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R&D IN ADVANCED COMMUNICATIONS TECHNOLOGIES FOR EUROPE

(RACE)

FINAL REPORT ON PHASE I (1988-1992)

OF THE 10-YEAR RACE PROGRAMME

(presented by the Commission pursuant to Article 6(3) and Article 9 of Council Decision 88/28/EEC on the RACE Programme)

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Executive Summary

Telecommunication now underpins most industrial activities and is central to the performance of the service sector in Europe. Good telecommunications are crucial to business competitiveness. The completion of the European Economic Space with no internal barriers to trade will open new opportunities and present new competitive pressures, and the increasing importance of telecommunications in international trade is already changing the way businesses operate. The prosperity of Europe in the 1990s will be critically dependent on good communications.

The telecommunications, computing and broadcasting sectors already account for an annual turnover of over 500 billion ECU in the world. By 2000, the telecommunications sector will be the third largest in Europe, after food & drink and chemicals. Telecommunications infrastructures will be economically more important than the physical transport infrastructures. Mastering the technology options has therefore become a key to economic growth and the creation of new employment. Over 50% of employment already depends on use of information and telematic systems, and the major growth in employment is in the information sector.

Demand for services is changing rapidly. Businesses need more flexible services, higher transmission capacities for fast data and image transmission and more competitive tariffs. The growth in value-added services over high-speed digital networks is currently near 40% per year, with 40 million service-user combinations in 1987, 180 million in 1989 and over 300 million in 1991. By 2000 as much as 30% of telecommunications revenues could be associated with such value-added services. Within a few years, most major European companies will require fast data communications between their design, manufacturing, management and retailing activities. Demand for such services is already strong in the US: all major research institutes have access to very high-speed data communications, and 60% of the top 500 companies make use of high-speed digital transmission links.

Recognising these trends, a "definition phase" of the RACE programme was launched in 1985, at the initiative of European Industry Ministers. It established that there was scope and need for a European framework for collaboration in R&D. The Decision on the first phase of a 10-year RACE Programme (Research and development in Advanced Communications technologies in Europe) was adopted by the European Council of Ministers in December 1987. This decision established the policy direction and a budget provision for an initial period of five years, to 1992, within the EC's 2nd Framework for Research and technology development. The objective was to "promote the competitiveness of the Community's telecommunications industry, operators and service providers in order to make available to final users, at minimum cost and with minimum delay, the services which will sustain the competitiveness of the European economy and contribute to maintaining and creating employment in the Community".

Article 9 of the decision requires that, "*after the completion of the first five-year period of the programme, the Commission shall, after consulting the Management Committee, send to the Member States and the European Parliament a report on the performance and results of the programme*". This is that report. It updates the 30-month review submitted in 1990.

The main achievements

As a result of the work carried out in the first five years of the RACE programme, Europe has a clear lead in the conceptual development of advanced communications networks and services. For the first time, telecommunications operators, the telematics industry and leading-edge users in most major application sectors have joined forces in development of the advanced communications technologies required for low-cost and innovative services. A unique environment has been created in the RACE programme for concertation of their efforts.

The RACE programme has strengthened the harmonisation of the European Telecommunications infrastructure; the development of Common Functional Specifications has provided a "blue-print" for Integrated Broadband Communications. The programme has fostered the close co-operation of central and peripheral regions, and has therefore contributed to the economic and social cohesion of the Community. In terms of technology development, development of the Asynchronous transfer mode for high-speed switching of digital communications has given European industry a lead in international competition; The research on network management has given European network management systems international recognition; The work on digital video and TV has resulted in international standards for coding, multi-gigabit signal distibution systems and specifications for digital video-recording. In the area of standardisation, the programme has contributed 596 draft specifications to European and international bodies - ETSI, CCITT and CCIR (see Annex II). An excellent complementarity with EUREKA activities has been developed, and over 1700 scientific and technical papers have been published in the open literature (see Annex III).

The results of the RACE Programme provide European telecommunications organisations and services providers with a strategic competitive advantage. It has created awareness within industry of the market opportunities which will accompany the implementation of the next generation of telecommunications services in Europe. It has demonstrated the advantages of collaboration on a European scale in pre-competitive R & D, and has substantially re-inforced European stndardisation in the telecommunications sector.

Management and evaluation of the RACE programme

The RACE programme is unique in the EC's 2nd Framework Programme: it was the only programme managed as a fully integrated set of tasks; each project has addressed one or more of an coherent set of R&D tasks, each of which has contributed to a single objective:

"Introduction of Integrated Broadband Communications, taking into account the evolving ISDN and national introduction strategies, progressing to Community-wide services by 1995"

The Workplan for the programme, adopted in 1987, set the framework for the work of each project and for their interaction. This interaction has further been reinforced by regular "Concertation" between projects, through technical discussions at 6 - 8 week intervals in which all projects were required to participate. The technical results of the projects have further been consolidated by a core project responsible for development of IBC implementation strategies, functional reference models, customer service functions and referance configurations. A strong and coherent interaction with European standardisation bodies has also been assured through a second key project responsible for consensus development and development of common functional specifications.

The evaluation and auditing of the work in the programme has reflected the strongly integrated nature of the programme.

At the programme level, a Strategic Audit was carried out in 1989 to evaluate the work in respect of the strategic and policy objectives of the Community. The progress in work was reported to the Council of Ministers and the European Parliament in 1990 in the "30 month" review provided for in the Council Decision. This was followed in 1990 by a re-assessment of new requirements for R&D by an independent Board of senior executives and Government Officials (Telecom 2000). In 1991 and early 1992, the work was evaluated, in the context of the other major IT and Telematics application programmes of the 2nd Framework Programme (ESPRIT and DRIVE) by an independent Panel[1]. Finally, in 1992, the Commission reported on the programme in the context of its Evaluation of the 2nd Framework Programme[2]), and the RACE Management Committee carried its own evaluation at the request of CREST[3].

The research and technology development within the programme has been accompanied by regular assessments of the economic and social impact of developments in advanced communications[4]. The most recent of these assessments was carried out in 1991 and disseminated in 1992. The major part of this activity has now been fully integrated into the 2nd Phase of RACE following the provisions made in the Council Decision on the Specific Programme on Communications Technologies.

The programme management procedures adopted by Commission services for the RACE programme were subjected to an independent "programme management Audit" in 1989, which resulted in a strong endorsement of the Commission's approach.

At the Project level, each project has been subject to a "Technical Audit" by independent experts in the relevent field of research every year. The first such Technical Audit took place in October 1988 and the last in October 1992. The results of these annual audits have been used to re-direct or terminate the work of Projects when necessary.

These evaluations and audits have all shown that the RACE Programme has been successful in relation to its original objectives.

The work started under the first phase of RACE has now been followed-up and broadened by R&D projects under the new Specific RTD programme on communications technologies, the second Phase of RACE. This is part of the EC's 3rd Framework Programme, and provides for EC part-funding of R&D until December 1994. These projects started work in January 1992, and the overlap RACE Phase I projects in 1992 has ensured continuity in the work. The Programme will continue to make a significant contribution to Europe's economic development and socio-economic integration. It is accompanied by national activities[5] and international actions, such as those of EURESCOM[6], which reinforce the EC activity, and which are reinforced by it. The RACE programme is a unique framework within which Telecommunications network operators, industry and users all co-operate.

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[1]The report of the information and communications technologies review Board, Chaired by Mr. W. Dekker, June 1992.

[2]Communication from the Commission on "Evaluation of the second Framework Programme for research and technological development (SEC(92)675 Final), July 1992.

[3]Reproduced in Section 3.2.1 of this report.

[4]The reports of these assessments have been published and widely disseminated as the series of reports on "Perspectives for Advanced Communications in Europe: PACE"

[5]Broadband communications trials are underway in B, D, DK, F, Irl, P and the UK.

[6]European Institute for research and strategic studies in telecommunications GmbH.

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1. Introduction

Telecommunications is the most dynamic and rapidly evolving of all industrial sectors in Europe. Telecommunications services generate a turnover of over 300 billion ECU per year in Europe, and investment in telecommunications networks and services is running at close to 30 billion ECU per year. The revenue is still largely associated with voice telephony, but most current capital investment is in the new generations of digital equipment, which can support the integration of voice, data and image communications. By 2000, as much as 30% of telecommunications revenues could be associated with value-added services using advanced data communications.

World-wide, all spheres of life are affected by the convergence of information technology, broadcasting and telecommunications. The combination of data processing techniques with innovative ideas in telecommunications has already led to the implementation of Integrated Services Digital Networks, but these are only a first step in a rapid evolution to a much wider range of multi-media services which will require new technologies, network and service management systems and new regulatory systems. The combination of service integration together with optical fibres offering cheap high-speed transmission (a million times faster than over copper wires) provide the techno-economic basis for a fundamental restructuring of all of the sectors through Integrated Broadband Communications (IBC). This development of this concept is the goal of the RACE Programme.

The present report summarises and documents the results of the first Phase of the 10-year RACE Programme, from 1988 to 1992.

The context, organisation and results of the Programme are described in Section 2, and the organisation and results of programme evaluations and audits are summarised in Section 3. Links with other EC and European actions are described in section 4. The results of the R&D in the first phase of RACE have already been widely exploited, both in development of standards, in new network and service developments, and as a basis for further work in Phase II of the programme. The exploitation of the results of Phase I of RACE are described in section 5, and the transition to Phase II is described in section 6. Future requirements and options for work at European level are described in Section 7.

Detailed information on the achievments of R&D projects are summarised in Annex I. The contributions to standardisation are listed in Annex II, and all scientific and technical publications resulting from the work are listed in Annex III. Applications for registration of Patents are listed in Annex IV; a glossary of technical terms is given in Annex V, and a list of references to the formal Decisions of the Council of Ministers and Communications of the Commission is given in Annex VI. The R&D projects funded under Phase I of the RACE programme are listed in Annex VII; the organisations involved are listed in Annex VIII, and financial and participation statistics are summarised in Annex IX.

2. The context and organisation of the RACE Programme

2.1 R&D as part of the Community's Telecommunications policy

The RACE Programme forms an integral part of the telecommunications policy of the EC. Linked to the standardisation policy and the information market policy, it builds on information technology developments in the framework of ESPRIT, and for the first time involves the European Telecommunications network operators, as major actors, in collaborative technology and service development. By addressing the future cost-performance of the communication infrastructures in Europe, the RACE programme has contributed to development of the single market, the international competitiveness of European industry and to the social and economic cohesion of the Community.

The major goals of the telecommunications policy of the Community as set out in the Council Resolution of June 1988[1] are to:

- Create or ensure Community-wide network integrity, based on the principle of full interconnectivity between all public networks concerned,
- Progressively create an open common market for telecommunications services,
- Promote the creation of Europe-wide services according to market requirements and social needs,
- Further develop an open, Community-wide market for terminal equipment,
- develop a common market in which telecommunications administrations and other suppliers can compete on an equal footing.
- continue Community measures regarding common standards;
- stimulate European co-operation at all levels, particularly in the field of research and development of telecommunications,
- create a social environment for the future development of telecommunications, and,
- integrate the less-favoured areas of the Community fully into the emerging Community-wide market.

These objectives provide a clear framework for the definition of future technology, services and applications development.

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[1] Council resolution of 30th June 1988 on the development of the common market for telecommunications services and equipment up to 1992; 88/C 257/01: O.J. No C 257/1, 4.10.88.

2.2 The objectives of RACE

The main objective of the RACE programme is to contribute to the:

"Introduction of IBC[2] taking into account the evolving ISDN and national introduction strategies, progressing to Community-wide services by 1995[3])"

The specific objectives of Phase 1 were:

- to promote the Community's telecommunications industry;
- to enable European network operators to compete under the best possible conditions;
- to enable a critical number of Member States to introduce commercially viable IBC services in 1995;
- to allow service providers to improve cost-performance and introduce new services; to make new services available at a cost and on a timetable at least as favourable as elsewhere;
- to support the formation of a single European market for telecommunications equipment and services, and
- to contribute to regional development by allowing less developed regions to benefit fully from telecommunications developments.

In addition, a number of technical objectives were set out in Annex I to the Decision. The contribution of RACE R&D projects to the achievement of these objectives is described in Table I.

During the development and implementation of the programme, the interpretation of the concept of Integrated Broadband Communications has evolved in response to changing market and regulatory conditions. The definition below reflects the consensus developed within the RACE Management Committee during 1990.

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[2]) "I" "Integrated" not only means "integrated services" (at the user level and at the appropriate network levels), it also points to "integrity" of the whole network, and therefore to the proper interworking of all its essential constituent, including the existing and emerging ones: telephony; packet-switched data, ISDN, satellite, mobile, etc .

"B" "Broadband" not only means the "high-end" (in terms of bit-rate) portion of the services, it also designates the total mix of services to be considered, starting from the "upper end" of ISDN (e.g. certainly including 2 Mbit/s accesses, and possibly even 64 Kbit/s in specific application areas), up to what will be required by a realistic introduction of video (interactive and distributive) services (e.g. 140 Mbits/s).

"C" "Communication" not only means the "conventional" switching/transmission/CPN functions, it also includes the most advanced features to make service provision user-friendly, performant and economically sound.

[3])Council Decision of 14 December 1987 on a Community programme in the field of telecommunications technologies - R&D in advanced Communications technologies in Europe (RACE programme); 88/28/EEC: O.J. No L 16/35, 21.1.88.

Objectives of Part I : IBC Development and Implementation Strategies

Common understanding of the IBC evolution and its implications	Establishment of framework for collaboration between operators, industry and users	Development of a common "System engineering" approach to network evolution planning
	Common strategic techno-economic investigations taking into account demand and technology options	Definition of of optimal conditions for IBC introduction
		Common identification of of major technical issues.
		A coherent EC position in international activities outside RACE.
Common definition of IBC systems and sub-systems	Development of a Reference Configurations to define the systems and sub-systems in Integrated Broadband Communication Networks	A reinforcement of European standardisation
		Agreement on a common European strategy in the domain of ATM specifications.
	Development of suitable implementation options and technologies.	
Guideline for functional specification of IBC systems and integrated services	Development of a Functional Reference Model, with a logical structure of functions and interfaces	Agreement on common functional specifications
		Agreements on "network integration" concepts and protocols.
		Agreements on medium and long-term options for broadband customer access.
Identification of technology and R&D requirements	Co-operative development of a Usage Reference Model to link user requirements to technical options.	A focusing and concentration of European R&D on key technologies and new user needs.
	Joint and common assessments of technology developments.	
An understanding of the cost-effectiveness of alternative implementation routes	Development of common tools for techno-economic and operational assessments.	Common tools have been developed for techno-economic analysis, for advanced network planning and management.
Analysis of standardisation requirements	Regular meetings with the standardisation bodies; Coordination between the Consensus Management Project and (ETSI), and joint investigations of standardisation requirements deriving from the evolution in user needs worldwide.	596 contributions to standardisation bodies (Annex II)

Objectives of Part II : IBC Technologies

Use of advanced technology for cost-effective implementation of IBC.	R&D in cost-critical optical components, subsystems and systems for both broadband transmission to the customer premises and switching. Investigations of short term opportunities for immediate cost reductions. Investigations of Medium/long-term opportunities for major cost savings and service enhancements.	Specification and prototype development of connectors, lasers and switching elements for local networks, CPNs, etc. Demonstration of prototypes, and low cost production procedures. Development of "direct" and "coherent" detection technologies. Development of ATM technologies for cost-effective bandwidth use. Development of compatible algorithms for bitrate compression for digital HDTV and high-quality video services, and low-cost CODEC development.
Telecommunications software for complex integrated systems.	Development of a new architecture for service provision: an Open Service Architecture Investigation of Advanced Information Processing Techniques for IBC functions. Investigation of new software technologies to specify, design, implement, verify and maintain telecom systems.	Development of "object oriented" programming for telecom systems. Validation of prototype Integrated Software Engineering tools. Development of TMN architectures and prototypes for traffic management, maintenance, Quality-of-service control, customer and network administration, and secure communications. Specification methods, development environment and on-line support for telecom systems. Establishment of integrity concepts for IBC services, and a portfolio of integrity primitives.
Advance in ergonomic and cognitive facilities of IBC equipment.	Investigations of usability issues for dialogue, distribution, retrieval, integrated services, and domestic CPNs. Investigations of usability issues for People with Special Needs (elderly and disabled). Development of usability design targets. Incorporation and evaluation of usability issues in Application Pilots.	A taxonomy for usability engineering. Implementation of easy-usability features in advanced communications experiments, including for people with special needs. Enhanced interaction between usability researchers, users and equipment designers. Systematic capture and analysis common usability issues in Application Pilot projects

Realisation of evolutionary subsystems and networks.	Definition and demonstration of generic architectures for IBC systems and subsystems,including video bit-rate reduction. Development of concepts and frameworks for Customer premises networks, to satisfy domestic and business requirements Development of prototype terminals. Adaptation of systems, enabling a smooth evolution to IBC. Development of prototype Integrated systems comprising local networks, customer premises networks and terminals, interconnected via agreed interfaces.	Definition of functional and design specifications for local networks, CPNs and terminals (multi-service, multi-media, incorporating digital video-recording and flat panel displays). Demonstration of a colour EL flat panel display and driver. Designs for components and sub-systems for domestic and business CPNs in an ATM environment. Specifications for integrated systems, and their validation through demonstrators.

Objectives of Part III : Development of IBC Application Schemes

Development of verification tools, verification of design concepts, functional groups or protocols	Joint development of tools and testing procedures for IBC Network Elements and subsystems. Verification of protocols at critical IBC reference points.	Verification of tools and IBC functions at terminals, in Customer Premises Networks, and at switches on local and trunk Exchanges. Identification of the test access points and protocols. Recommendations for protocol conformance testing.
Refinement of functional specifications and/or verification of standards proposals	Integration of pilot systems to test of interworking protocols. Pre-normative verification of critical standardisation and specification items.	Specifications of systems and subsystems in a multi-service environment. Validation of mechanisms for demonstration of interoperability and compliance with standards.
Development of experimental situations where service providers, network operators and users can test IBC experimental products - to clarify the potential for IBC commercial exploitation	Definition of future service requirements in collaboration with leading edge users from all major business sectors. Implementation of an IBC testbed at various locations in Europe. Exploration of interconnection and interworking issues.	Realisation of Application Pilots in all major sectors: Banking and Finance, Insurance, Media and Publishing, Manufacturing, Health Care, People with Special Needs, Transport and Distribution, HDTV Experimental Use. Definition of requirements and agreement on testbed interconnection trials.

2.3 The implementation of the Programme

In view of the rapid evolution of the telecommunications sector in Europe, a phased implementation of the RACE Programme was adopted. The Programme began with a Definition Phase[4]) in 1986. This was followed by the Phase I, the subject of this report, which formally began in June 1987, and which ended in December 1992.

In Phase I, the work structured in three parts :

Part I - IBC Development and Implementation Strategies

Part I projects addressed the development of functional specifications, systems and operations research towards the definition of proposals for IBC standards, concepts and conventions conforming to an open systems approach, and the analytical work addressing the interoperability of IBC equipment and services. The results of Part I projects are in the public domain and represent a major contribution to the work of the international standardisation bodies.

Part II - IBC Technologies

Part II projects addressed the technical challenges of IBC implementation. They have made a major contribution to development of the technology required for the low-cost realization of IBC equipment and services.

Part III - Pre-normative Functional Integration

Part III projects addressed pre-normative objectives related to the realization of an "open verification environment" designed to assess functions, operational concepts. Twenty of the projects in this part of the programme involved pilot applications of advanced communications in various business and service provision environments. These projects tested experimental equipment and applications against real world functional specifications and standardization proposals arising from the work of Part I projects.

The RACE Programme was implemented in two steps. The first set of projects started in January 1988 and addressed system engineering (Part I) and technological work (Part II)[5]. The second, which addresses the investigation of future services, system integration and verification (Part III), was the subject of a Call for Proposals in July 1988. These projects started work in January 1989.

The emphasis on each Part of the programme evolved during the selection of Projects and the implementation of the Programme. The resources devoted to Part I were increased from the estimated 11.9% to 18%: Part II decreased from 66% to 55%, and Part III increased from 22.4 to 27% of the resources. This evolution reflected a shift in emphasis from technology development towards service development and demand investigation, and the strength of proposals for work in Parts I and III of the programme.

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[4])Council Decision of 25th July 1985 on a definition phase for a Community action in the field of telecommunications technologies - R&D programme in advanced communications technologies for Europe (RACE): 85/372/EEC; O.J. No L 210/24; 7.8.1985

[5])Communication from the Commission to the Council and Parliament "Working towards Telecom 2000 - Launching the Programme RACE - COM(88) 240 final II of 31.5.88

The distribution of the financial resources of the Programme is summarised in Table 2.

TABLE 2

SUMMARY OF USE OF FINANCIAL RESOURCES IN PHASE I OF THE RACE PROGRAMME

PROGRAMME	DECISION (MECU)	(%)	ACTUAL (%)
Part I	60	11.9	18.0
I.1 IBC Strategies	14	2.8	
I.2 IBC Realization	28	5.5	
I.3 IBC Usage	10	2.0	
I.4 Common operational environment	8	1.6	
Part II	332	65.7	55.0
II.1 IBC Systems Functions	94	18.6	9.0
IBC Programming Infrastructure	49	9.7	25.0
Usability Engineering	12	2.4	11.0
Network Evolution	177	35.0	10.0
Part III	113	22.4	27.0
III.1 Verification tools	63	12.5	6.0
III.2 IBC Application Pilots	50	9.9	

The 92 R&D projects have involved the participation of 306 companies, including all the major European telecommunications actors. In addition, 27 organisations from EFTA countries (Austria, Finland, Norway, Sweden and Switzerland) participated in the work.

2.4 Key results

The RACE programme has strengthened the harmonisation of the European Telecommunications infrastructure: a prerequisite for the completion of the single market. The Common Functional Specifications are a "blue-print" for European Integrated Broadband Communications. This achievement has only been possible through the cooperation of all the European Network Operators, telecommunications industry, broadcasters and major leading-edge users: cooperation which has been the hallmark of the RACE programme.

In developing early awareness and reaction to change, the RACE Programme has also made a significant contribution to enabling European telecommunications and services actors to obtain strategic competitive advantage in the increasingly global market for telecommunications equipment and services.

Details of the achievements of each project are given in Annex I to this report and in the Annual reports for 1988, 1989, 1990, 1991 and 1992. Key achievements in each area of the programme are highlighted below.

Key achievements in Part I : IBC Development and Implementation Strategies

The work has led to a common understanding of IBC evolution and its implications; effective collaboration between operators, industry and users in development of common functional specifications for IBC, and in common strategic techno-economic investigations.

Close working relations with European and International standardisation bodies have been established. A coordination group between the Consensus Management Project and the European Telecommunications Standards Institute (ETSI) was set up in 1989. The work on the Aysnchronous Transfer Mode (ATM) has contributed directly to agreement on a common European strategy in the domain, and to emerging international standards.

Common definitions of IBC systems and sub-systems have been agreed, and Reference Configurations defining the system structure of the Integrated Broadband Communication Network have been developed. Functional specification of IBC systems and integrated services have been adopted, and a Functional Reference Model now exists. It defines a logical structure of the IBC functions and interfaces, acting as a central agency for all functional requirements on implementation. The Common Functional Specifications, CFS) were widely distributed in 1990.

Interface definitions at key reference points in Broadband networks have been defined, and components and system requirements have been established.

A "Usage Reference Model" has been developed to provide a conceptual framework to link user requirements and functional requirements.

Systematic assessments of technological and operational options, including optical communications, mobile communication, satellites, CPN, new switching techniques, and HDTV have been completed.

Tools of the evaluation of cost-effectiveness of alternative implementation routes have been developed: a first set is related to economic analysis and a second to network planning and standards. These tools provide the basis for transnational comparisons of options and strategies in relation to technical and economic characteristics as well as standardisation requirements.

Key achievements in Pt II: IBC Technologies

The R&D has focused on cost-critical optical components, subsystems and systems for both broadband transmission to the customer premises and switching, aiming at cost-efficient solutions for applications in all major domains.

ATM technologies have been defined and developed as a means to provide flexible and "future-proof" implementation of broadband communications. Realisation and comparison of different ATM options have been completed, and requirement specifications for ATM switching systems have been developed.

Compatible video coding techniques for (HD)TV and video telephony have been developed, ensuring cost-efficient use of bandwidth resources. Use of algorithms for bitrate compression techniques for high quality video services (TV & video-telephone) have been simulated and CODEC development has already had a major impact on the standardisation and commercial introduction of cheaper video-conferencing.

Major advances have been made in multi-gigabit optical communication systems and photonic switching. Specifications have been developed for systems, subsystems and components (connectors, lasers, switching elements, etc.), considering in particular cost aspects of different areas of applications (local network, CPN, etc.). Prototype components and subsystems have been produced and demonstrated.

In the area of telecommunications software for complex integrated systems, object-oriented models have been developed; Architectures and prototypes for traffic management, maintenance, customer and network administration have been defined; Specification methods, and a "development environment" for on-line support for telecom systems have been developed. An architecture for secure communications has been defined.

In the area of ergonomic and cognitive research, a taxonomy for usability engineering has been established, and usability engineering requirements in advanced communications have been identified, including for people with special needs.

Generic architectures and appropriate techniques and technologies for IBC systems and subsystems,including video bit-rate reduction, have been developed. These act as a framework for satisfying domestic, business and other requirements across a range of applications.

