTO regulatory matters are expected to be the main common binding force within ETNO until the end of this century and also to provide one of the main common issues of concern, together with technology development. The need for ETNO with its

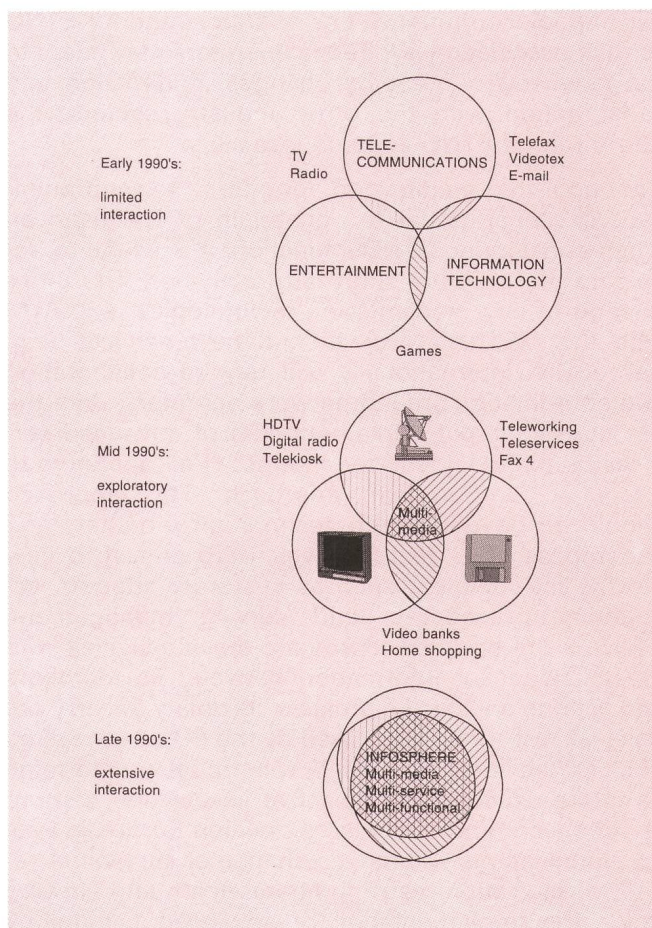


Fig. 7 Converging industries

present structure and with its current approach is manifest.

5 Technology Transition

The advent of digital technology, enabling the transport of various types of information, and the use of optical fiber, enabling high transport rates, have meant that the classical telecommunications operators no longer are sovereign over transmission technologies. Network operators in other fields such as cable TV, computer interconnection or electronic messaging are now in the position to offer general telecommunications services. In addition, the increasing intelligence and storage capacity of end-user equipment has further eroded the dominance of voice telephony service providers in offering telecommunications services. In general, services are becoming increasingly integrated, so that the present spectrum of individual telecommunications services will be offered in the future in an ISDN package and then, at a later stage, in an IBC services offering covering the large majority of anticipated information requirements.

The telecommunications, the entertainment and the information technology businesses are rapidly converging to provide a general 'infosphere' at the end of this century in the industrially developed countries (Fig. 7). This will have dramatic consequences for the

existing telecommunications operators and for ETNO as their association. While the operators may adapt to the new environment by changes in direction and collaboration with the other industry sectors, the future role of ETNO is much less clear.

Although the medium to long-term telecommunications scenarios are too uncertain to speculate on when considering ETNO's function, it is useful to anticipate the possible short-term activities. The introduction of new transmission technologies (e.g. ATM with the METRAN project) and new services (e.g. Euro-ISDN) internationally will require collaboration and coordination among network operators. With the pressure for rapid implementation of advanced services by the EU it is in the interest of all operators to adopt a pan-European approach. This approach should go beyond purely technological matters and encompass other features which are critical to new service introduction, such as customer support, accounting procedures, and service management. ETNO is the body to coordinate these activities with the exchange of information between its Members and actions on specific projects. Its ability to carry out this task will surely be viewed by the EU as a measure of its credibility and, as such, will probably determine its future existence. A proactive association demonstrating a common interest to develop European telecommunications will have a chance of survival. A reactive association resisting liberalization and slowing down the implementation of advanced technology will be doomed to a short life.

Another aspect of technological development which is of concern to ETNO is the possibility of diverging developments in different global regions. As has been seen with the development of high-definition TV, regional conflicts can occur where global standardization is required. ETNO should be in close contact with its counterparts in other global regions, in order to avoid confrontations, and also be the negotiating partner of the regulatory authorities.

