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FuE im Bereich der fortgeschrittenen
Kommunikationstechnologien
für Europa (RACE)

Schlußbericht über die Phase I (1988-1992)
des Zehnjahresprogramms RACE

(gemäß Artikel 6 Absatz 3 und Artikel 9 der
Ratsentscheidung 88/28/EWG über das Programm RACE
von der Kommission vorgelegt)

Inhalt

Zusammenfassung

Telekommunikation untermauert heutzutage die meisten gewerblichen Tätigkeiten und ist ein wesentlicher Faktor für die Leistungsfähigkeit des europäischen Dienstleistungssektors. Bedarfsgerechte Telekommunikationsmittel sind eine wesentliche Voraussetzung für die Wettbewerbsfähigkeit. Die Vollendung des europäischen Wirtschaftsraums ohne interne Handelshemmnisse wird neue Möglichkeiten eröffnen und zu einem neuen Konkurrenzdruck führen; die zunehmende Bedeutung der Telekommunikation für den Binnenhandel verändert schon jetzt die Arbeitsweise der Unternehmen. Der Wohlstand Europas in den 90er Jahren wird sich wesentlich nach der Verfügbarkeit bedarfsgerechter Kommunikationsmittel richten.

Die Bereiche Telekommunikation, Informatik und Rundfunk verzeichnen bereits weltweit einen Jahresumsatz von über 500 Mrd. ECU. Bis zum Jahr 2000 wird der Telekommunikationssektor in Europa nach Lebensmitteln, Getränken und Chemikalien die drittgrößte Branche darstellen. Telekommunikationsinfrastrukturen werden wirtschaftlich bedeutender sein als die technischen Verkehrsinfrastrukturen. Die Beherrschung der technologischen Optionen ist daher der Schlüssel zum Wirtschaftswachstum und zur Schaffung neuer Arbeitsplätze. Über 50 % der Arbeitsplätze sind bereits auf Informations- und Telematiksysteme angewiesen; das größte Beschäftigungswachstum ist im Informationssektor zu verzeichnen.

Die Nachfrage nach Diensten durchläuft einen raschen Wandel. Die Unternehmen benötigen flexiblere Dienste, höhere Übertragungskapazitäten für schnelle Daten- und Bildübertragung und günstigere Tarife. Das Wachstum bei Mehrwertdiensten, die über digitale Hochgeschwindigkeitsnetze erbracht werden, liegt derzeit bei annähernd 40 % pro Jahr, wobei es 1987 40 Millionen, 1989 180 Millionen und 1991 mehr als 300 Millionen Dienst-Benutzer-Kombinationen gab. Bis zum Jahr 2000 könnten 30 % der Einnahmen im Telekommunikationssektor aus derartigen Mehrwertdiensten stammen. In wenigen Jahren werden die meisten europäischen Firmen schnelle Datenübertragung zwischen den Entwurfs-, Fertigungs-, Management- und Vertriebsabteilungen benötigen. In den USA besteht bereits eine starke Nachfrage nach diesen Diensten: Alle führenden Forschungsinstitute haben Zugang zur Höchstgeschwindigkeitsübertragung; 60 % der 500 führenden Unternehmen nutzen digitale Hochgeschwindigkeitsverbindungen.

Angesichts dieser Tendenzen wurde 1985 auf Veranlassung der europäischen Industrieminister eine "Definitionsphase" des Programms RACE eingeleitet. Dabei wurde festgestellt, daß ein europäischer Rahmen für die Zusammenarbeit in FuE möglich und notwendig ist. Die Entscheidung über die erste Phase eines Zehnjahresprogramms RACE (FuE im Bereich der fortgeschrittenen Kommunikationstechnologien für Europa) wurde im Dezember 1987 vom Ministerrat der EG verabschiedet. Darin sind die politische Ausrichtung und Haushaltsvorschriften für eine erste Phase von fünf Jahren (bis 1992) als Teil des 2. EG-Rahmenprogramm für Forschung und technologische Entwicklung festgelegt. Das Programm soll "die Wettbewerbsfähigkeit der Telekommunikationsindustrie der Gemeinschaft, Betreiber und Anbieter von Diensten fördern, um den Endbenutzern mit einem Mindestmaß an Kosten und Verzögerungen diejenigen Dienste zur Verfügung zu stellen, die die Wettbewerbsfähigkeit der europäischen Wirtschaft über die nächsten Jahrzehnte hinweg aufrechterhalten und zur Erhaltung und Schaffung von Arbeitsplätzen in der Gemeinschaft beitragen werden."

In Artikel 9 heißt es: *"Nach Abschluß des ersten Fünfjahreszeitraums des Programms übermittelt die Kommission den Mitgliedstaaten und dem Europäischen Parlament nach Anhörung des Ausschusses einen Bericht über die Durchführung und die Ergebnisse des Programms."* Der vorliegende Bericht trägt dieser Forderung Rechnung und aktualisiert die nach 30 Monaten 1990 vorgelegte erste Überprüfung.

Hauptergebnisse

Aufgrund der Arbeiten während der ersten fünf Jahre des Programms RACE ist Europa in der Konzeption moderner Kommunikationsnetze und -dienste eindeutig führend. Erstmals haben Telekommunikationsbetreiber, die Telematikindustrie und führende Benutzer der meisten Hauptanwendungsbereiche bei der Entwicklung der modernen Kommunikationstechnologien zusammengearbeitet, die zur Bereitstellung kostengünstiger, innovativer Dienste erforderlich sind. Mit dem Programm RACE wurde ein einzigartiges Umfeld zur Konzertierung ihrer Maßnahmen geschaffen.

Mit RACE wurde die europäische Telekommunikationsinfrastruktur verstärkt harmonisiert; die Entwicklung gemeinsamer Funktionsspezifikationen führte zu einem Entwurf der integrierten Breitbandkommunikation. Das Programm förderte eine enge Zusammenarbeit von zentral gelegenen und Randgebieten und trug somit zum wirtschaftlichen und sozialen Zusammenhalt der Gemeinschaft bei. Auf technologischem Gebiet erlangte Europa mit der Entwicklung des Asynchronübertragungsverfahrens für digitale Hochgeschwindigkeitsvermittlung im internationalen Wettbewerb eine führende Position. Forschungsarbeiten über Netzmanagement verliehen europäischen Systemen internationale Anerkennung. Auf dem Gebiet der digitalen Video- und Fernsehsysteme wurden internationale Normen für Codierung, Gigabit-Signalverteilsysteme und Spezifikationen für Digitalvideoaufnahmen erstellt. Im Bereich der Normung wurden 596 Spezifikationsentwürfe für europäische und internationale Gremien - ETSI, CCITT und CCIR - erarbeitet (siehe Anhang II). Es entwickelte sich eine ausgezeichnete Komplementarität mit EUREKA-Projekten; über 1.700 wissenschaftliche und technische Unterlagen wurden in der freien Literatur veröffentlicht (siehe Anhang III).

Die Ergebnisse des Programms RACE bieten europäischen Telekommunikationsorganisationen und Diensteerbringern einen strategischen Wettbewerbsvorteil. Die Industrie hat die Absatzmöglichkeiten erkannt, die sich aus der Implementierung der nächsten Generation von Telekommunkationsdiensten in Europa ergeben. Das Programm hat die Vorteile einer europäischen Zusammenarbeit in der vorwettbewerblichen FuE demonstriert und maßgebend zur europäischen Normung im Telekommunikationssektor beigetragen.

Management und Bewertung des Programms RACE

Das Programm RACE hat innerhalb des zweiten Rahmenprogramms eine Sonderstellung: es war das einzige Programm, das als voll integrierter Aufgabenkomplex verwaltet wurde; jedes Projekt behandelte einen oder mehrere kohärente Komplexe von FuE-Aufgaben, die ausnahmslos zur Erreichung eines einzigen Ziels beitrugen:

"Einführung der integrierten Breitbandkommunikation (IBC) unter Berücksichtigung des in der Entwicklung befindlichen ISDN und der nationalen Einführungsstrategien, die bis 1995 zu gemeinschaftsweiten Diensten führen".

Der Arbeitsplan von 1987 steckt den Rahmen für die Tätigkeiten der einzelnen Projekte und deren Interaktion ab. Diese Interaktion wurde durch regelmäßige "Konzertierungsmaßnahmen", d.h. technische Besprechungen im Abstand von 6 bis 8 Wochen, verstärkt, an denen alle Projekte teilnehmen mußten. Die technischen Projektergebnisse wurden weiter konsolidiert durch ein Hauptprojekt zur Entwicklung von IBC-Implementierungsstrategien, funktionellen Referenzmodellen, Kundendienstfunktionen und Referenzkonfigurationen. Über ein weiteres Hauptprojekt, das auf die Herbeiführung eines Konsenses und die Entwicklung gemeinsamer Funktionsspezifikationen abzielte, wurde eine intensive, kohärente Zusammenarbeit mit europäischen Normungsgremien gepflegt.

Bei der Bewertung und Erstellung der Audits trat der stark integrierte Charakter des Programms zutage.

1989 wurde ein strategisches Audit auf Programmebene erstellt, das die Arbeit im Verhältnis zu den strategischen und politischen Zielen der Gemeinschaft bewertete. Ein Zwischenbericht wurde dem Ministerrat und dem Europäischen Parlament 1990 mit der Überprüfung nach dreißigmonatiger Laufzeit vorgelegt, die die Ratsentscheidung vorsah. Darauf folgte 1990 eine Überprüfung der neuen Anforderungen an FuE durch einen unabhängigen Ausschuß von hohen Beamten und Regierungsbeamten (Telecom 2000). 1991 und Anfang 1992 wurden die Tätigkeiten im Zusammenhang mit anderen wichtigen IT- und Telematikprogrammen des zweiten Rahmenprogramms (ESPRIT und DRIVE) von einem unabhängigen Gremium beurteilt[1]. Schließlich erstellte die Kommission 1992 einen Bericht in Verbindung mit der Bewertung des zweiten Rahmenprogramms[2]; der RACE-Verwaltungsausschuß führte aufgrund einer Aufforderung des CREST eine eigenständige Bewertung durch[3].

Die FTE-Arbeiten des Programms wurden flankiert durch regelmäßige Einschätzungen der wirtschaftlichen und sozialen Auswirkungen, die sich aus den Entwicklungen im Bereich der modernen Kommunikation ergeben[4]. Eine solche Einschätzung wurde zuletzt 1991 erstellt und 1992 verbreitet. Diese Arbeit wurde entsprechend der Ratsentscheidung über das spezifische Programm für Kommunikationstechnologien größtenteils in die zweite Phase von RACE integriert.

Die Managementverfahren, die die Kommissionsdienststellen für das Programm RACE festlegten, wurden 1989 in einem unabhängigen Programm-Management-Audit überprüft, in dem das Konzept der Kommission nachdrücklich befürwortet wurde.

Jedes Projekt wurde jährlich einem technischen Audit durch unabhängige Sachverständige des betreffenden Forschungsgebiets unterzogen, erstmals im Oktober 1988 und zuletzt im Oktober 1992. Aufgrund der Ergebnisse dieser Überprüfungen wurden die Projektarbeiten bei Bedarf neu ausgerichtet oder eingestellt.

All diese Bewertungen und Audits haben ergeben, daß das Programm RACE, gemessen an seinen ursprünglichen Zielen, erfolgreich war.

Die in der ersten Phase begonnenen Arbeiten wurden nun im Rahmen des neuen spezifischen FTE-Programms für Kommunikationstechnologien (RACE II) fortgeführt und erweitert. RACE II ist Teil des dritten Rahmenprogramms und sieht eine Teilfinanzierung der FuE durch die EG bis Dezember 1994 vor. Die Projekte liefen im Januar 1992 an; die Kontinuität war durch die überlappenden Projekte von 1992 (RACE I) gewährleistet. Das Programm wird weiterhin einen wesentlichen Beitrag zur wirtschaftlichen Entwicklung und sozio-ökonomischen Integration Europas leisten. Es wird von Tätigkeiten auf Landesebene[5] und internationalen Aktionen wie EURESCOM[6] flankiert, die die Arbeit der EG untermauern und umgekehrt durch diese unterstützt werden. RACE bildet einen einzigartigen Rahmen, in dem Netzbetreiber, Industrieunternehmen und Benutzer zusammenarbeiten.

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1) Bericht des Ausschusses zur Überprüfung von Informations- und Kommunikationstechnologien unter Vorsitz von W. Dekker, Juni 1992.

2) Mitteilung der Kommission zur "Bewertung des zweiten Rahmenprogramms für Forschung und technologische Entwicklung" (SEC(92)675 endg.), Juli 1992.

3) Vgl. Abschnitt 3.2.1 dieses Berichts.

4) Die entsprechenden Berichte wurden in der Reihe "Perspectives for Advanced Communications in Europe: PACE" veröffentlicht und fanden weite Verbreitung.

5) Breitbandkommunikationsversuche in B, D, DK, F, Irl, P und UK.

6) European Institute for Research and Strategic Studies in Telecommunications GmbH

FuE im Bereich der fortgeschrittenen Kommunikationstechnologien für Europa (RACE)

Schlußbericht über die Phase I (1988-1992) des Zehnjahresprogramms RACE

1. Einleitung

Telekommunikation ist der aktivste und wachstumsstärkste Sektor in Europa. Mit Telekommunikationsdiensten wird in Europa ein jährlicher Umsatz von 300 Mrd. ECU erzielt; die Investionen in Telekommunikationsnetze und -dienste liegen bei annähernd 30 Mrd. ECU pro Jahr. Die Einnahmen stammen noch immer größtenteils aus dem Sprachtelefondienst; jedoch wird derzeit überwiegend in neue Generationen von Digitalanlagen investiert, die die Integration von Sprach-, Daten- und Bildübertragung unterstützen. Bis zum Jahr 2000 könnten bis zu 30 % der Telekommunikationseinnahmen aus Mehrwertdiensten stammen, die fortgeschrittene Datenübertragung nutzen.

Weltweit sind alle Lebensbereiche von der Konvergenz der Informationstechnologie, des Rundfunks und der Telekommunikation betroffen. Die Kombination von Datenverarbeitungstechniken mit innovativen Telekommunikationsideen führte bereits zur Implementierung diensteintegrierender digitaler Fernmeldenetze; diese sind jedoch nur der erste Schritt einer raschen Entwicklung zu einer wesentlich breiteren Palette von Multimedia-Diensten, die neue Technologien, Netz- und Dienstemanagementsysteme sowie neue ordnungspolitische Systeme erfordern. Die Kombination der Dienstintegration mit der LWL-Technik, die kostengünstige Hochgeschwindigkeitsübertragung ermöglicht (millionenfach schneller als über Kupferkabel), bildet die technisch-wirtschaftliche Basis für eine grundlegende Umstrukturierung sämtlicher Bereiche durch integrierte Breitbandkommunikation (IBC). Dieses Konzept zu entwickeln, ist Ziel des Programms RACE.

Im vorliegenden Bericht werden die Ergebnisse der ersten Phase des Zehnjahresprogramms (1988-1992) zusammengefaßt und dokumentiert.

Umfeld, Organisation und Ergebnisse des Programms sind in Abschnitt 2 beschrieben. Abschnitt 3 vermittelt einen Überblick über die Organisation und Ergebnisse der Programmbewertungen und -audits. Verbindungen zu anderen EG- und europäischen Aktionen werden in Abschnitt 4 erläutert. Die FuE-Ergebnisse der ersten Phase von RACE wurden bereits weitgehend genutzt, nicht nur zur Entwicklung von Normen, neuen Netzen und Diensten, sondern auch als Basis für weitere Arbeiten in der zweiten Phase. Die Verwertung der Ergebnisse aus Phase I ist in Abschnitt 5, der Übergang zur Phase II in Abschnitt 6 erläutert. Künftige Anforderungen und Optionen für Arbeiten auf europäischer Ebene werden in Abschnitt 7 aufgezeigt.

Anhang I enthält nähere Informationen zu den Ergebnissen der FuE-Projekte. Die Normungsbeiträge sind in Anhang II, alle wissenschaftlichen und technischen Publikationen über die Arbeiten in Anhang III aufgelistet. Patentanträge sind in Anhang IV aufgeführt. Anhang V enthält ein technisches Glossar, Anhang VI Verweise auf offizielle Entscheidungen des Ministerrates und Mitteilungen der Kommission. In Anhang VII sind die aus RACE I finanzierten FuE-Projekte, in Anhang VIII die beteiligten Organisationen aufgelistet. Anhang IX enhält Finanz- und Beteiligungsstatistiken.

2. Umfeld und Organisation des Programms RACE

2.1 FuE als Teil der gemeinschaftlichen Telekommunikationspolitik

Das Programm RACE ist wesentlicher Bestandteil der Telekommunikationspolitik der EG. In Verbindung mit der Politik im Bereich der Normung und des Informationsmarktes baut RACE auf den informationstechnologischen Entwicklungen von ESPRIT auf. Hier sind erstmals europäische Netzbetreiber als Hauptakteure an der kooperativen Entwicklung von Technologien und Diensten beteiligt. Durch Verbesserung des künftigen Preis-Leistungsverhältnisses der Kommunikationsinfrastrukturen in Europa hat das Programm RACE einen Beitrag zur Entwicklung des Binnenmarktes, zur internationalen Wettbewerbsfähigkeit der europäischen Industrie und zum wirtschaftlichen und sozialen Zusammenhalt der Gemeinschaft geleistet.