Various types of terminals integrating flat panel displays have been tested and adapted for use with IBC services. Integrated systems, (comprising local networks, customer premises networks and terminals, interconnected via agreed interfaces at S and T reference points) have been used to validate functional specifications and technologies.

The research on "mobile communications" has set the conceptual framework for a 3rd generation of radio-based cellular communications. It has resulted in the definition of Universal Mobile Telecommunications (UMTS), which will be able to meet major European market demand in the mid-1990s.

Key achievenments in Part III : Development of IBC Application Schemes

This work has focused on development of verification tools, and verification of design concepts, functional groups or protocols. Terminals, Customer Premises Networks, Customer Access systems, Switching (on local and Trunk Exchanges) and transmission systems have all been the subject of testing procedures, jointly developed by system engineers and testing tools designers. Test access points and protocols have been defined.

Pilot applications of IBC have involved service providers, network operators and users in tests of IBC experimental products so as to speed the understanding of the characteristics of IBC commercial exploitation. Pilot applications have been carried out in all major sectors: Banking and Finance, Insurance, Media and Publishing, Manufacturing, Health Care, People with Special Needs, Transport and Distribution, and HDTV Experimental Use. They have involved the participation of more than 100 leading edge users.

For the implementation of Part III and some complementary work in Parts I and II, the need for a Europe-wide test infrastructure was recognised. In 1989, a proposal to provide a preliminary broadband network on an experimental basis was submitted by the major European Telecommunications administrations. This was based on an agreement to implement a European Broadband Interconnection Trial (EBIT) - at 2 Mbits/s progressing to 140 Mbits/s for trans-national connections. The Major participating Network Operators signed a Memorandum of Understanding, and a multi-national team was assembled to give advisory support to the Application Pilots on their network and software requirements in order to assure interoperability of end-user systems. This exploitation and support project, within RACE, helped to guide the various "Application Pilots". However, because of difficulties in the establishment of cost-effective trans-national links for research activities, most have so far been limited to experimentation on national test-beds. It is only now in 1993 and 1994, with the possibility of experimental use of ATM systems, that a transEuropean Broadband trial, with bandwidth on demand, is becomming a cost-effective possibility.

Nevertheless, the function of the application pilots, in providing feedback from real usage environments into the technology development and specifications developments, has been fulfilled.

2.5 Involvement of SMEs

Despite the high cost of R&D in advanced telecommunications, the first phase of RACE attracted a strong participation from small and medium-sized enterprises (SMEs). The represented 28% of the participations in RACE projects, significantly greater than the 16.5% for the 2nd Framework Programme as a whole[6]). Small organisations, whether enterprises of research organisations, participated in over 60% of projects.

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[6])Evaluation of the second Framework Programme of RTD: Report from CREST to Council, September 1992. CREST/1212/1/92.

2.6 Contribution to economic and social cohesion

By investigating and developing strategies for IBC introduction all areas of the EC, including in less favoured regions, the programme has paved the way for the realisation of TransEuropean broadband communications Networks as forseen in Chapter XII of the Treaty on European Union. Particular attention has been given to the need to link island, landlocked and peripheral regions with central regions of the Community.

A substantial number of accompanying measures, workshops and summer schools have ensured that the R&D carried out has been accessible to scientists and engineers from all areas of the European Community, and a particular effort has been made to organise workshops and seminars in less favoured areas. A full list of these activities is included in Annex I.

53 projects (60%) involved organisations from less favoured regions of the Community, and through their participation, contributed to tranfers of technology and expertise to these regions.

3 Evaluation and Auditing of the RACE Programme

3.1 Evaluation as an on-going process

In view of the rapid evolution of communication technologies and services, evaluation has been seen as an on-going process throughout the preparation of the programme, its implementation and its execution. It has also been a process that has affected every level: the strategic orientation of the programme, the operational management of the programme, and the technical direction of every project.

The evaluation process started with the extensive collaboration of telecommunications actors in planning the programme and in development of the Workplan. Continuing collaboration with industry and telecommunications operators allowed a yearly up-date of the both the Programme Workplan and the workplans of each project. In addition, regular meetings between the consortia making up the programme (Concertation Meetings) ensured that there was a continuous informal process of progress monitoring and adjustment by all projects. The consistency of work was assured by the Consensus Management Project, which developed close relations with European standardisation bodies.

The progress in work was reported to the Council of Ministers and the European Parliament in 1990 in the "30 month" review provided for in the Council Decision[7]).

This Final report has been prepared in response to Article 9 of the decision which requires that, after the completion of the first five-year period of the programme, *"the Commission shall, after consulting the Management Committee, shall send to the Member States and the European Parliament a report on the performance and results of the programme"*. It updates and replaces the 30-month review submitted in 1990.

In accordance with Article 6/4, third indent, the Commission referred this report to the Management Committee for its favourable opinion.

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[7])This report was in response to Article 9 of the Council Decision which required that: "The programme shall be reviewed after 30 months on the basis of an evaluation of the results achieved in relation to the precise objectives set out in Annex II to this Decision. The Commission shall inform the Council and the European Parliament of the results of this review."

3.2 Programme Audits and evaluations

The work on Integrated Broadband Communication (IBC) in RACE has been periodically adjusted to respond to rapidly evolving techno-economic conditions and service opportunities. Therefore, within the programme, a yearly critical examination (Audit) has been carried out in two aspects:

- **The strategic aspects**, evaluating the performance of RACE as a whole with respect to strategic and policy objectives of the Community in an international context

- **The technical aspects**, evaluating the performance of the RACE projects with respect to the RACE objectives

In addition a **programme management**, adit was carried out. This has provided an independent evaluation of the performance of Commission services in fullfilling their responsibility for the management of the programme.

3.2.1 Strategic Audits and programme evaluations

An independent Strategic Audit was carried out in 1989 to evaluate the work in respect of the strategic and policy objectives of the Community in an international context. The main conclusions were that:

- The basic RACE objective remained valid: IBC development is appropriate and necessary for Europe and the 1995 target date was consistent with requirements and with worldwide evolution.

- The emphasis in RACE on the different areas covered was appropriate

The Audit panel also recommended that, in the next phase, more effort should be given to customer-premises facilities, mobile applications, digital HDTV and verification and testing, with ATM considered as the key network technology.

In line with the principle of subsidiarity, the Strategic Audit also highlighted the actions that would need to be taken outside the RACE programme by National Government organisations and by the telecommunications actors to ensure that the achievements in R&D are effectively followed up by IBC implementation. These recommendations are recalled in Table 4.

Some of the recommendations were acted on: The recommendation that telecommunications administrations prepare an MOU on close collaboration in their intra-European long-distance links and operations was taken up in the METRAN MOU and in the setting up of the GEN agreements, and in establishment of EURESCOM; The extension of the scope of R&D was realised, standardisation efforts on ATM were strengthened, and an ATM experimental implementation is now being developed. However, other recommendations have not been followed up on the timetable proposed: The regulatory environment in Europe has not allowed the convergence of interest of telecommunications, broadcasting and cable-TV administrations in the way envisaged, and the development of HDTV has been slower than anticipated.

The strategic Audit was followed in 1990 with a forward looking investigation of future requirements and options in which leading strategy, policy and technical experts collaborated. The recommendations of this Requirements Board were documented in the "Telecom 2000" report, and formed the basis for the development of the Workplan for the 2nd Phase of RACE.

In 1991 and early 1992, the RACE programme was again evaluated in the context of the other major IT and Telematics application programmes of the 2nd Framework Programme (ESPRIT and DRIVE) by an independent Panel chaired by Mr Dekker[8]). The Commission has separately responded to the recommendations of this Panel[9]).

Recommendations of the Strategic Audit Panel in 1989

A) National Governments should collaborate to define by 1992 the conditions and regulatory provisions which should be applied to the introduction of pan-European advanced communications services;

B) Telecommunications, Broadcasting and Cable TV Administrations should propose, by mid-1989, a concerted approach to, and a timetable for, development and use of IBC infrastructures for both telecommunications and entertainment services including HDTV, taking full advantage of private sector investment initiatives when appropriate;

C) Telecommunications Administrations should prepare an initial Memorandum of Understanding by 1990 on closer collaboration in their intra-European long-distance links and operations;

D) Service Providers should specify, by the end of 1990, a first set of service requirements, commercial conditions and regulatory provisions which would favour an early and widespread use of IBC services;

E) Telecommunications, Broadcasting and Cable TV Administrations, Service Providers and the Telematics Industry should agree a Memorandum of Understanding by mid-1989 to complement the collaborative R&D in RACE by pilot implementation of some IBC Services on a European scale for a business-led introduction of IBC by 1992;

F) Collaborative R&D should be extended to include Integrated Service Engineering, fixed and mobile applications and techniques for verification & testing of communications equipment and service functions by the end of 1989;

G) European Standardisation Bodies should reinforce and co-ordinate their efforts towards international standardisation for IBC and advanced services. A standardisation schedule should be established by mid-1989, particularly for ATM;

H) Member States should address the problem of frequency allocation in Europe over the whole range of frequencies and applications. They should permit, by 1992, a rationalisation of frequency allocations reflecting evolving needs and priorities.

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[8])The report of the information and communications technologies review Board, Chaired by Mr. W. Dekker, June 1992.

[9])The Commission's response to the Dekker report, January 1993

Finally, in 1992, the Commission reported on the programme in the context of its Evaluation of the 2nd Framework Programme[10]. The Committee on Research Science and Technology (CREST) was invited by the Council to comment on the Commission's report. CREST passed on the invitation to the RACE Management Committee (RMC), which submitted the following report in July 1992:

Quality of Results & Impact on Competitiveness

In general terms, the RACE results have, as a minimum, been state-of-the-art, and there are many instances where breakthroughs have been achieved [eg. ATM: Asynchronous Transfer Mode, Mobile (UMTS: Universal Mobile Telecommunications System), Optical Technologies and Devices].

Europe is in a better position now than it would have been without RACE. Other countries may still be further ahead than Europe, but the technologies-gap in European telecommunications has narrowed appreciably, with respect to both the USA and Japan.

During the five years of the 2nd Framework Programme RACE has largely met its technical objectives, as determined in the Council Decision. However, the pace of change in the telecoms sector (eg. new service requirements, new technologies, increasing competitiveness between operators) has been such that the objectives and priorities of the Programme itself needed to be adjusted during the course of its five year duration. Other additional objectives with new priorities have arisen (such as communications experiments and infrastructures for test and verification), which have been taken up by subsequent programmes such as RACE II (the second phase of the 10-year RACE programme).

The RACE Programme has stimulated the cooperation between Public Network Operators (PNOs) (in strategic planning such as EURESCOM); between Industries (in the formation of an Industrial Consortium - RIC) and between PNOs & Industries (eg. in standards bodies such as ETSI). However, both the scale and scope of this type of cooperation need to be further developed.

Besides numerous scientific and technical results, RACE I produced 470 contributions (as of 6/92) to standards bodies (mainly ETSI) based on the development of its Common Functional Specifications.

For the telecoms industry, collaboration within RACE has increased its competitiveness within global markets. For European industry as a whole, the positive influence of RACE should become more visible in the longer term, with the wide-spread adoption of advanced communications. Further R&D on applications can demonstrate to the potential users the competitive edge they may gain through state-of-the-art communications.

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[10] Communication from the Commission on "Evaluation of the second Framework Programme for research and technological development (SEC(92)675 Final), July 1992.

Management and Cost Effectiveness

Within the Framework Programme, RACE is a coherent Programme with specific objectives common to all projects, within an overall timeframe of ten years. During RACE I greatest progress was made in the areas of ATM, Optical Components & Technologies, Mobile (UMTS), and Broadband Experiments. As a result, the latter two categories received much greater emphasis in RACE II. Areas where less progress was made include Security, and Usability Design, where original goals had to be diminished.

Central to the collaboration achieved within RACE is the Concertation Mechanism. In general, Europe-wide collaboration as realised by RACE is cost-effective as it leads to a multiplication factor in the results achieved by the partners for the investment they have individually made.

The tender evaluation and technical audit procedures worked well: for example, the "Red Flag" procedure successfully re-directed and re-vitalised projects that would otherwise not have met their objectives; or stopped projects at an early stage avoiding the wastage of resources.

Given that the programme was on the whole well structured and well managed, improvements are still possible in a number of areas:

o Cooperation/Collaboration with other European, multinational programmes of research has not been effective enough.

o There should be a mutual commitment amongst the Commission, PNOs and Industry on the support for the programme and its objectives before the Workplan is adopted.

o Increased effort should be made to maintain the quality of the overall programme as distinct from the individual projects within it. Eg. Too many key participants do not themselves remain involved over the life-time of the Programme.

o Cost effectiveness of Concertation Meetings needs further optimisation.

o The Consensus Management project should ideally be the first project to be engaged so that effective relationships with the other projects can be ensured.

o Measures should be taken to increase the active role and participation of SMEs in future programmes.

o Greater use should be made of Concerted Actions and Supporting Measures.

Consistency with EC Policies and Principles

The technical selection criteria used for both the evaluation of tenders and the auditing of projects have proved to be satisfactory.

Social and economic criteria were not explicitly taken into account in the selection of projects for RACE I. However, in general terms, a telecommunications programme such as RACE is consistent with prevailing policies on environment and energy conservation.

Concerning subsidiarity, it is clear that there are benefits to be gained from European-level collaboration in pre-normative research in telecommunications. However, closer inter-working with national programmes and experiments should also be encouraged.

Conclusions

1995 cannot be the end point for telecommunications research programmes within Europe. There needs to be a further programme after RACE.

Research and Development is necessary but not sufficient to gain a good position in the future telecommunications markets. The RMC is not, in this document, specifying what further measures are necessary to achieve this result. The change in emphasis of telecommunications R&D in the direction of services and applications should have an influence on the structure and organisation of future programmes.

The results of RACE should more widely be taken up and used within Europe. The necessary initiatives to achieve this transfer may need to be taken by the Sector Actors".

This report formed part of the basis on which CREST reported to the Council on the 2nd Framework Programme in October 1992.

3.2.2 Impact assessments and forecasts

The research and technology development within the programme has been accompanied throughout the five years by regular assessments of the economic and social impact of developments in advanced communications. The reports of these assessments have been published and widely disseminated as the series of reports on "Perspectives for Advanced Communications in Europe: PACE" The most recent of these assessments was carried out in 1991 and disseminated in 1992. This activity provides the factual background for the yearly up-date of the work under the programme as well as minor adjustments during the course of the year. The major part of this activity has now been fully integrated into the 2nd Phase of RACE following the provisions made in the Council Decision on the Specific Programme on Communications Technologies.

3.2.3 Programme management audit

The programme management procedures adopted by Commission services for the RACE programme were subjected to an independent "programme management Audit" in 1989.

The main recommendations were that the industrial programme management style adopted by Commission services was, on the whole, appropriate for the objectives and the partners in the Programme, and that yearly Technical Audits and the periodic Concertation Meetings have proved an effective approach to Programme Management.

3.2.4 Technical Audits of RACE projects

To be able to adapt the Programme to the development of technology and to changes in the perception of demand, the RACE Decision foresaw an annual revision of the workplan.

This implied that the progress of all the on-going projects be annually reviewed with respect to the objectives and also be compared with new needs. For this reason, each project has been subject to a "Technical Audit" by independent experts in the relevent field of research every year. The first such Technical Audit took place in October 1988 and the last in October 1992. The results of these annual audits has been used to re-direct or terminate the work of Projects when necessary.

The Technical Audit has consisted of the following major elements:

(a) Each year, the partners in each project have carried out a "self-evaluation" by reviewing the project in all its essential aspects and have documented the results in an Annual Review Report.

(b) These have been evaluated by independent external experts (Auditors) identified with the help of RMC. Following the evaluation of the reports, the projects are given a "hearing" under the chairmanship of the Commission. The Projects had the opportunity to highlight achievements and to outline future work. The Auditors, grouped in Panels according to their respective expertise, have been able to question the projects to complete the picture given by the Annual Report and the Presentation.

(c) The Panels have consolidated their conclusions and recommendations, and have documented them in the Audit Panel Reports to the RMC and to the Commission.

(d) The Audit Reports have been complemented by an assessment of the contractual deliverables by the Project Officers of the Commission (in general the deliverables are considered confidential and are not disclosed to the Auditors).

This procedure has proved both fair and effective. The Audit reports have served as an excellent basis for negotiation of contracts for the detailed workplans of each project, each year.

4. Links with other EC and European actions

4.1 Links with CEPT.

Links with CEPT and its subsidiary bodies have changed substantially during the development and implementation of RACE.

During the definition Phase, the Special Group on Broadband communications (GSLB) set up by the CEPT made a major input into the workplan for the Phase I of RACE. During 1987 and 1988, coordination with the work in CEPT was assured by GMR (Group Mixed RACE) established for this purpose in September 1987.

In 1988, collaboration with CEPT also resulted in 13 European Telecommunication Administrations signing a MoU to introduce a generalised testbed for IBC work (EBIT).

The re-regulation of telecommunications, in line with the new European Telecommunications Policy, led the CEPT to set up a number of separate bodies, two of which have established strong linkages with RACE activities: ETNO, the European Telecommunications Network Operators group, is now the forum for discussions between network operators on network interoperation issues; and EURESCOM provides a forum for joint strategic research. Not all major European PNOs participate in EURESCOM, but it nevertheless serves as a valuable interface between the Commission, RACE projects and the most network operators.

4.2 Links with European and international standardisation bodies

As part of the implementation of European telecommunications policy, ETSI, the European Telecommunications Standardisation Institute, was set up in 1988. It is now established as the major European forum for the development of technical specifications. The pre-normative work in RACE has produced 596 separate contributions to the standardisation work of ETSI, CCITT and CCIR.

In addition, regular meetings have been held with representatives of CEN/CENELEC, EBU and SPAG.

4.3 Links with other Community programmes/European activities

RACE projects capitalize on the results of projects developing generic technologies, i.e. ESPRIT (microelectronics components, software tools, AIP for network management etc.); similarly, the telecommunications requirements of telematics applications (DRIVE, DELTA and AIM) draw heavily on the techniques addressed by the current RACE projects.

The collaboration with COST has been implemented by close links between related work and periodic meetings on the programme management level.

With the EUREKA Initiative, the strongest interaction has evolved in the field of audiovisual technologies. Part of the work related to the promotion of HDTV (EUREKA project 95) was complemented by work under a RACE contract; and EUREKA project 256 on video-coding was associated with the RACE integration activities.

4.4 Links with organisations in EFTA counries

Organisations from Austria, Finland, Norway, Sweden and Switzerland are involved in RACE. 27 organisations from those countries participated in 72 projects (in over 80% of the work).

5. The exploitation of RACE results

The opportunities presented by the new communications technologies will have a very important impact on future economic growth in the Community and the international division of labour world-wide. Three distinct but interlinked growth processes are at work:

- Improved access to better information raises productivity throughout the economy,
- Improvements in communications raise the utility, and consequently the marketability, of both old and new services leading to their expansion,
- Transition to the new service-driven and information-based economy requires very large public and private investment in new infrastructures, both physical - cable, switches, terminals - and human, for the development of value-added telecommunications services.

Thus the quality - both technical and organisational - of communications will be crucial for future economic growth since it determines the capacity of the economy both to generate, and to use efficiently, the single most important factor of modern "production" : knowledge. The geographic organisation of infrastructures will strongly influence the social, economic and cultural space of tomorrow, just as railways did in the 19th century.

For these reasons, the results of Communications-related R&D must be promptly and effectively exploited. Particular attention has therefore been given to the exploitation of RACE results throughout the programme.

5.1 The RACE exploitation plan

In order to stimulate and assess the exploitation of RACE results by the participants, a "RACE Exploitation Plan" has been regularly updated throughout the period from 1988 to 1992. It provides an integral view of the exploitation of the results by participants.

The contributions to standardisation are listed in Annex II, and the titles of scientific and technical publications are listed in Annex III. With over 1700 scientific and technical publications as as result of the work, the RACE programme has made a major contribution to the open scientific literature.

The results of technology development has also been protected by Patent applications where appropriate. 73 Patent applications relate to RACE work have already been registered. They are listed in Annex IV.

5.2 IBC implementation planning

Effective exploitation of R&D is only possible if all actors have a coherent view of the direction and pace of commercial developments. The R&D in the RACE programme has therefore always been scheduled and specified in relation to an indicative implementation plan for Integrated Broadband Communications, which has been regularly updated. It involves a step-wise introduction of advanced services, starting with the ones for which there is business and professional demand as early as 1992/1993. The current indicative implementation schedule, as described in the RACE annual report for 1992 (RACE'92) involved the following milestones:

1992/1993:

- Early introduction of business and professional applications;
- Advanced Communications Experiments to test new services and network management systems: ATM, MAN,and IBC in Customer Premise networks.
- Procurement/investment decisions for future pan-European IBCN and full IBC services,
- Major standards finalisation,

1994:

- Completion of inter-connection of all capitals of the Community and with neighbouring countries, based on the extension of existing optical trunk networks, but supporting voice, data and image traffic, either separately or as integrated services.

1995:

- Initial IBC network implementation and completion of customer access for business in centres of economic and manufacturing activity: At least 50,000 corporate users of advanced services.
- Application field trials to test a full range of IBC services (incl. residential customers with 2-way video and digital HDTV) using commercial IBC equipment,

1996:

- Offer of commercial basic broadband services, based on 2, 34 and 155 MBit/s links, including fast inter-LAN data transmission, dest-top video-confrerncing, video-processing, CAD/CAM and telework applications.
- Inter-operation of fixed broadband networks with mobile, satellite and other networks.

1997:

- Availability of IBC services to business users in towns of more than 500,000 inhabitants, and beginning of wide-spread "fibre-to-the-home" implementation.

2005-2010:

- 50% penetration of IBC services.

This indicative timetable will again be reviewed in 1993, in the context of the preparation of guideline for the development of TransEuropean Broadband Networks, as foreseen in Title XII, Article 129b and c of the Treaty on European Union.

6. Implementation of Phase II of RACE

The RACE programme was always intended as a ten-year programme of work, to be implemented in two phases. To ensure continuity, the second phase was adopted in June 1991 as a specific programme within the third EC Framework Programme for research and technology development.

However, by 1991, an important shift in perception had occurred. What had seemed to be an ambitious, almost futuristic, vision at the beginning of the Programme, had matured to a realistic opportunity. Commercial introduction of Integrated Broadband Communications was now confidently expected within four years. Moreover, it had become even more evident that telecommunications and advanced information services would play a key role in world socio-economic development as we approach the 21st century.

These changes led the European Parliament and the Council of Ministers to give priority to adoption of the new Specific programme[11]). It was the first of those in the 3rd Framework Programme to be adopted, and the Workplan was immediately the subject of a favourable opinion of the Management Committee. A call for proposals was published in June 1991; the proposals were evaluated in September and October 1991. Over 200 proposals were evaluated and 95 projects started work in early 1992. They are scheduled to complete their work, within the current budget provisions, by the end of 1994.

Whereas the projects in Phase I of RACE concentrated on the evaluation of options, those in Phase II prepare for the introduction of IBC. The RACE II projects will reinforce the collaboration and commitments already made by industrial users, the telematics industry and telecommunications operators in RACE I. The focus of the new R&D is on applications, services, operation and management, but maintains a high level of technology development to consolidate and extend the key areas needed for realisation of cost-effective provision of IBC services.

The work covers the eight priority areas identified in the Annex to the Council Decision:

AREA 1 IBC (Integrated Broadband Communications) R&D
AREA 2 Intelligence in networks/flexible communications resource management
AREA 3 Mobile and personal communications
AREA 4 Image and data communications
AREA 5 Integrated services technologies
AREA 6 Information security technologies
AREA 7 Advanced communications experiments
AREA 8 Test infrastructures and interworking (horizontal R&D area supporting the other priority areas).

A full description of the new R&D projects in Phase II, and of their inter-relationship with the Phase I projects, is available in the Annual reports for 1992 (RACE'92) and 1993 (RACE'93).

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11) Council Decision 91/352/CEE of 7th June 1991: O.J. No L 192/8, 16.7.91

7. Future requirements and options for R&D on communications technologies at European level.

In June 1992, the RACE Management Committee set up an ad-hoc group to identify priorities for future European R&D in the area of telecommunications. The report of the group is reproduced below:

Many of these ideas and themes for future EC R&D have already been reflected in the Commission's Working Document of the 4th Framework Programme, notably in the proposed themes of "Image technologies", "high-performance computing and networks", "functional integration in manufacturing" and "Advanced Communications". The Commission will bring forward its proposals for Specific Programmes within the 4th Framework Programme, following consideration of all contributions, in 1993.

Rationale For R&D at Community Level

It remains the view of the RMC that there are clear advantages and benefits to be gained from undertaking R&D in Telecommunications at Community level. Globally speaking, research (and in particular Telecommunications Research) is a continuous process. To maintain the improved position already gained by the Sector Actors through their participation in Community actions such as RACE their collaborative research effort will need to be continued, further building on the results achieved to date.

Further consolidation of the fragmented telecommunications systems of the Community is necessary, both to ensure that the Single Market operates effectively, and to strengthen the competitive edge of European organisations in global markets. Standards bodies such as ETSI have come to value the technical contributions received as a direct result of the work of RACE. The process of "managing the flow" of results from Community R&D to Standard Bodies needs to be continued - and strengthened, as a part of subsequent programmes.