6 Moving Markets

With the advent of liberalization, the information society, the introduction of services in GATT and continuing globalization new market forces will take effect. The classical network operators will be forced to change their structure and market approach. The dominating engineering concern of the past will be replaced by a predominant customer service with a focus on specific market segments. Following current social developments, the trend will probably be to visual (vision as the dominating sense), intelligent (to enable personal choice features), and personal (increased independence) communications. Many new market entrants are expected to appear at different levels in these fields.

Telecommunications operators are being forced to segregate their activities. They have typically passed from an all-encompassing PTT at the beginning of the decade to a cost-centered telecommunications unit at the present time. Increasing competition will necessitate a concentration on specific beneficial

areas in the near future and the rejection of non-profitable activities (*Fig. 8*).

Future responsibility for network infrastructure will probably be shared between various operators from different market backgrounds (e.g. cable TV, transport, computing, facilities, banking, etc.). Furthermore, the overlapping and interfacing of different transmission media (e.g. satellite, radio and cable) and services (e.g. GSM, ISDN and telepaging) will blur the operating domain of each network. A trend described by Noam in [7] is that telecommunications is moving from the traditional monopoly, by way of a 'network of networks', to a 'system of systems'. Users may be served in the future by integrators of numerous systems that access each other. This is far from the fixed public network operators that form ETNO now. Add to this problem the question of what is a European operator in an age of international alliances and penetration of the European market by foreign companies, and the situation becomes precarious for ETNO.

Within such a multitude and variety of telecommunications network operators it is difficult to see a unifying and clear role for ETNO. It is certain that the definition of ETNO membership must be changed over the next few years and that, as for the operators themselves, flexibility will be the key to success and survival. Segregation into interest groups is a possibility and, providing intergroup coordination exists, could be a viable solution.

Increasing competition implies a drive for increased productivity in specific domains and the rejection of

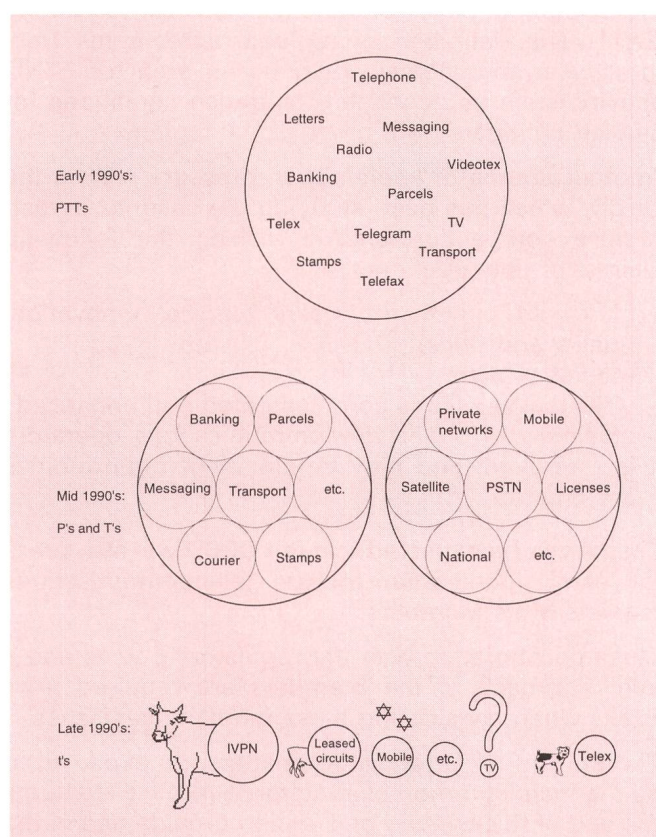


Fig. 8 PTT segmentation

activities resulting in deficit. The result is often a significant reduction in workforce, which, considering the scale of the European telecommunications industry, could take on major social implications. Depending on the economical developments in Europe, ETNO may be called on to take measures to reduce unemployment. An example could be the organization of personnel retraining schemes on a European scale. Similar social aspects have already been considered by ETNO in connection with aid programs for the Central and Eastern European countries. As for other large organizations, ETNO will probably be expected to take increasing responsibility for the social and environmental aspects of telecommunications.