Entsprechend der Ratsentschließung vom Juni 1988[1)] strebt die Telekommunikationspolitik der Gemeinschaft folgende Hauptziele an:

- Gewährleistung der gemeinschaftsweiten Netzintegrität nach dem Prinzip der vollen Interkonnektivität aller betroffenen öffentlichen Netze
- Schrittweise Schaffung eines offenen gemeinsamen Marktes für Telekommunikationsdienste
- Förderung des Aufbaus europaweiter Dienste unter Berücksichtigung der marktwirtschaftlichen und gesellschaftlichen Anforderungen
- Weiterentwicklung eines offenen Gemeinschaftsmarktes für Endgeräte
- Entwicklung eines gemeinsamen Marktes, auf dem Fernmeldeverwaltungen und andere Betreiber gleichberechtigt konkurrieren können
- Fortsetzung der Gemeinschaftsmaßnahmen im Bereich der Normung
- Förderung der europäischen Zusammenarbeit auf allen Ebenen, insbesondere in bezug auf Forschung und Entwicklung im Telekommunikationsbereich
- Schaffung eines gesellschaftlichen Umfelds für künftige Telekommunikationsentwicklungen
- Vollständige Integration der benachteiligten Gebiete der Gemeinschaft in den künftigen Binnenmarkt.

Diese Ziele bilden einen klaren Rahmen für die Festlegung künftiger Entwicklungen von Technologien, Diensten und Anwendungen.

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1) Entschließung des Rates vom 30. Juni 1988 zur Entwicklung des gemeinsamen Marktes für Telekommunikationsdienste und -geräte bis 1992, 88/C 257/01: ABl. Nr. C 257/1 vom 4.10.1988.

2.2 Ziele des Programms RACE

Hauptziel des Programms RACE ist die

> *"Einführung der integrierten Breitbandkommunikation (IBC)2) unter Berücksichtigung des in der Entwicklung befindlichen ISDN und der nationalen Einführungsstrategien, die bis 1995 zu gemeinschaftsweiten Diensten führen"3).*

Die Phase I zielte vor allem darauf ab,

- die Telekommunikationsindustrie der Gemeinschaft zu fördern;
- den europäischen Netzbetreibern optimale Wettbewerbsbedingungen zu ermöglichen;
- eine ausschlaggebende Zahl von Mitgliedstaaten in die Lage zu versetzen, 1995 rentable IBC-Dienste einzuführen;
- den Diensterbringern die Verbesserung des Preis-Leistungsverhältnisses und die Einführung neuer Dienste zu ermöglichen und diese mindestens ebenso kostengünstig und rasch bereitzustellen wie in anderen Ländern;
- die Schaffung eines europäischen Binnenmarktes für Telekommunikationsgeräte und -dienste zu unterstützen und
- zur Regionalentwicklung beizutragen, indem strukturschwachen Gebieten die Entwicklungen im Bereich der Telekommunikation uneingeschränkt zur Verfügung gestellt werden.

In Anhang I der Entscheidung werden außerdem technische Ziele vorgegeben. Die Beiträge der RACE-Projekte zur Verwirklichung dieser Ziele sind in Tabelle 1 zusammengestellt.

Im Laufe der Entwicklung und Durchführung des Programms hat sich die Interpretation des IBC-Konzepts den veränderten markt- und ordnungspolitischen Bedingungen entsprechend weiterentwickelt. Die Definition in Fußnote 2) entspricht dem Konsens, der 1990 im RACE-Verwaltungsausschuß erreicht wurde.

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2) "I": "Integriert" steht nicht nur für "integrierte Dienste" (auf Benutzerebene und auf den entsprechenden Netzebenen), sondern bedeutet auch "Integrität" des gesamten Netzes und damit das einwandfreie Zusammenwirken aller wesentlichen Bestandteile, einschließlich vorhandener und künftiger Netze: Telephonie, paketvermittelte Netze, ISDN, Satelliten-, Mobilfunknetze usw.

"B": "Breitband" steht nicht nur für die Dienste höherer Leistung (nach Bitrate), sondern bezeichnet auch die gesamte Dienstekombination, die zu berücksichtigen ist, angefangen am "oberen Ende" des ISDN, (z.B. mit Sicherheit 2 Mbit/s-Anschlüsse, möglicherweise 64 Kbit/s in bestimmten Anwendungsbereichen), bis hin zu den Voraussetzungen für die konkrete Einführung von (Dialog- und Verteil-)Videodiensten (z.B. 140 Mbit/s).

"C": "Communication" beinhaltet nicht nur die herkömmlichen Vermittlungs-/Übertragungs-/CPN-Funktionen, sondern auch die innovativsten Merkmale, die Dienste benutzerfreundlich, leistungsfähig und rentabel gestalten.

3) Entscheidung 88/28/EWG des Rates vom 14. Dezember 1987 über ein Gemeinschaftsprogramm auf dem Gebiet der Telekommunikationstechnologien Forschung und Entwicklung im Bereich der fortgeschrittenen Kommunikationstechnologien für Europa (RACE-Programm), ABl. Nr. L 16/35 vom 21.1.1988.

Tabelle 1

Technische Ziele	Maßnahmen zur Erreichung der Ziele	Auswirkungen der RACE-Arbeiten
Teil I: IBC-Entwicklung und Implementierungsstrategien		
Einheitliches Konzept der IBC-Entwicklung und ihrer Auswirkungen	Festlegung von Rahmenbedingungen für die Zusammenarbeit von Betreibern, Unternehmen und Benutzern.	Entwicklung eines gemeinsamen "systemtechnischen" Konzepts für die Planung der Weiterentwicklung.
	Gemeinsame strategische, technisch-wirtschaftliche Untersuchungen unter Berücksichtigung der Nachfrage und der technologischen Optionen.	Festlegung optimaler Bedingungen für die Einführung der IBC. Abgrenzung wesentlicher technischer Fragen. Kohärenter Standpunkt der EG bei internationalen Tätigkeiten außerhalb von RACE.
Gemeinsame Definition von IBC-Systemen und -Subsystemen	Entwicklung von Referenzkonfigurationen zur Definition der Systeme und Subsysteme in IBC-Netzen.	Intensivierung der europäischen Normungsarbeiten.
	Entwicklung geeigneter Implementierungsoptionen und -technologien.	Vereinbarung über eine europäische Strategie für ATM-Spezifikationen.
Leitlinie für Funktionsspezifikationen von IBC-Systemen und integrierten Diensten	Entwicklung eines Funktionsreferenzmodells mit logischer Struktur der Funktionen und Schnittstellen.	Vereinbarung über gemeinsame Funktionsspezifikationen. Vereinbarungen über "NetzintegrationsÞ"konzepte und -protokolle. Vereinbarungen über mittel- und langfristige Optionen für den Teilnehmerzugang zu Breitbanddiensten.
Ermittlung der technologischen und FuE-spezifischen Anforderungen	Gemeinsame Entwicklung eines Nutzungsreferenzmodells, das Benutzeranforderungen und technische Optionen verknüpft.	Konzentration der europäischen FuE auf Schlüsseltechnologien und neue Benutzeranforderungen.
	Gemeinsame Bewertung technologischer Entwicklungen.	
Ermittlung der Kostenwirksamkeit alternativer Implementierungsverfahren	Entwicklung gemeinsamer Werkzeuge für technisch-wirtschaftliche und operationelle Bewertungen.	Es wurden gemeinsame Werkzeuge für technisch-wirtschaftliche Analysen, zukunftsorientierte Netzplanung und Management entwickelt.

Technische Ziele	Maßnahmen zur Erreichung der Ziele	Auswirkungen der RACE-Arbeiten
Prüfung des Normungsbedarfs	Regelmäßige Zusammenkünfte mit Normungsgremien, Koordinierung zwischen dem Konsens-Management-Projekt und ETSI; Prüfung der Normungsanforderungen, die sich aus der weltweiten Bedarfsentwicklung ergeben.	596 Beiträge zur Arbeit der Normungsgremien (s. Anhang II).
Teil II: IBC-Technologien		
Einsatz moderner Technologien zur kostenwirksamen Einführung der IBC	FuE im Bereich der optischen Bauelemente, Subsysteme und Systeme, die sich auf die Kosten kritisch auswirken, sowohl für die Breitbandübertragung zum Kunden als auch für die Vermittlung. Prüfung kurzfristiger Möglichkeiten zur unmittelbaren Kostensenkung. Prüfung mittel- und langfristiger Möglichkeiten wesentlicher Kosteneinsparungen und Verbesserungen der Dienste.	Spezifikation und Prototypentwicklung von Steckverbindern, Lasern und Schaltelementen für lokale Netze, Teilnehmernetze (CPN) u.ä. Demonstration von Prototypen und kostengünstigen Produktionsverfahren. Entwicklung "direkter" und "kohärenter" Erkennungstechnologien. Entwicklung von ATM-Technologien für kostenwirksame Breitbandnutzung. Entwicklung kompatibler Algorithmen zur Bitratenkompression für Digital-HDTV und Videodienste hoher Qualität; Entwicklung kostengünstiger CODECs.

Technische Ziele	Maßnahmen zur Erreichung der Ziele	Auswirkungen der RACE-Arbeiten
Telekommunikations-Software für komplexe integrierte Systeme.	Entwicklung einer neuen Architektur für die Erbringung von Diensten (offene Dienstearchitektur).	Entwicklung einer "objektorientierten" Programmierung für Telekom-Systeme. Validierung von Prototypen integrierter Software-Engineering-Werkzeuge.
	Untersuchung moderner Informationsverarbeitungstechniken für IBC-Funktionen.	Entwicklung von TMN-Architekturen und Prototypen für Verkehrsmanagement, Wartung, Qualtitätssicherung, Kunden- und Netzverwaltung sowie sichere Kommunikation.
	Prüfung neuer Softwaretechnologien für Spezifikation, Entwurf, Implementierung, Test und Wartung von Telekom-Systemen.	Spezifikationsverfahren, Entwicklungsumgebung und Online-Unterstützung für Telekom-Systeme.
		Festlegung von Integritätskonzepten für IBC-Dienste und eines Bestands an Integritätselementen. Taxonomie des "Usability Engineering".
Fortschritte bei ergonomischen, kognitiven Einrichtungen von IBC-Anlagen	Untersuchung von Faktoren der Nutzbarkeit von Dialog-, Verteil-, Abfrage- und integrierten Diensten sowie von privaten Teilnehmernetzen (CPN).	Implementierung benutzerfreundlicher Merkmale bei fortgeschrittenen Kommunikationsversuchen, u.a. für Teilnehmer mit speziellen Bedürfnissen.
	Prüfung der Einsatzmöglichkeiten für Teilnehmer mit speziellen Bedürfnissen (Senioren und Behinderte).	Verstärkte Interaktion zwischen Forschern, Benutzern und Hardware-Entwicklern.
	Entwicklung von "Usability Design Targets"	Systematische Erfassung und Analyse von Fragen der generellen Nutzbarkeit bei Pilotanwendungen.
	Einbeziehung und Bewertung von Nutzbarkeitsaspekten in Pilotanwendungen.	

Technische Ziele	Maßnahmen zur Erreichung der Ziele	Auswirkungen der RACE-Arbeiten
Realisierung evolutionärer Subsysteme und Netze	Definition und Demonstration generischer Architekturen für IBC-Systeme und -Subsysteme u.a. mit komprimierter Video-Bitrate. Entwicklung von Konzepten und Rahmenbedingungen für Teilnehmernetze, die dem privaten und geschäftlichen Bedarf gerecht werden. Entwicklung von Prototyp-Endgeräten. Anpassung von Systemen, um den reibungslosen Übergang zur IBC zu ermöglichen. Entwicklung von Prototypen integrierter Systeme mit lokalen Netzen, Teilnehmernetzen und Endgeräten, die über vereinbarte Schnittstellen miteinander verbunden sind.	Festlegung von Funktions- und Entwurfsspezifikationen für lokale Netze, Teilnehmernetze und Endgeräte (für Multi-Service- und Multi-Media-Funktionen, u.a. digitale Videoaufnahmen und Flachbildschirme). Demonstration eines farbigen EL-Flachbildschirms mit Treiber. Entwurf von Komponenten und Subsystemen für private und geschäftliche Teilnehmernetze in ATM-Umgebung. Spezifikationen für integrierte Systeme und deren Validierung anhand von Demonstrationsobjekten.
Teil III: Entwicklung von IBC-Anwendungsprojekten		
Entwicklung von Testwerkzeugen, Überprüfung der Entwurfskonzepte, Funktionsgruppen und Protokolle	Gemeinsame Entwicklung von Werkzeugen und Testverfahren für IBC-Netzelemente und -Subsysteme. Überprüfung von Protokollen an kritischen IBC-Referenzpunkten.	Überprüfung von Werkzeugen und IBC-Funktionen an Endgeräten, in Teilnehmernetzen sowie an Orts- und Fernvermittlungsstellen. Festlegung der Testanschlußpunkte und -protokolle. Empfehlungen für Protokollkonformitätsprüfungen.
Verbesserung der Funktionsspezifikationen und/oder Überprüfung der Normungsvorschläge	Integration von Pilotsystemen zum Testen der Protokolle für das Zusammenwirken. Pränormative Überprüfung kritischer Normungsund Spezifikationsaspekte	Spezifikation von Systemen und Subsystemen in einer Multi-Service-Umgebung. Validierung von Mechanismen zur Demonstration der Interoperabilität und Normkonformität.

Technische Ziele	Maßnahmen zur Erreichung der Ziele	Auswirkungen der RACE-Arbeiten
Simulation von Situationen, in denen Diensteerbringer, Netzbetreiber und Benutzer IBC-Versuchsprodukte testen können, um die Möglichkeiten der kommerziellen Nutzung der IBC zu klären.	Festlegung künftiger Diensteanforderungen in Zusammenarbeit mit führenden Benutzern aus allen wesentlichen Branchen. Einrichtung von IBC-Testumgebungen an verschiedenen europäischen Standorten. Prüfung von Aspekten des Verbunds und Zusammenwirkens.	Realisierung von Pilotanwendungen in allen wichtigen Bereichen: Bankwesen und Finanzen, Versicherungen, Medien und Verlage, Fertigung, Gesundheitsfürsorge, Teilnehmer mit speziellen Bedürfnissen, Verkehr und Vertrieb, HDTV-Versuche. Festlegung der Anforderungen und Vereinbarung über Versuche mit dem Verbund der Testumgebungen.

2.3 Durchführung des Programms

Angesichts der raschen Entwicklung des europäischen Telekommunikationssektors wurde beschlossen das Programm RACE stufenweise durchzuführen. Es begann 1986 mit einer Definitionsphase[4]. Darauf folgte die Phase I, die offiziell im Juni 1987 anlief, im Dezember 1992 abgeschlossen wurde und Gegenstand dieses Berichtes ist.

Phase I gliederte sich in drei Teile:

Teil I - IBC-Entwicklung und Implementierungsstrategien

Die Projekte des Teils I dienten zur Entwicklung von Funktionsspezifikationen, Systemen und Operations Research, um Vorschläge für IBC-Normen, -Konzepte und -Konventionen für ein offenes Systemkonzept zu erarbeiten. Ferner wurde die Interoperabilität von IBC-Anlagen und -Diensten geprüft. Die Ergebnisse dieser Projekte sind im öffentlichen Bereich angesiedelt und tragen wesentlich zur Arbeit der internationalen Normungsgremien bei.

Teil II - IBC-Technologien

Die Projekte des Teils II befaßten sich mit den technischen Aufgabenstellungen der IBC-Implementierung. Sie leisteten einen maßgebenden Beitrag zur Entwicklung der notwendigen Technologie für die kostengünstige Realisierung von IBC-Anlagen und -Diensten.

Teil III - Pränormative Funktionsintegration

Die Projekte des Teils III behandelten pränormative Ziele im Zusammenhang mit der Realisierung einer "offenen Testumgebung" zur Bewertung von Funktionen und operationellen Konzepten. 20 Projekte dieses Programmabschnitts beinhalteten Pilotanwendungen der fortgeschrittenen Kommunikation in verschiedenen kommerziellen und diensterelevanten Umgebungen. Mit diesen Projekten wurden Versuchsanlagen und Anwendungen anhand der Realwelt-Funktionsspezifikationen und Normungsvorschläge getestet, die im Rahmen des Teils I erarbeitet wurden.