Advanced telecommunications is of increasing importance to the well being of national economies, to the extent that its constituent elements ("Information" and the ability to "communicate" that information) are considered to be strategic resources. This can be measured in terms of:

- the increasing proportion of national economies taken up by telecommunications investment, and

- the increasing impact of advanced telecommunications services on other sectors of economic activity.

These trends have been recognised in both the Single Act and in current efforts to complete the internal market of the European Community. The Maastricht Treaty foresees the establishment of Trans-European Networks (which include telecommunications networks). The creation at a European level of telecom infrastructures and services will require the long-term commitment of all the sector actors involved.

The synchronisation of evolution (again at a European level) towards the establishment of a broadband communications infrastructure offers a clear economic advantage, for return on investments made. This synchronisation would also facilitate the take up of new applications across all European regions, and enable rapid attainment of the critical mass necessary for self-sustaining growth in use of advanced services. There is no doubt, that telecom networks and an increasing number of Community services have a growing international scope. A wider cooperation outside of European regions might also be encouraged.

For all these reasons, the RMC is of the opinion that a specific Community R&D action in Telecommunications should be included as part of any future framework programme. This should further build on the substantial base established through previous programmes. However, the nature of telecoms R&D required beyond the 1995 time-frame is significantly different in emphasis to that which has been undertaken within RACE up to now.

Objectives for Future R&D in Telecommunications

Realisation of the Advanced Communication Vision where "everyone can communicate with everyone else at any place, at any time, by using text, sound and images" - requires that Europe take new initiatives in R&D.

Existing programmes such as RACE & ESPRIT have already made a major contribution towards the basic technical feasibility of this vision. The driving force for a new programme of Community R&D in telecommunications must now come from the needs of applications. In principle, these should also define the actions and priorities needed for further research in the basic supporting technologies.

It follows that any new programme should be centred on the following dual objectives:

- To promote "Operational Trials" of advanced services, to improve their usability and ensure that the end-result is attractive enough for widespread use in the daily life of Europeans.

- To further research "Future Technologies" needed to support advanced communications, to achieve a cost reduction of key components and so enable the provision of advanced services to become more feasible, economically speaking.

These two issues are particularly significant for the pan-European commercial realisation of advanced communication networks and services, even though this "realisation" also depends upon a number of other factors. To move this Advanced Communications Vision further towards reality, it is necessary to build on the growing mutual consultation by the sector actors, thereby gaining consensus on:

- how best to achieve the necessary enhancement to the performance of services and associated supporting technologies.

- target opportunities created by the convergence of telecommunications, broadcasting and information technology, on which a rapid evolution towards advanced communications may be based.

In short, continued Community R&D in advanced communications will in itself promote European cooperation and harmonisation, leading to the strengthening of European competitiveness in international markets and hence to the strengthening of the European economy as a whole.

Basis for Collaboration (Modus Operandi)

To develop the widespread attractiveness of Advance Communications and make technologies more "economically feasible", it is necessary to involve all the interested actors: Users, Network Operators, Service Providers, Industry, Research Centres, and Universities. The involvement of all these sector actors has to be guarantied from the beginning, through their involvement in the definition of an agreed workplan. In particular, the active collaboration of Public Network Operators (PNOs) in support of communication experiments should be encouraged, taking possible benefits of the existing or foreseen infrastructures.

In the next R&D programme, an increased role should be reserved for SMEs, many of whom have valuable expertise in the development of applications and services. This expertise is central to the needs of the Community to undertake this new domain of research. The need to strengthen the role of SMEs in future Communications R&D suggests that specific measures should be taken to facilitate further their active participation. As an example, more supportive contractual procedures may need to be utilised by the Commission (eg. the CRAFT mechanism used in BRITE/EURAM or other novel approaches).

Though RACE was on the whole successful, some new, or improvements to existing procedures should be considered for managing the next R&D Communications programme. The individual projects should be formulated within a well structured framework, defined in the workplan and geared specifically to achieving programme objectives. The Concertation Mechanism used successfully in RACE will also need to be further strengthened.

Increased coordination of Community programmes, better collaboration with other European or multinational programmes of research, and a closer interworking with national programmes and experiments all have to be encouraged whenever possible. Concerted actions with EUREKA, COST and other projects at a national level can also be considered.

Supporting measures for the programme should include a proper advertising of the projects during their execution and the promotion of results (and potential benefits/applications of these results) to all the sector actors, and especially the potential users of advanced communications.

Operational Trials and Development of Services

Past experience with the introduction of new network technologies and services has shown that the development and implementation of new applications requires well-organised, pre-operational and practical validation (operational trials) including all actors in the sector. The real challenge for these next generations of European operational trials is therefore to show ways and means to bundle (under free market conditions) potential services to meet the needs of key market sectors.

R&D in operational trials and development of services should concentrate on generic issues, which will allow advanced services to evolve. Though based on existing technology, the trials should point to suitable realisations of applications as networks become more intelligent and services more flexible. Major objectives for Operational Trials should include the formulation and contribution of proposals to the process of standardisation and proposals for platforms which include all viewpoints of the sector's application:

- *the enterprise (including organisation, interaction, information to user, management and security policies, cost/benefit analysis, legal, ethical and social approach),*
- *the information per se (including the definition of information elements, its quality, flow, and presentation to users),*
- *the telematics functions (including communication and processing functions, data representation types)*
- *the technologies (including hardware and software).*

In this way, Operational Trials should take account of changes in legislation, management and security policies, user access and man-machine interfaces, as well as give cost/benefit analyses and information quality definitions.

Generic services development requires service creation tools, incorporation of multimedia teleservices and terminals and the provision of advanced capabilities for services, their management and service engineering. As a consequence, the following prerequisites have to be met by future applications: They must

- *have sector-specific definitions; determined by providers and users*
- *be based on generic services, and consistent with open network provision;*
- *be defined by clear cost/benefit targets;*
- *have international market potential.*
- *have an ability to encompass within the short term, new requirements like personal mobility and ubiquity, broadband multimedia services, co-operative or intelligent networking.*

An empirical basis for identifying these applications may be gained from current national and CEC programmes (eg. in RACE, Telematic Systems, ESPRIT). The essential focus for future R&D programmes is to perform pre-operational tests and to demonstrate the European validity of applications. The following specific "Service Developments" should, in the opinion the RMC, be included in a future programme of R&D to better match user needs:

- *Enhanced videoconferencing and Interactive multimedia services;*
- *Teleworking and Virtual presence;*
- *Mobility, ubiquity and Information security;*
- *Narrow/Broad-casting services;*
- *Service management, and intelligent network services;*

Research of Supporting Technologies

Any new programme of telecommunications research should further build on the substantial technology base established through previous programmes. Strategic research is now required to enable cost advantages to be gained from next generation technologies. The overall objectives for this may be stated as:

- Provision of the technologies required for the evolution of cost-competitive networks and services in Europe ahead of the competing economic blocks, to make an important contribution to the strengthening of the European economy.

- Creation of the basis for a technically feasible and economically reasonable evolution of the telecoms network, also - in respect of standardisation - with the aim of strengthening the European economy.

The knowledge gained from these general areas of research may necessitate modification of the objectives and priorities in other areas of the programme. For example, the evolution of services technology may give some inputs to research on both component and network technology. However, the dominant concept should remain focused on the new services that can be delivered to the users through the telecom network. Given that a high level of personalisation will become a characteristic of these services, a closed loop interaction between network evolution and services development is needed. The following specific areas of research should in the opinion of the RMC, be included in a future programme:

Evolution of the network to create the basis for technically feasible, and economically reasonable, advanced communications

- *Integration of existing and new transmission media and systems (copper cable, optical fibre, terrestrial radio, satellites), including in distribution and access networks (fibre in the local loop etc.); Integration of mobile and fixed networks;*
- *Evolution of managed transmission hierarchies, and improved network management systems*
- *Ultra-high capacity optical transmission systems, and photonic network architectures;*
- *Managed nodes for B-ISDN (ATM) and enhanced signalling;*
- *Advanced intelligent networks, information network architectures (combining IN & TMN), and advanced software architectures.*

Evolution of technologies based upon the results of RACE and other EC programmes, in particular the evolution of terminals towards improved cost/performance and user friendliness

- *Multimedia workstations, and video-telephony;*
- *Advanced image and audio processing;*
- *Digital TV (SDTV, EDTV, HDTV);*
- *Voice Control in natural language;*
- *Ultra LSI devices for switching and transmission circuits;*
- *Advanced microwave IC's based on Si, III-V-materials; and*
- *Opto-electronic materials and devices for telecom applications.*

Annex I

Project contributions to the RACE objectives

Annex 1

PROJECT CONTRIBUTIONS TO RACE OBJECTIVES

1. PART I : IBC Development and Implementation Strategies

1.1 Consensus Management and Synthesis

Project	Main Deliverable(s)	Impact
R1045 Consensus Management	Consensus management across all RACE projects, leading to the publication of Common Functional Specifications (CFS) for IBC. Workplan for, and organisation of the Technical Groups which undertook the drafting of the CFSs (staffed by other projects' participants).	Secured the "overall" results of the RACE programme, through co-operation between Industry and Operators within the project. Formal conduit for coherent transfer of RACE results to ETSI. Exploitation of results through standardisation, and by widespread distribution of CFS to organisations participating in RACE.
R1044 IBC Development & Implementation Strategies	Provided a consistent view of IBC systems options, based on own work and that of all other RACE projects. Functionally separated service definitions into service components and service control elements. Developed reference configurations for specific network implementations, and used these to identify and evaluate evolution steps towards IBC. Developed a series of detailed specifications defining the UNI at the "T" reference point (the termination interface for public networks).	Core project to the systems study of RACE. The largest source of RACE contributions to standardisation bodies. Many publications. Active in the detailed transfer of results to and from RACE usage projects, (via R1077) and all other systems projects. Provided the backbone of support offered to R1045 for development of the CFS.
R1077 URM	Compilation of operational requirements based on results of usage projects. Results captured in a usage database. Methodology for, and examples of the derivation of generic service definitions from usage requirements. Wide ranging contributions to CFSs and consensus formation.	Concepts relevant to service designers working in a market driven environment. Core project of the usage area of RACE. Impact mainly felt within the programme, transferring results to and from the systems projects.

1.2 Functional Specification

Project	Main Deliverable(s)	Impact
R1023 BEST	Functional Specification Methodology. Handbook and consultation support given to other RACE Projects.	Harmonised approach to functional specification work.
R1024 NETMAN	Models and Methods for TMN functional specifications (eg. Cube Model, QoS Methodology). The actual specification of TMN Functions. Animated Simulation (Hypermedia tool) of the behavioural aspects of TM Functions.	Significant impact on Standards (CCITT SG IV and ETSI NA4). Results exploited by EURESCOM and RACE II Projects.
R1025 SECURITY	Definition of basic security services (authentication, integrity, confidentiality, non repudiation and denial of service detection). Concepts for a functional architecture for IBC security and security policy guidelines.	Integration of security aspects within IBC specifications.
R1040 RIPE	Recommended Portfolio of Integrity Primitives. Specified modes of use for these.	Implementation of secured network systems. Improved understanding of integrity primitives (statistical tests and simulation tools).
R1047 TIMI	Development of integrity concepts within IBC services, to support legally binding procedures for data exchange.	Introduction of low cost, reliable and easy to operate security measures in IBC.

1.3 Reference Configurations

Project	Main Deliverable(s)	Impact
R1002 Satellite communication for IBC	Specification of satellite system capabilities with respect to their utilisation in evolutionary scenarios towards IBC	Identification of the role of satellite communications in IBC. Contribution to elaboration of IBC standards, identification of role of satellite technology within IBC
R1026 International Radio and TV	Identification of requirements and scenarios for the integration of the Eurovision network into IBC.	Eurovision and Euroradio network digitalisation, ensuring Europe remains in the forefront of technical excellence and programme quality. Essential step towards full digitalisation of TV media.
R1028 REVOLVE	Evolution Scenarios most likely to be implemented within Less Favoured Regions (LFRs) were identified and assessed. Platforms for co-operation of Sector Actors established in Portugal and Greece	Tools for strategic planners responsible for LFRs, in their preparation of business plans and justification for further investment in infrastructure
R1041 FUNCODE	Techno-economic studies to determine optimal locations for video codecs. Contributions to image and voice coding standards.	Standardisation and strategic network planning of audio-visual services.
R1049 ATM Concept	Contributions to the specification of the ATM layer, ATM signalling protocol and Connectionless Services in B-ISDN.	Contributions to ETSI NA5 and CCITT SG I, XI, XIII, XVIII Recommendations on B-ISDN.
R1052 SPOT	Simulation and optimisation of sub-carrier multiplexing systems for the CAC network	Exploitation, development and assessment of signal processing techniques in a CAC environment
R1053 TERRACE	TMN Reference Configurations at three levels of detail. Methods and criteria to design, describe and evaluate Reference Configurations. Concept of GAMS - Gradual Automation of Management Systems, used internally by the project to define the evolution of the TMN. Surveys and case studies (SDH, MAN and ATM)	Means of implementing TMN now understood in detail. Results exploited by EURESCOM, and are influencing ONP studies. Also exploited by RACE II projects addressing Reference Configurations for IBC Services. Significant contributions to Standards (CCITT & ETSI).
R1085 TET Adapt	Provision of tools for techno-economic analysis	Tools widely used for evaluation of IBC scenarios by RACE systems projects

1.4 Usage Reference Model

Project	Main Deliverable(s)	Impact
R1037 User criteria for the realisation of opportunities afforded by IBC	Development of a methodology to identify and quantify user requirements	Contribution to further work under R1071 (IBC Applications Analysis)
R1071 (1050) IBC Applications Analysis	Based on 126 case-studies in 102 organisations, the project has identified eleven generic IBC services and implemented a formalised methodology for description of IBC market developments	Market entry strategies for IBC. Improved understanding of factors affecting service take-up and delivered substantive usage data for the definition of IBC services.
R1076 REMUS	Requirements for Usability Design Targets Database	Method for making end-user requirements available to designers

PART II : IBC Technologies

2.1 Networks and Switching

Project	Main Deliverable(s)	Impact
R1012 BLNT	2 major demonstrators: an ATM switch model and a Customer Access Connection (CAC), based on SDH and an optical link, using OEICs. Definition of performance parameters for the ATM switch, based on traffic studies. VLSI produced to implement the switch. 4 patents filed relating to CAC and ATM.	Low cost local loop and ATM switch , able to support a wide range of broadband services in a flexible and cost effective manner. Demonstrated incorporation of new OEIC techniques and technologies. Contributions to standardisation of ATM/SDH mapping and broadband interfaces for the access network.
R1013 HDTV switching	Switch matrix chip operating in synchronous time division multiplex mode at speeds up to 1.25 Gbit/s.	Key technology for support of digital (HD)TV services using ATM switching networks.
R1014 Atmospheric	Network configurations and solutions to accommodate uncertainties in the growth and mix of services during network transitions towards a full ATM-based IBC. Flexible and economic network & system architectures to maintain compatibility with existing public / private networks and terminals, as advanced networks evolve. Solutions evaluated in a demonstrator.	Evolutionary network architectures and contributions to the standardisation of new transmission and switching techniques, and of interworking. Extended Stratified Reference Model (ERM) now adopted by ETSI allowing a more flexible use of the lower three layers of the OSI model.
R1022 ATD	Defined generic ATM components. Implemented RATT (R1022 ATD Technology Testbed), a laboratory network integrating several models of ATM subsystems. Introduction scenarios and techno-economic evaluation for ATM - consolidated in a Network Planning Guide. Other results include architectures and interfaces, ATM traffic engineering methods, performance evaluation of ATM traffic control, traffic source models, and signalling.	Major impact on the development of ATM Standards by ETSI & CCITT. Results further by exploited consortium members in RACE II (the laboratory testbed), and in national field trials. Commercially available products based on project prototypes (components and subsystems).
R1043 Mobile Telecommunications Project	Provided the foundation for the work now undertaken by RACE II projects in UMTS and MBS. Preparation of CFSs for UMTS	Definition of the spectrum requirements for UMTS. Prime-mover for the establishment of ETSI SMG5.

2.2 Optical Communications

Project	Main Deliverable(s)	Impact
R1008 Silicon-based Low-cost Passive Optical Components	Low cost passive optical components including very low loss waveguides, 3dB directional coupler, fibre pigtailed power splitter, 1:4 WMUX/DMUX devices	Components for the realisation of an economic and & flexible architecture of the Customer Access
R1010 Subscriber Coherent Multi-channel System	Demonstrator of a CMC network with a transmission rate of 140 Mbit/s on each of ten channels. Coherent optical devices evaluated on 3 testbeds: 622 Mbit/s CPFSK, 565Mbit/s DPSK, and 565 Mbit/s FSK	"Path-finder" technology, having strong economic potential to meet requirements of domestic customers for non-switched services in the longer term .
R1019 Polymeric Optical Switch	Optically non-linear polymers and devices, such as electro-optical modulators and 2x2 electro-optical switches	Progress towards low cost optical switching matrices
R1020 HYBRID	Integrated ultra-fast all-optical switching devices; technologies for low cost polymers	Low cost devices for all optical communication systems
R1027 Integrated Opto-electronics towards the Coherent Multi-Channel IBCN	Components for HDWDM: 3-channel DM-DPSK heterodyne transmission experiment using DFB lasers, state-of-the-art receiver preamplifier, InP integrated polarisation modulator, uniform grating DFB lasers with narrow spectral line width, multi-electrode DFB laser as FSK transmitter, continuous tuneable narrow line width DBR lasers, GSMBE amplifiers for coherent multi-channel systems, OEIC receivers (4 and 8 channels)	High bandwidth services through HDWDM using optical frequency multiplexing with coherent detection. Project results exploited commercially include : a grating, coherent transmitters and receivers and state-of-the-art fabrication techniques.
R1029 Improved InP Substrate Material for Opto-electronic Device Production	Semi-conducting Sn-doped and semi-insulating Fe-doped InP-substrates fabrication; method of routinely testing Fe-doped "Epi-ready" substrates	European InP- substrates, Sn- and Fe- doped, commercially available and competitive in world markets.

Project	Main Deliverable(s)	Impact
R1030 ACCESS	Flexible Customer Access Connection (CAC) for 622 MBit/s services in the future IBC (interactive services, plus analogue CaTV). CAC systems and architectures using TDMA/SCM 2 Mbit/s. Design and evaluation of key components and modules (Flexible multiplexers, broadband switches, EDFA-modules optimised for AM-TV distribution). Cost analysis has shown that fibre solutions are often cheaper than copper.	Cost optimisation of the Customer Access. Inherent flexibility in service provision to residential and small business users through use of optical network topologies. Realisation of corresponding Opto-electronic components.
R1031 Low Cost Opto-electronic Components	Integrated transceiver modules, high speed detector. Coaxial packages of lasers, micro-optics and detectors. 1.5 μm all MOVPE grown SIPBH lasers. Wafer testable 1.5 μm DFB-lasers Alignment and fixing of fibre and lenses, package material costs, hybrid integration of the opto-electronic and electronic functions.	Low cost active opto-electronic devices made commercially available for early implementation of IBC:
R1032 Optical Components for Subscribers Networks	Key components, technologies and test equipment required for introduction of optical fibres in customer premises	Low cost, rugged devices for use in Customers Premises. Complementary perspective to related projects addressing public networks
R1051 Multi-Gigabit Transmission in the IBC Subscriber Loop	10 Gbit/s optical transmission system distributing 64 TV-channels (each at 155 Mbit/s) to over 8 million different terminals	Technology for distributing digital (HD)TV now capable of supporting more subscribers than are likely to be connected to a single network node under any network architectures currently envisaged.
R1057 AQUA	High speed (up to 10 Gbit/s) and high power Quantum Well lasers	Europe now manufacturing high speed components for direct detection multi-gigabit transmission systems
R1064 MIOCA	Monolithically integrated, laser diode-monitor chip, and optical switch & amplifier chip with ridge waveguide structures.	Monolithic optical integration on InP substrates is a key technology for cost effective manufacturing of essential IBC components
R1069 EPLOT	Optical lasers for coherent systems, high speed devices for multi-gigabit systems, integration of amplifiers with DFB lasers	High density coherent systems and very high speed components made feasible, as a result of narrower spectral line-width and better control of wavelength.
R1089 LOOP	Realisation of superior quality passive optical components-better than any other commercially available devices. A low cost optical connector, de-mountable, achieving reflection-free 30% coupling to DFB lasers. A prototype connector-mounting machine for factory use. A fan-out connector (multi-way to single-way) equipped with optional monitoring functions.	The "Euro-Connector" now launched commercially, and adopted by most manufacturers and operators in Europe. Vigorous standardisation efforts ongoing, within international IEC and European CEN / CENELEC. Such components facilitate the earliest implementation of optical communications throughout Europe. Being truly transparent devices, evolution from multimode, to single mode and in future, to coherent transmission can be supported.

2.3 Advanced Information Processing

Project	Main Deliverable(s)	Impact
R1003 GUIDELINE	Synthesis of TMN Architecture based on experimental results and prototypes of other RACE I projects. Guidelines on the Application of AIP techniques to network management	Results exploited by RACE II and EURESCOM Projects. Potential harmonisation and reduction of risks in the commercial development of TMN systems. Significant contribution to Standards (CCITT and ETSI).
R1005 NEMESYS	3 major testbeds for the evaluation of AIP techniques for Traffic and QoS Management. Corresponding simulators for Network, ATM traffic, Services & Users. Practical verification using case studies on Call acceptance & Virtual path.	Reduction of risks in the commercial development of Traffic Management and QoS related TMN systems. Specific results (Simulators, Platform, testbeds) used by RACE II and ESPRIT Projects.
R1006 AIM	Prototypes of maintenance applications for BERKOM, System X and Interconnected MANs. Specification of corresponding IBC maintenance functions. Development of AIP based Generic Maintenance System (GMS) in 11 modules Evaluation of applicability.	Significant increase in the reuse of system components when developing new applications. Larger scale prototype GMS applied to real networks in RACE II (R2002 GEMA) and ESPRIT projects. Development of commercial products based on GMS.
R1009 ADVANCE	Prototypes for Network and Customer Administration Systems (NCAS). Evaluation of the applicability of AIP techniques .	Reduction of risks in the commercial development of NCAS. Results used by RACE II and ESPRIT Projects.
R1017 IOLE	On-line environment (operating system) to support the execution of applications within IBC. Prototype tools for on line software extension, fault tolerance, testing, monitoring and HMI.	An Open Services Architecture for IBC Applications. Exploited by project consortium (embedded in products) and RACE II projects.
R1021 ARISE	Prototype integrated software engineering environment, specifically tailored for Telecommunications. Methods for software reuse. More than 20 tools for use within the environment. Applied to ISDN and IN software development.	Improvements in the cost and time required to develop software. Results exploited by RACE II and ESPRIT Projects and consortium members. Products now being based on tools produced by the project.
R1046 SPECS	Method providing maximum automation in the production, execution and maintenance of telecommunications software, based on the use of FDTs - Formal Description Techniques. Ability to handle and incorporate less formal specifications. Open tool architecture to support the method. Prototype tool set used in pilot case studies.	Facilitated the application of Formal Description Techniques in industrial environments. Significant contribution to Standards (CCITT SG X and ISO). Results exploited by RACE II and ESPRIT Projects and consortium members.
R1068 ROSA I (see also R1093)	Feasibility study for an Open Services Architecture. Identification of requirements and development of the essential concepts to be incorporated.	Leading-edge technology and concepts for service provision. Justified increased RTD in this field.

Project	Main Deliverable(s)	Impact
R1093 ROSA II (See also R1068)	Architectural framework for the provision of IBC services - this a fundamental step towards the definition of an Open Services Architecture. Developed an object model (ROOM), compatible with the ODP standard, and incorporating the characteristics required in a Telecommunications Open Architecture and for IBC service specifications. Methodology for Service analysis, specification and implementation..	Major benefits in terms of cost and time for the development of advanced IBC services. Significant contribution to world-wide research initiatives (TINA-C). Results are exploited by EURESCOM and various RACE Projects.

2.4 IBC Customer Systems

Project	Main Deliverable(s)	Impact
R1001 DVT	Video codec and scanner assembly for 100 Mbit/s HDTV digital recorder on very high density ME tapes.	High density digital video recorder for the consumer electronics market.
R1004 Electro-luminescent Flat panel Display	1st European electro-luminescent (EL) flat panel display and corresponding driver developed and launched commercially.	World leadership in multicolour EL displays. Technology essential for multi-service terminal and high quality displays.
R1011 B-CPN	B-CPN demonstrator, validating a framework architecture covering business requirements across many applications and network sizes.	Economically viable evolution steps from current installations in customer premises, towards the future IBC.
R1015 D-CPN	D-CPN demonstrator, validating a concept which supports services and applications offered by pre-existing systems (e.g. EUREKA IHS) as well as new advanced services like switched high quality sound and video, using low cost technology.	Definition of services and technical/technological developments to facilitate the introduction of IBC in the domestic environment.
R1018 HIVITS	HDTV codec for use by the EBU during WARC 92 for HDTV broadcasting around 20GHz. (Digital video codecs for video telephony, TV and HDTV.) Successful demonstration that current low-bitrate coding standards can be significantly improved by means of advanced image analysis techniques. Significant advances in VLSI technology for video encoding.. Complete study of video transportation over ATM networks. Adaptation of current coding schemes for ATM.	World leadership in devising hierarchical multi-resolution coding techniques which will play a key role in the ongoing definition of digital TV standards. Central contribution to the development by ETSI of the 34Mbit/s standard for contribution codecs. Hierarchical coding is an essential element for the compatibility of different terminal types where video interworking will be required under future MPEG (& multimedia) standards. Products based on HIVITS technology are already being marketed. Basis for further analysis/coding projects in Race II.
R1035 CPN Part I	Specification of the terminal-CPN interface (at the S reference point), including medium adapters. Definition of CPN architectures suitable for business and domestic environments. Evaluation of options these provide, for evolution from present diverse implementations towards IBC.	Provided customers perspective on public-network termination requirements. Strong contributions to standards bodies (ETSI and CCITT). Results exploited within RACE Part II Projects.
R1036 WTDM Broadband Customer Premises Network	Broadband Customer Premises Network suitable for digital (HD)TV contribution services and for a wide range of applications up to 40 Gbit/s. Uses 16 WDM channels (at 2.5 Gbit/s each). Mux/Demux: 16 STM-1 to STM-16 and vice-versa. All-fibre 16x16 star coupler. Node controller for internal CPN routing. Wavelength demultiplexer with wavelength tracking. 2.5 Gbit/s silicon ASICs (interleaver/disinterleaver, 12x12 expandable cross-point switch matrix). Project has proven interworking of a WTDM CPN and a public B-ISDN through a protocol converter.	A practical solution for routing of studio quality digital video and HDTV signals within private domains. Can also support interworking across public networks : The viability of early IBC implementations depend on an ability to support a rapidly expanding demand for video services. Expectation that this technology will be increasingly exploited as HDTV is introduced. Contributions to ETSI TM3 on the use of SDH for studio quality video and audio services.