7 Conclusions

The drastic changes which are presently occurring in the European telecommunications environment will affect all of the existing public fixed network operators and consequently their association ETNO. Increasing liberalization, continuing globalization and the convergence of different business sectors will increase competition between service providers, including the present ETNO Members. Despite this precarious trend for ETNO, there are areas, such as joint development projects, standards, tariff arrangements, international service coordination and liaison with the regulatory bodies, where cooperation between service providers will be necessary. This will provide the 'raison d'être' for ETNO, but will require flexibility and a willingness to cooperate closely with the EU over the next few years. These last two aspects will probably determine the future short-term existence of ETNO at the dawn of a new age in telecommunications.

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Abbreviations

| | |
|----------|--|
| ATM | Asynchronous Transfer Mode |
| CEPT | Conférence européenne des Administrations des postes et des télécommunications |
| ECU | European Currency Unit |
| ETNO | European Public Telecommunications Network Operators' Association |
| ETSI | European Telecommunications Standards Institute |
| EU | European Union |
| EURESCOM | European Institute for Research and Strategic Studies in Telecommunications |
| GATT | General Agreement on Tariffs and Trade |
| GATS | GATT Services agreement |
| GSM | Global Services Mobile / Groupe Spécial Mobile |
| IBC | Integrated Broadband Communications |
| ISDN | Integrated Services Digital Network |
| METRAN | Managed European Transmission Network |
| OECD | Organization for Economic Cooperation and Development |
| RACE | Research and Development in Advanced Communication Technologies in Europe |
| SME | Small and Medium-sized Enterprises |
| WTO | World Trade Organization |

Appendix 1: ETNO Common Positions, Reports and Reflection Documents

Common Positions

- | | |
|--------------|---|
| CP01 (04/91) | ETNO Common Position on the European Telecommunications Equipment Industry |
| CP02 (04/91) | ETNO Common Position on the Draft Directive on Mutual Recognition of Licenses |
| CP03 (10/91) | CEC's Analysis Report on ONP Applied to Voice Telephony — Comments |
| CP04 (07/92) | ETNO Common Position on the Proposal for a Council Resolution for European-wide Cooperation on Telecommunications Numbering |
| CP05 (10/92) | ETNO Common Position on the Draft Review of Telecommunications Tariffs in the Community |
| CP06 (11/92) | ETNO Common Position on ITU APP-02 Preparations |
| CP07 (11/92) | ETNO Common Position on Communication from the Commission — The European Telecommunications Equipment Industry |
| CP08 (12/92) | ETNO Comments on ONP applied to Voice Telephony |
| CP09 (12/92) | ETNO Common Position on the NERA Report on ONP Network Management |
| CP10 (01/93) | ETNO Common Position on the 4th Framework Program |
| CP11 (03/93) | ETNO Common Position on the Creation of a European Numbering Space |

- CP12 (03/93) ETNO Common Position on the International Freephone Service
- CP13 (06/93) ETNO Common Position on Objectives and Contents of the 4th Framework Program
- CP14 (09/93) ETNO Common Position on the Results of the Detailed Spectrum Investigation (1st phase)
- CP15 (10/93) ETNO Common Position on the KPMG Study for the EC on ONP Applied to Intelligent Networks
- CP16 (10/93) ETNO Common Position on Telecommunications in the GATT Context
- CP17 (11/93) ETNO Common Position on the Application of ONP to the ISDN 'U' Interface
- CP18 (11/93) ETNO Recommendations for Telecommunications R & D Community Actions
- CP19 (12/93) ETNO Common Position on Satellite Communications
- CP20 (01/94) ETNO Comments on 'Document Related to the Development of ISDN as a TEN'
- CP21 (03/94) ETNO Common Position on the Handbook of ONP Essential Requirements
- CP22 (04/94) ETNO Common Position on the Draft Commission Directive amending Directives 88/301/EEC and 90/388/EEC, in particular with regard to Satellite Communications
- CP23 (04/94) ETNO Common Position on SS7 Message Traffic
- CP24 (05/94) ETNO Common Position on EC Distance Selling Directive
- CP25 (06/94) ETNO Common Position on EU White Paper and its Consequences on the Development of TENs
- CP26 (06/94) ETNO Common Position on Trials on the 4th Framework Program
- CP27 (07/94) ETNO Common Position on Green Paper on Security of Information Systems

Reports

- R01 (02/93) ETNO Report on the Review of the Situation in the Telecommunications Services Sector (Review 1992)
- R02 (10/93) ETNO Report on proposed Council Directive on Data Protection, in particular in ISDN and Digital Mobile Network (SYN 288)
- R03 (06/94) ETNO Report on the Green Paper on Mobile Communications