Das Programm RACE wurde in zwei Abschnitten durchgeführt. Im Januar 1988 wurde der erste Komplex von Projekten eingeleitet, die sich mit der Systemtechnik (Teil I) und technologischen Arbeiten (Teil II) befaßten[5]. Zum zweiten Abschnitt (Analyse künftiger Dienste, Systemintegration und Überprüfung - Teil III) wurde im Juli 1988 eine Aufforderung zur Einreichung von Vorschlägen veröffentlicht; die Projekte liefen im Januar 1989 an.

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4) Entscheidung des Rates vom 25. Juli 1985 über eine Definitionsphase für eine Gemeinschaftsaktion auf dem Gebiet der Telekommunikationstechnologien - Forschungs- und Entwicklungsprogramm im Bereich der fortgeschrittenen Kommunikationstechnologien für Europa (RACE): 85/372/EWG; ABl. Nr. L 210/24 vom 7.8.1985

5) Mitteilung der Kommission an den Rat und das Europäische Parlament: "Auf dem Weg zur Telecom 2000 - Start des Programms RACE - KOM(88) 240 endg. II vom 31.5.1988

Die Schwerpunkte der einzelnen Programmteile entwickelten sich während der Projektauswahl und Durchführung des Programms. Die Mittel für Teil I wurden ursprünglich mit 11,9 % veranschlagt, dann aber auf 18 % erhöht. Die Mittel für Teil II wurden von 66 % auf 55 % gekürzt, diejenigen für Teil III von 22,4 % auf 27 % aufgestockt. Diese Umschichtung entspricht einer Verlagerung des Schwerpunkts von der technologischen Entwicklung zur Entwicklung von Diensten und Bedarfsermittlung sowie dem Stellenwert, den die Vorschläge für die Programmteile I und III erhielten.

Die Zuweisung der Finanzmittel ist in nachstehender Tabelle aufgeschlüsselt.

TABELLE 2

ÜBERSICHT ÜBER DIE VERWENDUNG DER FINANZMITTEL IN DER ERSTEN PHASE DES PROGRAMMS RACE

Programm	Beschluß (Mio. ECU)	(%)	Ist (%)
Teil I	60	11,9	18,0
I.1 IBC-Strategien	14	2,8	
I.2 IBC-Durchführung	28	5,5	
I.3 IBC-Nutzung	10	2,0	
I.4 Gemeinsame Betriebsumgebung	8	1,6	
Teil II	332	65,7	55,0
II.1 IBC-Systemfunktionen	94	18,6	9,0
IBC-Programmierinfrastruktur	49	9,7	25,0
Usability Engineering	12	2,4	11,0
Netzevolution	177	35,0	10,0
Teil III	113	22,4	27,0
III.1 Testwerkzeuge	63	12,5	6,0
III.2 IBC-Pilotanwendungen	50	9,9	

An den 92 FuE-Projekten beteiligten sich 306 Firmen, darunter alle führenden Unternehmen des europäischen Telekommunikationssektors. Darüber hinaus wirkten 27 Organisationen aus EFTA-Ländern (Finnland, Norwegen, Österreich, Schweden, Schweiz) mit.

2.4 Hauptergebnisse

Das Programm RACE trug zur Harmonisierung der europäischen Telekommunikationsinfrastruktur bei, die Voraussetzung für die Vollendung des Binnenmarktes ist. Die gemeinsamen Funktionsspezifikationen stellen den Entwurf der europäischen integrierten Breitbandkommunikation dar. Dies war nur durch die Zusammenarbeit aller europäischen Netzbetreiber, Telekommunikationsunternehmen, Rundfunkanstalten und führenden Benutzer möglich, die das Programm RACE prägte.

Durch Aufklärung und Entwicklung flexibler Verhaltensweisen verhalf RACE den europäischen Telekommunikationsbetreibern und Diensterbringern zu einem strategischen Wettbewerbsvorteil auf dem Markt für Telekommunikationsgeräte und -dienste, der eine zunehmend weltweite Dimension aufweist.

Einzelheiten zur Durchführung der Projekte sind dem Anhang I zu diesem Bericht sowie den Jahresberichten 1988, 1989, 1990, 1991 und 1992 zu entnehmen. Die wichtigsten Ergebnisse der jeweiligen Programmbereiche werden nachstehend erläutert.

Hauptergebnisse des Teils I: IBC-Entwicklung und Implementierungsstrategien

Die Arbeiten führten zu einem einheitlichen Konzept der IBC-Entwicklung und ihrer Auswirkungen sowie zu einer effizienten Zusammenarbeit der Betreiber, Industrieunternehmen und Benutzer bei der Erstellung gemeinsamer Funktionsspezifikationen für IBC und bei strategischen, technisch-wirtschaftlichen Untersuchungen.

Es wurden enge Beziehungen zu europäischen und internationalen Normungsgremien geknüpft. 1989 wurde eine Gruppe zur Koordinierung des Konsens-Management-Projekts mit dem Europäischen Institut für Telekommunikationsnormen (ETSI) gebildet. Die Arbeiten im Bereich der Asynchronübertragung (ATM) leisteten einen unmittelbaren Beitrag zu einer Vereinbarung über eine europäische Strategie auf diesem Gebiet und zur Entwicklung internationaler Normen.

Man einigte sich auf Definitionen von IBC-Systemen und -Subsystemen; ferner wurden Referenzkonfigurationen der Systemstruktur von IBC-Netzen entwickelt. Es wurden Funktionsspezifikationen für IBC-Systeme und integrierte Dienste festgelegt, so daß nunmehr ein Funktionsreferenzmodell vorliegt. Es definiert die logische Struktur von IBC-Funktionen und -Schnittstellen als zentrales Profil der Implementierung. Die gemeinsamen Funktionsspezifikationen fanden 1990 weite Verbreitung.

Schnittstellen an wesentlichen Referenzpunkten in Breitbandnetzen wurden definiert, Komponenten- und Systemanforderungen festgelegt.

Ferner wurde ein "Nutzungs-Referenzmodell" entwickelt, das den theoretischen Rahmen zur Verknüpfung des Benutzerbedarfs mit den Funktionsanforderungen bildet.

Systematische Bewertungen technologischer und betrieblicher Optionen wie Bildübertragung, Mobil- und Satellitenfunk, Teilnehmernetze, neue Vermittlungstechniken und HDTV wurden abgeschlossen.

Es wurden Werkzeuge zur Bewertung der Kostenwirksamkeit alternativer Implementierungsverfahren entwickelt: ein erster Werkzeugsatz betrifft wirtschaftliche Analysen, ein weiterer die Netzplanung und Normen. Diese Werkzeuge bilden die Basis für internationale Vergleiche von Optionen und Strategien in bezug auf technische und wirtschaftliche Merkmale und Normungsanforderungen.

Hauptergebnisse des Teils II: IBC-Technologien

Die FuE konzentrierte sich auf optische Bauelemente, Subsysteme und Systeme, die sich auf die Kosten kritisch auswirken, sowohl für die Breitbandübertragung zum Kunden als auch für die Vermittlung; dabei wurden kostenwirksame Lösungen für Anwendungen in allen Hauptbereichen angestrebt.

ATM-Technologien wurden definiert und entwickelt, um die flexible, "zukunftssichere" Implementierung der Breitbandkommunikation zu ermöglichen. Realisierung und Vergleich verschiedener ATM-Optionen wurden abgeschlossen und Bedarfsspezifikationen für ATM-Vermittlungssysteme entwickelt.

Ferner wurden kompatible Video-Verschlüsselungstechniken für (HD)TV und Bildtelefon erarbeitet, die die kostenwirksame Nutzung der Bandbreiten gewährleisten. Algorithmen für Bitraten-Kompressionstechniken im Hinblick auf qualitativ hochwertige Videodienste (Fernsehen und Bildtelefon) wurden simuliert; die CODEC-Entwicklung hat sich bereits entscheidend auf die Normung und Markteinführung preiswerter Videokonferenzsysteme ausgewirkt.

Wesentliche Fortschritte wurden bei optischen Kommunikationssystemen im Gigabit-Bereich und bei der Photonenvermittlung erzielt. Es wurden Spezifikationen für Systeme, Subsysteme und Bauelemente (Steckverbinder, Laser, Schaltungselemente u.a.) entwickelt, die vor allem die Kostenaspekte verschiedener Anwendungsbereiche berücksichtigen (lokale Netze, Teilnehmernetze usw.). Außerdem wurden Prototypen von Bauelementen und Subsystemen hergestellt und demonstriert.

Im Bereich der Telekommunikationssoftware für komplexe integrierte Systeme wurden objektorientierte Modelle entwickelt, Architekturen und Prototypen für Verkehrsmanagement, Wartung, Kunden- und Netzverwaltung definiert. Darüber hinaus wurden Spezifikationsverfahren und eine "Entwicklungsumgebung" zur Online-Unterstützung von Telekom-Systemen erarbeitet und eine sichere Kommunikationsarchitektur festgelegt.

Auf dem Gebiet der ergonomischen und kognitiven Forschung wurden eine Taxonomie des Usability Engineering erstellt und entsprechende Anforderungen an moderne Kommunikationsdienste festgelegt, unter anderem für Teilnehmer mit speziellen Bedürfnissen.

Es wurden generische Architekturen und entsprechende Techniken für IBC-Systeme und -Subsysteme mit komprimierter Video-Bitrate entwickelt. Sie bilden einen Rahmen zur Deckung des privaten, geschäftlichen und sonstigen Bedarfs bei etlichen Anwendungen.

Verschiedene Endgerätetypen mit Flachbildschirmen wurden getestet und für IBC-Dienste angepaßt. Integrierte Systeme (mit lokalen Netzen, Teilnehmernetzen und Endgeräten, die über Schnittstellen an S- und T-Referenzpunkten zusammengeschaltet sind) wurden zur Validierung von Funktionsspezifikationen und Technologien eingesetzt.

Die Forschung im Bereich des Mobilfunks steckte den theoretischen Rahmen für eine dritte Generation von Zellularfunksystemen ab. Sie führte zur Festlegung der Universal Mobile Telecommunications (UMTS), die den wichtigsten europäischen Marktbedarf Mitte der 90er Jahre decken wird.

Hauptergebnisse des Teils III: Entwicklung von IBC-Anwendungprojekten

Diese Arbeiten konzentrierten sich auf die Entwicklung von Prüfwerkzeugen und die Überprüfung von Entwurfskonzepten, Funktionsgruppen und Protokollen. Endgeräte, Teilnehmernetze, Teilnehmerzugangssysteme, Orts- und Fernvermittlungen sowie Übertragungssysteme wurden ausnahmslos den von den Systemtechnikern und Entwicklern der Testwerkzeuge ausgearbeiteten Prüfverfahren unterzogen. Ferner wurden Testzugangspunkte und Protokolle definiert.

Im Rahmen von IBC-Pilotanwendungen wirkten Diensteerbringer, Netzbetreiber und Benutzer an Tests von IBC-Pilotprodukten mit, um sich möglichst rasch über die Merkmale der kommerziellen IBC-Nutzung zu informieren. Pilotversuche wurden in allen wesentlichen Bereichen durchgeführt: Banken und Finanzwesen, Versicherungen, Medien und Verlage, Fertigung, Gesundheitsfürsorge, Teilnehmer mit speziellen Bedürfnissen, Verkehr und Vertrieb, HDTV-Pilotversuche. Über 100 führende Benutzer waren an diesen Versuchen beteiligt.

Zur Durchführung des Teils III und einiger zusätzlicher Arbeiten in Teil I und II erwies sich eine europaweite Testinfrastruktur als notwendig. 1989 unterbreiteten die führenden europäischen Fernmeldeverwaltungen einen Vorschlag zur Bereitstellung eines vorläufigen Breitbandnetzes auf experimenteller Basis. Der Vorschlag stützte sich auf eine Vereinbarung zur Durchführung eines European Broadband Interconnection Trial (EBIT), anfangs mit 2 Mbit/s, später mit bis zu 140 Mbit/s bei Auslandsverbindungen. Die führenden Netzbetreiber unterzeichneten eine gemeinsame Absichtserklärung; auch wurde ein multinationales Team gebildet, das bei Pilotversuchen in bezug auf Netz- und Softwareanforderungen beratend zur Seite stehen soll, um die Interoperabilität der Endbenutzersysteme zu gewährleisten. Dieses Betriebs- und Unterstützungsprojekt im Rahmen von RACE diente bei den verschiedenen Pilotversuchen als Richtschnur. Angesichts der Schwierigkeiten beim Aufbau kostenwirksamer Auslandsverbindungen für Forschungstätigkeiten beschränkten sie sich jedoch bislang überwiegend auf Versuche in nationalen Testumgebungen. Erst 1993 und 1994, wenn ATM-Systeme versuchsweise eingesetzt werden können, wird ein transeuropäischer Breitbandversuch mit nachfragegerechter Bandbreite wirtschaftlich möglich sein.

Dennoch haben die Pilotversuche durch die Rückkopplung von realen Umgebungen zur Entwicklung von Technologien und Spezifikationen ihre Funktion erfüllt.

2.5 Beteiligung von KMU

Trotz der hohen FuE-Kosten bei innovativen Telekommunikationsdiensten war in der ersten Phase von RACE eine starke Beteiligung kleiner und mittlerer Unternehmen (KMU) zu verzeichnen. Ihr Anteil an RACE-Projekten betrug 28 % und lag damit wesentlich höher als beim zweiten Rahmenprogramm insgesamt (16,5 %)[6]. Kleine Organisationen, seien es Unternehmen oder Forschungsinstitute, wirkten an über 60 % der Projekte mit.

2.6 Beitrag zum wirtschaftlichen und sozialen Zusammenhalt

Durch Prüfung und Entwicklung von Strategien zur Einführung der IBC in sämtlichen EG-Regionen, auch in benachteiligten Gebieten, hat das Programm den Weg zum Aufbau transeuropäischer Breitbandnetze bereitet, wie sie in Kapitel XII des Vertrages über die Europäische Union vorgesehen sind. Besondere Aufmerksamkeit galt der Anbindung von Insel-, Einschluß- und Randgebieten an die zentral gelegenen Regionen der Gemeinschaft.

Durch eine beträchtliche Zahl von flankierenden Maßnahmen, Workshops und Sommerkursen wurde sichergestellt, daß Wissenschaftler und Ingenieure aus allen Gebieten der EG Zugang zu den FuE-Ergebnissen erhalten; der Schwerpunkt lag auf Workshops und Seminaren in den benachteiligten Gebieten. Anhang I enthält eine vollständige Liste dieser Tätigkeiten.

An 53 Projekten (60 %) waren Organisationen aus den strukturschwachen Gebieten der Gemeinschaft beteiligt, die somit zum Technologie- und Knowhow-Transfer in ihre Regionen beitrugen.

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6) Bewertung des zweiten FTE-Rahmenprogramms: Bericht des CREST an den Rat, September 1992. CREST/1212/1/92.

3. Bewertung und Audits des Programms RACE

3.1 Bewertung als fortlaufender Prozeß

Angesichts der raschen Entwicklung der Kommunikationstechnologien und -dienste wurde die Bewertung als fortlaufender Prozeß betrachtet, der die Vorbereitung und Durchführung des Programms umfaßt. Er betraf außerdem jede Stufe: die strategische Ausrichtung des Programms, das Programm-Management und die technische Leitung der einzelnen Projekte.

Der Bewertungsprozeß begann mit einer breitangelegten Kooperation der Akteure bei der Programmplanung und Erstellung des Arbeitsplans. Dank einer ständigen Zusammenarbeit mit der Industrie und den Telekommunikationsbetreibern konnten die Arbeitspläne für das Programm und die einzelnen Projekte jährlich aktualisiert werden. Regelmäßige Sitzungen der Konsortien (Konzertierungssitzungen) gewährleisteten die fortlaufende informelle Überwachung des Fortschritts und Anpassung sämtlicher Projekte. Die Kohärenz der Arbeiten wurde durch ein Konsens-Management-Projekt sichergestellt, das enge Beziehungen zu den Europäischen Normungsgremien anknüpfte.

1990 wurde dem Ministerrat und dem Europäischen Parlament ein Zwischenbericht - die in der Ratsentscheidung vorgesehene "Überprüfung nach 30 Monaten Laufzeit"(7) - vorgelegt.

Der vorliegende Schlußbericht entspricht Artikel 9 der Entscheidung; dort heißt es: "Nach Abschluß des ersten Fünfjahreszeitraums des Programms übermittelt die Kommission den Mitgliedstaaten und dem Europäischen Parlament nach Anhörung des Ausschusses einen Bericht über die Durchführung und die Ergebnisse des Programms." Er aktualisiert und ersetzt die 1990 vorgelegte Überprüfung nach 30monatiger Laufzeit.

Gemäß Artikel 6 Absatz 4 dritter Gedankenstrich leitete die Kommission diesen Bericht dem Verwaltungsausschuß zur befürwortenden Stellungnahme zu.