2.5 Usability Engineering

Project	Main Deliverable(s)	Impact
R1034 Usability Engineering Requirements for IBC	An overview of usability issues for IBC.	Contribution to IBC requirements in the area of Usability Engineering.
R1065 ISSUE	Usability requirements and design recommendations for videophone and multi-media retrieval services	Guidelines for embedding user requirements in the design process for IBC equipment and services
R1066 IPSNI	Functional specification of requirements for input/output media at the man-machine interface of a generic IBC terminal	Full incorporation of people with special needs within the population using IBC services and equipment
R1067 GUIDANCE	Design method and recommendations for distributed multi-author multi-media co-operative system	Guidelines for embedding user requirements in the design process for IBC equipment and services
R1088 TUDOR	Usability requirements, market data and design recommendations regarding elderly and/or handicapped people	Full incorporation of people with special needs within the population using IBC services and equipment

PART III Pre-normative Functional Integration

3.1 Demonstrators and Verification

Project	Main Deliverable(s)	Impact
R1007 ITIS	Multi-service, multi-media IBC terminal demonstrator on a PC platform with ISDN and TV interfaces	Initial implementation of functional design, modular architecture and user interface for multi-service terminals.
R1016 Test Tools and Equipment	Specific hardware, software and ancillary requirements for an IBC testbed.	Availability of tools for verification of Subscriber Network functionality
R1033 OSCAR	3 photonic switching demonstrators: Access Cross-Connect for fully transparent optical switching, space packet-switching at 622 Mbit/s and VHSOL with a ring structure New packaging techniques for low cost mass-manufacture of OEICs	Photonic switching components (optical switches, optical amplifiers, detectors and electronics) complete the realisation of systems employing all-optical transmission / switching .
R1038 MCPR	IBC terminal demonstrator on workstation platform, having multimedia, hypermedia, and ATM handling functions	Architecture for multi-media information access on IBC facilities
R1048 RSVP	Initial studies towards a common methodology for Verification	Identification of an approach for the development of common verification techniques
R1056 BIPED	A business IBC demonstrator integrating multi-service-terminals, CPN, customer access network and ATM switch with a gateway to ISDN	Assessment of the relationship between QoS and Network Performance within selected network configurations
R1072 ITACA	Protocol Conformance test specification and automation	Protocol specification and testing methodologies.
R1080 HDTV Experimental Usage	Complete chain of HDTV production, transmission, and consumer equipment according to HD-MAC.	Operational experience in HDTV production and distribution. Raised public awareness of HDTV, within Europe.
R1081 BUNI	IBC Demonstrator constructed as two separate sub-systems, each comprising multi-service terminals, customer premises network, customer access and broadband switch. One demonstrator addresses the broadcasters studio environment, the other, domestic needs. These were later integrated together as a final, 3rd demonstrator.	Major contribution to the agreed T-interface specification in Europe. Verification of IBC system design concepts. Feedback on the application of test tools to the demonstrator, to improve both future network performance and the tools themselves.
R1082 QOSMIC	Methods and Models for the verification of Quality of Service (QoS). 2 prototype tools for verification of QoS. Physically connected to the hardware test environment via the UNI. 4 Case studies evaluated. Animated presentation of project results.	Prototypes of future commercial test equipment. Significant contributions to standards formation in ETSI.
R1083 PARASOL	ATM traffic generator and analyser tools for network verification	Support of network integration projects with tools for testing and verification
R1084 MIME	Emulator/Simulator hybrid systems for ATM networks	Provision of tools to support design, verification and testing of methods, protocols and functions of IBC (including TMN prototypes)
R1087 PROVE	Development of a series of verification and testing modules as an integrated tool set : cell generator/analyser, testing of signalling protocols using test scripts, analysis of signalling and call handling	Verification, test and maintenance strategies for IBC. Contributions to ETSI (e.g. Computer Aided Test Generation). User interface design for test tools. Assessment of ATM signalling.
R1092 DIRAC	Definition of a structured data collection procedure targeted on an innovative analysis method for reliability data. Calculation of reliability of telecommunication systems.	Production of a specification on reliability prediction and measurement. Potentially a European standard.

3.2 Applications Pilots

Project	Main Deliverable(s)	Impact
R1039 DIMUN	Development and testing of new 'intelligent' applications & services to support distributed design and manufacture	A multimedia communications facility proven in an international manufacturing environment. Yielded increased efficiency, reduced costs and reduced time for the order-design-manufacture cycle
R1042 MULTIMED	Definition and development of a prototype multimedia environment for the health-care sector	Improvement in the accessibility and usability of multimedia health-care information.
R1054 APPSN	Six videophone service trials for (social care of) elderly and/or handicapped people	Service models for applications of videophone in social care; user requirements for elderly and handicapped people
R1055 MERCHANT	Definition of a general architecture for a pan-European ERP (Electronic Retail Payment) system. Implementation of a laboratory demonstrator. Validation of technical options for wider-scale implementation.	A new generation of ERP systems that respects the role, independence and responsibility of each existing ERP actor.
R1058 RESAM	Field trials have shown that real demand exists for broadband applications in the airline industry, supporting unscheduled aircraft maintenance. These applications involve video, still picture and broadband data transmissions, supporting aircraft maintenance . Users, their needs and business functions, application domains and system requirements were each identified or defined.	Meets the need for multimedia, distributed problem-solving applications within airlines, aircraft manufacturers and shipping companies. Potential applications in many other sectors identified, e.g. design, health care, crisis management, marketing and sales.
R1059 DIVIDEND	Production of functional requirement specifications for the use of advanced communications within the banking sector, and a multimedia terminal based on these.	Raised awareness of users re the potential offered by advanced services in banking sector. User interest triggered.
R1060 DIDAMES	Demonstration of collaborative work in manufacturing, using local and wide area broadband communications, supporting PC-integrated video conferencing.	Resulted in commercial tools, applications and telecommunications products. with emphasis on standards, (eg. for workstation interface cards and video codecs).

Project	Main Deliverable(s)	Impact
R1061 DIMPE	Pilot of Distributed Multimedia Publishing Environment between major publishing sites.	An understanding of publishers requirements, to realise commercial viability of the application. Development of an open, flexible application architecture and agreement on standards.
R1062 MARIN ABC	Demonstration of IBC application in the maritime industry: non-routine maintenance and repair of a ship at sea, with assistance of shore-based expertise.	Demonstrated feasibility and cost effectiveness of ship-to-shore video communications via satellite, to prevent/solve maintenance problems as they arise.
R1063 MAPS	Specification of four application pilot schemes for mobile communications	Focus and approach better defined for subsequent projects in RACE II
R1070 Testing pay-per view	Pilots for pay-per view television in three separate, existing CaTV networks. Specialised software for traffic modelling and evaluation tools.	Requirements for the man-machine interface. Strategy for the transition to IBC.
R1073 GEOTEL	Multinational pilot implementation of a library service for petrochemical and related industries	An effective commercial image library accessible from all over Europe (initially by ISDN)
R1074 ECHO	Installation of an IBC-based, electronic case handling system within insurance companies.	Increase in effectiveness and productivity of clerical and professional personnel in the insurance sector by the use of a distributed system of workstations and servers.
R1075 Telepublishing	2 Application Pilots : An individualised electronic newspaper The designing, printing and publishing of catalogues.	Scenario of a broadband working environment, providing easy, time shared interaction between separate locations in the printing and publishing industry.
R1078 European Museums Network	A full digital multimedia system with as applications, an authoring tool for museum staff and a "discovery machine" for navigation of the museum by visitors	Identification of requirements for workstations and man-machine interface.
R1079 CAR	A conference demonstrator to support design engineers at different sites in their decision-making. A remote surveillance system relevant to the manufacturing sector. A multimedia messaging system between the various actors in manufacturing design. New methodologies for requirements capture and evaluation	Provided an understanding of the implications of introducing IBC services in the automotive industry. Established knowledge base for future service design.
R1086 TELEMED	Demonstration of the potential for medical image and data transmission in an IBC environment	Stimulation of the development of medical applications such as remote expert consultation and diagnosis, co-operative research and teaching
R1091 ESP	Assessment of a common strategy for implementation of the communication links required to support RACE Application Pilots. Assisted in the Pilots' own assessment of requirements for end-systems, software protocols and network provision.	Focused the on-going discussions amongst Sector Actors, and acted as a catalyst for further network provision initiatives. Results & synergies achieved now exploited in RACE II.

Concerted Actions and Accompanying Measures

Date	Event / Workshop	Impact
1988 (7 Dates)	**RACE Concertation Meetings**	Established working relationships amongst RACE projects, with appropriate links to other CEC programmes (Esprit, COST and Eureka). Technical approaches and systems concepts pooled, to mutual advantage.
1989 (7 Dates)	**RACE Concertation Meetings**	Integration of application pilots, usage and verification projects within the on-going programme. Extensive work supporting the development of Common Functional Specifications (CFS)
6 & 14 June 1990	**User Meeting on Advanced Communications in Europe**	Raised awareness of the potential for application of advanced communications in different business sectors. Generated the interest of user organisations to respond to possible future call for application pilots.
20 June 1990 (in Dublin)	**IBC Islands Workshop**	Highlighted the extent to which broadband communications already existed, and showed how interconnection of such "islands" could feasibly be achieved in the shorter term
26 June 1990	**Fibre to the Home**	Examined the economics of deploying optical fibre in the Customer Access network, and highlighted the most promising technical approaches, for further development.
2 July 1990	**Mobile Communications in IBC**	Determined the relationship between systems supporting broadband and mobile communications. Intelligence in Networks and "Mobility in the fixed network" amongst the common factors.
10-12 July 1990 (in Aveiro)	**Optical Communications Summer School**	Strengthening of links with peripheral countries. Dissemination of optical RACE results to engineers expecting to begin research in this field.
15 October 1990 (in London)	**International IBC Conference**	Single conference giving the broadest coverage of RACE I results, and progress made in the functional specifications of IBC. Wide dissemination achieved.
23 October 1990	**Impact Assessment and Forecasting**	A review of socio/political issues pertinent to the development of IBC. An indication of the priorities for future RTD in the area.
24 October 1990	**Intelligent Network, Service Engineering and Usability**	Raised awareness of the potential for separation of service provision from network operation. Technological basis for a faster, more effective approach to service design, based on combinations of discrete service components.
26 October 1990	**IBC Implementation Framework**	Communication with the sector actors concerned. Examined the feasibility of implementing evolutionary scenarios developed within RACE.
30 October 1990	**Image Communications**	Identification of priority areas for RTD to meet emerging IBC requirements, based on a review of the state-of-the-art in image communications.
13 December 1990	**Intelligent Cities**	Development of co-operation between City authorities , in applying informational resources and communications links to find solutions to urban problems. Identified requirements for RTD, which led to the establishment of the ENS Action.
1990 (6 Dates)	**RACE Concertation Meetings**	Mid-Term results collated and fed into planning process for RACE II. First draft of CFSs fed back to projects.
10 September 1991	**Fibre to the User (International Audit)**	Comparison of roll-out strategies in Japan, USA, Canada and Europe, for introduction of optical fibre in the customer access. Factors determining the technical and economic suitability of the different approaches examined in detail
1991 (6 Dates)	**RACE Concertation Meetings**	Highlighted issues of common interest, for further examination. Second consolidation of CFS.
1992 (6 Dates)	**RACE Concertation Meetings**	Transfer of RACE I results to newly launched RACE II projects. Assured continuity of momentum and links between RACE Projects & other Programmes.

Annex II

Contributions to Standards

RACE
CONTRIBUTIONS TO STANDARDS

R1003 AIP and Standards for TMN

Taxonomy of Reference Points (Re view of M.30)	CCITT		1991/03	UK
Mediation function definition	ETSI	NA 4	1990/03	UK
Taxonomy of Reference Points (Review of M.30)	ETSI	NA 4	1991/03	UK
The workstation function	ETSI	NA 4	1990/03	UK
TMN reference point definition	ETSI	NA 4	1990/09	UK
Taxonomy of Reference Points (Re view of M.30)	ETSI	NA4	1991/03	UK

R1014 Atmospheric

Distributed Bit Scrambling Method for ATM Cells	ANSI	T1S1.1.	1989/09	Canada
The Distributed Bit Scrambling Method for ATM Cells	ANSI	T1S1.5	1990/02	USA
New questions on string mode for the next CCITT period	CCITT		1992/06	
Distributed Sample Scrambler : State Transition Machine	CCITT	SG	1991/06	Switzerland
Mapping of ATM cells into lower-order VCs	CCITT	SG	1992/03	
On the Equivalence Between two Proposed Network Architectures	CCITT	SG	1991/06	Switzerland
On the harmonisation of two proposed network architectures	CCITT	SG	1991/12	Australia
The Distributed Bit Scrambling Method for ATM Cells	CCITT	SG	1990/01	Switzerland
The Stratified Concept - an extension to ISDN PRM I.320	CCITT	SG	1990/01	Italy
Distributed Sampler Scrambler : Technical Description	CCITT	SG	1990/12	Japan
Cell Delineation with the Distributed Sample Scrambler	CCITT	SG	1990/10	Japan
Distributed Sample Scrambler : Synchronisation Confidence Limits	CCITT	SG	1990/12	Japan
Introduction of the Stratified Reference Model	ETSI	NA4	1989/11	
Signalling and Management in the SRM	ETSI	NA4	1992/09	
Stratified Reference Model	ETSI	NA4	1992/03	
31st Order Distributed Sample Scrambler	ETSI	NA5	1990/10	France
600 Mbit/s structure at T	ETSI	NA5	1989/03	Germany
Allocation of PTI Values	ETSI	NA5	1991/04	Netherlands
ATM Cell Format	ETSI	NA5	1989/03	Germany
ATM header error control cell delineation combined with scrambling	ETSI	NA5	1989/05	France
ATM Information Field Size	ETSI	NA5	1989/03	Germany
ATM Routing Field	ETSI	NA5	1989/03	Germany
ATM Routing Field	ETSI	NA5	1989/05	France
Distributed Bit Scrambler with 8-bit HEC	ETSI	NA5	1990/03	Italy
Distributed Bit Scrambling Method for ATM Cells	ETSI	NA5	1989/09	France
Distributed Scrambler with 31st order Polynomial	ETSI	NA5	1990/09	Spain
Frame Synchronisation	ETSI	NA5	1989/04	Netherlands
Layer Stamping	ETSI	NA5	1990/10	France
Mapping the ATM UNI into the SDH UNI	ETSI	NA5	1989/03	Germany
Media Adaptors at T	ETSI	NA5	1989/03	Germany
Multi-link protocols for ATM	ETSI	NA5	1991/09	Turkey
NT1 Functionality	ETSI	NA5	1989/04	Netherlands
Proposed Structure of CCITT B-ISDN Rec.	ETSI	NA5	1989/05	France
Service Requirements for ATM Priority and Layering	ETSI	NA5	1989/03	Germany
Service Requirements for ATM Priority and Layering	ETSI	NA5	1989/03	Germany
String Mode	ETSI	NA5	1991/09	Turkey
String Mode Protocol for ATM Network	ETSI	NA5	1991/04	Netherlands
Synchronisation	ETSI	NA5	1988/10	Netherlands
The Distributed Bit Scrambling Method for ATM Cells	ETSI	NA5	1989/10	Sweden
The Distributed Bit Scrambling Method for ATM Cells	ETSI	NA5	1989/11	UK
The Distributed Byte Scrambling Method for ATM Cells	ETSI	NA5	1990/04	Portugal
The resilience of the distributed bit scrambling method to Random or Malicious Interference	ETSI	NA5		
Transmission aspects - Virtual Bandwidth	ETSI	NA5	1992/09	
Transmission Format	ETSI	NA5	1988/10	Netherlands
Transmission Format for ATM	ETSI	NA5	1988/10	Netherlands
Transmission System on the Line Side of NT1	ETSI	NA5	1989/03	Germany
Virtual Network Concept	ETSI	NA5	1988/10	Netherlands
Virtual Path Identifier	ETSI	NA5	1988/10	Ireland

VPI Field Size at the UNI	ETSI	NA5	1989/11	UK
Proposal for definition of the Service Profile Concept for B-ISDN and its use for customer/access/terminal	ETSI	SPS3	1991/05	Germany
Mapping ATM into lower order VCs	ETSI	TM1	1990/10	Germany
The Distributed Bit Scrambling Method for ATM Cells	ETSI	TM3	1989/10	Portugal
Signalling at the UNI and NNI. Introductory Remarks	RACE	ARG	1990/06	Norway
Naming and Addressing within the Stratified Reference Model	RACE	STG 1.1	1992/05	
The Extended Stratified Reference Model	RACE	STG 1.1	1991/09	
Contribution to D410 CFS : Signalling Protocols	RACE	STG 3.1	1990/05	Belgium
Contribution to the Functional Model for IBC Basic Service	RACE	STG 3.1.	1991/02	Belgium

R1015 Domestic Customer Premises Network

Comments on Draft Recommendation I.363	ETSI	NA 5	1990/04	Portugal

R1018 High Quality Videotelephone and (High Definition) Television

Impact of digital transmission on HDTV sampling parameters	CCIR	IWP-11/	1990	
Hardware realisation of a 140/155 Mbit/s HDTV-codec progress report	CCIR	TG11-2	1991/02	France
ATM cell loss experiments with TM1	CCITT	IEC	1992/07	Netherlands
ATM cell loss experiments with TM1	CCITT	ISO	1992/07	Netherlands
H 261 compatible 2-layer video codec with high cell loss resiliance.	CCITT	SG XV	1991/05	France
Simulation of random cell loss	CCITT	SG XV	1992/01	UK
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	Germany
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	France
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	Italy
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	Netherlands
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	Sweden
Two Remarks to the text of the Flexible Hardware specification	CCITT	SG XV	1989/11	UK
ATM cell loss experiments with TM1	CCITT	SG XV/1	1992/07	Netherlands
Error sensivity of the TM1 syntax	CCITT	SG	1992/07	Netherlands
Normes pour les systèmes de distribution secondaire	CMTT		1989	France
Rewording of annex A of report AD/CMTT	CMTT		1990/03	
Comparison of the two VLC and videomultiplier proposals according to report AD/CMTT	CMTT/2		1989/12	
Contribution codec VLC parameters	CMTT/2		1989/10	
Contribution to the adhoc group on 34 Mbit/s DCT coding	CMTT/2		1988/03	
Contribution to the specification writing	CMTT/2		1988/08	
Corrections and rewording to the draft recommendation AT/CMTT	CMTT/2		1990/03	
Criticality and Quantisation	CMTT/2		1989/09	
Hardware realisation of the 34/45 Mbit/s 4:2:2 codec and of the 140 Mbit/s HDTV codec	CMTT/2		1990/03	
Performances of the VLC based on ACVLC	CMTT/2		1989/10	
Proposal for an amendment to CMTT DCT ad hoc group document No 1	CMTT/2		1988/04	
Scanning standard to be used on the secondary distribution channels	CMTT/2		1990/02	
Specification of a variable length coding	CMTT/2		1989/09	
The issue of VLC and videoframing	CMTT/2		1989/10	
Variable length coding	CMTT/2		1989/08	
Videoframing	CMTT/2		1989/09	
VLC and videomultiplex proposal	CMTT/2		1988/06	
Hardware realisation of a 140/155 Mbit/s HDTV-codec Progress Report	CMTT/2	WB11	1991/02	France
34/45 Mbit/s videocodec - The issue of VLC and videoframing	ETSI	NA	1990	
Introduction to the project HIVITS	ETSI	NA	1990	
Status of the 34/45 Mbit/s contribution codec standard	ETSI	NA	1990	
H 261 compatible 2-layer video codec with high cell loss resiliance.	ETSI	NA 5	1991/04	Netherlands
Specification for CCITT H.261 comatible video coding for ATM networks	ETSI	NA 5	1992/02	UK
A draft proposal for ALL Type 2	ETSI	NA5	1992/05	UK

R1022 Technology for ATD

AAL-PDU Structure for CBR audio and video services	CCITT	SG	1990/01	Portugal
Sequence number protection for AALL Class 1 services	CCITT	SG	1990/05	Portugal
VCI Management For A Signalling Link	CCITT	SG		USA
"VPI/VCI pastition at UNI and ""active bits"" restriction"	CCITT	SG	1990/01	Germany
Compatibility Between S and T Interfaces In The Subscriber Premises Network	CEPT	NA5	1988/10	Portugal
Echo in the Finnish PSTN	CEPT	NA5	1988/10	Portugal
Bit Error Bursts At 139 264 kbit/s	CMTT	IWP		
Monitoring Of The Quality Of Digital Circuits Using ATM	CMTT	IWP		
On The Necessity Of Protection Against Cell Losses For High-Quality Audio And Video Services	CMTT	IWP		

Synchronization Aspects In A Pure ATM-Based Broadband Network	CMTT	IWP		
Treatment Of Cell Losses In An ATM-Based Broadband Network	CMTT	IWP		
AAL Sequence number synchronization algorithm	ETSI	NA 5	1990/09	Portugal
Application Of Maintenance Principles To B-ISDN Basic Customer Access	ETSI	NA 5	1989/03	
Impact of ATM Cell Size on Mobile Communications	ETSI	NA 5	1989/05	
Priorities In An ATM Network	ETSI	NA 5		Germany
ROS subattributes in I. 2XX	ETSI	NA 5	1989/11	
Sequence number protection for AAL Class 1 Services	ETSI	NA 5	1990/04	Portugal
Sequence number protection for AAL type 1	ETSI	NA 5	1990/10	Portugal
Service Bit Rates Amendments to Draft Rec. I. 2XX	ETSI	NA 5	1989/11	
Considerations on the ATM Layer Functions	ETSI	SPS 3	1990/04	
Considerations on the Cell Header Translation Function	ETSI	SPS 3	1990/04	
Considerations on the Physical Layer Functions	ETSI	SPS 3	1990/04	
Considerations on Virtual Channel	ETSI	SPS 3	1990/04	
Functions of ATM Network Nodes	ETSI	SPS 3	1990/04	
General Characteristics of ATM Network Nodes	ETSI	SPS 3	1990/04	
INTERFACES	ETSI	SPS 3	1989/10	
"Introduction, Scope and Field of Application (for Rec. on Broad-Bandswitching)"	ETSI	SPS 3	1990/04	
New Structure for Recommendation on Broadband Switching	ETSI	SPS 3	1990/04	
Some Considerations on Overload Handling	ETSI	SPS 3	1989/10	
ATM-Related Functions	ETSI	STG 3.2	1990/06	Netherlands
Connection Acceptance Control	ETSI	STG 3.2	1990/08	Netherlands
Connections through an Exchange	ETSI	STG 3.2	1990/06	Netherlands
Maintenance aspects of an ATM Exchange	ETSI	STG 3.2	1990/06	Netherlands
Performance of established connections	ETSI	STG 3.2	1990/07	Netherlands
Service specific functions in an ATM Exchange	ETSI	STG 3.2	1990/06	Netherlands
Traffic Characterization	ETSI	STG 3.2	1990/08	Netherlands

R1024 Functional Specifications for IBC System Requirements

QOS Methodology	ETSI	NA	1990/03	UK
Analysis of Network Management Requirements	ETSI	NA 4	1990/09	

R1030 Advanced Customer Connections, an Evolutionary System

Consideration concerning loopback in CAC	ETSI	NA 5	1991/06	Sweden

R1031 Low Cost Optoelectronic Components

Measurement Techniques for Essential Ratings and Characteristics of Components	CCITT	IEC		
"Blank detail specification: ""Coaxial laser"""	CENELEC	CECC	1989/04	Germany

R1035 Customer Premises Network

Physical Layer OAM for cell based option.	ETSI	NA 5	1991/09	
Cost and performance of different coaxial cable and receiver types.	ETSI	TM 3	1991/04	
Definition of terminal failure voltage for the coaxial interface at 155.52 Mbps.	ETSI	TM 3	1991/04	
"Input to the ""Living List"" for Rec. I.432."	ETSI	TM 3	1991/04	
Line code for Interfaces at TB- and SB reference points.	ETSI	TM 3	1991/04	