Reflection Documents

- RD01 (09/93) ETNO Reflection Document on the Future of ONP
- RD02 (12/93) ETNO Reflection Document on the Development of Universal Service for Telecommunications in a Competitive Environment

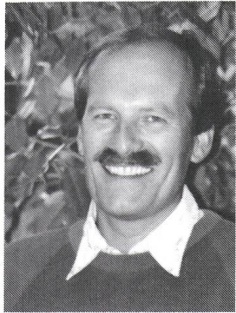
- RD03 (12/93) ETNO Reflection Document on the Concept of Trans-European Telecommunications Networks
- RD04 (01/94) ETNO Reflection Document on 'Requirements and Options in Advanced Communications Technologies and Services/ACTS'
- RD05 (02/94) ETNO Reflection Document on Access Charges
- RD06 (03/94) ETNO Reflection Document on ITU/PP 94
- RD07 (04/94) ETNO Reflection Document on ONP Applied to Local Loop
- RD08 (05/94) ETNO Reflection Document on the Liberalization of Alternative Infrastructure
- RD09 (05/94) ETNO Reflection Document on Special Rights
- RD10 (05/94) ETNO 2nd Reflection Document on ITU/PP 94

Appendix 2: Current ETNO Working Groups

| | | | |
|----------|---|---------------|------------------|
| WG 92/01 | Data protection | R. Seaman | BT |
| WG 92/04 | Numbering issues | J.-M. Colomb | France Telecom |
| WG 92/05 | ONP | N. Siljee | PTT Telecom |
| WG 92/07 | Satellite communications | S. Gomes | CPR Marconi |
| WG 92/09 | Frequency management | E. Zinovieff | France Telecom |
| WG 92/10 | Research and development | F. Da Silva | Telecom Portugal |
| WG 93/02 | Central and Eastern European countries | O. Villányi | HTC |
| WG 93/03 | Economic implications of liberalization | J. L. Machota | Telefónica |
| WG 93/04 | Infrastructure | C. Carrelli | STET |
| WG 93/05 | Mobile Communications Green Paper | M. Sentinelli | STET |
| WG 93/08 | Senior Executive Conference | J.-A. Muñoz | Telefónica |
| WG 93/09 | ITU/PP 94 | W. Lucas | BT |
| WG 93/10 | Information security | L. Kahn | Telia AB |
| WG 94/01 | Quality of service | P. M. Longo | STET |

Appendix 3: ETNO Special Rapporteurs

| | | |
|---------------------------|-----------------|-----------------|
| CEPT matters | M. Norbye | BT |
| Clearing matters | J. L. Chabannes | France Telecom |
| ESA matters | J. Tomlinson | BT |
| ETSI matters | T. Kaijanen | Telecom Finland |
| GATT matters | O. Nordling | Telia |
| Relations with the unions | J. Meerts | Belgacom |



Harold Mantle graduated from the University of London with a degree in physics in 1969 and two years later with a postgraduate diploma in environmental science and technology. After undertaking research into thin-film metallurgy, failure analysis of integrated circuits and techniques of microscopy at various institutes in Switzerland, he joined the Research and Development Division of the Swiss PTT in 1984. There he carried out microscopical studies of integrated circuits and worked on the development of a voltage standard based on thin-film Josephson junctions. In order to avoid a 'funnelling effect' of ever increasing specialization, he joined the Network Planning Division in 1991, where he was responsible for the planning of public switched telephone networks linking Switzerland to various foreign partners. Following the nomination of Swiss Telecom PTT to the Chairmanship of the ETNO General Assembly for 1994, Mr. Mantle has taken up a post as assistant to the Chairman, Mr. K. E. Wuhrmann.



Pierre-André Wenger joined the Telecom Department of the General Directorate of the Swiss PTT in 1968 as a specialist in text transmission services. He was one of the pioneers of national and international facsimile services (telefax, bureaufax); as a result, he became chairman of several international ITU and CEPT groups. He was also Chairman of the CCITT-UPU Contact Committee responsible for coordinating the international relations between the telecommunications and postal sectors. From 1988 to 1992, Mr. Wenger was Vice-Chairman of Study Group I of the CCITT (Service Definition) and Chairman of the Working Group I/2 'Telematics' of the CCITT. Since the creation of ETNO in 1992 he has been responsible for European matters at the Management Services and International Affairs Division of Swiss Telecom PTT in Berne and is an Alternate Member of the ETNO Steering Committee.