3.2 Programmaudits und -bewertungen

Die Arbeiten des Programms RACE zur integrierten Breitbandkommunikation (IBC) wurden in regelmäßigen Abständen neu ausgerichtet, um der raschen Entwicklung der technisch-wirtschaftlichen Bedingungen und des Diensteangebots Rechnung zu tragen. Daher wurde eine jährliche kritische Überprüfung (Audit) des Programms unter zwei Aspekten durchgeführt:

- **Strategische Aspekte**, wobei die Ergebnisse von RACE insgesamt gegenüber den strategischen und politischen Zielen der Gemeinschaft im internationalen Kontext geprüft wurden;

- **technische Aspekte**, wobei die Projektergenisse gegenüber den Zielen von RACE überprüft wurden.

Zusätzlich wurde ein **Programm-Management**-Audit erstellt. Dabei handelt es sich um eine unabhängige Bewertung der Leistungen der Kommissionsdienststellen bei der Abwicklung des Programms.

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(7)Gemäß Artikel 9 der Ratsentscheidung: "Das Programm wird nach 30 Monaten anhand einer Bewertung der Ergebnisse überprüft, die gegenüber den in Anhang II im einzelnen aufgeführten Zielen erreicht worden sind. Die Kommission unterrichtet den Rat und das Europäische Parlament über die Ergebnisse dieser Überprüfung."

3.2.1 Strategische Audits und Programmbewertungen

1989 wurde eine unabhängige strategische Bewertung der Arbeiten im Vergleich zu den strategischen und politischen Zielen der Gemeinschaft im internationalen Kontext erstellt. Die wichtigsten Schlußfolgerungen waren:

- Das Hauptziel von RACE war nach wie vor gültig: Die Entwicklung der IBC ist für Europa angemessen und notwendig; der Termin 1995 entspricht den Anforderungen und der weltweiten Entwicklung.

- Die Schwerpunkte waren sinnvoll auf die verschiedenen Bereiche verteilt.

Das Audit-Gremium empfahl ferner, sich in der nächsten Phase verstärkt auf Teilnehmereinrichtungen, Mobilfunkanwendungen, Digital-HDTV-Überprüfungen und Tests zu konzentrieren, wobei ATM als zentrale Netztechnolgie zu betrachten ist.

Dem Subsidiaritätsprinzip entsprechend wurde im strategischen Audit auch auf die Aktionen hingewiesen, die außerhalb des Programms RACE von staatlichen Organisationen und Telekommunikationsakteuren durchzuführen sind, um zu gewährleisten, daß IBC-Systeme nach der FuE-Phase tatsächlich implementiert werden. Tabelle 4 vermittelt einen Überblick über diese Empfehlungen.

Einige wurden umgesetzt: die Empfehlung an die Fernmeldeverwaltungen, eine gemeinsame Absichtserklärung über eine enge Zusammenarbeit bei den innereuropäischen Fernverbindungen und Transaktionen vorzubereiten, wurde mit der Absichtserklärung METRAN, den GEN-Vereinbarungen und EURESCOM aufgegriffen. Der FuE-Bereich wurde ausgedehnt; die ATM-Normungsarbeiten wurden intensiviert; eine ATM-Versuchsanlage befindet sich zur Zeit in der Entwicklung. Andere Empfehlungen wurden jedoch nicht planmäßig umgesetzt: Die vorgesehene Konvergenz der Interessen von Telekommunikationsorganisationen, Rundfunkanstalten und Kabelbetreibern war angesichts des ordnungspolitischen Umfelds in Europa nicht möglich, und die Entwicklung des HDTV ging langsamer vonstatten als vorgesehen.

Auf das strategische Audit folgte 1990 eine vorausschauende Untersuchung der künftigen Anforderungen und Optionen, bei der führende Fachleute auf strategischem, politischem und technischem Gebiet zusammenarbeiteten. Die Empfehlungen dieses Gremiums sind dem Bericht "Telecom 2000" zu entnehmen und bildeten die Grundlage des Arbeitsplans für die zweite Phase von RACE.

1991 und Anfang 1992 wurde das Programm RACE erneut in Verbindung mit den übrigen großen IT- und Telematikprogrammen des zweiten Rahmenprogramms (ESPRIT und DRIVE) durch ein unabhängiges Gremium unter Vorsitz von Herrn Dekker bewertet(8). Die Kommission hat die Empfehlungen dieses Gremiums gesondert beantwortet(9).

(8)Bericht des Information and Communications Technologies Review Board unter Vorsitz von W. Dekker, Juni 1992.
(9)Antwort der Kommission auf den Dekker-Bericht, Januar 1993.

EMPFEHLUNGEN DES GREMIUMS FÜR STRATEGISCHE AUDITS VON 1989

A) Die einzelstaatlichen Regierungen sollten zusammenarbeiten, um bis 1992 die Bedingungen und Rechtsvorschriften für die Einführung fortgeschrittener Kommunikationsdienste auf europäischer Ebene festzulegen.

B) Telekommunikations-, Rundfunk- und Kabelfernseh-Organisationen sollten bis Mitte 1989 ein konzertiertes Konzept und einen Zeitplan für die Entwicklung und Nutzung von IBC-Infrastrukturen (Telekommunikation und Unterhaltung einschließlich HDTV) vorschlagen und dabei gegebenenfalls die Investitionsinitiativen des Privatsektors nutzen.

C) Die Telekommunikationsorganisationen sollten bis 1990 eine erste gemeinsame Absichtserklärung zu einer engeren Zusammenarbeit bei ihren innereuropäischen Fernverbindungen und Abläufen vorbereiten.

D) Die Diensteerbringer sollten bis Ende 1990 einen vorläufigen Katalog von Diensteanforderungen, kommerziellen Bedingungen und Rechtsvorschriften erstellen, die eine frühzeitige Nutzung von IBC-Diensten auf breiter Basis fördern würden.

E) Telekommunikations-, Rundfunk- und Kabelfernseh-Organisationen, Diensteerbringer und die Telematikindustrie sollten bis Mitte 1989 eine gemeinsame Absichtserklärung ausarbeiten, um die kooperative FuE von RACE durch Pilotimplementierungen einiger IBC-Dienste auf europäischer Ebene zu ergänzen und damit die kommerzielle Einführung der IBC bis 1992 zu ermöglichen.

F) Integriertes Service Engineering, feste und mobile Anwendungen sowie Prüfverfahren für Kommunikationsanlagen und Dienstemerkmale sollten bis Ende 1989 in die kooperative FuE einbezogen werden.

G) Die europäischen Normungsgremien sollten ihre Maßnahmen zur Erstellung internationaler Normen für IBC und fortgeschrittene Dienste intensivieren und koordinieren. Bis Mitte 1989 sollte vor allem für ATM ein Normungsplan festgelegt werden.

H) Die Mitgliedstaaten sollten sich dem Problem der Frequenzzuweisung in Europa widmen und dabei das gesamte Frequenzund Anwendungsspektrum berücksichtigen. Sie sollten bis 1992 rationellere Frequenzzuweisungen ermöglichen, die der Bedarfsentwicklung und den Prioritäten Rechnung tragen.

Schließlich erstellte die Kommission 1992 im Zusammenhang mit der Bewertung des zweiten Rahmenprogramms[10] einen Bericht über RACE. Der Ausschuß für wissenschaftliche und technische Forschung (CREST) wurde vom Rat aufgefordert, dazu Stellung zu nehmen. CREST leitete die Aufforderung an den RACE-Verwaltungsausschuß (RMC) weiter, der im Juli 1992 folgenden Bericht vorlegte:

Qualität der Ergebnisse und Auswirkungen auf die Wettbewerbsfähigkeit

Generell waren die Ergebnisse von RACE mindestens auf dem neuesten Stand der Technik; vielfach wurden Durchbrüche erzielt [z.B. bei ATM: Asynchronübertragungsverfahren, Mobilfunk (UMTS: Universal Mobile Telecommunications System), optischen Technologien und Geräten].

Europa ist nun besser gestellt als es ohne RACE der Fall wäre. Andere Länder mögen zwar noch immer einen Vorsprung vor Europa haben, doch hat sich die Technologiekluft, die im Bereich der Telekommunikation zwischen Europa, den USA und Japan besteht, erheblich verringert.

In der ersten Fünfjahresphase des zweiten Rahmenprogramms hat RACE die technischen Ziele der Ratsentscheidung mehr als erreicht. Allerdings durchlief der Telekommunikationssektor einen so raschen Wandel (neue Diensteanforderungen, neue Technologien, zunehmender Wettbewerb zwischen Betreibern), daß die Ziele und Prioritäten des Programms selbst während seiner fünfjährigen Laufzeit angepaßt werden mußten. Es ergaben sich weitere Ziele mit neuen Prioritäten (z.B. Kommunikationsversuche und Testinfrastrukturen), die von Nachfolgeprogrammen wie RACE II (zweite Phase des Zehnjahresprogramms RACE) aufgegriffen wurden.

RACE hat die Zusammenarbeit zwischen TO (bei strategischen Planungen wie EURESCOM), zwischen Unternehmen (bei der Bildung eines Industriekonsortiums - RIC) sowie zwischen TO und Unternehmen (z.B. in Normungsgremien wie ETSI) gefördert. Jedoch muß diese Art von Zusammenarbeit weiter intensiviert und ausgebaut werden.

Neben zahlreichen wissenschaftlichen und technischen Ergebnissen leistete RACE I 470 Beiträge zur Arbeit der Normungsgremien (hauptsächlich ETSI), die auf der Entwicklung gemeinsamer Funktionsspezifikationen basieren.

Die Zusammenarbeit der Telekommunikationsindustrie im Rahmen von RACE hat ihre Wettbewerbsfähigkeit auf den Weltmärkten verbessert. Für die europäische Industrie insgesamt wird sich der positive Einfluß von RACE mit der Einführung moderner Kommunikationsdienste in breiten Kreisen auf längere Sicht deutlicher zeigen. Durch weitere, anwendungsorientierte FuE-Arbeiten kann Interessenten der Wettbewerbsvorteil vor Augen geführt werden, den sie mit innovativen Kommunikationsmitteln erreichen können.

10)Mitteilung der Kommission zur "Bewertung des zweiten Rahmenprogramms für Forschung und technologische Entwicklung (SEC(92)675 endg.), Juli 1992.

Management und Kostenwirksamkeit

Als Teil des Rahmenprogramms stellt RACE ein kohärentes Programm dar, dessen spezifische Ziele allen Projekten gemeinsam sind und das sich über einen Zeitraum von insgesamt zehn Jahren erstreckt. In der ersten Phase von RACE wurden die größten Fortschritte in den Bereichen ATM, optische Bauelemente und Technologien, Mobilfunk (UMTS) und Breitbandversuche erzielt. Infolgedessen wurde der Schwerpunkt bei RACE II vor allem auf die beiden letztgenannten Bereiche gelegt. Weniger Fortschritte wurden auf den Gebieten Sicherheit und Usability Design erreicht, wo die ursprünglichen Ziele zurückgesteckt werden mußten.

Die Zusammenarbeit im Rahmen von RACE basiert im wesentlichen auf dem Konzertierungsmechanismus. In der Regel ist diese europaweite Kooperation kostenwirksam, da sie bei den Ergebnissen, die die Partner mit Eigeninvestionen erzielt haben, einen Multiplikatoreffekt auslöst.

Die Verfahren der Angebotsbewertung und der technischen Audits funktionierten reibungslos: beispielsweise wurden mit dem "Red-Flag-Verfahren" Projekten, die andernfalls ihre Ziele nicht erreicht hätten, mit Erfolg eine neue Ausrichtung und neue Impulse verliehen. Andere Projekte wurden frühzeitig eingestellt, um keine Mittel zu vergeuden.

Insgesamt war das Programm gut aufgebaut und gesteuert; dennoch sind in einigen Bereichen noch Verbesserungen möglich:

o Die Zusammenarbeit mit anderen europäischen multinationalen Forschungsprogrammen war nicht effizient genug.

o Die Kommission, TO und Industrieunternehmen sollten sich vor Festlegung des Arbeitsplans gegenseitig verpflichten, das Programm und seine Ziele zu unterstützen.

o Man sollte sich verstärkt darum bemühen, die Qualität des Gesamtprogramms im Gegensatz zu den einzelnen Projekten zu gewährleisten. Beispielsweise sind viele wichtige Partner nicht während der gesamten Laufzeit des Programms beteiligt.

o Die Konzertierungssitzungen sind noch kostenwirksamer zu gestalten.

o Im Idealfall würde als erstes das Konsens-Management-Projekt eingeleitet, um optimale Verbindungen zu den übrigen Projekten herzustellen.

o Es sollten Maßnahmen ergriffen werden, um die Beteiligung von KMU an künftigen Programmen zu verstärken und ihnen eine wichtigere Funktion zuzuweisen.

o Es sollten mehr konzertierte Aktionen und Unterstützungsmaßnahmen durchgeführt werden.

Kohärenz mit politischen Maßnahmen und Grundsätzen der EG

Die technischen Auswahlkriterien für die Angebotsbewertung und Projektaudits haben sich als zufriedenstellend erwiesen.

Gesellschaftliche und wirtschaftliche Kriterien wurden bei der Auswahl von RACE I-Projekten nicht explizit berücksichtigt. In der Regel ist jedoch ein Telekommunikationsprogramm wie RACE mit der derzeitigen Umwelt- und Energiepolitik kohärent.

Was die Subsidiarität betrifft, steht fest, daß eine europäische Zusammenarbeit bei der pränormativen Forschung im Telekommunikationsbereich Vorteile bringt. Jedoch sollten auch engere Verbindungen zu einzelstaatlichen Programmen und Versuchen gefördert werden.

Schlußfolgerungen

1995 kann nicht das Endziel für europäische Forschungsprogramme im Bereich der Telekommunikation sein. Auf RACE muß ein weiteres Programm folgen.

Forschung und Entwicklung sind notwendig, aber nicht ausreichend, um auf den künftigen Telekommunikationsmärkten eine starke Position zu erlangen. Hier wird nicht ausgeführt, welcher weiteren Maßnahmen es dazu bedarf. Die Verlagerung des Schwerpunkts auf Dienste und Anwendungen dürfte sich auf den Aufbau und die Organisation künftiger Programme auswirken.

Die Ergebnisse von RACE sollten in breiteren europäischen Kreisen aufgegriffen und verwertet werden. Die Initiativen für diesen Transfer sind gegebenenfalls von den betroffenen Akteuren zu ergreifen."

Der Bericht über das zweite Rahmenprogramm, den der CREST dem Rat im Oktober 1992 übermittelte, basiert teilweise auf dieser Vorlage.

3.2.2 Folgenabschätzung und Vorausschau

Parallel zu den Forschungs- und technologischen Entwicklungsarbeiten des Programms wurden während des gesamten Fünfjahreszeitraums regelmäßig die wirtschaftlichen und gesellschaftlichen Auswirkungen der Entwicklungen bei fortgeschrittenen Kommunikationsdiensten abgeschätzt. Die entsprechenden Berichte wurden in der Reihe "Perspectives for Advanced Communications in Europe: PACE" veröffentlicht und fanden weite Verbreitung. Die neueste Folgenabschätzung wurde 1991 durchgeführt und 1992 verbreitet. Damit wird der sachliche Hintergrund für die jährliche Aktualisierung des Programminhalts und geringfügige Anpassungen im Laufe des Jahres geschaffen. Diese Tätigkeiten wurden nun aufgrund der Ratsentscheidung über das spezifische Programm für Kommunikationstechnologien überwiegend in die zweite Phase von RACE integriert.

3.2.3 Programm-Management-Audit

Die Managementverfahren, die die Kommissionsdienststellen für das Programm RACE festgelegt hatten, wurden 1989 einem unabhängigen "Programm-Management-Audit" unterzogen.

Die wichtigsten Schlußfolgerungen ergaben, daß der industrielle Managementstil, den die Kommissionsdienststellen übernommen hatten, insgesamt den Zielen und Programmpartnern angemessen war und sich die jährlichen technischen Audits und regelmäßigen Konzertierungssitzungen als effizientes Konzept erwiesen haben.

3.2.4 Technische Audits der RACE-Projekte

Um das Programm der technologischen Entwicklung und den Veränderungen des Nachfrageprofils anzupassen, sah die RACE-Entscheidung eine jährliche Revision des Arbeitsplans vor.

Die Fortschritte sämtlicher laufender Projekte waren jährlich im Verhältnis zu den Zielsetzungen zu überprüfen und mit neuen Anforderungen zu vergleichen. Daher wurde jedes Projekt jährlich einem "technischen Audit" durch unabhängige Sachverständige des jeweiligen Forschungsgebiets unterzogen. Der erste technische Audit wurde im Oktober 1988, der letzte im Oktober 1992 erstellt. Aufgrund der Ergebnisse dieser jährlichen Überprüfungen wurden die Projektarbeiten neu ausgerichtet oder gegebenenfalls eingestellt.

Die technischen Audits umfaßten folgende Hauptelemente:

(a) Die Projektpartner führten jährlich eine "Selbstbewertung" durch, d.h. sie überprüften das Projekt unter allen wesentlichen Aspekten und stellten die Ergebnisse in einem Jahresbericht zusammen.