R1041 Functional Specifications of Codes

Principle of Functional Modelling	ETSI	NA 4	1990/09	France

R1044 IBCN Development of the Functional Reference Model

UK Contribution on Protocol Reference Models	CCITT	SG	1988	
UK contribution on Signalling Channel Structures	CCITT	SG	1988	
Optical CATV User-Network-Interface Based on a High-speed WDM	ETSI	NA 3	1990/02	Germany
Optical CATV-User-Network-Interface b.opt.	ETSI	NA 3	1990/02	Germany
Impact of intelligent Networks on TMN	ETSI	NA 4	1989/10	Denmark
A formal stage I description of Multi-Media services	ETSI	NA 5	1989/10	Denmark
AAL messages	ETSI	NA 5	1990/09	Belgium
AAL primitives for non-assured operation without flow control	ETSI	NA 5	1990/09	Belgium
AAL primitives for operation with flow control	ETSI	NA 5	1990/09	Belgium
AAL protocol model and peer-to-peer procedures	ETSI	NA 5	1990/09	Belgium
AAL type 3 functional model (allocation AAL)	ETSI	NA 5	1991/09	Belgium
An adaptation convergence sub-layer (CS) and protocol for connectionless services	ETSI	NA 5	1990/03	

An adaptation layer protocol model for signalling packet-mode connection oriented service and	ETSI	NA 5	1989/10	
An ATM Adaption Layer Protocol Model for IEEE LAN Interconnects	ETSI	NA 5	1989/11	Belgium
An ATM Adaption Layer Protocol Model for packet mode services	ETSI	NA 5	1989/11	Belgium
Analysis of Multi Media Aspects of Broadband Services	ETSI	NA 5	1989/10	Denmark
Answer to CCITT XI/4 open questions on meta-signalling	ETSI	NA 5	1990/09	Belgium
ATM adaptation layer for VBR service	ETSI	NA 5	1989/10	
ATM adaptation model layer service classification for non-time-related services	ETSI	NA 5	1990/03	
ATM signalling channel allocation and meta-signaling issues	ETSI	NA 5	1989/10	
Atributes classification	ETSI	NA 5	1990/09	Belgium
B-ISDN Arch.Prin.for Interactive and Non-Switch.Distribn.Services	ETSI	NA 5	1990/07	UK
B-ISDN Arch.Prin.for Interactive and Non-Switch.Distribn.Services	ETSI	NA 5	1990/07	Germany
B-ISDN bearer service definition	ETSI	NA 5	1990/09	Belgium
B-ISDN Connection Types and their attributes	ETSI	NA 5	1992/01	Belgium
Basic Requirements and Principles for MANs	ETSI	NA 5	1990/01	Belgium
Benefits of activation/deactivation at the TB reference point	ETSI	NA 5	1990/09	Belgium
Categorization of B-ISDN Connection Types	ETSI	NA 5	1992/01	Belgium
Clarification of channel associated signalling (CAS) at the access	ETSI	NA 5	1991/01	Belgium
Clarification of the ATM adaptation service classification model	ETSI	NA 5	1990/03	
Comments on ATM header functions	ETSI	NA 5	1990/10	
Comments on NA5 Draft Rec.1413 (UNI)	ETSI	NA 5	1989/11	
Comments on SG XI meta-signalling document	ETSI	NA 5	1991/01	Belgium
Common channel signalling (CCS) for B-ISDN	ETSI	NA 5	1991/01	Belgium
Contribution on Short term IBCN	ETSI	NA 5	1989/03	
Cost comparison of the coaxial with the fibre optical interface at UNI	ETSI	NA 5	1989/11	
Cost figures of a coaxial interface at UNI	ETSI	NA 5	1989/11	
Cost figures of a fibre optical interface at UNI	ETSI	NA 5	1989/11	
Error detection for PO services	ETSI	NA 5	1989/11	
Estimate of activation times for an activation/deactivation procedure at the TB reference point	ETSI	NA 5	1990/09	Belgium
Evolution of Optical Multi-Customer Access Links in the IBCN	ETSI	NA 5	1990/03	Germany
Guidelines for dynamic description of Multi-Media services using SDL diagrams	ETSI	NA 5	1989/10	
Implications of the introduction of the P bit for AAL type 3 and 4 (allocation AAL)	ETSI	NA 5	1991/09	Belgium
Information type related attributes for service components	ETSI	NA 5	1989/03	Germany
Introduction IBCN Reference Configuration	ETSI	NA 5	1990/03	
Introduction of the BRAN and LIT functional groups into the functional architectural model (allocation	ETSI	NA 5	1991/09	Belgium
Introduction to the static description of multimedia services	ETSI	NA 5	1989/03	Germany
Introductory description of multimedia services	ETSI	NA 5	1989/03	
List of parameters for the physical medium dependent layer of an electrical interface at the Tb reference	ETSI	NA 5	1989/09	
Location of meta-signalling in the B-ISDN FRM	ETSI	NA 5	1991/01	Belgium
Meta-signalling	ETSI	NA 5	1990/03	Italy
Meta-signalling message transport	ETSI	NA 5	1989/11	
Meta-signalling states description	ETSI	NA 5	1989/11	
Multi-media structure	ETSI	NA 5	1990/09	Belgium
Notes on Access Network MAN Architecture 5	ETSI	NA 5	1990/03	Italy
Open questions on meta-signalling raised at Brussels meeting of CCITT SG XI/4	ETSI	NA 5	1991/01	Belgium
Optical CATV User-Network-Interface Based on a High-speed WDM	ETSI	NA 5	1990/02	Germany
Optical CATV-User-Network-Interface b.opt.	ETSI	NA 5	1990/02	Germany
Optical Multicustomer Access Networks and its Evolution	ETSI	NA 5	1990/03	Germany
Optical Multicustomer Access Networks and its Evolution	ETSI	NA 5	1990/03	Germany
Optical Network Architecture for a Combined B-ISDN & CATV Multicustomer Access Link in IBCN	ETSI	NA 5	1990/04	Switzerland
Optical Network Architecture for a Combined B-ISDN & CATV Multicustomer Access Link in IBCN	ETSI	NA 5	1990/04	Germany
Optical Reference Configuration of Multigigabit CATV Customer Access Network (R.1051)	ETSI	NA 5	1990/02	Germany
Physical layer of the cell-based UNI	ETSI	NA 5	1990/09	Belgium
Power feeding accross the interface at the Tb reference point	ETSI	NA 5	1989/09	
Preliminary Network Architecture for the IBCN	ETSI	NA 5	1989/10	
Principles on Interworking	ETSI	NA 5	1989/10	UK
Proposal for a cyclic counting in the AAL sequence number field	ETSI	NA 5	1990/03	
Proposal for a data-link protocol as part of AAL Convergence Sub-layer (CS) protocol for non-time-related	ETSI	NA 5	1990/03	Italy
Proposal for basic primitives between the ATM adaptation layer (AAL) and the ATM layer	ETSI	NA 5	1990/03	
Proposal for primitives between the ATM adaptation layer and the ATM layer	ETSI	NA 5	1990/03	
Proposal for single BASIC ATM Adaptation (SAR) sub-layer for all Packet Oriented (PO) services	ETSI	NA 5	1989/11	
Proposed Document Structure for MAN Standards	ETSI	NA 5	1990/01	Belgium
Proposed Structure for ETSI draft ETSI on MANs	ETSI	NA 5	1990/03	
Prose description and definition of multimedia services	ETSI	NA 5	1989/03	Germany
Protocol Architecture for AAL type 3 and type 4 (allocation AAL)	ETSI	NA 5	1991/09	Belgium
Reference Configuration for TMN	ETSI	NA 5	1989/03	

Reference Configurations Construction Rules	ETSI	NA 5	1990/09	Belgium
Service Component Concept	ETSI	NA 5	1988/03	Germany
Service primitives exchanged between the ATM Layer Entity and the AAL Layer Entity (allocation PRS)	ETSI	NA 5	1991/09	Belgium
Service Requirements for MANs	ETSI	NA 5	1990/01	Belgium
Signalling requirements for multiparty calls	ETSI	NA 5	1990/09	Belgium
Specification of the Physical Characteristics for an electrical interface of 155.52 MBit/s	ETSI	NA 5	1989/11	Belgium
Stage 2 studies on Multi-Media Services	ETSI	NA 5	1989/10	Denmark
Support of Broadband distributive services	ETSI	NA 5	1989/10	
SVCI management protocol SDL	ETSI	NA 5	1990/09	Belgium
Target IBCN Reference Configuration	ETSI	NA 5	1990/03	
Target IBCN Reference Configurations	ETSI	NA 5	1989/03	
The BRANching functional group in the CAN	ETSI	NA 5	1992/01	Belgium
The Optical Line Outlet concept	ETSI	NA 5	1989/10	
The use of selective broadcasting	ETSI	NA 5	1990/09	Belgium
Transmission range for coaxial interface	ETSI	NA 5	1989/09	
Transmission ranges for an optical fibre interface	ETSI	NA 5	1989/11	
Use of generic layering architecture to structure the broadband user-network signalling interface	ETSI	NA 5	1989/10	
Use of unused octets in meta-signalling messages and indication	ETSI	NA 5	1991/01	Belgium
User network interface based on SDH	ETSI	NA 5	1989/10	
Utilisation of the 780 nm optical window for transmission at the UNI	ETSI	NA 5	1990/09	Belgium
A framework for the TSI TC/TR on "Signalling protocol requirements for B-ISDN services"	ETSI	NA5	1991/11	Finland
A proposal for S-AAL protocol architecture	ETSI	NA5	1992/05	Sweden
AAL functional models for class D services	ETSI	NA5	1991/10	Greece
AAL SSCP protocol model for B-ISDN signalling and CO Data Service	ETSI	NA5	1992/05	Sweden
AAL SSCP protocol model for B-ISDN signalling & (high speed) conection oriented data services	ETSI	NA5	1992/01	France
AAL type 3 functional model	ETSI	NA5	1991/09	Turkey
AAL type 4 functional model	ETSI	NA5	1991/09	Turkey
Application of the Service Component - Concept to stage 2 and 3 of I.130	ETSI	NA5	1991/04	Turkey
B-ISDN Connection Types and their attributes	ETSI	NA5	1992/01	France
Categorization of B-ISDN Connection Types	ETSI	NA5	1992/01	France
Cell delineation for burst & continuous ATM, cell based option	ETSI	NA5	1991/09	Turkey
Clarification of the PRM information flows	ETSI	NA5	1992/01	France
Comments on pr ETS DE/NA-52511 par. 13 "Operational Functions"	ETSI	NA5	1992/09	Sweden
Comparison of the BRAN FG Concept for the Optical Access Network as an addition to the liaison statement	ETSI	NA5	1992/04	Italy
Editorial amendment for paragraph 4.4 in I.432	ETSI	NA5	1991/10	Greece
Functional ATM Layer Model for service primitives definitions	ETSI	NA5	1991/09	Turkey
General NNIs and Interworking	ETSI	NA5	1992/09	Sweden
Identifiers for B-ISDN signalling	ETSI	NA5	1991/11	Finland
Impact of service component concept on stage 2 & stage 3 of CCITT Rec. I.130	ETSI	NA5	1991/10	Greece
Implication of the introduction of the P bit for AAL type 3 & 4	ETSI	NA5	1991/09	Turkey
Improved wavelength allocation	ETSI	NA5	1991/10	Greece
Introduction of BRAN into the Generic RC of CE; Introduction of BRANs into the FAM of a PL	ETSI	NA5	1992/09	Sweden
Introduction of the BRAN and LIT functional groups into the functional architecture model	ETSI	NA5	1991/09	Turkey
Loss priority parameter in AAL Primitives	ETSI	NA5	1991/10	Greece
Maintenance for cell based UNI	ETSI	NA5	1991/09	Turkey
Mapping of service components into bearer components for multimedia services	ETSI	NA5	1991/10	Greece
Naming conventions for primitives related to the association between VCI/VPI & CEI	ETSI	NA5	1992/01	France
No need for a Fast Reservation Protocol	ETSI	NA5	1991/09	Turkey
Physical layer functional model for service primitives definition	ETSI	NA5	1991/10	Greece
Physical Layer OAM for cell based option	ETSI	NA5	1991/09	Turkey
Physical layer OAM for cell based option	ETSI	NA5	1991/10	Greece
Primitives definition related to local monitoring functions : M-ATM CONGESTION-INDICATION	ETSI	NA5	1992/09	Sweden
Primitives definition related to local monitoring functions : M-ATM MONITOR-INVOKE	ETSI	NA5	1992/09	Sweden
Primitives definition related to local monitoring functions : M-ATM MONITOR-REMOVE	ETSI	NA5	1992/09	Sweden
Primitives definition related to local monitoring functions : M-ATM MONITOR-INDICATION	ETSI	NA5	1992/09	Sweden
Primitives exchanged between the PMD sublayer entity & the TC sublayer entity	ETSI	NA5	1991/10	Greece
Proposal for a Concept of multiparty	ETSI	NA5	1991/09	Turkey
Proposal for burst ATM transmission	ETSI	NA5	1991/09	Turkey
Proposed Structure for MANs	ETSI	NA5	1990/03	Italy
Protocol architecture for AAL type 3 & type 4	ETSI	NA5	1991/09	Turkey
Revision of ATM layer functional model	ETSI	NA5	1992/01	France
Revision of service primitives exchanged between the ATM Layer Entity & the AAL Layer Entity	ETSI	NA5	1992/03	Portugal
Service primitives exchanged between the ATM Layer Entity and the ATM Layer Management Entity	ETSI	NA5	1991/09	Turkey
Service primitives exchanged between the ATM Layer Entity and the ATM Layer Management Entity	ETSI	NA5	1991/09	Turkey
Service primitives exchanged between the ATM Layer Entity and the AAL Layer Entity	ETSI	NA5	1991/09	Turkey

Service primitives exchanged between the ATM Layer Entity and the SAR Sublayer Entity	ETSI	NA5	1991/09	Turkey
Service primitives exchanged between the ATM layer Management Entity related to data transfer	ETSI	NA5	1991/09	Turkey
Service primitives exchanged between the PH layer entity & the ATM layer entitiy	ETSI	NA5	1991/10	Greece
State matrix at TB interface for cell based option	ETSI	NA5	1991/10	Greece
The BRANching functional group in the Customer Access Network	ETSI	NA5	1992/01	France
The way ahead on broadband numbering within NA2	ETSI	NA5	1991/09	Turkey
Use of the PRM for user plane and control plane connection establishments	ETSI	NA5	1991/09	Turkey
Comments on SG XI meta-signalling document	ETSI	SPS 3	1991/01	Belgium
Comments on the CCITT SG XI metasignalling protocol working document WD4-33	ETSI	SPS 3	1990/04	Belgium
Global messages for remove and check procedures	ETSI	SPS 3	1990/10	Belgium
Global primitives for remove and check procedures	ETSI	SPS 3	1990/10	Belgium
Initialisation of Meta-signalling and SVCI assignment procedure	ETSI	SPS 3	1990/10	Belgium
Location of meta-signalling in the B-ISDN FRM	ETSI	SPS 3	1991/01	Belgium
Metasignalling protocol functions and limitations	ETSI	SPS 3	1990/04	Belgium
Open questions on meta-signalling raised at Brussels meeting of CCITT SG XI/4	ETSI	SPS 3	1991/01	Belgium
Point-to-point signalling channel management procedures and SDLs	ETSI	SPS 3	1990/10	Belgium
Signalling Virtual Channel Bandwidth	ETSI	SPS 3	1990/10	Belgium
Use of unused octets in meta-signalling messages and indication	ETSI	SPS 3	1991/01	Belgium

R1045 Consensus Management

UK contribution on the Service Component Concept for the definition of Multi Media Services	CCITT		1988	UK
UK contribution to CCITT SG XVIII on Protocol Reference Models	CCITT		1988	UK
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Proposal for a new work item : Study of the Scope for interoperability testing	ETSI	ATM	1990/04	France
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Standardisation opportunities in the area of formal test methods	ETSI	ATM	1991/06	Sweden
Technical Specifications of the IBC PCT Service	ETSI	ATM	1990/09	Netherlands
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Contribution to the Definition of Reference Configurations (RCs) for the Telecommunications Management	ETSI	NA 4	1990/03	UK
Definition of QoS and NP	ETSI	NA 4	1990/09	France
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Draft text for ETR on TMN vocabulary	ETSI	NA 4	1991/03	Belgium
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Revised Vocabulary of Terms for TMN	ETSI	NA 4	1990/09	France

Some comments on draft CCITT Recommendation I.35B	ETSI	NA 4	1990/09	France
Taxonomy and Naming of Reference Points	ETSI	NA 4	1991/03	Belgium
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The timeline model	ETSI	NA 4	1991/07	Belgium
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A Formal Stage 1 Description of Multimedia Services	ETSI	NA 5	1989/10	Denmark
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All functional Models for Class O Services	ETSI	NA 5	1991/10	Belgium
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"An Adaption Layer Protocol Model for Signalling, Packet Mode-Connection oriented and Connectionless	ETSI	NA 5	1989/10	Belgium
An Application Layer Protocol Model for Signalling - Packet Mode-Connection oriented and	ETSI	NA 5	1989/10	Denmark
Analysis of Multimedia Aspects of Broadband Services	ETSI	NA 5	1989/10	Denmark
Answer to liaison statement from NA5 concerning Activation/Deactivation Procedures in B-ISDN	ETSI	NA 5	1990/03	Italy
Application of the Service Component concept to stage 2 and 3 of I.130	ETSI	NA 5	1991/09	Belgium
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ATM Adaptation Layer for VBR Services	ETSI	NA 5	1989/10	Denmark
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ATM based Broadband ISDN	ETSI	NA 5	1989/03	Germany
ATM cell format	ETSI	NA 5	1988/12	Ireland
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ATM Header Functionalities and Size	ETSI	NA 5	1989/03	Germany
ATM Signalling Channel Allocation and Meta-signalling issues	ETSI	NA 5	1989/10	Denmark
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B-ISDN Connection Types and Attributes Values	ETSI	NA 5	1990/10	France
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Commonality between SNI and T interfaces	ETSI	NA 5	1990/06	Finland
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Cost comparison of the coaxial with the fibre optical interface at UNI	ETSI	NA 5	1989/11	UK
Cost figures of a coaxial interface at UNI	ETSI	NA 5	1989/11	UK
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Estimate of motivation time for activation/deactivation procedure for broadband ISDN	ETSI	NA 5	1990/09	Spain
Evolution of MANs	ETSI	NA 5	1991/02	Belgium
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Impact of Deactivation on Metasignalling and Signalling	ETSI	NA 5	1991/03	Belgium
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Indentifiers for B-ISDN Signalling	ETSI	NA 5	1991/10	Greece
Information Field Size	ETSI	NA 5	1989/03	Germany
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Introduction of the BRAN and LIT functional groups into the functional architectural model	ETSI	NA 5	1991/09	Belgium
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List of Contributions	ETSI	NA 5	1990/09	Spain
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Proposal for a cyclic counting in the Sequence number field	ETSI	NA 5	1990/03	Italy
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Proposal for a single BASIC ATM Adapt. (SAR) sublayer for all Packet Oriented (PO)Services	ETSI	NA 5	1989/11	UK
Proposal for Basic Primitives Between the ATM adaptation Layer and the ATM layer	ETSI	NA 5	1990/03	Italy
Proposal for cell delineation at S reference point	ETSI	NA 5	1989/10	Denmark
Proposal for Characterization of Broadband Traffic	ETSI	NA 5	1990/09	Spain
Proposal for data-link protocol as part of AAL Convergence Sublayer (CS) protocol for non-time related	ETSI	NA 5	1990/03	Italy
Proposal for Physical Layer Transmission Parameter	ETSI	NA 5	1990/04	Portugal
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Proposal for text on AAL Type 3 primitives for AAL operations to be inserted in I.363	ETSI	NA 5	1990/09	Spain
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Proposal for text on ATM Layer Primitives to be inserted in I.321	ETSI	NA 5	1990/04	Portugal

Proposal for the use of Terms in I.311	ETSI	NA 5	1990/03	Italy
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Reference Configurations (RC) and their Implementation Options	ETSI	NA 5	1989/11	UK
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Selective broadcastsignalling channel (SBSVC) management	ETSI	NA 5	1990/09	Spain
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Service Requirements for MANs	ETSI	NA 5	1990/01	Germany
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Specification of different functionality	ETSI	NA 5	1989/11	UK
Specification of the self-synchronizing scrambler in Recommendation I.432	ETSI	NA 5	1990/09	Spain
Specifications of B-ISDN addressing functions - first draft	ETSI	NA 5	1991/02	Belgium
Stage 1 Description of CL Service (1)	ETSI	NA 5	1990/06	Finland
Stage -1 Description of CL Service (2)	ETSI	NA 5	1990/06	Finland
Stage 2 studies on Multimedia Services	ETSI	NA 5	1989/10	Denmark
Support of Broadband Distributive Services	ETSI	NA 5	1989/11	UK
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The Coding of the Sequence Number (SN) in SAR class 2	ETSI	NA 5	1990/04	Portugal
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The Optical Line Outlet Concept	ETSI	NA 5	1989/10	Denmark
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Traffic aspects	ETSI	NA 5	1991/02	Belgium
Transmission aspects in the core network	ETSI	NA 5	1991/02	Belgium
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UPT Numbering Plan Requirements related to Location Information included in the Number	ETSI	NA 7	1990/09	Netherlands
UPT Terminology	ETSI	NA 7	1990/09	Netherlands

UPT User Requirements related to Charging	ETSI	NA 7	1990/09	Netherlands
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Numbering and Addressing Requirements Architectural Requirements	ETSI	NA2	1990/10	Denmark
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Medium Term Evaluation on Codec location in B-ISDN	ETSI	NA3	1989/10	UK
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Comments on SG XI metasignalling baseline document	ETSI	SPS	1991/01	France
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Cost benefits of utilising the 800 nm optical window for transmission at the UNI	ETSI	TM 3	1991/04	Belgium
EMC aspects of CATV cable at the B-UNI: spectral considerations	ETSI	TM 3	1991/04	Belgium
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Improved Wavelength Allocation in OAN's	ETSI	TM 3	1991/10	Belgium
Optical Interfaces for the Customer ACCESS Network	ETSI	TM 3	1990/04	Germany
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Study items for the network aspects of UMTS	ETSI	UMTS	1991/03	Belgium
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R1054 Application Pilot for People with Special Needs

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R1060 Distributed Industrial Design and Manufacturing

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R1077 Usage Reference Model for IBC

Engineering IBC Services. Joint URM/CSF/RCD Position Paper	ETSI	HF-1008	1991	

R1079 CAR-CAR/CAM for Automotive Industry in RACE

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Progress on development of studio equipment for progressively scanned HDTV	CCIR		1991/02	
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"Qos and NP, Relationship between related terms."	ETSI	NA 4	1991/07	France

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R1089 Low Cost Optimized Optical Passive Components

"Sectional Specification, Connectors sets type CF08"	CCITT	IEC	1990/07	France
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Annex III

List of Publications

RACE
List Of Publications

R1001 Digital Video tape Recording Terminal for HDTV

A new single-table assignment technique for transform coded images
1990/04 Paper for 8th Conference on Video, Audio & Data Recording

A Simple Recursive Motion Estimation Technique for Compression of HDTV Signals
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CoCr double-layered media with NiFe and CoZrNb soft-magnetic layers
1988 Journal of Applied Physics, vol 63(8)

Data Compression System for Home-Use Digital Video Recording
IEEE Journ. Sel. Areas Commun, Spec. Issue on Digital Rec.

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1992/06 Signal Processing and Image Communications, Vol 4, No 3

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1991/06 Digest of the Magnetic Recording Conference 1991 (TMRC 91)

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1990/04 8th Conference on Video, Audio & Data Recording

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1990/09 Proceedings of the European Signal Processing Conference

Head-to-tape spacing and recording process evaluated from modulation noise spectra
1988/11 Intermag 88, IEEE Trans. Magn.

High-performance metal-in-gap heads with very small track widths
1990 J. Magnetism and Magnetic Material (jmmm) 83

High-performance small-track-width metal-in-gap heads made by reactive-ion etching
1990 J. Magnetism & Magnetic Materials (JMMM)

Implementation of TV and HDTV in B-ISDN
1990/09 Invited paper for 16th ECOC conference

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1990/01 MRM'89, published in IEEE Trans Magn, vol 26

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Motion adaptive intraframe transform coding of video signals
1989 Philips Journal of Research, vol 44 Nos 2/3

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1990/10 Proceedings 11th Benelux Symposium Information Theory, Noordwijkerhout 1990

On the interpretation of tape friction
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Sputtered sandwich heads for high-density digital video recording
1990/04 INTERMAG Conference

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1989 PMRC'89, Journal Magn. Soc

Transform Coding of Digital TV Signals using Vector Quantization
1990 Image Communication

Transform Coding of Images using Adaptive Tree-Searched Vector Quantization
1988/09 Abstract in Proceedings Picture Coding Symposium

Transform Coding of Images using Directionally Adaptive Vector Quantization
1988/04 Proceedings International Conference on Accoustics, Speech and Signal Processing

R1002 Satellite Communication for IBC

Satellite links and integrated broadband communication networks
1990/10 Int. Conf. on Integrated Broadband Services & Networks

R1003 AIP and Standards for TMN

A Model of the TMN Workstation Function
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A Proposal for an Integration Methodology for a TMN
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1989/11 Telematikbrief Nr 3, FhG/ISI

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1992/09 Thèse de Doctorat Un. de NICE-SOPHIA ANT

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1991 Performance Engineering Workshop '91

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1991/11 5th TMN conference

Queueing Models of Packet-Sqitched Networks with Locally Adaptive Routing
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1992/09 6th TMN Conference

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1992/09 6th TMN Conference

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1991/11 5th TMN conference

R1086 TELEMED

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1990/11 12th International Conference

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1990/06 EuroPACS 90

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1990/02 2nd Information Technology Conference

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1991/05 PACS and Teleradiology Conference

The RACE TELEMED Project R1086
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1991/03 Milano Europa

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1990 Medical Informatics in Europe

Videoconference
1991/06 Informatica in Radiologia

R1087 PROVE - Provision of Verification

Architecture Modulaire de Test pour Reseaux ATM Large-Bande
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1992 Nachrichtentechnik, Elektronik - Berlin - Vol 2-3-4

Modulare Testarchitektur fuer Breitbandige ATM-Netze
1992/02 NTZ : Nachrichtentechnische Zeitschrift - Helft 2, 45 Jahrgang, pp 88-97

Provision of Verification in RACE
1993/01 BT Technology Journal, Vol 11, No 1

RACE Partners all over Europe
1992/09 Clemessy "News Magazine" - No 2

Test architecture for Broadband Network
TE&M magazine (Geneva exhibition issue)

Test derivation for SDL based on ACTs
1992 FORTE 92 - 5th International Conference on Formal Description Techniques

The RACE to Test Broadband Nets
1991/09 TE&M : Telephone Engineer & Management - Vol 95 No 17 pp 68-72

R1088 TUDOR - Usability Issues for People with Special Needs

Attitudes and acceptance
1991 Chapter in Issues in Telecommunications for People with Disabilities, COST 219

Concerns of elderly consumers and their attitudes towards new technologies
1990/09 13th HFT Conference

Domestic Terminals
1991 Future Telecommunications and Teleinformatics for Disabled People. Final report of COST 219

Elderly people in a new world: Attitudes to advanced communications
1991/08 Gerontechnology: First International Conference on Technology and Ageing

Picture Communication
1991/10 6th World Telecommunications Exhibition and Forum

Pilot Applications for Advanced Communication Technology in Care for the Elderly in Europe
1991/08 1st Internationa Conference on Technology and Ageing

RACE projects: APPSN and TUDOR
1990/06 Telematics '90 - Proceedings of the Conference held at Bremen

Remote Working in the United Kingdom
1991 Future Telecommunications and Teleinformatics for Disabled People. Final report of COST 219

Telecommunications needs as expressed by elderly people and people with disabilities
1991 Chapter in Issues in Telecommunications for People with Disabilities, COST 219

The interface between the elderly and new technology
1990/04 BPS Annual Conference

The Role of Human Factors in Designing for Special Needs
1990/05 Belgium Ergonomics Society Journal

Uability Issues for People with Special Needs with Regards to IBC
1990/04 Institute of Electrical Engineers

R1089 LOOP - Low-cost Optimised Optical Passive Components

Achievements of Both Low Cost, Low Loss and Very Low Reflection for a New European Connector
1991/03 French-German Workshop on Optical Measurements Techniques and Fibre Optics Conference

Connecteur monomode à hautes performances et à faible cout = Application au Reseau Large Bande
1991/03 OPTO '91

High performance and low cost passive optical components for the subscriber loop
1991 IWCS 1991

Low cost wavelength independent 1 x N and N x N Branching Components
1991 ECOC 91 Proceedings

Low Reflection Receptacles for Active Devices
1992/05 42nd Electronic Components and Technology Conference - San Diego, CA - USA

Passive components for multichannel networks
1991/02 Technical Digest of OFC 91

Silicon-based fibre-pigtailed 1x16 and 2x16 power splitters
1992/09 ECOC 92 - Berlin

R1091 ESP - Exploitation and Service Project

Contributions to the integration of advanced applications with high-speed protocols - RACE 1091 ESP
1991/05 RARE 2nd European Networking Conference

ESP - Exploitation of RACE I Application Pilots
1991/06 Networks 91

Perspektiven zu einem europNischen IBC
1990 TUBKOM-Kolloquium Breitbandtechnik

Prototyping Multimedia Tele-Services
1991/06 R1022 Technical Committee Workshop

Transportprotokoll Profile und erweiterte Transport Service fÄr integrierte Breitbandnetze
1990 Vorschlag des RACE Projectes 1091 ESP, TUBKOM-Kolloquium Breitbandtechnik

What Infrastructure do the RACE Advanced Communication Experiments Need
1990/06 RACE Broadband Islands Workshop

R1092 DIRAC - Database for Reliability Calculations

DIRAC - A Component Reliability Database
1991 Proceedings of ESREF 91

European Database for Component Reliability in Telecommunications
1990/06 Proceedings of 7th International Conference on reliability and maintainability

R1093 ROSA - RACE Open Services Architecture

Introduction to Algebraic Specifications based on ACT ONE
1989/12 GMD Technical report

Object-Oriented Service Descriptions in ROSA
1991/04 Proceedings of the TINA Workshop

Platform Modelling Requirements from the ROSA Project
1992/01 Proceedings of the TINA Workshop

ROSA: An Object Oriented Architecture for Open Services
1990/10 British Telecom Technology Journal

ROSA: An Object-Oriented Architecture for Integrated Broadband Communication Services
1990/06 Proceedings of the TINA workshop

ROSA: From the service to the Architecture
1991/06 Proceedings of the TINA Workshop

ROSA - RACE Open Services Architecture
1989/07 Proceedings of SETSS '89

Suggestions for Object Oriented Modelling form ROSA
1992/01 Proceedings of the TINA Workshop

The ROSA Object Model
1991/10 Proceedings International Workshop on Open Distributed Processing

Towards a Convergence between Telecommunication Services Architectures and ODP
1991/10 Proceedings International Workshop on Open Distributed Processing

Annex IV

RACE Patents Registered

RACE PATENTS REGISTERED

PROJECT : R1010
PAT-TITLE : Modulierbare Laserdiode für hohe Frequenzen
PAT-AUTHOR : Siemens
DATE : 1992/07/08
COUNTRY : Germany
OBSERVATIONS : German Patent Application P 42 22 466.7 - GR 92 P 1393 DE

PROJECT : R1010
PAT-TITLE : Abstimmbarer Halbleiterlaser
PAT-AUTHOR : Siemens
DATE : 1989/02/15
OBSERVATIONS : European Patent Application 89 10 25 96.7 - GR 89 P 1075.E.
Corresponding applications in Japan and USA.

PROJECT : R1010
PAT-TITLE : Doppel-PIN-Photodiode mit sperrendem p-n-Übergang zwischen Substrat und Absorptionsschicht
PAT-AUTHOR : Siemens
DATE : 1989/03/17
COUNTRY : Germany
OBSERVATIONS : German Patent Application P 39 08 886.3 - GR 89 9 1181 DE

PROJECT : R1010
PAT-TITLE : Monolitisch integrierte Photodiode-FET-Kombination
PAT-AUTHOR : Siemens
DATE : 1990/15/16
COUNTRY : Germany
OBSERVATIONS : European Patent Application 0 400 399 - GR 89 P 1457 E.
Corresponding applications in Japan and USA.

PROJECT : R1010
PAT-TITLE : pin-FET-Kombination mit vergrabener p-Schicht
PAT-AUTHOR : Siemens
DATE : 1990/06/11
COUNTRY : Germany
OBSERVATIONS : European Patent Application 0 405 214 - GR 89 P 1525 E.
Corresponding applications in Japan and USA.

PROJECT : R1010
PAT-TITLE : Verfahren zur Herstellung eines dotierten Bereiches in einer Halbleiterschicht
PAT-AUTHOR : Siemens
DATE : 1989/09/15
COUNTRY : Germany
OBSERVATIONS : European Patent Application 0 417 348 - GR 89 P 1770 E.
Corresponding applications in Japan and USA.

PROJECT : R1010
PAT-TITLE : Verfahren zur Herstellung von FETs
PAT-AUTHOR : Siemens
DATE : 1989/10/19
COUNTRY : Germany
OBSERVATIONS : German Patent Application P 39 864.4 - GR 89 P 1918 DE

PROJECT : R1011
PAT-TITLE : Verfahren zur Übertragungstechnischen Integration von ISDN-Kanälen mit einem breitbandigen asynchronen Zeitmultiplex-Kanal für digital betriebene Kommunikations-Vermittlungsanlagen

PROJECT : R1012
PAT-TITLE : Koppelnetz, bei dem Kurzwege schaltbar sind
PAT-AUTHOR : Siemens
DATE : 1992/08/06
COUNTRY : Germany
OBSERVATIONS : Patent No 92 11 34 50.8 - GR 92 P 1477 E

PROJECT : R1012
PAT-TITLE : Monolithisch integrierte Laserdiode-Wellenleiter-Kombination
PAT-AUTHOR : Siemens
DATE : 1989/05/24
COUNTRY : Germany
OBSERVATIONS : German Patent Application P 39 16 962.6 - GR 89 P 1404 DE

PROJECT : R1012
PAT-TITLE : Verfahren und Schaltungsanordnung für die Aufnahme und Weiterleitung nach einem asynchronen Transfermodus übertragen
PAT-AUTHOR : Siemens
DATE : 1990/08/10
OBSERVATIONS : Corresponding applications in Canada, Japan and USA. European Patent Application 90 11 54 17.9 - GR 90 P 1488 E.

PROJECT : R1012
PAT-TITLE : Verfahren zur Überwachung und Glättung von Datenströmen, die nach einem asynchronen Übertragungsverfahren übertragen worden
PAT-AUTHOR : Siemens
DATE : 1991/02/01
OBSERVATIONS : European Patent Application 91 30 08 07.4 - GR 91 P 8002 E (Coapplicant Plessey Research Roke Manor Ltd. Corresponding)

PROJECT : R1013
PAT-TITLE : Circuitry for regeneration and synchronization of a digital signal (P4025 004)
ABSTRACT : The invention describes a way to perform bitsynchronization of a data stream with respect to a local or masterlock in a mesochronous or plesiochronous environment (jitter, wander, static phase arbitrary).
The principle can be used from DC up to slightly above 1 Gbit/s, using available semiconductor technologies. It can be monolictically integrated, no chip-external components are needed.
This is done by oversampling (for medium frequencies) or tapped delay lines (for 1/TB>300 Mbits).
The correlation of subsequent samples (spaced < = TB/4) of the input signal used to evaluate the eye opening.
The eye opening is catched and tracked in a way that data are sampled in its middle.
In a first stage jitter and wander are overcome up to 1.5 bitlenghts; a second stage, working with bit clock, overcomes bigger jitter and wander, only limited by chip size, not by principle. The second stage is realized with FIFO, RAM or shift register structures.
A control clock, which processes the algorithm for catching and tracking, organizes a coordinated step of the two stages, if the first stage is going to reach its range limits. This is done without slips or biterrors --> Bit slip compensation.
PAT-AUTHOR : K.-D. Menk and H. Preisach - SEL ALCATEL ZFZ/NV
DATE : 14990/08/dd
COUNTRY : Gennany

PROJECT : R1015
PAT-TITLE : Procédé et dispositif pour contrôler le débit de données d'un terminal couplé à un réseau de transmission de l'information
DATE : 1990/12/27
OBSERVATIONS : Registration No (France) : 90 16330

PROJECT : R1015
PAT-TITLE : Procédé et dispositif de protection contre les erreurs bits et les pertes de cellules dans un reseau temporel asynchrone
ABSTRACT : The ATM Adaption Layer of the Protocol Reference Model of the B-ISDN aims at ensuring the Time Transparency and the Information Transparency for the services,
This patent describes a mechanism which deals with the Information Transparency. Based on an interleaving mechanism gathered with a Reed-Solomon error correcting code this patent provides a Convergence Sublayer format, the originality of zhich is the splitting of one cell payload on two rows of the interleaving array used together with the capacity of correcting errors and erasures.
PAT-CATEGORY : IBC Customer Systems
PAT-AUTHOR : Mr B. Guilbaud
DATE : 1991/06/25
COUNTRY : France
OBSERVATIONS : Registration No 91 07 797

PROJECT : R1015
PAT-TITLE : Procédé et dispositif pour le multiplexage asynchrone de donnéées sur des réseaux à support partagé
ABSTRACT : Thanks to a flow control mechanism installed inside data sources connected on a small multiplexer, a file dimensioning is possible for both data source and multiplexer without assumptions on the other party, This mechanism is based on a counter inside the sourcem increased when data are sentm decreased at a regular rate. Further data can be sent only if the counter value is below a given threshold. This is an original application of the "leaky bucket" mechanism.
PAT-CATEGORY : IBC Customer Systems
PAT-AUTHOR : F. Adam
DATE : 1991/02/01
COUNTRY : France
OBSERVATIONS : Registration No (France) : 91 01171

PROJECT : R1020
PAT-TITLE : Bistable optic device utilising the thermo-optic effect in a polymer
PAT-AUTHOR : D.J. Westland, V. Skarda, W. Blau, L. Costa

PROJECT : R1020
PAT-TITLE : Non-linear optical switch utilising organic conjugated materials and four wave mixing techniques
PAT-AUTHOR : D.J. Westland, V. Skarda, W. Blau, L. Costa
OBSERVATIONS : Ultra-fast all-optical switch

PROJECT : R1027
PAT-TITLE : A method for adjusting the operation on integrated optic devices
ABSTRACT : A method for the adjustment of operation characteristics of integrated optical devices, which allows the recovery of a considerable fraction of devices, being initially out of tolerance, by depositing on the surface of the waveguide material, after the final processing step of the device, a suitable layer of transparent material.
PAT-CATEGORY : Optical Communiation
PAT-AUTHOR : C. Caldera, S. Morasca, C. de Bernardi
DATE : 1991/03/07
COUNTRY : Italy, USA, Canada, Japan, GB, F, D, NL and Sweden
OBSERVATIONS : Applicant : CSELA - It will be extended by March 1991 to USA, Canada, Japan, GB, F, D, NL and Sweden.

PROJECT :	R1027
PAT-TITLE :	Fabrication procedure for an integrated semiconductor structure
ABSTRACT :	The fabrication of a butt-coupled integrated photodectector-waveguide with high efficiency of the detector, is usually prevented by the poor quality of the regrown interface. To overcome this limitation, a special structure is proposed, with the photosensitive material grown on a double stepped waveguide/substrate surface; this structure is also made suitable the high optical power thanks to the insertion of a beam spreading region between the waveguide and the detector.
PAT-CATEGORY :	Optical Communication
PAT-AUTHOR :	L. Menigaux, A. Carenco, A. Scavennec
DATE :	1990/05/21
COUNTRY :	France
OBSERVATIONS :	Applicant : CNET

PROJECT :	R1031
PAT-TITLE :	High Speed Submount
PAT-AUTHOR :	H.P. Mayer, G. Luz
OBSERVATIONS :	German Patent No P4110378

PROJECT :	R1031
PAT-TITLE :	Laserwafer und Verfahren zu seiner Herstellung (Laser wafer and method for fabrication)
PAT-AUTHOR :	K. Dutting, K. Wünstel
COUNTRY :	Germany
OBSERVATIONS :	German Patent OE 3934748 and European Patent EP 423513

PROJECT :	R1031
PAT-TITLE	Dispositif semiconducteur intégré incluant un élément optoélectronique de commutation en forme de Y
PAT-AUTHOR :	Ph. Authier, M. Erman. LEP
DATE :	1988/06/27
COUNTRY :	UK, F, D, I, SW, NL
OBSERVATIONS :	Filed with the US, Japan and South Korea Patent Office and under the European Patent Convention

PROJECT :	R1031
PAT-TITLE :	Method for testing edge emitting semiconductor devices
PAT-AUTHOR :	K.H. Bihler, H. Hauer, B. Schwaderer
COUNTRY :	Germany
OBSERVATIONS :	Applied for German Patent under No P3916924

PROJECT :	R1033
PAT-TITLE :	Dispositif semiconducteur intégré incluant un commutateur optoélectronique
PAT-AUTHOR :	J.A. Cavailles, LEP
DATE :	1989/06/09
COUNTRY :	UK, F, D, I, NL, SW
OBSERVATIONS :	Filed with the US, Japan and South Korea Patent Office and under the European Patent Convention

PROJECT :	R1033
PAT-TITLE :	Dispositif semiconducteur intégré incluant un élément optoélectronique de commutation
PAT-AUTHOR :	M. Erman, LEP
DATE :	1988/11/28
COUNTRY :	UK, F, D, I, SW, NL
OBSERVATIONS :	Filed with the US, Japan and South Korea Patent Office and under the European Patent Convention

PROJECT : R1033
PAT-TITLE : Optical Devices (HBT Waveguides)
PAT-AUTHOR : GEC
DATE : 1988/06/16
COUNTRY : F, D, I, NL, SW
OBSERVATIONS : Filed with the US Patent Office and under the European Patent Convention

PROJECT : R1033
PAT-TITLE : Verfahren und Vorrichtung zum dezentralen Aussenden von Information auf eine Uebertragungsstrecke
PAT-AUTHOR : S. Rao, M. Potts, R. Beeler, ASCOM TECH AG
OBSERVATIONS : Filed with the Swiss Patent Office (No 04 093/88-4)

PROJECT : R1033
PAT-TITLE : Dispositif semiconducteur comprenant un guide de lumière intégré qui présente au moins une partie rectiligne
PAT-AUTHOR : Ph. Autier, M. Erman, J.M. Auger, LEP
DATE : 1988/06/27
COUNTRY : UK, F, D, NL
OBSERVATIONS : Filed with the US, Japan and South Corea Patent Office and under the European Patent Convention

PROJECT : R1033
PAT-TITLE : Dispositif semiconducteur incluant un coupleur directionnel pour les composantes TE, TM
PAT-AUTHOR : J. Angenent, J.A. Cavailles, LEP
DATE : 1989/07/28
COUNTRY : UK, F, D, I, SW, NL

PROJECT : R1033
PAT-TITLE : Uebertragungseinrichtung mit einer optischen Uebertragungsstrecke
PAT-AUTHOR : P. Vogel, Th. Martinson, Ascom Tech AG
DATE : 1989/12/12
OBSERVATIONS : Filed with the Swiss Patent Office

PROJECT : R1033
PAT-TITLE : Bit- und Rahmensynchronisiereinheit für einen Zugriffseinheit einer optischen Uebertragungseinrichtung
PAT-AUTHOR : P. Vogel, Th. Martinson, ASCOM TECH AG
DATE : 1990/04/09
OBSERVATIONS : Filed with the Swiss Patent Office (No 01 192/90-3)

PROJECT : R1033
PAT-TITLE : Code-Erkennungseinheit und Verwendung derselben
PAT-AUTHOR : P. Vogel, Th. Martinson, ASCOM TECH AG
DATE : 1990/05/23
OBSERVATIONS : Filed with the Swiss Patent Office (No 01 769/90-0)

PROJECT : R1033
PAT-TITLE : Optoelectronic assemblies (SiTHRU packaging)
PAT-AUTHOR : I.R. Crostonm S.G. Tyler, GEC-Marconi
DATE : 1991/06/26
OBSERVATIONS : Filed with the UK Patent Office

PROJECT : R1035
PAT-TITLE : Connectionless ATM Data Services
OBSERVATIONS : Official publication of the application did not occur yet

PROJECT : R1038
PAT-TITLE : Vermittlungsunabhängiges Konferenzsystem (Audio/Video)
OBSERVATIONS : Application submitted by Alcatel SEL

PROJECT : R1038
PAT-TITLE : Videophone bei Multimedia mittels Umlenkspiegelanordnung
OBSERVATIONS : Application submitted by Alcatel SEL

PROJECT : R1038
PAT-TITLE : Videophone bei Multimedia - "Periskoplösung"
OBSERVATIONS : Application submitted by Alcatel SEL

PROJECT : R1041
PAT-TITLE : Hybrid-Codierer für Videosignale
PAT-AUTHOR : J. Speidel, P. Vogel
OBSERVATIONS : Patent No EP 0 244 01

PROJECT : R1041
PAT-TITLE : Verfahren u. Schaltungsanordnung zur Bitratenreduktion
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3631252 - EP 0 260 748

PROJECT : R1041
PAT-TITLE : Quellcodierer für Videobilder
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3710119 - EP 0 284 161

PROJECT : R1041
PAT-TITLE : System zur Übertragung von Videobildern
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3726520 - EP 0 290 085

PROJECT : R1041
PAT-TITLE : Verfahren zur Bestimmung von Bewegungsvektoren
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3727530

PROJECT : R1041
PAT-TITLE : System zur Übertragung von Videobildern
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3744280

PROJECT : R1041
PAT-TITLE : Schaltungsanordnung zur Auswertung eines Videosignals
PAT-AUTHOR : M. Riegel
OBSERVATIONS : Patent No DE 3809076 - EP 0 333 274

PROJECT : R1041
PAT-TITLE : Steuersignalgenerator für die Verarbeitung eines Videosignals
PAT-AUTHOR : M. Riegel
OBSERVATIONS : Patent No DE 3809075 - EP 0 333 275

PROJECT : R1041
PAT-TITLE : Prädiktiver Standbildcodierer
PAT-AUTHOR : K. Hienerwadel & G. Weth
OBSERVATIONS : Patent No DE 3811536 - EP 0 336 510

PROJECT : R1041
PAT-TITLE : Hybrid-Codierer für Videosignale
PAT-AUTHOR : K. Hienerwadel & G. Weth
OBSERVATIONS : Patent No DE 3811535 - EP 0 336 535

PROJECT : R1041
PAT-TITLE : Verfahren zur Speicherung und Wiedergabe von Videosignalen
PAT-AUTHOR : G. Weth
OBSERVATIONS : Patent No DE 38731277

PROJECT : R1041
PAT-TITLE : Speicher für Videosignale
PAT-AUTHOR : M. Riegel
OBSERVATIONS : Patent No DE 3838171 - EP 0 365 069

PROJECT : R1041
PAT-TITLE : Verfahren zur Bestimmung der Bewegungsvektoren einer Sequenz von Videobildern
PAT-AUTHOR : K. Hinerwadel
OBSERVATIONS : Patent No DE 3839502

PROJECT : R1041
PAT-TITLE : Schaltungsanordnung zur Filterung eines Videosignals
PAT-AUTHOR : K. Hinerwadel
OBSERVATIONS : Patent No DE 3917085

PROJECT : R1041
PAT-TITLE : Codierer für blocksweise Codierung von Videobildern
PAT-AUTHOR : P. Vogel
OBSERVATIONS : Patent No DE 3929280

PROJECT : R1041
PAT-TITLE : Schaltungsanordnung zur Bestimmung der Lage von extremalen Werten einer Ähnlichkesf
PAT-AUTHOR : K. Hinerwadel
OBSERVATIONS : Patent No DE 4009610 - EP 0 449 363

PROJECT : R1041
PAT-TITLE : Vorrichtung zur Steuerung einer Videokamera
PAT-AUTHOR : W. Demmer & G. Weth
OBSERVATIONS : Patent No DE 4012846

PROJECT : R1041
PAT-TITLE : Adaptives Filter zur Reduktion von Codierartefakten
PAT-AUTHOR : W. Demmer
OBSERVATIONS : Patent No 4017375

PROJECT : R1041
PAT-TITLE : Schaltungsanordnung zum Erkennen eines menschlichen Gesichts
PAT-AUTHOR : E. Badiqué
OBSERVATIONS : Patent No DE 4028191 - EP 0 474 304

PROJECT : R1041
PAT-TITLE : Anordnung zur Speicherung digitaler Farbbildsignale
PAT-AUTHOR : B. Friedrich
OBSERVATIONS : Patent No DE 4041821

PROJECT : R1044
PAT-TITLE : Multi-user Optical line Outlet
PAT-AUTHOR : Fussgänger (SEL)
DATE : 1990
COUNTRY : Germany
OBSERVATIONS : Exploitation of this patent will be "free of charge" to all participants in RACE Programme

PROJECT : R1044
PAT-TITLE : Optical Communication System for the Multi-Customer Access Area
ABSTRACT : Multi-Customer Optical Line Inlet/Multi-Customer Optical Line Outlet (MC-OLI/MC-OLO); Threefold WDM :
- High Density WDM (eg. 2-5 nm) for multi-customer signal transmissions
- Medium-Density WDM (eg. 65-85 nm) for bidirectional signal transmissions, and
- Low-Density WDM (eg. 185-235 nm) for optical integration of interactive (B)ISDN and distributive CATV service signals

PAT-CATEGORY : IBC Customer Systems
PAT-AUTHOR : Dr. Kurt Fussgaenger, SEL
DATE : 1989/90
COUNTRY : Germany, EC

PROJECT : R1064
PAT-TITLE : Integrierte optische Anordnung mit wenigstens einem auf einem Substrat aus Halbleitermaterial integriertem optischem Wellenleiter
DATE : 1989/09/01
COUNTRY : Germany
OBSERVATIONS : German Application P 39 29 131.6 - GR 89 P 1730 DE

PROJECT : R1064
PAT-TITLE : Monolithisch integrierter Schaltkreis mit einer DDB-Laserdiode, optischem Schalter und Wellenleiterverbindungen
DATE : 1990/05/03
COUNTRY : Germany
OBSERVATIONS : German Application P 40 14 234.5 - GR 90 P 1231 DE