(b) Diese Berichte wurden von unabhängigen externen Sachverständigen ausgewertet, die mit Hilfe des RMC ermittelt wurden. Nach der Auswertung der Berichte erfolgte eine "Anhörung" der Projektteilnehmer unter Vorsitz der Kommission. Dabei hatten die Projektteilnehmer Gelegenheit, die Leistungen hervorzuheben und künftige Arbeiten zu umreißen. Die Sachverständigen, die je nach Fachgebiet bestimmten Gremien angehörten, konnten Fragen zu den Projekten stellen, um das durch den Jahresbericht und die Darstellung vermittelte Bild abzurunden.

(c) Die Gremien konsolidierten ihre Schlußfolgerungen und Empfehlungen und stellten sie in ihren Berichten an den RMC und die Kommission zusammen.

(d) Die Audit-Berichte wurden durch eine Bewertung der vertraglichen Leistungen durch die Projektbeauftragten der Kommission ergänzt (in der Regel gelten die vertraglichen Leistungen als vertraulich und werden den Prüfern nicht mitgeteilt).

Dieses Verfahren hat sich als sinnvoll und wirksam erwiesen. Die Audit-Berichte bildeten eine ausgezeichnete Basis für die jährliche Aushandlung der Verträge über detaillierte Arbeitspläne zu jedem Projekt.

4. Verbindungen zu anderen gemeinschaftlichen und europäischen Aktionen

4.1 Verbindungen zur CEPT

Die Verbindungen zur CEPT und ihren nachgeordneten Stellen haben sich während der Entwicklung und Durchführung des Programms RACE grundlegend geändert.

Während der Definitionsphase erbrachte die von der CEPT eingesetzte Sondergruppe für Breitbandkommunikation (GSLB) eine wesentliche Vorleistung für den Arbeitsplan RACE I. 1987 und 1988 wurden die Arbeiten bei der CEPT durch die GMR (Groupe Mixte RACE) koordiniert, die zu diesem Zweck im September 1987 gebildet wurde.

Ferner unterzeichneten 13 europäische Fernmeldeverwaltungen 1988 dank der Zusammenarbeit mit der CEPT eine gemeinsame Absichtserklärung zur Schaffung einer generellen IBC-Testumgebung (EBIT).

Angesichts der Neuregulierung des Telekommunikationssektors im Sinne der neuen europäischen Telekommunikationspolitik setzte die CEPT mehrere gesonderte Gremien ein, von denen zwei enge Beziehungen zu RACE angebahnt haben: ETNO, die Gruppe europäischer Netzbetreiber, die nun das Diskussionsforum für Fragen des Zusammenwirkens von Netzen bildet, und EURESCOM, ein Forum für gemeinsame strategische Forschung. Nicht alle führenden europäischen TO sind in diesem Forum vertreten; dennoch stellt es eine sinnvolle Berührungsfläche zwischen der Kommission, RACE-Projekten und den meisten Netzbetreibern dar.

4.2 Verbindungen zu europäischen und internationalen Normungsgremien

Im Rahmen der europäischen Telekommunikationspolitik wurde 1988 ETSI, das Europäische Institut für Telekommunikationsnormen, gegründet. Es ist mittlerweile das wichtigste europäische Forum zur Entwicklung technischer Spezifikationen. Die pränormativen Tätigkeiten im Rahmen von RACE umfaßten 576 gesonderte Beiträge zur Normungsarbeit von ETSI, CCITT und CCIR.

Ferner wurden regelmäßige Sitzungen mit Vertretern von CEN/CENELEC, UER und SPAG abgehalten.

4.3 Verbindungen zu anderen Gemeinschaftsprogrammen und europäischen Initiativen

RACE baut auf den Ergebnissen von ESPRIT-Projekten zur Entwicklung generischer Technologien auf (Mikroelektronik-Bauelemente, Software-Werkzeuge, AIP für Netzmanagement usw.); in gleicher Weise profitieren die Anwendungsprogramme DRIVE, DELTA und AIM für ihren Bedarf an Telekommunikation von den Techniken, die mit derzeitigen RACE-Projekten entwickelt werden.

Bei der Zusammenarbeit mit COST wurden enge Verbindungen zwischen verwandten Tätigkeiten hergestellt und regelmäßig Programm-Management-Sitzungen veranstaltet.

Die intensivste Interaktion mit der EUREKA-Initiative entwickelte sich im Bereich der audiovisuellen Technologien. Die Arbeiten zur Förderung des HDTV (EUREKA-Projekt 95) wurden teilweise durch Tätigkeiten im Rahmen von RACE-Verträgen ergänzt; das EUREKA-Projekt 256 (Videocodierung) war an RACE-Integrationsinitiativen gekoppelt.

4.4 Verbindungen zu Organisationen der EFTA-Länder

Organisationen aus Finnland, Norwegen, Österreich, Schweden und der Schweiz sind an RACE beteiligt. 27 Organisationen dieser Länder wirkten an 72 Projekten (= über 80 % der Arbeiten) mit.

5. Verwertung der Ergebnisse des Programms RACE

Die Möglichkeiten neuer Kommunikationstechnologien werden sich entscheidend auf das künftige Wirtschaftswachstum der Gemeinschaft und die internationale Arbeitsteilung auf weltweiter Ebene auswirken. Drei eng verzahnte Wachstumsprozesse lassen sich derzeit unterscheiden:

- Ein verbesserter Informationszugang steigert die Produktivität der gesamten Wirtschaft.

- Verbesserungen im Kommunikationssektor steigern den Nutzen und mithin die Absatzmöglichkeiten für bestehende und neue Dienste und führen damit zur Expansion.

- Der Übergang zu einer neuen, diensteorientierten und informationsgestützten Wirtschaft erfordert sehr hohe öffentliche und private Investitionen in neue Infrastrukturen technischer (Kabel, Vermittlungen, Endgeräte) und personeller Art, um Mehrwertdienste zu entwickeln.

Daher ist die technische und organisatorische Qualität von Kommunikationsdiensten für das künfte Wirtschaftswachstum ausschlaggebend, da sie die Fähigkeit der Wirtschaft bestimmt, den wichtigsten modernen "Produktionsfaktor" - Wissen - zu erzeugen und effizient einzusetzen. Der geographische Aufbau der Infrastrukturen wird den gesellschaftlichen, wirtschaftlichen und kulturellen Raum von morgen ebenso entscheidend beeinflussen, wie es im 19. Jahrhundert mit der Eisenbahn der Fall war.

Aus diesen Gründen müssen die Ergebnisse der kommunikationsorientierten FuE unverzüglich und effizient genutzt werden. Besondere Aufmerksamkeit wurde daher der Verwertung der RACE-Ergebnisse während der gesamten Laufzeit des Programms gewidmet.

5.1 Plan zur Verwertung der RACE-Ergebnisse

Um die Nutzung von RACE-Ergebnissen durch die Teilnehmer zu fördern und zu beurteilen, wurde der Plan zur Verwertung der RACE-Ergebnisse im Zeitraum 1988-1992 regelmäßig aktualisiert. Er vermittelt einen Gesamtüberblick über die Nutzung der Ergebnisse durch die Teilnehmer.

Die Normungsbeiträge sind in Anhang II, die Titel der wissenschaftlichen und technischen Publikationen in Anhang III aufgeführt. Mit über 1700 wissenschaftlich-technischen Publikationen leistete das Programm RACE einen wesentlichen Beitrag zur frei zugänglichen wissenschaftlichen Literatur.

Die technologischen Ergebnisse wurden gegebenenfalls durch Patentanträge geschützt. 73 Patentanträge für RACE-Arbeiten wurden bereits registriert. Sie sind in Anhang IV aufgelistet.

5.2 Planung der IBC-Implementierung

Die FuE-Ergebnisse können nur dann sinnvoll genutzt werden, wenn alle Beteiligten eine kohärente Vorstellung von der Ausrichtung und Geschwindigkeit der kommerziellen Entwicklungen haben. Daher wurden die FuE-Arbeiten des Programms RACE stets in Verbindung mit einem vorläufigen IBC-Implementierungsplan programmiert und spezifiziert, der regelmäßig aktualisiert wurde. Er sieht eine stufenweise Einführung fortgeschrittener Dienste vor, wobei diejenigen, nach denen eine kommerzielle und professionelle Nachfrage besteht, bereits 1992/1993 aufgenommen werden sollen. Der derzeitige vorläufige Implementierungsplan beinhaltet folgende Etappen (vgl. RACE-Jahresbericht 1992):

1992/1993:

- Einführung kommerzieller und professioneller Anwendungen
- Zukunftsorientierte Kommunikationsversuche mit neuen Diensten und Netzmanagement-Systemen: ATM, MAN und IBC in Teinehmernetzen
- Beschaffungs-/Investitionsentscheidungen für künftige europaweite IBC-Netze und flächendeckende IBC-Dienste
- Abschluß wichtiger Normungsarbeiten

1994:

- Fertigstellung des Verbunds sämtlicher Hauptstädte der Gemeinschaft mit Anschluß an Nachbarländer durch Erweiterung bestehender LWL-Fernnetze, die jedoch Sprach-, Daten- und Bildübertragung unterstützen, entweder getrennt oder in Form von integrierten Diensten

1995:

- Erste Implementierung von IBC-Netzen und Fertigstellung des Zugangs für Firmen in Wirtschafts- und Industriezentren: mindestens 50 000 gewerbliche Benutzer fortgeschrittener Dienste
- Anwendungsfeldversuche zur Prüfung des gesamten Spektrums von IBC-Diensten (einschließlich Privatkunden mit Zweiweg-Video und digitalem HDTV) mit kommerziellen IBC-Anlagen

1996:

- Angebot an kommerziellen Basisbreitbanddiensten mit 2, 34 und 155 Mbit/s-Verbindungen, einschließlich schneller Datenübertragung zwischen LANs, Videokonferenzen, Video-Verarbeitung, CAD/CAM und Telearbeit
- Zusammenwirken von festen Breitbandnetzen mit Mobilfunk-, Satellitenund sonstigen Netzen

1997:

- Bereitstellung von IBC-Diensten für gewerbliche Benutzer in Städten mit mehr als 500 000 Einwohnern und Beginn der breitangelegten Installation von "Fasern zum Teilnehmer"

2005-2010:

- 50 %ige Flächendeckung von IBC-Diensten

Dieser vorläufige Zeitplan wird 1993 im Zusammenhang mit der Erstellung von Leitlinien für die Entwicklung transeuropäischer Breitbandnetze erneut überprüft (vgl. Titel XII, Artikel 129 b und c des Vertrages über die Europäische Union).

6. Durchführung Phase II des Programms RACE

RACE war von Anfang an als Zehnjahresprogramm konzipiert, das in zwei Phasen durchgeführt werden sollte. Um die Kontinuität zu gewährleisten, wurde die zweite Phase im Juni 1991 als spezifisches Programm des Dritten EG-Rahmenprogramms für Forschung und technologische Entwicklung festgelegt.

1991 hatte sich jedoch die Perspektive grundlegend verändert. Was zu Beginn des Programms eine ehrgeizige, nahezu futuristische Vision zu sein schien, war nun zu einer realistischen Möglichkeit geworden. Man rechnete nunmehr zuversichtlich mit der kommerziellen Einführung der integrierten Breitbandkommunikation innerhalb von vier Jahren. Auch stand eindeutig fest, daß Telekommunikations- und Informationsdienste an der Schwelle zum 21. Jahrhundert eine entscheidende Rolle bei der weltweiten sozio-ökonomischen Entwicklung spielen würden.

Angesichts dieser Veränderungen räumten das Europäische Parlament und der Ministerrat dem neuen spezifischen Programm Priorität ein. Es wurde innerhalb des Dritten Rahmenprogramms als erstes verabschiedet[11]; der Arbeitsplan wurde vom Verwaltungsausschuß umgehend befürwortet. Im Juni 1991 wurde eine Aufforderung zur Einreichung von Vorschlägen veröffentlicht; die Bewertung der Vorschläge erfolgte im September und Oktober 1991. Es wurden über 200 Vorschläge bewertet; Anfang 1992 liefen 95 Projekte an. Die Arbeiten sollen nach den derzeitigen Haushaltsvorschriften bis Ende 1994 abgeschlossen sein.

Während sich die Projekte der Phase I auf die Bewertung von Optionen konzentrierten, wird mit der Phase II die Einführung der IBC vorbereitet. Mit den Projekten von RACE II wird die bestehende Zusammenarbeit zwischen gewerblichen Benutzern, der Telematikindustrie und Telekommunikationsbetreibern intensiviert und erhalten die eingegangenen Verpflichtungen verbindlichen Charakter. Der Schwerpunkt der neuen FuE-Arbeiten liegt auf Anwendungen, Diensten, Betrieb und Management, wobei jedoch gleichzeitig spitzentechnologische Entwicklungen zu konsolidieren und die Schlüsselbereiche für die kostenwirksame Bereitstellung von IBC-Diensten auszudehnen sind.

Entsprechend dem Anhang zur Ratsentscheidung 91/352/EWG umfassen die Arbeiten acht prioritäre Bereiche:

BEREICH 1: FuE auf dem Gebiet der IBC (integrierte Breitbandkommunikation)
BEREICH 2: Intelligente Netze/Flexible Verwaltung der Kommunikationsressourcen
BEREICH 3: Mobil- und Privatkommunikation
BEREICH 4: Bild- und Datenkommunikation
BEREICH 5: Integrierte Dienstetechnologien
BEREICH 6: Technologien der Informationssicherheit
BEREICH 7: Fortgeschrittene Kommunikationsfeldversuche
BEREICH 8: Testinfrastruktur und Kommunikation zwischen Teilnetzen (horizontaler FuE-Bereich, der die anderen prioritären Bereiche unterstützt)

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11) **Ratsentscheidung 91/352/EWG vom 7. Juni 1991; Abl. Nr. 192/8, 16.7.91**

Eine vollständige Beschreibung der neuen FuE-Projekte der Phase II und ihrer Verbindungen zu denen der Phase I ist den Jahresberichten 1992 (RACE '92) und 1993 (RACE '93) zu entnehmen.

7. Künftige Anforderungen und Optionen der FuE im Bereich der Kommunikationstechnologien auf europäischer Ebene

Im Juni 1992 setzte der RACE-Verwaltungsausschuß (RMC) eine Ad-hoc-Gruppe ein, um die Prioritäten der künftigen europäischen FuE auf dem Gebiet der Telekommunikation zu ermitteln. Der Bericht dieser Gruppe wird im folgenden wiedergegeben.

Viele dieser Anregungen und Themen für die künftige europäische FuE wurden bereits in der Arbeitsunterlage der Kommission zum Vierten Rahmenprogramm umrissen, insbesondere in den Vorschlägen zu Bildverarbeitungstechnologien, Hochleistungsrechnern und -netzen, Funktionsintegration in der Fertigung und fortgeschrittener Kommunikation. Die Kommission wird ihre Vorschläge für spezifische Programme 1993 mit dem Vierten Rahmenprogramm unter Berücksichtigung sämtlicher Beiträge vorlegen.

Überlegungen zur FuE auf Gemeinschaftsebene

Der RMC ist nach wie vor der Ansicht, daß FuE im Telekommunikationsbereich eindeutig Vorteile bietet, wenn sie auf Gemeinschaftsebene durchgeführt wird. Forschung (insbesondere auf dem Gebiet der Telekommunikation) ist grundsätzlich ein kontinuierlicher Prozeß. Um die verbesserte Position, die die betroffenen Akteure bereits durch ihre Beteiligung an Gemeinschaftsaktionen wie RACE erlangt haben, beizubehalten, müssen sie ihre Forschung weiterhin in Zusammenarbeit durchführen und dabei auf den bisherigen Ergebnissen aufbauen.

Die aufgesplitterten Telekommunikationssysteme der Gemeinschaft müssen weiter konsolidiert werden, um sowohl das einwandfreie Funktionieren des Binnenmarktes zu gewährleisten als auch den Wettbewerbsvorteil europäischer Organisationen auf den Weltmärkten auszubauen. Normungsgremien wie ETSI bewerten die eingehenden technischen Beiträge als unmittelbares Ergebnis der Arbeiten von RACE. Der "Strom von Ergebnissen", der den Normungsgremien aus der gemeinschaftlichen FuE zufließt, ist im Rahmen künftiger Programme weiterhin und verstärkt zu steuern.

Moderne Telekommunikationsmittel sind für den Wohlstand der Volkswirtschaften von zunehmender Bedeutung, insofern als ihre Bestandteile ("Informationen" und die Möglichkeit der Informationsübertragung) als strategische Ressourcen zu betrachten sind. Dies läßt sich ermessen an:

- dem zunehmenden Anteil von Investitionen in Telekommunikationsanlagen an den Volkswirtschaften und

- den zunehmenden Auswirkungen moderner Telekommunikationsdienste auf andere Wirtschaftszweige.