PROJECT : R1064
PAT-TITLE : Steuerbarer integrierter optischer Richtkoppler
DATE : 1990/09/28
COUNTRY : Germany
OBSERVATIONS : German Application P 40 30 754.9 - GR 90 P 1725 DE

PROJECT : R1064
PAT-TITLE : Steuerbarer integrierter optischer Mach-Zehnder-Interferometer
DATE : 1990/09/28
COUNTRY : Germany
OBSERVATIONS : German Application P 40 30 755.7 - GR 90 P 1726 DE

PROJECT : R1064
PAT-TITLE : Passiver integrierter optischer Richtkoppler
DATE : 1990/09/28
COUNTRY : Germany
OBSERVATIONS : German Application P 40 30 756.5 - GR 90 P 1727 DE

PROJECT : R1083
PAT-TITLE : Method and Circuit Arrangement for Data Block Synchronisation in TDM Communiation System, particularly in an ATM
PAT-AUTHOR : S. Wahl, B. Cesar
DATE : 1991/07/12
OBSERVATIONS : (EP 91 111 615.0 12.07.91)

PROJECT : R1089
PAT-TITLE : Verfahren zum Absetzen von Kabeln, insbesondere Lichtwellenleiterkabeln
ABSTRACT : Cutting of aramid yarns for cable end preparation
PAT-AUTHOR : H. Deharde, J. Rogalla, J. Schulte
DATE : 1989/0
COUNTRY : Germany
OBSERVATIONS : Application Submitted

PROJECT : R1089
PAT-TITLE : Verfahren zum zugfesten Verbinden eines Steckers mit einem Lichtwellenleiterkabel
ABSTRACT : Procedure for the mounting of the crimp sleeve of an optical connector
PAT-AUTHOR: H. Deharde
DATE : 1990/01
COUNTRY : Germany
OBSERVATIONS : Application submitted

PROJECT : R1089
PAT-TITLE : Connecteurs pour fibres optiques à verrouillage et déverrouillage rapide
ABSTRACT : Design of the housing for a push-pull operating fibre optic connector
PAT-AUTHOR : E. Grassin d'Alphonse, S. Dubois, N. Valade
DATE : 1990/06/21
COUNTRY : France
OBSERVATIONS : Application submitted, extension to foreign countries planned

PROJECT : R1089
PAT-TITLE : Connecteur pour fibres optiques
ABSTRACT : Silicone-based membrane fixed inside the adaptor connecting 2 optical fibres
PAT-AUTHOR : L. Boillot, S. Boudard
DATE : 1990/01/29
COUNTRY : France
OBSERVATIONS : Application submitted, extension planned for European cointries and the US

PROJECT : R1089
PAT-TITLE : Oblique Fibre Cleaving
OBSERVATIONS : Application submitted

PROJECT : R1089
PAT-TITLE : Singleway re-enterable splice
OBSERVATIONS : Application submitted

PROJECT : R1089
PAT-TITLE : Design of compact fan-out with splitters
OBSERVATIONS : Application submitted in April 1992

Annex V

Glossary of technical terms

ATM - Asynchronous Transfer Mode.
CEPT - Conference of European Post and Telecommunications Organisations
CCIR - Comite Consultatif International des Radiocommunications of ITU
CCITT - Comite Consultatif International des Telegraphique et Telephonique - International Telephone and Tele
CFS - Common Functional Specifications
CODEC - Coder/Decoder
COST _ Co-operation in Science and Technology: A European multi-national framework for R&D co-operation.
CPN - Customer Premises Network
CREST - EC Committee on Research, Science and Technology.
DRIVE - EC R&D on Telematic systems in the area of Transport
EBIT - European Broadband Interconnection Trial
ECU - European Currency Unit
EDTV - Enhanced Definition Television
EFTA - European Free Trade Association
EL - Electro-luminescent
ESPRIT - European Strategic Programme of Research in Information Technologies
ETSI - European Telecommunications Standards Institute
EURESCOM - European Institute for Research and Strategic Studies in Telecommunications GmbH
GEN - General European Network: A 34 MBit/s fibre transmission Backbone
IBC - Integrated Broadband Communicatons
IC - Integrated Circuit
IN - Intelligent Networking
ISDN - Integrated Services Digital Network
ITU - International Telecommunications Union
HDTV - High Definition Television
LSI devices - Large-Scale Integrated devices
METRAN - Managed European Transport Network
MOU - Memorandum of Understanding
PNO - Public Network Operator
RACE - Research on Advanced Communications technologies for Europe
RMC - RACE Management Committee
SME - Small and medium-sized Enterprise
TMN - Telecommunications Management Network
UMTS - Universal Mobile Telecommunications System

Annex VI

Key references

Council Decision of 25th July 1985 on a definition phase for a Community action in the field of telecommunications technologies - R&D programme in advanced communications technologies for Europe (RACE): 85/372/EEC; O.J. No L 210/24; 7.8.1985

Council Decision of 14 December 1987 on a Community programme in the field of telecommunications technologies - R&D in advanced Communications technologies in Europe (RACE programme); 88/28/EEC: O.J. No L 16/35, 21.1.88.

Council resolution of 30th June 1988 on the development of the common market for telecommunications services and equipment up to 1992; 88/C 257/01: O.J. No C 257/1, 4.10.88.

Communication from the Commission to the Council and Parliament "Working towards Telecom 2000 - Launching the Programme RACE - COM(88) 240 final II of 31.5.88

Report of the IBC strategic Audit: "Establishing advanced communications in Europe". February 1989.

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The report of the information and communications technologies review Board, Chaired by Mr. W. Dekker, June 1992.

Communication from the Commission on "Evaluation of the second Framework Programme for research and technological development (SEC(92)675 Final), July 1992.

Evaluation of the second Framework Programme of RTD: **Report from CREST to the Council**, September 1992. CREST/1212/1/92.

Annex VII

Listing of Projects

1001 DVT:Digital video-tape recording terminal for HDTV
1002 Satellite communications for IBCN
1003 GUIDELINE:AIP and standards for TMN
1004 Electro-luminescent flat-panel display for terminal applications
1005 NEMESYS:Traffic and QOS management for IBCN
1006 AIM: AIP application to IBCN maintenance
1007 ITIS: IBC terminal for interactive services
1008 Silicon-based low-cost passive optical components
1009 ADVANCE: Network and customer administration systems for IBCN
1010 Subscriber coherent Multi-channel system
1011 Business CPN
1012 BLNT: Braodband local network technology
1013 HDTV-Switching
1014 ATMOSPHERIC
1015 Domestic CPN
1016 Test tools and equipment
1017 IOLE: IBC on-line environment
1018 HIVITS: High-quality video-telephone and hihg-definition television system
1019 Polymeric optical switching
1020 All-optical switching and bi-stable devices based on semi-conducting polymers
1021 ARISE: A resuable infrastructure for software engineering
1022 Technology for ATD
1023 BEST: A methodological approach to IBC system requirements specifications
1024 NETMAN: Functional specifications for IBC TNM
1025 Functional specification of security and privacy in IBC
1026 International transmission of digital radio and television
1027 Integrated opto-electronics towards coherent multi-channel IBCN
1028 REVOLVE: Regional evolution planning for IBC
1029 Development of improved InP substrate material for opto-electronic devices
1030 ACCESS: Advanced customer connections, an evolutionary systems strategy
1031 Low-cost opto-electronic components
1032 Development and testing of optical components for subscriber networks
1033 OSCAR: Optical switching systems, components and architecture research
1034 Usability engineering requirement for IBC
1035 Customer premises network (CPN)
1036 WDTM broadband customer premises network
1037 User criteria for the realisation of opportunities afforded by IBC
1038 MCPR: Multi-media communication, processing and representation
1039 DIMUN: Distributed international manufacturing
1040 RIPE: RACE integrity primitives evaluation
1041 FUNCODE: Functional specification of codes
1042 MULTI-MED: Functional service integration in support of professional users
1043 Mobile telecommunications project
1044 IBCN development and implementation strategies

1045 Consensus management project
1046 SPECS: Specification and programming environment for comms software
1047 Techniques and integrity mechanisms in IBCN
1048 RSVP: RACE strategy for verification
1049 ATM concept
1050 IBC applications analysis
1051 Multi-gigabit transmission in IBCN subscriber loops
1052 SPOT: Signal processing for optical and cordless transmission
1053 TERRACE: TMN evolution of reference configurations for RACE
1054 APPSN: Application pilot for people with special needs
1055 MERCHANT: Methods in electronic retail cash handling
1056 BIPED: Basic business IBC demonstrator
1057 AQUA: Advanced quantum-well lasers for multi-gigabit transmission
1058 RESAM: Remote expert support for aircraft maintenance
1059 DIVIDEND: Dealer interactive video
1060 DIDAMES: Distributed industrial design and manufacturing of electronic subassemblies
1061 DIMPE: Distributed integrated multi-media publishing environment
1062 MARIN: Marine industry applications of broadband communications
1063 MAPS: RACE mobile applications pilot scheme
1064 MIOCA: Monolithic integrated optics for customer access applications
1065 ISSUE: IBCN systems and services useability engineering
1066 IPSNI: Integration of people with special needs by IBC
1067 Usability design information support
1068 ROSA: RACE open services architecture
1069 EPLOT: Enhanced performance lasers for optical transmission
1070 Testing Pay-per-view in Europe
1071 Applications analysis
1072 ITACA: IBCN testing architecture for conformance assessment
1073 GEOTEL: Application pilot in the petroleum and chemicals industry
1074 ECHO: Electronic case-handling in offices
1075 Telepublishing
1076 REMUS: Reference models for useability specifications
1077 Usage reference model for IBC
1078 European museums network
1079 CAR: CAD/CAM for the automotive industry in Europe
1080 HDTV experimental usage
1081 BUNI demonstrator
1082 QOSMIC: QOS verification methodology and tools for integrated communications
1083 PARASOL: ATM specific measurement equipment
1084 MIME: Development of emulators and simulators
1085 TET-ADAPT: Adaptation of techno-economic evaluation tools for RACE
1086 TELEMED
1087 PROVE: Provision of verification
1088 TUDOR: Usability issue for people with special needs
1089 LOOP: Low-cost optical components
1091 ESP: EBIT service project
1092 DIRAC: Database for reliability calculations

Annex VIII

Organisations involved in RACE Projects

ANNEX B - Alphabetical List of Participating Organisations

	Organisation	Country	Project(s)
01-PLIRO	01-PLIROFORIKI	GR	R1075
AAS/TAU	Austrian Academy of Sciences Technology Assessment Unit	A	R1037
ACEC	ACEC SA	B	R1018, 22, 41
AEG	AEG Aktiengesellschaft	D	R1018, 39
AEG	AEG Forschungsinstitut	D	R1041
AEG	AEG Kabel AG	D	R1030, 44, 56
AEG	AEG Olympia AG	D	R1063
AET	Applicazioni Elettrotelefoniche A.E.T. Spa	I	R1044
AIB	Allied Irish Bank Plc	IRL	R1059
AKZO	AKZO International Research BV	NL	R1019*
ALCASP	Alcatel Espace SA	F	R1002*, 86
ALGO	Algotech Sistemi	I	R1076*
ALPHA	ALPHA SAI	GR	R1016, 84
AMPER	Amper SA	E	R1044, 45, 81
ANALYSIS	Analysis Ltd	UK	R1028
ANDUS	ANDUS GmbH	D	R1060
ANITRA	Anitra Medienprojekte	D	R1070*
ANT	ANT Nachrichtentechnik GmbH	D	R1002, 30, 31, 44, 47*, 51
APD	Grupo de Empresas A.P.D.	E	R1042
APM	Architecture Projects Management	UK	R1068
APSIS	APSIS	F	R1042
APT	AT&T en Philips Telecommunicatie Bedrijven BV	NL	R1022, 31, 33, 44, 51, 81, 83
ASCOM	Ascom Tech AG	CH	R1053, 83, 87
AT&T NSI	AT&T Network Systems International BV	NL	R1045, 77
ATEA	ATEA	B	R1044
ATR	ALCATEL Radiotelephone	F	R1043
AXI	AXION A/S	DK	R1009
B&S	Barr & Stroud Ltd (Pilkington)	UK	R1019
B3i	Bureau International d'Ingénierie Informatique	F	R1083
BALT	Baltimore Technologies (Subcontractor)	IRL	R1021
BARCO	Barco Industries N.V.	B	R1044
BED	BED	D	R1015
BBC	British Broadcasting Corporation	UK	R1018, 36*, 43, 63, 77, 81
BC	Bertin & Cie.	F	R1092
BCOM	Broadcom Eireann Research Ltd	IRL	R1003, 09*, 21*, 23, 24*, 28, 53, 91
BELSER	Belser Verlag	D	R1078
BIBA	Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaft an der Universität Bremen	D	R1039*, 62, 85
BICC	BICC Cables Plc	UK	R1032*, 39, 60
BNP	Banque Nationale de Paris	F	R1059
BOSCH	Robert Bosch GmbH	D	R1043, 44, 54

BT	British Telecommunications Plc	UK	R1003*, 06, 09, 18, 22, 23, 24, 25, 28, 30, 32, 33, 34, 37*, 41, 43, 44, 45, 48, 55, 59, 67, 68*, 77, 79, 81*, 87, 91, 92*
BT/NoI	British Telecommunications Plc (Northern Ireland)	UK	R1028
BT/NoS	British Telecommunications Plc (North of Scotland District)	UK	R1028
BTM	Alcatel/BTM	B	R1002, 22*, 44, 45, 46, 83
BTS	Broadcast Television Systems GmbH	D	R1080
BURDA	Burda GmbH	D	R1061
CAP	CAP SESA Régions	F	R1087
CAP	CAP Sesa Telecom	F	R1021
CAP	CAP SOGETI Innovation	F	R1016, 17
CASE	Case Communications Ltd	UK	R1003, 05*, 53, 79, 82
CCETT	Centre Commun d'Etudes de Télédiffusion et Télécommunications	F	R1018
CEA	Commissariat à l'Energie Atomique	F	R1008
CEL	Crosfield Electronics	UK	R1061
CERDA	Institut Cerda	E	R1037, 71
CET	(Centro de Estudos de Telecommunicações) Correios & Telecomunicações de Portugal	P	R1009, 21, 23, 24, 28*, 54,
CIRU	Computer Industry Research Unit	UK	R1055, 59
CIT	Alcatel CIT SA	F	R1022, 44, 45
CLEM	Clemessy SA	F	R1016, 82, 87
CNET	Etat Français - Ministère des PTT Centre National d'Etudes des Télécommunications	F	R1015, 18, 22, 27, 30, 32, 5, 41, 44, 46, 48, 57, 68, 3, 87, 92
CNR	Consiglio Nazionale Delle Ricerche	I	R1066*
CNRG	Communication Networks Research Group	GR	R1083
CNUSC	C.N.U.S.C.	F	R1086
CONTEL	Contel IPC (UK) Ltd	UK	R1059
CORNEL	Cornelsen Verlag	D	R1075
COSI	Consorzio per l'OSI in Italia	I	R1044, 72*
CPR	Consorzio Pisa Ricerche	I	R1091
CPS	Condatec Projekt Software GmbH	D	R1075
CSATA	CSATA - Tecnopolis (Centro Studi e Applicazioni in Tecnologie Avanzate)	I	R1028, 38, 92
CSELT	C.S.E.L.T. - Centro Studi e Laboratori Telecomunicazioni Spa	I	R1018, 27, 44, 46, 48, 53*, 54, 57, 68
CT	Compagnie Technicon	F	R1042
CTE	Centro de Textos Electronico SA	E	R1061
CTT	Correios e Telecomunicações de Portugal	P	R1022, 91
CU	Commercial Union Assurance Company	UK	R1074
CWI	Stichting Mathematisch Centrum - CWI	NL	R1040*
DANAOS	Danaos Shipping Co.	GR	R1062

DANET	DANET GmbH	D	R1006
DBP	Bundesministerium für das Post und Fernmeldewesen	D	R1045
DBP	Deutsche Bundespost	D	R1051, 92
DEA	Danish Engineering Academy	DK	R1092
DETECON	DETECON GmbH	D	R1075*, 86*, 91*
DEUTSCH	Compagnie Deutsch	F	R1031
DHL	DHL Worldwide Express	B	R1063*
DHZ	Deutches Herzentrum	D	R1086
DIT/UPM	Departamento de Ingenieria Telemática Universidad Politecnica de Madrid	E	R1072
DLV	Delta Lloyd Verz.	NL	R1074
DORNIER	Dornier System GmbH	D	R1002
DTB	Deutsche Thomson-Brandt GmbH	D	R1001, 18
EBT	EB Teknologi Ltd	N	R1039, 43, 46
EBU	Technical Centre of the EBU	B	R1026*
ELBASA	ELBASA	E	R1060
ELCENT	ElektronikCentralen	DK	R1016, 84, 87
ELCOMA	Philips International BV. Elcoma Division	NL	R1022
ELEC	Electricity Council	UK	R1063
ELIN	Alcatel Austria Elin Forschungcentrum GmbH	A	R1046
ELSYP	ELSYP	GR	R1075
EMI	EMI Electromagnetics Institute	DK	R1014
EMP	Empirica GmbH	D	R1054
ENI	Enichem Synthesis Spa	I	R1020
EOLAS	The Irish Science and Technology Agency	IRL	R1087
EPFL	EFPL	CH	R1057
ERA	ERA Technology Ltd	UK	R1020
ERC	Alcatel Austria - ELIN Research Center	A	R1017
ERICSSON	Ericsson Radio Systems AB	S	R1043
ERICSSON	Ericsson Telecom	S	R1056*, 68, 81
ESTTO	ESTTO SA	GR	R1061
FACE	Industrie FACE Standard Spa	I	R1002, 06, 08, 13, 17, 22, 38, 44, 45, 66
FATME	Fabbrica Apparecchiature Telefoniche e Materiale Elettrico - Brevetti Ericsson	I	R1011*, 15, 35*, 44, 45, 56, 72, 81
FCR	France Cable & Radio	F	R1059, 87
FCRE	F.C.R. Entreprises	F	R1091
FI/DBP	Forschungsinstitut der DBP TELEKOM beim Fernmeldetechnischen Zentralamt	D	R1018, 22, 25*, 32, 41
FIAR	Fabricca Italiana Apparecchiature, Radioelettriche SpA	I	R1009
FINTEL	Post and Telecommunications of Finland	SF	R1039, 44
FIT	Swiss Federal Institute of Technology, Zurich	CH	R1033

FHG	Fraunhofer Abbeitsgruppe für Graphische Datenverarbeitung	D	R1079
FLZ	Fischer-Madsen & Lorenz Petersen Data Communications Consultants A/S (Fischer and Lorenz)	DK	R1005
FMH	Universidade Tecnica de Lisboa, Faculdade de Motricidade Humana, Departamento de Educaçao Especial e Reabilitaçao, (FMH-DEER)	P	R1054, 88
FOKKER	Fokker Aircraft BV	NL	R1058
FORD	User 2 - Ford (Europe)		R1079
FORTH	Foundation for Research and Technology - Hellas	GR	R1005, 66
FTZ	Deutsche Bundespost TELEKOM - Fernmeldetechnisches Zentralamt	D	R1044, 48, 53, 87
FUB	Fondazione Ugo Bordoni	I	R1043, 65, 68, 72
GEC	GEC-Marconi Research Ltd.	UK	R1043, 92
GEC	GEC Research Ltd (Subcontractor)	UK	R1011
GEC	The General Electric Company Plc (GEC Research Ltd, Marconi Research Centre)	UK	R1002
GEC	The General Electric Company Plc	UK	R1014, 18, 24, 30, 33, 35, 36
GEOSTOCK	Société Francaise de Stockage Géologique	F	R1073*
GMD	Gesellschaft für Mathematik & Datenv.	D	R1068, 72, 75
GPT	GEC-Plessey Telecommunications Ltd.	UK	R1005, 44, 45, 46, 51 56, 81
GRUNDIG	Grundig AG	D	R1001
HAI	Hellenic Aerospace Industry	GR	R1044
HAMBURG	Museum Hamburg	D	R1078
HASLER	Research & New Technologies Division of Ascom Holding Ltd (Hasler AG)	CH	R1016, 33
HELL	Dr. Ing. Rudolf Hell GmbH	D	R1061
HHI	Heinrich Hertz Institut	D	R1010
HIDB	Highlands & Islands Development Board	UK	R1028
HP	Hewlett-Packard Ltd	UK	R1016, 83
HUSAT	Husat	UK	R1063, 65*, 76, 79
HUT	Helsinki University of Technology	SF	R1039, 62
IAD	International Automotive Design	UK	R1079*
IBM	IBM France SA	F	R1005, 46, 53, 68, 79, 82*, 84
ICOM	International Council of Museums	F	R1078
ICOM	Intracom SA	GR	R1009, 21, 24
IDATE	IDATE	F	R1050, 71, 77, 86
IFC	IFC Research Ltd	UK	R1050*, 71*, 77
IMEC	Inter-universitair Mikro-electronika Centrum vzw	B	R1010, 19, 22, 33, 69
IMS	Irish Medical Systems	IRL	R1086
INESC	Instituto de Engenharia de Sistemas e Computadores	P	R1011, 22, 46
INET	I-NET Limited	UK	R1053

INMARSAT	Inmarsat	UK	R1062
INST	Instruments SA	F	R1032, 36
INSTM	Institut Montpellier	F	R1086
INTECS	INTECS Sistemi Spa	I	R1017, 21
INTELSA	Industrias de Telecomunicacion SA	E	R1023, 44, 48
INTERCAI	INTERCAI	NL	R1070
INTRACOM	Intracom SA	GR	R1053, 60, 61
IPSYS	IPSYS Plc	UK	R1021
IROE	Instituto di Recerca sulle Onde - Electromagnetiche del Consiglio Nazionale dell Recerche	I	R1020
IRR	Institute for Rehabilitation Research	NL	R1066
ISI	ISI-Fraunhofer GmbH	D	R1050, 71, 75, 78*
ISL	Institut für Seeverkehrswirtschaft und Logistik	D	R1062
ISOFT	Intrasoft (Subcontractor)	GR	R1009, 21
ISR	Alcatel/ISR	F	R1053, 55, 60, 63
IST	Instituto Superior Tecnico	P	R1051
ITALTEL	Societa Italiana di Telecomunicazioni SpA	I	R1012, 44, 45, 49, 81
ITEC	Reading ITEC (Information Technology Centre)	UK	R1066
JTAS	Jutland Telephone Aktieselskab	DK	R1022, 44, 72, 81
KME	Kabelmetal Electro GmbH	D	R1032, 44, 89
KONE	Kone Belgium SA	B	R1039
KTAS	Kjobenhavns Telefon Aktieselskab	DK	R1005, 09, 22, 44, 53, 58, 82, 83, 84, 91
KUL	Katholieke Universiteit Leuven	B	R1066
L-CUBE	L-CUBE Information Systems SA	GR	R1061
LABEIN	Labein	E	R1072
LC	Lohja Corporation Electronic Industries	SF	R1004*
LDM	Laboratoires de Marcoussis	F	R1006, 19, 27, 46, 57
LEP	Philips - LEP (Laboratoires d'Electronique Philips)	F	R1010, 18, 33*
LER	Thomson-CSF	F	R1080*
LME	L.M.Ericsson Ireland	IRL	R1009
LME	Telefonaktiebolaget L M Ericsson	S	R1014, 21, 30, 33
LOEWE	Loewe Opta GmbH	D	R1007*
LOHJA	Lohja Corporation	SF	R1081
LUT	Loughborough University of Technology Dept of Electronic & Electrical Engineering	UK	R1042
LWB	Lloyd Werft Bremerhaven GmbH	D	R1062*
MARCONI	Marconi Italiana Spa	I	R1044
MARI	MARI Advanced Microelectronics Ltd	UK	R1007, 09, 21, 23*, 81
MATRA	MATRA Communication	F	R1004, 07, 18, 41, 81
MATRA	SA Matra-Space	F	R1014
MBLE	MBLE N.V./ S.A.	B	R1022
MCC	Maxwell Communication Corporation Plc	UK	R1061*

MCS	(Marconi Communication Systems) The Marconi Company Limited	UK	R1002
MCP	MCP Wafer technology	UK	R1029*
MECF	Medical Computers France	F	R1042
MET	Matra-Ericsson Télécommunications	F	R1014*, 44, 56, 83
METATYPE	Metatype SA	GR	R1061
MM	Midland Montagu	UK	R1059
MONOTYPE	Monotype Corporation Plc	UK	R1061
MSS	Marconi Space Systems The Marconi Company Limited	UK	R1002
NAH	Nassauisches Heim	D	R1054
NAVICON	Navicon SA	E	R1062
NCC	National Computing Centre Ltd.	UK	R1048
NCI	Norcontel (Ireland) Ltd	IRL	R1059
NEDPTT	Centraaldirectie Nederlandse PTT	NL	R1088
NEWPOL	Newcastle Polytechnic	UK	R1088
NIHE	The National Institute for Higher Education	IRL	R1046
NKT	Aktieselskabet Nordiske Kabel & Traadfabriker Denmark	DK	R1014, 30*, 45, 51, 56
NMRC	National Microelectronics Research Centre	IRL	R1020, 43
NOKIA	NOKIA Corporation	SF	R1011, 22, 35, 43, 44
NSDD	Telecom Eireann NSDD	IRL	R1059
NTA	Norwegian Telecommunications Administration	N	R1022, 44, 53, 68, 83, 86, 91
NTA	Research Department (Teledirektorat) of Norwegian Telecommunications Administration	N	R1023
NTE	NTE GmbH	D	R1075
NTUA	National Technical University of Athens	GR	R1014, 22, 24, 62
NTUA	National Technical University of Athens (Subcontractor)	GR	R1009
ORT	Offset Repro Technik	D	R1075
OTE	Hellenic Telecommunications	GR	R1028, 43
OTTO	Otto Versand	D	R1075
OXC	Oxford Consultants (Europe)	UK	R1042
OXP	Oxford Polytechnic Dept of Computing And Mathematical Science	UK	R1042
PEUSA	Peugeot SA	F	R1079
PHILIPS	Nederlandse Philips Bedrijven BV	NL	R1001, 10*, 31, 64, 69, 80
PHILIPS	Philips SA	B	R1022
PHILIPS	Philips Telecommunicatie en Data Systemen, Nederland BV	NL	R1022, 45
PHILIPS	Philips USFA	NL	R1040, 47
PHILIPS	Philips International BV	NL	R1074*
PKB	PK Berlin	D	R1078
PKI	Philips Kommunikations Industrie AG	D	R1015, 18, 22, 35, 41, 43, 44, 58, 74, 78, 83
PLANET	Planet SA	GR	R1061, 73
PLES	Plessey Research, Roke Manor Ltd	UK	R1009, 11, 12*, 15, 35, 49*