Diese Tendenzen wurden sowohl in der Einheitlichen Akte als auch bei den derzeitigen Bemühungen zur Vollendung des Binnenmarktes der EG erkannt. Der Vertrag von Maastricht sieht die Schaffung transeuropäischer Netze vor (zu denen auch Telekommunikationsnetze gehören). Der Aufbau von Telekom-Infrastrukturen und -Diensten erfordert langfristige Zusagen aller Beteiligten.

Die Gleichschaltung der Evolution zu einer Breitbandkommunikations-Infrastruktur (wiederum auf europäischer Ebene) bietet einen klaren wirtschaftlichen Vorteil hinsichtlich der Investitionsrentabilität. Sie würde auch die Übernahme neuer Anwendungen in allen europäischen Regionen fördern und die Erreichung der kritischen Masse ermöglichen, die für autarkes Wachstum bei fortgeschrittenen Diensten erforderlich ist. Zweifellos haben Telekommunikationsnetze, mehr und mehr auch Gemeinschaftsdienste, eine zunehmend internationale Dimension. Eine breitere Zusammenarbeit mit außereuropäischen Gebieten könnte ebenfalls gefördert werden.

Aus diesen Gründen vertritt der RMC die Auffassung, daß alle künftigen Rahmenprogramme eine spezifische FuE-Aktion der Gemeinschaft im Telekommunikationsbereich umfassen sollten. Sie sollte sich auf die soliden Grundlagen stützen, die mit früheren Programmen geschaffen wurden. Die FuE auf dem Gebiet der Telekommunikation nach 1995 wird sich jedoch wesentlich von den bisherigen Arbeiten des Programms RACE unterscheiden.

Zielsetzungen der künftigen FuE im Telekommunikationsbereich

Die Verwirklichung des Traums von modernen Kommunikationsdiensten, die es "jedem ermöglichen, überall, jederzeit über Text, Ton und Bild mit beliebigen anderen Personen zu kommunizieren", setzt voraus, daß Europa neue FuE-Initiativen ergreift.

Derzeitige Programme wie RACE und ESPRIT haben bereits dafür gesorgt, daß dieser Traum grundsätzlich technisch realisierbar ist. Die Impulse für ein neues gemeinschaftliches FuE-Programm im Bereich der Telekommunikation müssen nun aus dem Bedarf an Anwendungen stammen, die prinzipiell die Aktionen und Prioritäten für künftige Forschungsarbeiten auf dem Gebiet der flankierenden Technologien bestimmen sollten.

Daher sollten sich neue Programme auf folgende Ziele konzentrieren:

- Förderung von "Betriebsversuchen" mit fortgeschrittenen Diensten, um deren Nutzbarkeit zu verbessern und zu gewährleisten, daß das Endergebnis für eine breite Anwendung im Alltag der Europäer attraktiv genug ist.

- Förderung der Forschung im Bereich der "zukunftsorientierten Technologien", die zur Unterstützung fortgeschrittener Kommunikationsdienste erforderlich sind; Senkung der Kosten für Schlüsselkomponenten, um so die Bereitstellung fortgeschrittener Dienste in wirtschaftlicher Hinsicht zu ermöglichen.

Diese beiden Aspekte sind eine wesentliche Voraussetzung für die europaweite kommerzielle Realisierung moderner Kommunikationsnetze und -dienste, wenngleich hierfür auch mehrere andere Faktoren maßgebend sind. Um den Traum von modernen Kommunikationsdiensten in Reichweite zu rücken, ist von der zunehmenden Bereitschaft der Beteiligten zu gegenseitigen Konsultationen auszugehen, um in folgenden Fragen zu einem Konsens zu gelangen:

- Möglichkeiten zur Erreichung der notwendigen Leistungssteigerung bei Diensten und entsprechenden flankierenden Technologien;

- Möglichkeiten, die sich aus der Konvergenz von Telekommunikation, Rundfunk und Informationstechnologie ergeben und die Basis für eine rasche Entwicklung zu modernen Kommunikationsdiensten bilden können.

Kurz, die kontinuierliche FuE der Gemeinschaft auf dem Gebiet der fortgeschrittenen Kommunikationsdienste als solche wird die europäische Zusammenarbeit und Harmonisierung fördern, zur Steigerung der europäischen Wettbewerbsfähigkeit auf internationalen Märkten führen und damit die europäische Wirtschaft insgesamt festigen.

Grundlagen der Zusammenarbeit (Verfahrensweise)

Um moderne Kommunikationsdienste für breite Kreise attraktiv und Technologien "wirtschaftlich realisierbar" zu gestalten, sind alle Beteiligten einzubeziehen: Benutzer, Netzbetreiber, Diensteerbringer, Industrieunternehmen, Forschungszentren und Hochschulen. Diese Einbeziehung war von Anfang an durch ihre Mitwirkung bei der Festlegung eines Arbeitsplans gewährleistet. Vor allem sollten eine intensive Zusammenarbeit der öffentlichen Netzbetreiber bei Kommunikationsversuchen gefördert und etwaige Vorteile bestehender oder geplanter Infrastrukturen genutzt werden.

Beim nächsten FuE-Programm sollte den KMU, die vielfach über ein wertvolles Knowhow bei der Entwicklung von Anwendungen und Diensten verfügen, eine wichtigere Funktion zugewiesen werden. Dieses Knowhow ist für die Bestrebungen der Gemeinschaft auf diesem neuen Forschungsgebiet von entscheidender Bedeutung. Da die KMU bei künftigen FuE-Programmen der Gemeinschaft eine wichtigere Funktion übernehmen müssen, sollten spezifische Maßnahmen getroffen werden, um ihre tatkräftige Mitwirkung zu ermöglichen. Beispielsweise muß die Kommission gegebenenfalls günstigere Vertragsbedingungen einräumen (z.B. analog zu dem CRAFT-Mechanismus bei BRITE/EURAM oder anderen neuen Konzepten).

Zwar war RACE insgesamt erfolgreich, dennoch sollten für die Abwicklung des nächsten FuE-Programms im Bereich der Telekommunikation neue bzw. verbesserte Verfahren in Betracht gezogen werden. Die einzelnen Projekte sollten in einem streng gegliederten Rahmen formuliert, im Arbeitsplan definiert und eindeutig auf die Erreichung der Programmziele ausgerichtet sein. Auch der Konzertierungsmechanismus, der sich bei RACE bewährt hat, ist zu verstärken.

Zu fördern sind, wo immer möglich, eine verstärkte Koordinierung der Gemeinschaftsprogramme, eine bessere Zusammenarbeit mit anderen europäischen oder multinationalen Forschungsprogrammen und eine engere Kooperation mit nationalen Programmen und Experimenten. Konzertierte Aktionen mit EUREKA, COST und anderen einzelstaatlichen Programmen kommen ebenfalls in Betracht.

Flankierende Maßnahmen sollten die Unterrichtung der Öffentlichkeit über die Projekte während deren Durchführung und die Weitergabe der Ergebnisse (und etwaiger Vorteile bzw. Anwendungen) an alle Beteiligten umfassen, insbesondere an potentielle Benutzer moderner Kommunikationsdienste.

Betriebsversuche und Entwicklung von Diensten

Bisherige Erfahrungen mit der Einführung neuer Netztechnologien und Dienste haben gezeigt, daß die Entwicklung und Implementierung neuer Anwendungen eine durchorganisierte, voroperationelle, praktische Validierung (Betriebsversuche) erfordert, an der alle betroffenen Akteure beteiligt sind. Aufgabe der nächsten Generationen von europäischen Betriebsversuchen ist es daher, Mittel und Wege aufzuzeigen, um potentielle Dienste (unter freien Marktbedingungen) zu kombinieren und damit dem Bedarf zentraler Marktsegmente gerecht zu werden.

Die FuE zur Durchführung von Betriebsversuchen und Entwicklung von Diensten sollte sich auf generische Aspekte konzentrieren, die die Evolution fortgeschrittener Dienste ermöglichen. Ausgehend von der vorhandenen Technologie, sollten die Versuche mit der zunehmend intelligenten Ausstattung von Netzen und flexibleren Diensten auf geeignete Anwendungen ausgerichtet sein. Hauptziele der Betriebsversuche wären die Formulierung von Vorschlägen als Beitrag zum Normungsprozeß sowie Vorschläge für Plattformen, die alle Aspekte bereichsspezifischer Anwendungen berücksichtigen:

- das Unternehmen (Organisation, Interaktion, Informationsvermittlung für Benutzer, Management- und Sicherheitsstrategien, Kosten-Nutzenanalyse, rechtliches, ethisches und gesellschaftliches Konzept);

- die Informationen als solche (Definition der Infomationselemente, Qualität der Informationen, Informationsfluß und Darstellung für den Benutzer);

- die Telematikfunktionen (Kommunikations- und Verarbeitungsfunktionen, Arten der Datendarstellung);

- die (Hard- und Software-)Technologien.

Auf diese Weise sollten die Betriebsversuche Änderungen der Rechtsvorschriften, der Management- und Sicherheitsstrategien, des Benutzerzugangs und der Mensch-Maschine-Schnittstellen berücksichtigen, Kosten-Nutzenanalysen erstellen und die Qualität der Informationen definieren.

Die Entwicklung generischer Dienste erfordert entsprechende Werkzeuge, die Integration von Multimedia-Telediensten und Endgeräten sowie die Bereitstellung fortgeschrittener Funktionen für Dienste, deren Management und Service Engineering. Infolgedessen müssen künftige Anwendungen

- bereichspezifischen Definitionen entsprechen, die von Diensteerbringern und Benutzern erstellt werden;

- auf generischen Diensten basieren und mit dem offenen Netzzugang kompatibel sein;

- von eindeutigen Kosten-Nutzen-Vorgaben bestimmt sein;

- internationale Absatzmöglichkeiten bieten;

- kurzfristig neuen Anforderungen gerecht werden, als da sind: persönliche Mobilität und Erreichbarkeit, multimediale Breitbanddienste, kooperative bzw. intelligente Netze.

Eine empirische Basis für die Festlegung dieser Anwendungen können die derzeitigen Programme der Mitgliedstaaten und der EG liefern (z.B. RACE, Allgemeinrelevante Telematiksysteme, ESPRIT). Im Brennpunkt künftiger FuE-Programme stehen präoperationelle Tests und die Demonstration der Einsatzfähigkeit von Anwendungen auf europäischer Ebene. Folgende spezifische "Dienstentwicklungen" sollten nach Auffassung des RMC in ein künftiges FuE-Programm einbezogen werden, um dem Benutzerbedarf besser gerecht zu werden:

- *Fortgeschrittene Videokonferenzen und multimediale Dialogdienste;*
- *Telearbeit und virtuelle Präsenz;*
- *Mobilität, Erreichbarkeit und Informationssicherheit;*
- *Rundfunkdienste für die Öffentlichkeit und bestimmte Zielgruppen;*
- *Dienstemanagement und intelligente Netzfunktionen.*

Forschung im Bereich der flankierenden Technologien

Neue Forschungsprogramme im Bereich der Telekommunikation sollten auf der breiten technologischen Basis aufbauen, die mit früheren Programmen geschaffen wurde. Nun sind strategische Forschungsarbeiten erforderlich, um bei der nächsten Technologiegeneration Kostenvorteile zu erzielen. Die generellen Ziele lassen sich wie folgt definieren:

- Bereitstellung der notwendigen Technologien für die Weiterentwicklung kostenorientierter, wettbewerbsfähiger Netze und Dienste in Europa, die gegenüber den konkurrierenden Wirtschaftsblöcken einen Vorsprung haben, um so einen wesentlichen Beitrag zur Festigung der europäischen Wirtschaft zu leisten.

- Schaffung der Basis für eine technisch realisierbare und wirtschaftlich sinnvolle Weiterentwicklung des Telekom-Netzes, ebenfalls (unter dem Aspekt der Normung) mit dem Ziel, die europäische Wirtschaft zu festigen.

Die Kenntnisse, die in diesen allgemeinen Forschungsbereichen gewonnen werden, erfordern gegebenenfalls eine Anpassung der Ziele und Prioritäten anderer Programmabschnitte. Beispielsweise kann die Weiterentwicklung der Dienstetechnologie Vorleistungen für die Forschung auf dem Gebiet der Komponenten- und Netztechnologie erbringen. Der Schwerpunkt sollte jedoch weiterhin auf neuen Diensten liegen, die über das Telekom-Netz bereitgestellt werden können. Da weitgehende individuelle Anpassung ein Merkmal dieser Dienste sein wird, bedarf es einer engen Interaktion zwischen der Netzevolution und der Entwicklung von Diensten. Folgende spezifische Forschungsbereiche sollten nach Ansicht des RMC in ein künftiges Programm einbezogen werden:

Netzevolution als Basis für technisch realisierbare, wirtschaftlich sinnvolle fortgeschrittene Kommunikationsdienste

- Integration vorhandener und neuer Übertragungsmedien und -systeme (Kupferkabel, Lichtwellenleiter, terrestrischer Funk, Satellitenfunk), auch bei der Verteilung und beim Netzzugang (LWL in der lokalen Schleife usw.); Integration von mobilen und festen Netzen.
- Weiterentwicklung gesteuerter Übertragungshierarchien, verbesserte Netzmanagement-Systeme.
- Optische Übertragungssysteme mit sehr hoher Kapazität, Photonen-Netzarchitekturen.
- Gesteuerte Netzknoten für B-ISDN (ATM) und verbesserte Zeichengabe.
- Fortgeschrittene intelligente Netze, Informationsnetz-Architekturen (mit Kombination von IN und TMN), innovative Softwarearchitekturen.

Weiterentwicklung von Technologien aufgrund der Ergebnisse von RACE und anderen EG-Programmen, insbesondere Verbesserung des Preis-Leistungsverhältnisses und der Benutzerfreundlichkeit von Endgeräten

- Multimediale Arbeitsplätze, Bildtelefon.
- Fortgeschrittene Bild- und Tonverarbeitung.
- Digital-Fernsehen (SDTV, EDTV, HDTV).
- Sprachsteuerung in natürlicher Sprache.
- ULSI-Bauelemente für Vermittlungs- und Übertragungsleitungen.
- Fortgeschrittene Mikrowellen-ICs auf der Basis von Si und III-V-Werkstoffen.
- Optoelektronische Werkstoffe und Geräte für Telekom-Anwendungen.