PLES	Plessey Research (Caswell) Ltd	UK	R1010, 18, 64, 69*
PLESSEY	Plessey UK Ltd	UK	R1043, 67, 68
PRC	Philips Radio Communication Systems Ltd	UK	R1043*, 63
PRENSA	PRENSA	E	R1075
PROMAR	Proyectos Marinos	E	R1062
PRL	Philips Research Labs	UK	R1043
PTT	Swiss PTT	CH	R1045, 86
PUM	Philips Universitaet Marburg	D	R1057
QMC	QMC Instruments Ltd	UK	R106
QMC	Queen Mary College, London	UK	R1022
QMW	Queen Mary & Westfield College (University of London)	UK	R1083
RADI	Radiall SA	F	R1032, 89*
RAL	Rutherford Appleton Laboratory of the Science and Engineering Research Council	UK	R1042
REFER	Refer BVBA	B	R1076, 87
RIC	RIC Association Internationale	B	R1044*, 45*
RKL	Regio Kabel Limbourg	NL	R1070
RNL	Research Neher Laboratories of the Netherlands PTT	NL	R1015, 18, 19, 22, 25, 33 35, 36, 40, 41, 43, 44, 46, 48, 54, 65, 68, 81, 91
RTC	RTC-Compelec	F	R1031
RTT	Régie T.T.	B	R1022, 44, 45
SACM	SACM	F	R1062
SAGEM	Sagem Sa	F	R1047
SAIT	SAIT S.A. (Subcontractor)	B	R1041
SARDE	Sarde S.A.	F	R1073
SARIN	Sarin	I	R1065
SAS	SAS Denmark	DK	R1058*
SAT	Société Anonyme de Télécommunications	F	R1030, 44, 45, 56
SEB	S-E-Banken, SEB Data	S	R1059
SEC	SOURIAU & Cie.	F	R1089
SEL	Alcatel/SEL AG	D	R1003, 06*, 13*, 15, 16*, 17*, 22, 31*, 32, 33, 34*, 35, 38*, 44, 45, 51*, 53, 54*, 57*, 60, 67*, 77*, 81, 83, 86, 87, 88*
SEPT	Service d'Etudes communes des Postes et Télécommunications	F	R1025
SES	Scitex Europe Sa	B	R1061
SESA	Alcatel/SESA	E	R1002, 06, 11, 17, 18, 22, 35, 36, 38, 43, 44, 46, 48, 56
SFI	Senter for Industrieforskning	N	R1039
SGS	SGS Microelletronica SpA	I	R1004, 14, 44
SGS	SGS-Thomson Microelectronics SA	F	R1030, 36
SIBS	Sociedade Interbancaria de Servicos	P	R1055
SID	Synergie Informatique et Developpement	F	R1068
SIE	Sistemas Expertos	E	R1042,

SIEMENS	Siemens AG	D	R1010, 12, 31, 40, 44, 45, 47, 49, 53, 64*, 69, 81, 83, 92
SIETEC	SIETEC	D	R1075
SIETTE	SIETTE	I	R1086
SIGOS	SIGOS	D	R1074
SINTRA	Thomson - SINTRA	F	R1033
SIP	Società Italiana per le Telecomunicazioni	I	R1053
SIRTI	SIRTI SpA	I	R1032, 89
SIXCOM	Sixcom (Olivetti Group)	I	R1055
SLIGOS	Sligos	F	R1055*
SNS	Sloman Neptun Schiffahrts AG	D	R1062
SOFREC	SOFRECOM	F	R1070
SOGITEC	SOGITEC	F	R1075
SOPHA	Sopha Medical	F	R1042
SOURIAU	Souriau et Cie.	F	R1030
SPAG	SPAG Services S.A.	B	R1048*, 87*
SPECTRUM	Spectrum Energy & Information Technology Ltd	UK	R1073
STAL	Televerket (Swedish Telecommunications Administration)	S	R1009, 11, 14, 18, 21, 23, 24, 25, 30, 33, 35, 41*, 43, 44, 45, 53, 56, 59, 67, 83, 86, 87
STAT	STAT SA	GR	R1075
STC	Alcatel STC Plc	UK	R1014, 22, 24, 27*, 31, 36, 44, 45, 53, 56, 57, 59*, 68, 83, 86, 89
STK	Alcatel/STK	N	R1022, 38, 86
STL	STC Technology Ltd	UK	R1036
STL	STC Plc, STC Technology Ltd	UK	R1008*
STOLL	Stollmann GmbH	D	R1060
SUS	SUS Research Ltd	IRL	R1028
SWIFT	S.W.I.F.T.	B	R1055
SWIN	(Swedish Institute for the Handicapped	S	R1088
SYD	Synergie Informatique et Developpement	F	R1009
T&T	Thrane & Thrane	DK	R1062
TCD	University of Dublin, Trinity College	IRL	R1009, 20*
TCE	Thomson Consumer Electronics	F	R1080
TCSF	Thomson-CSF	F	R1015*, 18*, 29, 33, 35, 36, 47, 57, 81
TECHNI	Technisystems	GR	R1062
TECHNO	TechnoPlan	D	R1060
TECSI	GSI-Tecsi SA	F	R1005, 46*, 59, 82, 84
TEE	Telecom Eireann (Subcontractor)	IRL	R1020
TEKNON	Teknon Gesellschaft für Wissenbasierte Systeme GmbH	D	R1017
TELE-S	Telematic Services GmbH	D	R1060*

TELEFON	Telefónica de España SA	E	R1014, 18, 22, 24, 27, 28, 30, 41, 44, 48, 51, 53, 55, 72,
TELENORMA	Telefonbau & Normalzeit GmbH	D	R1011, 35, 38, 44, 45, 56
TELES	Télésystèmes SA	F	R1061, 65, 73, 74, 77, 86
TELETTRA	Telefónica Elettronica e Radio Spa	I	R1027, 44
TELINDUS	Telindus N.V.	B	R1044
TELSI	Telefónica Sistemas	E	R1009, 42*, 78, 86, 91
TELSPACE	Telspace S.A.	F	R1002
TESA	Telettra Espanola S.A.	E	R1043, 44, 45, 81
TFL	Teleteknisk Forskningslaboratorium	DK	R1046, 68
THEM	Thomson Hybrides et Microondes SA	F	R1029, 30, 43
THOMSON	Thomson SA	F	R1044, 45
THORN	Thorn EMI Central Research Labs	UK	R1015, 43
TITN	T.I.T.N.	F	R1044, 61
TL	TeleLOGIC AB	S	R1021, 24
TLP	Telefones de Lisboa e Porto	P	R1053, 78
TNC	The Networking Centre Ltd	UK	R1083
TRCF	Technical Research Centre of Finland	SF	R1008, ,42, 54, 65, 66
TRICOM	Konsortium TRICOM	CH	R1022, 44
TRT	Telecommunications Radioélectriques et Téléphoniques	F	R1018, 22, 43, 63
TST	Telefunken System Technik and Logistics	D	R1062
TUB	Technische Universität Berlin	D	R1075
TUD	Technical University of Denmark	DK	R1013, 27
TVE	Thomson Video Equipment	F	R1080
UCL	University College London	UK	R1005, 54, 67, 79
UCW	University College of Wales (Subcontractor)	UK	R1021
UDOR	Universitat Dortmund	D	R1033
UNIBIT	UNIBIT (Holdings)	UK	R1006
UOA	University of Athens	GR	R1027, 51
UOA	University of Aveiro	P	R1052*
UOB	University of Bremen	D	R1062
UOC	University of Cambridge	UK	R1042
UOD	University of Dundee	UK	R1066
UOF	University of Florence	I	R1086
UOG	University of Ghent	B	R1004
UOH	University of Heidelberg	D	R1086
UOL	University of London	UK	R1086
UOM	University of Manchester	UK	R1088
UOMU	University of Mulhouse	F	R1087
UOS	University of Strathclyde	UK	R1043
UOS	University of Stuttgart	D	R1022, 57
UPM	Fundaciòn General de la Universidad Politècnica de Madrid	E	R1023
UPMC	DNAC - Université Pierre et Marie Curie	F	R1009
UST	Stirling University	UK	R106[illegible]

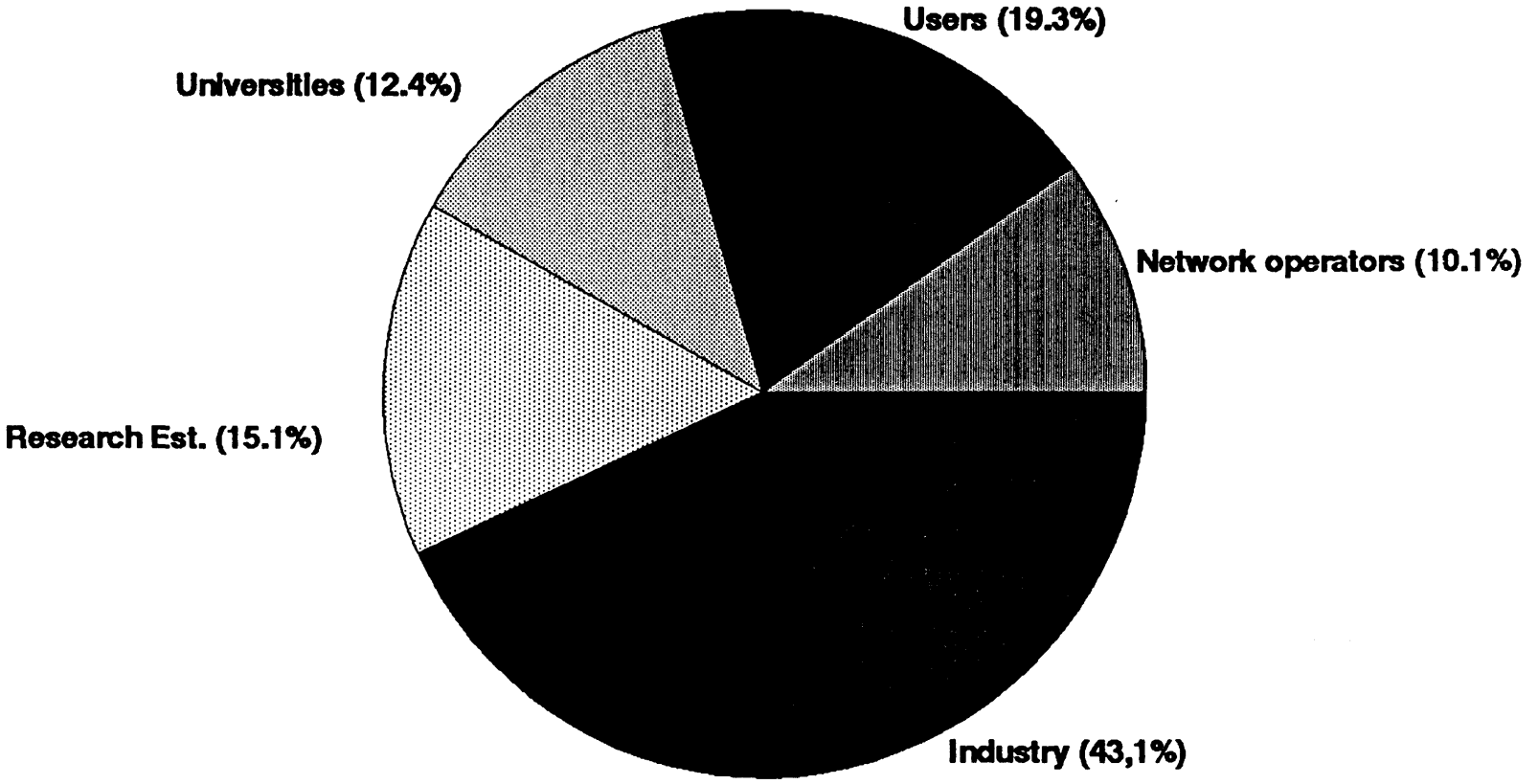
USTL	Université de Sciences et Techniques du Languedoc	F	R1029
UVA	University of Aarhus	DK	R1040
UVD	University of Durham	UK	R1084
UVL	University of Leuven	B	R1040
UVS	University of Surrey	UK	R1023
VERITAS	Det Norske Veritas	N	R1062
VITEC	VITEC	F	R1079
W&G	Wandel & Goltermann GmbH & Co	D	R1083*
WRC	Work Research Center Ltd	IRL	R1034, 77
WSD	Wärtsilä Diesel	SF	R1062
ZMF	ZMF	D	R1078

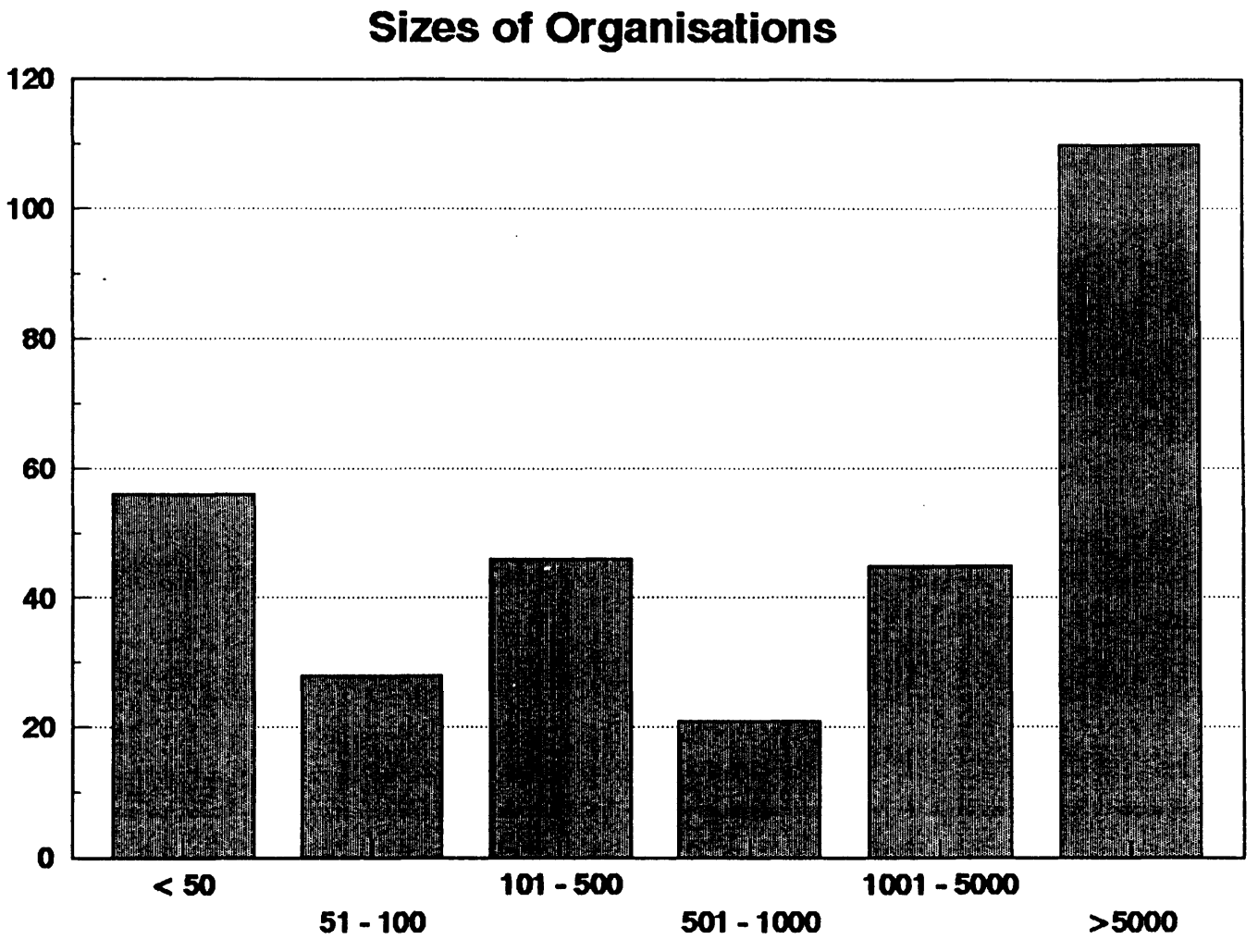
*** Prime Contractor for Project**

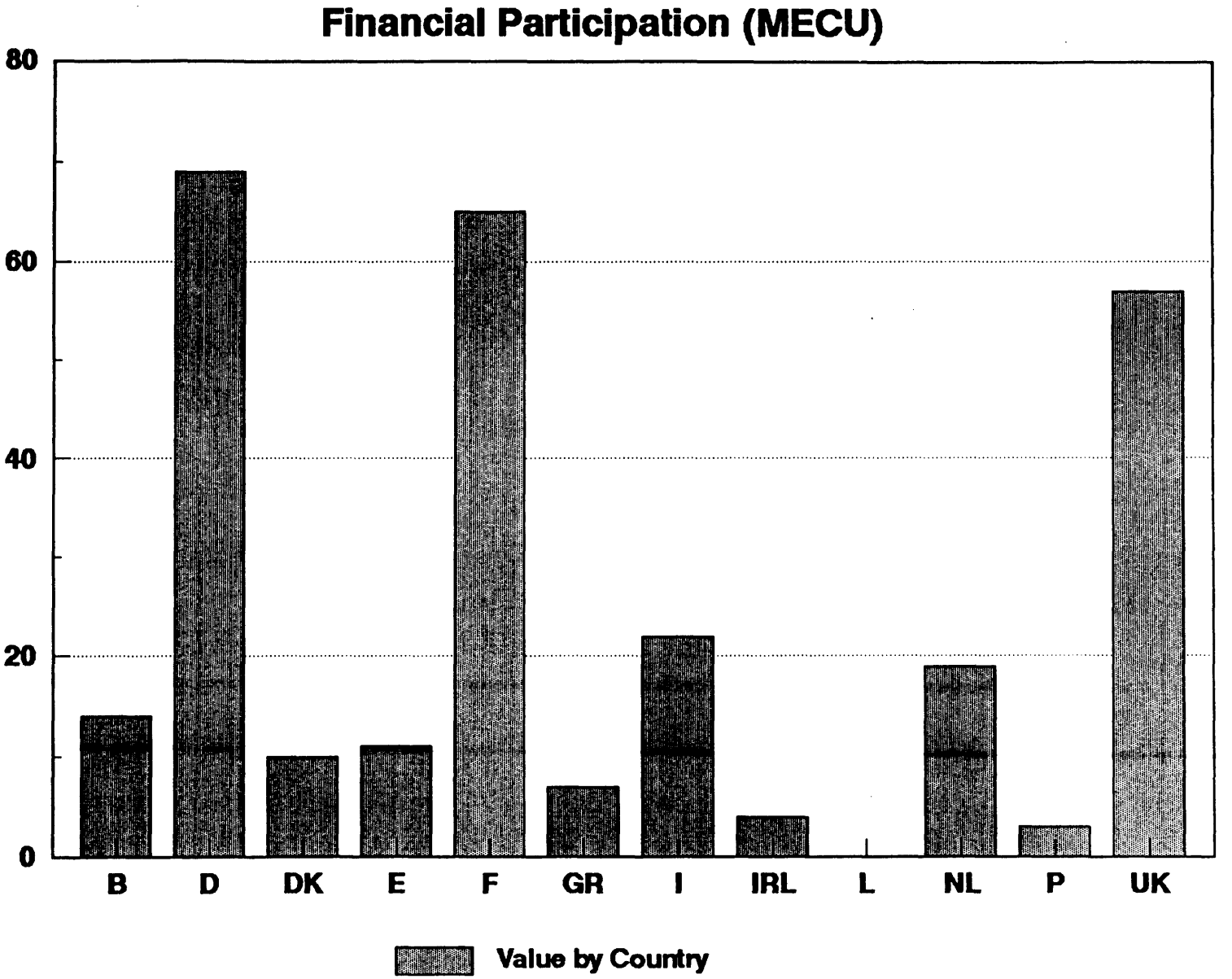
Annex IX

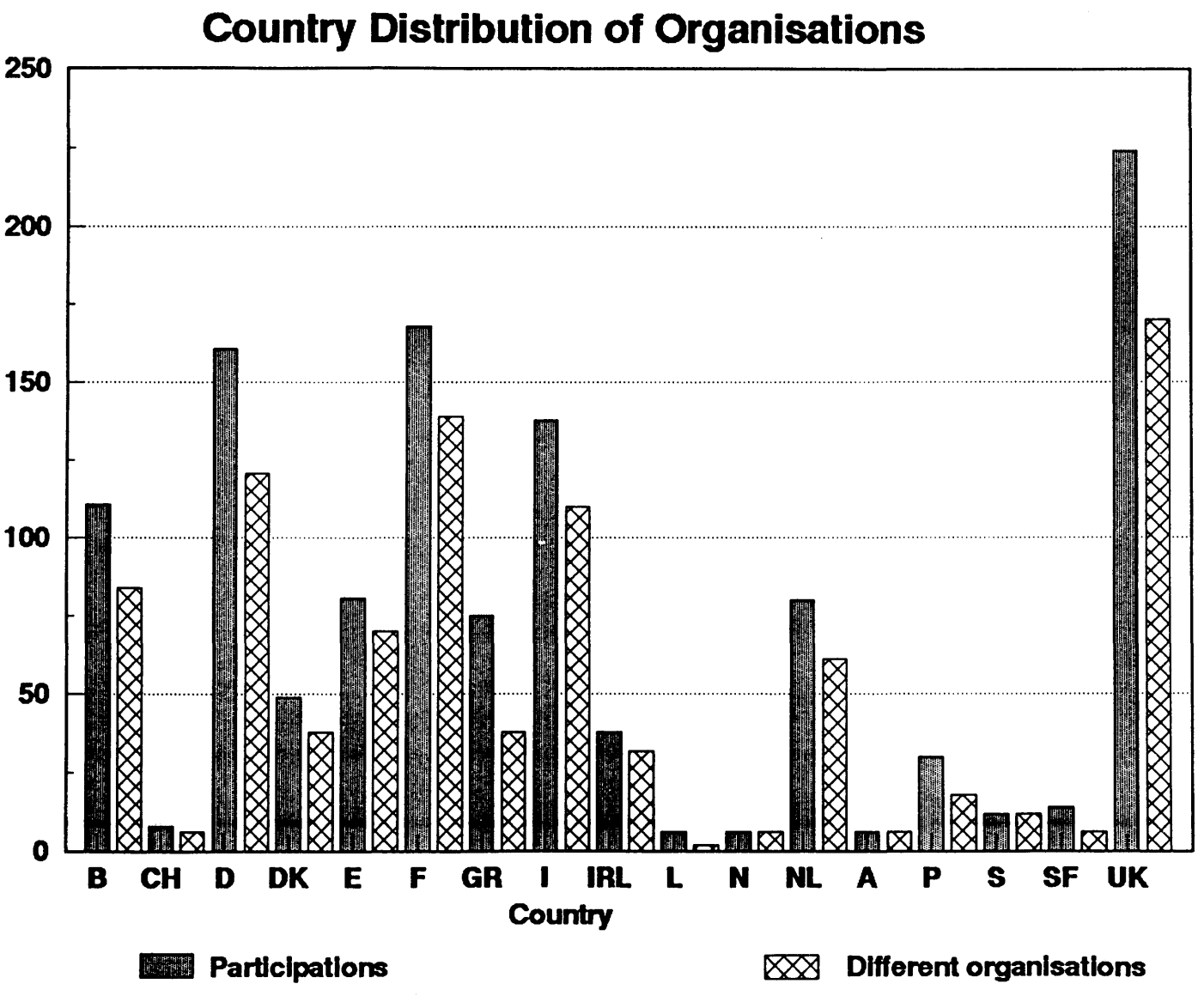
Financial and participation statistics

Types of Organisations




Sizes of Organisations
120
100
80
60
40
20
0
< 50
51 - 100
101 - 500
501 - 1000
1001 - 5000
>5000


Financial Participation (MECU)
80
60
40
20
0
B
D
DK
E
F
GR
I
IRL
L
NL
P
UK
Value by Country


Country Distribution of Organisations
250
200
150
100
50
0
B
CH
D
DK
E
F
GR
I
IRL
L
N
NL
A
P
S
SF
UK
Country
Participations
Different organisations

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