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 L320	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	
Attributes 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
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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
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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	
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Clarification of the ATM Adaptation Service Classification Model	ETSI	NA 5	1990/03	Italy
Comments on ATM Header Functions	ETSI	NA 5	1989/10	Denmark
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Commonality between SNI and T interfaces	ETSI	NA 5	1990/06	Finland
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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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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
Introductory IBCN Reference Configurations	ETSI	NA 5	1990/03	Italy
List of Contributions	ETSI	NA 5	1990/09	Spain
List of contributions from RIC	ETSI	NA 5	1989/09	France
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Mapping of Service Components into Bearer Components for multi-media Services	ETSI	NA 5	1991/10	Greece
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Metasignalling Protocol Functions and Limitations	ETSI	NA 5	1990/04	Portugal
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MSS Functional Model	ETSI	NA 5	1990/06	Finland
Multimedia service structure	ETSI	NA 5	1990/09	Spain
No need for a Fast Reservation Protocol	ETSI	NA 5	1991/09	Belgium
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Performance measurement aspects of the cell based interface	ETSI	NA 5	1991/02	Belgium
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Proposal for Basic Primitives Between the ATM adaptation Layer and the ATM layer	ETSI	NA 5	1990/03	Italy
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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
Proposal for Primitives Between the ATM adaptation Layer and the ATM layer	ETSI	NA 5	1990/03	Italy
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 the use of Terms in I.311	ETSI	NA 5	1990/03	Italy
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Service primitives between the ATM LE and the ATM LME for error reporting	ETSI	NA 5	1991/09	Belgium
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Service primitives exchanged between the ATM LE and the ATM LME for data transfer	ETSI	NA 5	1991/09	Belgium
Service Primitives exchanged between the PM Layer Entity and the ATM Layer Entity	ETSI	NA 5	1991/10	Belgium
Service Primitives for the Connectionless Data Service	ETSI	NA 5	1991/04	Belgium
Service Requirements for MANs	ETSI	NA 5	1990/01	Germany
Signalling Virtual Channel bandwidth	ETSI	NA 5	1990/09	Spain
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
Surface Transfer Impedance in the specification of the TB interface	ETSI	NA 5	1990/09	Spain
Target IBCN Reference Configurations	ETSI	NA 5	1990/03	Italy
Termination of the section and path overhead (POH) at the UNI	ETSI	NA 5	1989/10	Denmark
Termination of the SOH and POH at the UNI	ETSI	NA 5	1989/09	France
Terminology Lifecycle	ETSI	NA 5	1990/09	Netherlands
Terminology (related to Connectionless Data Service)	ETSI	NA 5	1990/09	Spain
Terminology Related to connectionless Services	ETSI	NA 5	1990/06	Finland
Terminology Update	ETSI	NA 5	1990/10	Sweden
The Branching Functional Group with Functions and Reference Points in the Customer Access Network	ETSI	NA 5	1992/01	France
The Coding of the Sequence Number (SN) in SAR class 2	ETSI	NA 5	1990/04	Portugal
The messages used by the AAL protocol for B-ISDN signalling and connection oriented data services	ETSI	NA 5	1990/09	Spain
The OLI/OLO concept	ETSI	NA 5	1991/02	Belgium
The Optical Line Outlet Concept	ETSI	NA 5	1989/10	Denmark
The Optical Line Outlet Function	ETSI	NA 5	1990/10	France
The way ahead on Broadband numbering within NA2	ETSI	NA 5	1991/09	Belgium
Third-Party-Charging	ETSI	NA 5	1991/09	Belgium
Traffic aspects	ETSI	NA 5	1991/02	Belgium
Transmission aspects in the core network	ETSI	NA 5	1991/02	Belgium
Transmission Range for a Coaxial Interface	ETSI	NA 5	1989/08	France
Transmission ranges for an optical fibre interface	ETSI	NA 5	1989/11	UK
Units for Traffic Capacity in ATM Networks	ETSI	NA 5	1990/04	Portugal
Use of Generic Layering Architecture to structure the Broadband User - Network Signalling Interface	ETSI	NA 5	1989/10	Denmark
Use of the PRM for User Plane and Control Plane connection establishment	ETSI	NA 5	1991/09	Belgium
"Use of unused octets in metasignalling message, and identification"	ETSI	NA 5	1991/01	France
User Network Interface based on SDH	ETSI	NA 5	1989/10	Denmark
Vocabulary - Abbreviations	ETSI	NA 5	1989/09	France
Working procedures for ETSI/NA5	ETSI	NA 5	1990/09	Spain
Workprogramme for ETSI/NA5	ETSI	NA 5	1990/09	Spain
Execution of Service on a Functional IN Model	ETSI	NA 6	1989/11	Germany
Intelligent Network Terminology Definitions	ETSI	NA 6	1989/11	Germany
Liaison Report from RACE	ETSI	NA 6	1989/11	Germany
Liaison Report from RACE	ETSI	NA 6	1990/02	UK
Proposal for a functional Plane Architecture	ETSI	NA 6	1990/02	UK
Proposal for further Definition	ETSI	NA 6	1990/02	UK
Broadening of the User Concept in UPT	ETSI	NA 7	1990/09	Netherlands
Requirements for User Profiles in UPT	ETSI	NA 7	1990/09	Netherlands
UPT Numbering Plan Requirement related to the ACCESS of the UPT Service Centre	ETSI	NA 7	1990/09	Netherlands
UPT Numbering Plan Requirements related to Distinguishing between UPT - and ohter numbers	ETSI	NA 7	1990/09	Netherlands
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
UPT User Requirements related to Information Feedback at Call Set-up Time	ETSI	NA 7	1990/09	Netherlands
Numbering and Addressing Requirements Architectural Requirements	ETSI	NA2	1990/10	Denmark
Numbering and Addressing Requirements : Concepts of addressing	ETSI	NA2	1990/10	Denmark
Numberings and Addressing Requirements : Requirements from customers and B-ISDN	ETSI	NA2	1990/10	Denmark
Numberings and Addressings Requirements : Requirements from services with special addressing needs.	ETSI	NA2	1990/10	Denmark
Medium Term Evaluation on Codec location in B-ISDN	ETSI	NA3	1989/10	UK
TV Picture frequencies used in picture coding for transmission	ETSI	NA3	1990/05	Sweden
Comments on SG XI metasignalling baseline document	ETSI	SPS	1991/01	France
Connection Acceptance Control	ETSI	SPS 3	1990/10	Italy
Definition of Call and Connection in the B-ISDN	ETSI	SPS 3	1990/10	Italy
Performance of Established Connections	ETSI	SPS 3	1990/10	Italy
Requirements for the separation of Call and Connection Control	ETSI	SPS 3	1990/10	Italy
Traffic Characterization	ETSI	SPS 3	1990/10	Italy
Spectrum Allocation in the Optical Local Network	ETSI	TM 1	1989/10	France
CMI coding on the 155.520 Mbit/s optical interface	ETSI	TM 3	1991/04	Belgium
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
Functional Architecture Model & Realisation of an Optical Access Network (OAN) with OLI/OLO	ETSI	TM 3	1991/04	Belgium
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
Optical Interfaces for the Customer Access Network	ETSI	TM 3	1991/03	Belgium
Optical Transmission of the OAN - Architecture and Evolution	ETSI	TM 3	1991/03	Belgium
Proposal for Physical Layer Transmission Parameters	ETSI	TM 3	1990/04	Austria
Quality of Services and Netw. Performance Requirements in ATM Networks	ETSI	TM 3	1989/10	Portugal
Specification of Surface Transfer Impedance to Tb interface cabling and connectors	ETSI	TM 3	1991/04	Belgium
Utilisation of the 800 nm optical window for transmission at the UNI	ETSI	TM 3	1990/10	
Evolution towards UMTS	ETSI	UMTS	1990/11	Belgium
Status of the RACE Mobile Project	ETSI	UMTS	1990/11	Belgium
Study items for the network aspects of UMTS	ETSI	UMTS	1991/03	Belgium
UMTS at the Turn of the Century	ETSI	UMTS	1990/08	Belgium
UMTS Requirements to B-ISDN	ETSI	UMTS	1990/11	Belgium
UMTS Services - Environmental Considerations/Potential Usage Characteristics	ETSI	UMTS	1990/11	Belgium

R1046 Specification and Programming Environment

"Extension of SDL to support Object-Orientation, Generic Parameter and Libraries"	CCITT	SG X	1990/06	Finland

R1053 TMN Evolution of Reference Configuration for RACE

A TMN Functional Hierarchy	ETSI	NA 4	1990/03	UK
Contribution to the Definition of Reference Configurations (RCs) for the Telecommunication Management	ETSI	NA 4	1990/03	UK

R1054 Application Pilot for People with Special Needs

Specifications of terminals for disabled users with respect to standards for user-system interface	ETSI	NA3.2	1991	

R1060 Distributed Industrial Design and Manufacturing

"Structural Walkthrough of the IPC Standard and Electrical Conceptual Model, STEP"	CCITT	ISO	1990/09	Germany

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

Appraisal of M-IT-04	CEN	TG 11-2	1992/06	UK

R1080 HDTV Experimental Usage

Progress on development of studio equipment for progressively scanned HDTV	CCIR		1991/02	
Progress on HDTV standards conversion	CCIR		1991/02	
Progress report on the 1250/50/2 system	CCIR		1991/01	

R1082 Quality of Service (QoS) Verification Methodology and Tools

"Relationship between Qos terms such as Planned, Achieved, Inferred, Qos etc."	ETSI			
"Qos and NP, Relationship between related terms."	ETSI	NA 4	1991/07	France

The Timeline Model	ETSI	NA 4	1991/07	France

R1089 Low Cost Optimized Optical Passive Components

"Sectional Specification, Connectors sets type CF08"	CCITT	IEC	1990/07	France
"Sectional specification, connectors sets type CF08"	CENELEC	CECC	1990/10	France

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
1992/04 IEEE proceedings 4th Int. Conf. Image Proc. & its Applications (IPA 92), Conf. Publ. No 354 -

Characterisation and measurements of non-linear bit shifts in digital magnetic tape recording
1990/04 8th conference on Video, Audio & Data Recording

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.

Digital Consumer HDTV Recording based on Motion Compensated DCT Coding of Video Signals
1992/06 Signal Processing and Image Communications, Vol 4, No 3

Electronics for reading and writing
1991/06 Digest of the Magnetic Recording Conference 1991 (TMRC 91)

Error detecting run-length limited sequences
1990/04 8th Conference on Video, Audio & Data Recording

Full-Search versus Tree-Search Vector Quantization of Discrete Cosine Transform Coefficients
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

Magnetic recording trends: media developments and future (video) recording systems
1990/01 MRM'89, published in IEEE Trans Magn, vol 26

Modelling of electromagnetic systems
1991/11 IEEE Transaction on Magnetics, Vol. Mag-27, No. 6

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

On the Construction of High-Performance Self-Synchronizing Codes
1990/10 Proceedings 11th Benelux Symposium Information Theory, Noordwijkerhout 1990

On the interpretation of tape friction
1990 IEEE Trans Magn., vol 26

Perpendicular recording with a one-sided MIG-head on SL Co-Cr
Intermag'90

Source Coding of HDTV with Compatibility to TV
1990/10 SPIE Vol. 1360, Proc. 5th Visual Communications & Image Processing '90

Sputtered sandwich heads for high-density digital video recording
1990/04 INTERMAG Conference

Structural Inhomogenities in Co-Cr layers and the influence on the magnetic properties
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
1991/11 Proceeding of the Fifth RACE TMN Conference.

A Proposal for an Integration Methodology for a TMN
1991/11 Proceedings of the Fifth RACE TMN Conference

An architecture for the management of a Broadband Multi-service network
1990/05 XIII International Switching Symposium Proceedings

Broadband Communications Management the RACE TMN Approach
1990/10 IEEE Broadband Conference on Broadband TELECOM

Network Management for RACE
1991/11 British Telecommunications Engineering Journal, to be pub. later this year.

Synergies Between ESPRIT and RACE
1990/08 European conference on Artificial Intelligence (ECAI - 90)

Telecommunications Management Network Concepts
1990/01 IEE Electronics division colloquium organised by professional group E7 (Telecom Networks &

The application of information modelling in the telecommunication management network (TMN)
1991/03 Telecommunications Information Networking Architecture Workshop (TINA '91)

R1004 Electro-Luminescent Flat Panel Display for Terminal Applications

A 9 inch diagonal Compact, Multicolor TFEL Display
1991 SID 1991

Active matrix CdSe TFT addressed electroluminescent displays
1988/10 Proceedings of the International Display Research Conference

Aspects on Thin-film Electroluminescence
1990 Acta Polytechnica Scandinavica, Vol. Ph. 170

Bildschirme Flache Flundern
1989/03 Techno-Tip Nr. 3

Brightness and light conversion Efficiency in High Field AC Electroluminsescence
1990 Acta Polytechnica Scandinavica, vol Ph 170

Design of a prototype active matrix CdSe TFT addressed EL display
1990/09 Eurodisplay '90

Development of Advanced Thin-Film Electroluminescent Displays
1990 Proceedings of Eurodisplay 1990

Evaluation of a 64x64 CdSE TFT Addressed ACFTEL display demonstrator
1991/10 91 International Display Research Conference

Green Emitting Thin-Film Electroluminescent Device grown by Atomic Layer Epitaxy
1990 SID 1990 DIGEST

High-voltage polycrystalline CdSe TFT's
1990 IEEE Transactions on Electron Devices, ED-37.

Large Area VGA-Compatible EL-Display with 16 Gray Shades
1989/06 ED 89 Electronic Displays Conference Proceedings

Low-Power Thin-Film Electromuniscent Display
1991 SID International Symposium, Digest of Technical Papers, Vol. XXII

Modeling & Simulation of an ACTFEL Display
1990 SID 1990 DIGEST

Modeling the Luminescence of the ACTFEL Display
1990/06 5th International Workshop on Electroluminescence

Multi-colour Thin-Film Electroluminescent Displays
1992 6th Int. Workshop on Electroluminescence - El Paso

Multicolour Electroluminescent Displays
1990 Proceedings of 14th Nordic Semiconductor Meeting

The realization and evaluation of poly-CdSe TFT driving circuits
1988/10 Proceedings of the International Display Research Conference

Thin-Film Electroluminescent Displays
1989/05 Society for Information Displays,Seminar Lecture Notes,volume I

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A Model of the TMN Workstation Function
1991/11 5th RACE TMN Conference - London

AIP Utilisation in Traffic and Quality of Service Management Systems
1992/09 6th RACE TMN Conference - Madeira

An Approach to Distributed O-o databases
1991/06 2nd Workshop of the Object Modelling Special Interest Group

An Architecture for Distributed Network Management
1991/11 5th RACE TMN Conference - London

An Experimental Evaluation of Call Acceptance Management Algorithms in ATM Based Networks
1992/09 Canadian Conference on Electrical and Computer Engineering - Toronto

ATM Network Simulator
1990/11 GUIDELINE 2nd TMN Implementation Workshop

Constraint Logic Programming for a Virtual Path Bandwith Management
1990/11

Experience Design TMN Computing Platforms for constraining TMN Management Applications
1992/09 6th RACE TMN Conference - Madeira

Experience of Modelling and Implementing a Quality of Service Management System
1992/09 6th RACE TMN Conference - Madeira

Generic Management Browser
1992/05 IFIP Conference on Upper Layer Protocols, Architecture and Applications - Vancouver

HCI Consideration in TMN Systems
1992/09 6th RACE TMN Conference - Madeira

HCI in TMN : Issues and Technology
1991/11 5th RACE TMN Conference - London

Inference and Control in a Generic Maintainance System
1990 International Switching Symposium Stock

Integration in TMN Systems
1990/11 GUIDELINE 2nd TMN Implementation Workshop

NEMESYS and WINER: a comparison of two QoS Network Management Experiments
1990/11

ODP Viewpoint of IBCN Service Management
IBM Technical Report No 439104

OSI Management and UNIX - the OSIMIS Platform
1992/05 Dansk Data Conference - Copenhagen

Quality of Service Management in IBC : an OSI Management Based Prototype
1991/11 5th RACE TMN Conference - London

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1992 IBM Systems Journal 4Q.1992

Service Management for IBC
1992/10 IFIP/IEE International Workshop on Distributed Systems, Operation and Management - Munich,

Service Modelling in the NEMSYS Project
1991/11 5th RACE TMN Conference - London

TeleUSE UIMS Evaluation Report
1990/11 GUIDELINE 2nd TMN Implementation Workshop

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1992/09 6th RACE TMN Conference - Madeira

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Using Neural Computing Methods to Build an Adaptive Distributed Routing Algorithm
1990/11 2nd TMN Workshop

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1992/09 6th RACE TMN Conference - Madeira

Virtual Path and Call Acceptance Management for ATM Networks
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R1006 AIM-AIP Application to IBC Maintenance

A design of the Operation, Maintenance and Construction of an Intelligent Management Information Base
1991/11 Proceedings of the Fifth RACE TMN Conference

A knowledge based resource scheduler for network maintenance
1991/07 British Telecom Technol. Journal, Vol. 9, no. 3

A Model-Based Reasoning System for the Maintenance of Telecommunication Networks
1991/05 Eleventh Workshop on Expert Systems & Their Applications, Avignon '91 Conference

A Proposal for an integration methodology for a TMN
1991/11 RACE TMN 5 Conference

Advanced Information Modelling for Integrated Network Management Applications
1992

An architecture for the management of a Broadband Multiservice Network
1990/06 13th ISS

Computing beliefs according to Dempster-Shafer and Possibilistic Logic
1990/07 3rd Int Conference Information Processing & Management of Uncertainty in Knowledge Based

Computing Numerical Beliefs Using Propositional Inference as a Basis
1990/07 Conference -3rd International Conference on Information processing & the Management of

Conclusions from the BERKOM Maintenance Prototype and Recommendations for future Maintenance Systems
1991/11 Proceedings of the Fifth RACE TMN Conference

Design of the Resource Scheduler
1990/11 RACE TMN conference

Ein Modellbasiertes Expertensystem fur die Wartung von Telekommunikationsnetzwerken
1991/10 GI Jahrestagung Conference

Fault Management within Broadband Communication Networks by using a Knowledge Based System
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1990/11 RACE TMN conference

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1991/11 Proceedings of the Fifth RACE TMN Conference

Knowledge representation of networks in the RACE project AIM
1990/11 RACE TMN conference

OBSIL: A simple object oriented query language as a basis for TMN systems interactions
1991/11 RACE TMN 5 Conference

Open University (UK) - Contributions to the course on data/knowledge bases.
1990/09 Preliminary Script on the Open University Interview on Object Modelling

Representation of generic structure and behaviour of networks for model based diagnostic applications
1991/07 British Telecom Technol J. Vol. 9 No 3

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1990/11 RACE TMN conference

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Towards a logical basis for communication in network management
1991/07 British Telecom Technol. J., Vol 9 No 3

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16-channel optical wavelength multiplexer/demultiplexer integrated on silicon substrate
1991/06 Proceedings EFOC'91

Birefringence control and dispersion characteristics of silicon oxynitride optical waveguides
1991 Electronics Letters 27

Fiber Pigtailed Wavelength Multiplexer/Demultiplexer at 1.55 microns ntegrated on silicon substrate
1990/06 Proceedings of EFOC '90

Fibre pigtailed silicon based low cost passive optical components
1990/09 Proceedings of ECOC'90

Integrated Photonic Circuits on Silicon
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Low cost silica on silicon single mode 1:16 optical power splitter for 1550 nm
1990/06 Proceedings of EFOC'90

Low-loss PECVD silica channel waveguides for optical communications
1990/12 Electronics Letters

Microguides de lumière à très faibles pertes en technologie OIS pour communications optiques
1990/10 Journees Nationales d'Optique Guidee (JNOG)

New method for low cost and efficient optical connections between single mode fibres and silica guides
1991/01 Electronics Letters

Nouvelle methode de connexion entre circuit integre sur Silcium et fibre optique monomode
1990/10 11èmes Journees Nationales d'Optique Guidee (JNOG)

Precision prism coupling setup applied to measure silica planar optical waveguides on silicon
1992/05 University Report; General Report CV in physics.

Self-aligned multiple coupling for silica on silicon integrated optics
1991/06 Proceedings EFOC'91

Silica on silicon optical waveguide technology : results on 3 dB coupler realisation
1991/01 Proceedings of OCTIMA'91

Silicon based integrated optics : a suitable technolgy for a hybrid approach to optoelectronics
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Silicon oxinitide 3dB coupler for 1540 nm single mode applications
1991 Proceedings ECOC '91

Wide pass band wavelength multi/demultiplexer at 1.3/1.55 μm based on etched Fresnel mirror
1992/06 IEE Proc. J. Optoelectronics

R1009 ADVANCE - Network and Customer Administration Systems for IBC

A Decision Support System for Planning GSM Radio Coverage
1991/01 IEE Colloqium GSM and PCN enhanced mobile services

A Framework for Computing Platforms to support TMN systems
1991/11 Fifth RACE TMN Conference

A KBS for Mobile Cell Configuration
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A Methodology for developing NCAS user interfaces
1991/11 Fifth RACE TMN Conference

A Model of a broadband session and of the corresponding charging record
1990/10 International Conference on Integrated Broadband Services and Networks

A Service Model for Network and Customer Administration Systems
1991/11 Fifth RACE TMN Conference

A specification of a distributed heterogeneous systems administration
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AIP architecture in R1009 ADVANCE
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An approach to Transparent Communication Handling in NCAS
1990/11 4th RACE TMN conference

An Architecture for the Implementation of an Integrated Management System
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An Implementation Architecture for Network and Customer Admnistration Systems
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Applying artificial intelligence techniques to heterogeneous network management
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Article on Portugese work in RACE
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1991/07 BT Technology Journal, VOL. 9, NO. 3

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Extending Database Technology
1991/01 AXIOM, Journal of LMERCSSON LTD. IRELAND, Issue 2

Generic Message Set - An Information Based Interaction Language
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Management of Open Networks in Heterogeneous Context
1990/09 International Symposium on Local Communications Systems Management - IFIP TC6

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The application of object oriented distributed systems for Integrated Network Management Systems in IBCN
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Unification of Heterogeneous Management by a Generic Object Oriented Agent
1990/11 4th RACE TMN conference

Will the Real Managed Objects Please Stand up
1991/10 6TH World Telecommunications Forum

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1989 Proceedings 15th ECOC - paper TuB10-5

140 Mb/s and 560 Mb/s FSK heterodyne polarisation diversity receiver using nearly perfect square-law
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3.8 nm continous tuning range of a low threshold distributed Bragg reflected laser
1990/09 IEEE International Semiconductor Laser Conference

A 2.3 GHz low noise balanced receiver for FSK heterodyne reception, using commercially available
1989 Proceedings 15th ECOC - paper ThB20-7

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1991 ECOC 91

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A Bidirectional 1.5/1.3 μm Gbit/s direct detection system overlayed by a coherent 1.5 μm T-distribution system
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A linewidth and bitrate flexible FSK heterodyne system, using a frequency discriminator and biphase linecoding
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A new DFB-laser diode with reduced spatial hole burning
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A self-routing ATM switch for small customer premises networks
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1988 Proceedings ECOC - Vol. 1

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Analytical expressions for the sensivity penalty by large IF bandwidth in coherent optical ASK receivers with
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Compact and low feedback optical polarisation diversity device
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1990 OFC 1990

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Coupling coefficients in gain coupled DBF lasers: Inherent compromise between coupling strength and loss
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Fabrication and Spectral Characteristics of a 1.55 m Distributed Feedback Laser with a Tunable External Cavity
1989 Journal Appl. Phys. 66 (1989) 1525

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1991 Electron. Letters 27

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1991/05 Proceedings of the Teleconference Europe '91

Generic User Services Defined
1992/03 Elsevier - North Holland

Glossary : A Guide to IBC Terminology from a Usage Perspective
1992/03 Elsevier - North Holland

IBC - Views from Usage
1991 Integrated Broadband Communications: Views from RACE Network and Engineering Aspects

Integrated Broadband Communications : Views from RACE : Usage Aspects
1992/03 Elsevier - North Holland

Integration of Services for Applications
1992/03 Elsevier - North Holland

Integration of Services for Human End-Users : Design Principles, Enabling States Analysis, and a Design
1992/03 Elsevier - North Holland

Modelling Advanced Communication Services
1991/04 The International Symposium on Subscriber Loops and Services

Modelling Broadband Services from a Usage Perspective
1990 Proceedings of Human Factors in Telecoms Conference

Multimedia Communications in CSCW
1991/07 Proceedings of Seminar:Computer Supported Cooperative Work

Piloting New Services
1992/03 Elsevier - North Holland

Public Infrastructure Design from a Usage Viewpoint
1992/03 Elsevier - North Holland

Stored programme controlled telecommunication services
1990 International Conference on Communications

Telecommunications from the usage point of view
1991 Integrated Broadband Communications: Views from RACE. Network and Engineering Aspects

The Implications of Human Factors Recommendations for Network Infrastructure Design
1992/08 HFT, Darmstadt, 1993

The Usage Reference Model
1991 The Enabling States Approach : designing usable telecommunications services.

Usage oriented service design
1992/06 HFT, Darmstadt, 1993

Usage oriented service engineering
1992/08 International Symposium on subscriber loops and services, Vancouver, 1993

Usage Reference Model for Integrated Broadband Communications
1990/10 Proceedings of the IEE conference

R1079 CAR - CAR/CAM for Automotive Industry in RACE

A generic model for the use of high speed communications and CAD/CAM for design and manufacturability
1991/07 International Ergonomics Association, 11th Congress

A user-centred approach to define high-level requirements for next generation CAD systems for mechanical
1989/12 IEEE Transactions and Engineering Management Special Issue

An investigation into control protocols and use of video in a MULTIMEDIA task environment
1991/04 Ergonomics Society Annual Conference

An investigation into control protocols and use of video in a MULTIMEDIA task environment
1991/07 International Ergonomics Association, 11th Congress

An Investigation of User Requirements for Broadband Communications in the Automotive Industry
1990 Human Computer Interaction, Interact '90, Elsevier

An investigation of user requirements for broadband communications in the automotive industry
1990/08 Interact '90

Assimilating IBCN into CIM - some Human Factors aspects
1990/08 Human Factors in Design for Manufacturability in Process Planning (Hellander conference)

Communication and Interaction Issues in a Multi-Media Customer Facing System
1991/03 British Telecom FCTS Technical Workshop

Communications in the concurrent engineering paradigm - a European perspective invited paper in session,
1991/12 ASME 1991 Winter Meeting

Cooperative graphical applications in high speed networks
1991/10 Proceedings of the GI Conference - Darmstadt, Germany

Cooperative Sketching in a Network Environment for the Automotive Industry in Europe
1992 Eurographics '92 - Vienna, Austria

Design by Optimisation : Addressing Usability Problems in Multimedia Conferencing Systems
1993/04 Inter CHI 93, Amsterdam

Design to Product. A prototype of a system to enable Design for Manufacturability
1992/05 Chapter in "Human Factors in Design for Manufacturability", ed M. Helander and Mitsuo

Evaluating complex systems: the application of Heisenberg's uncertainty principle
1991/07 International Ergonomics Association, 11th Congress

First computer vision symposium
1991/06 ESA

Formal Specification and Design of an On-line Product Catalogue
1991/09 Journal of Computer and Software Engineering

Formal Specification and Design of an Online Product Catalogue
1992/04 Journal of Computer and Software Engineering

Future Communications Services in the Automotive Industry
1993 BT Technology Journal

Human Factors Implications of the 'Distributed Enterprise'
1992/05 Journal of Engineering Computers

Human factors in concurrent engineering
1991/07 International Ergonomics Association, 11th congress

IBC and Co-operative Working in the Automotive Industry
1990/09 Computer Supported Co-operative Work, Multi-User Interfaces and Applications

IBC Networks: Security from the users view
1990/10 International Conference on Integrated Broadband Services and Networks

Kooperative graphische Anwendungen in Hochgeschwindigkeitsnetzwerken
1991 Proceeding GI '91 - Darmstadt

Management of Technical and Organisational Change in large scale CIM systems
1990/08 Human Factors Aspects of Advanced Manufacturing & Hybrid Automation

Managing Screens and Interactions : Observations on the use of Multimedia Conferencing
1992/11 ACM Conference on CSCW - Toronto

Managing the organisations knowledge resources
1989/09 Proceedings of 3rd International Conference on Human-Computer Interaction

Module for the DTI Awareness Programme for Strategic Manufacturing - Man Machine Interfacing
1992/03 HCI and User Interface Design - Institute for Electrical Engineers

Multi media interactive working in design to manufacture
1990/05 Proceedings of 22nd International Symposium on Automotive Technology and Automation

Multi-Media Collaborative Working in the Automotive Industry - The role for Broadband Communications
1992/04 Ergonomics and Design Colloquium - East Midlands Ergonomics Group of the Ergonomics Society

Multimedia Collaborative Working in the Automotive Industry - The Role for Broadband Communication
1990/05 Proceedings of the CIM Europe Conference

Multimedia Conferencing as a Tool for Collaborative Writing : A case study
1991/11 Proceedings of the CSCW SIG Seminar on Collaborative Writing

Multimedia Conferencing : From Prototype to National Pilot
1992/06 Proceedings of INET '92 Conference - Kobe

Multimedia interactive working in design to manufacture
1991/09 4th IFIP Conference on computer applications in production and engineering

New Applications in High Speed Networks for the European Automotive Industry (in German)
1991/10 Annual GI Conference 91 - Darmstadt, Germany

Problems of Designing Task-Based User Interfaces for large-scale CIM systems
1992/05 Computer-Integrated Manufacturing Systems, Butterworth-Heinemann Ltd, Vol 5 No 2, 91-96

RACE CAR - New applications in High Speed Networks for the European Automotive Industry
1991/10 Proceedings of the GI Conference 91 - Darmstadt, Germany

Some Multimedia Traffic Characterisation and Measurement Results
1992/04 Networks '92 - Trvandrum, India

The Open Multimedia System Architecture : An overview
1992/05 The Computer Journal

User requirements specifications for workstations incorporating high speed broadband communications links
1990/08 Human Factors Aspects of Advanced Manufacturing & Hybrid Automation

R1080 HDTV Experimental Usage

HD tape to film transfer
1992/02 SPIE/IS & T - San Jose, US

HDP/HDQ processing in an Experimental Digital HDTV studio
1992/06 Les assises des jeunes chercheurs - Tokyo

HDTV production and postproduction : an original compatible digital approach
1992/06 FKTG Berlin

Progress on development of studio equipment for progressively scanned 1250/50 HDTV
1991/02 Document TG 11/1, Document TG 11/2

Progress on HDTV standard conversion
1991/02 Document TG11/1. Document WP11/A

Progress report on the 1250/50/2 system
1991/01 Document : TG 11/1

Transferring to film
1991/09 HDTV Dublin

Vision 1250, A European economic interest grouping
1991/02 Document TG 11/1

R1081 BUNI - Broadband User/Network Interface Demonstrator

An European Demonstrator and Test-bed for the Broadband User/network Interface
1993/01 BT Technical Journal

Broadband User-Network Interface Projects in RACE
1990/10 International Conference on Integrated Broadband Services and Networks, IEE

R1082 Qual. of Serv. Verif. Method. & Tools for Integr. Broadband

ATM technology
1990/10 7th Congress de Nouvelles Architectures pour les Communications

QoS in Broadband Networks
1990/06 NETWORKS '90 conference

Some aspects of quality of service
1991 13th ITC Conference

R1083 PARASOL - ATM Specific Measurement Equipment

A Model for Real-Time Generation of ATM Traffic from a Large Number of Sources
1990/08 9th Nordic Teletraffic Seminar

ATM Measurement Tool
1990/08 9th Nordic Teletraffic Seminar

ATM Traffic Processes: A Model for Real-Time Generation
1990/09 Technical Seminar on B-ISDN

Bitfehlerstrukturanalyse in der Breitband-ISDN-Me-technik
1991 Nachrichtentechnische Zeitschrift 44

Correlation in ATM traffic streams
1991/06 Queuing Performance & Control in ATM

Guaranteeing B-ISDN transmission quality internationally
1991 Telcom Report International 14, No 2

Me-prezision auf breitem Band
1991 Telcom Report 14, Heft 2

Measurement precision over broadband
1991 Telcom Report 14, No 3

Messtechnik fÅr zukÅnftige Breitbandsysteme
1990/12 Nachrichtentechnische Zeitschrift ntz.

Network performance measurements in ATM systems
1991/08 Telecommunications

Testing in the ATM environment
1991/10 Communications International

Traffic generation for ATM systems testing environment modelling and feasibility studies
1991 ITC-13

Uebertragungsqualitaet im B-ISDN international sicherstellen
1991 Telcom report 14

R1084 MIME - Development of Emulators and Simulators

A high speed parallel simulator for ATM networks
1990/11 Proceedings of 4th RACE TMN conference

A high speed simulation engine for B-ISDN
1991/05 3rd Bangor Communications Symposium

A modular simulator for ATM based B-ISDN communication
1991/04 IEE conference

An ATM parallel simulator
1991/06 4th Greek National Confeence of Informatics

ATM Network Simulation Emulation Hybrid Systems
1990/11 2nd TMN Implementors Workshop

Broadband Network Simulation Using Parallel Transputer Technology
1990/10 RACE/IEE Conference - Publication No 329

Conservative parallel simulation of ATM networks
1991/11 5th TMN Conference

Contribution à la realisation d'un simulateur de reseaux ATM
1992/09 Thèse de Doctorat Un. de NICE-SOPHIA ANT

MEM for arbitrary exponential open network with blocking and multiple job classes
1991 Performance Engineering Workshop '91

Modelling of ATM networks
1991/11 5th TMN conference

Queueing Models of Packet-Sqitched Networks with Locally Adaptive Routing
1991 Performance Engin. Workshop '91

Simulation support for the Management Network
1992/09 6th TMN Conference

Switch Models for TMN applications
1992/09 6th TMN Conference

Unified representation of different Flow Control Methods
1991/11 5th TMN conference

R1086 TELEMED

Anwendung neuer Kommunikationskonzepte zur kooperativen Bearbeitung unterschiedlich strukturierter
1990/06 Berliner Herzkonferenz

Bridging the Gap: Using a Summary Primary Health Care Patient Record in Secondary Health Care
1990/12 Second European Conference on Health Services Research & Primary Health Care

Communication aspects in the RACE TELEMED Project
1990/11 12th International Conference

Communications between Hospitals and Remote Users
1990/04 IMIA working conference

Creation d'une banque de donnees europeenne inter-universitaire d'Imagerie Medicale

Design of a Cost-Effectivesness Analysis Study in Teleradiology
1991/07 CAR '91, 5th International Symposium & Exhibition

Design of a Portable software on X-Window for Interactive Image Analysis PACS Workstations
1990/06 EuroPACS 90

Experiences in picture communications in the medical field
1990/11 IDATE 12th International Conference: Key Technologies, Experiments, New Concepts

High Speed Medical Applications
1989/05 Proceedings of EARN 89. An International Conference of Technical Aspects of networking and

Integration und Kommunikation von Patientenbefunddaten am Deutschen Herzzentrum Berlin
Einsatz der EDV im Gesundheitswesen S.164

Laboratory results - Reporting to General Practitioners
1990 Current Perspectives in Health Computing

Perspectives in Teleradiology
1991/06 IV Congr. Naz. Ass. Ital. Fisica Biomedica

Presentation of the TELEMED project
1990/10 RACE seminar (organised by Swedish Telecom)

Proposal of a Relational Model for a Radiological Scientific Data Base
1990/05 EuroPACS 90

Proyecto de una PACS en un Hospital pedi†trico con integraci†n en el proyecto TELEMED
1990/11 XX Congresso Nacional de Radiologia

RECPHONE: A new environment for medical remote expert consultation
1991/07 EuroPACS '91, 9th International Meeting

Scientific and Technological Experiences and Tendency of Medicine in Italy
1991/02 Teleradiology

Specifications for the Development of a Programming Environment for Remote Expert Consultation in Medicine
1991/05 3rd Panhellenic Conference on Computer Technology

TELEMED: First results from Europe's largest Broadband Communications Project in Telemedicine
1990/05 EuroPACS 90

Telemed: il ruolo della tecnologia fiorentina in un programma europeo di ricerca applicata
1991/03 Rotary Club Firenze Sud

Telemed: project within telemedicine
1990/02 2nd Information Technology Conference

Telemed: un progretto Applicativo
1991/01 Assolombarda

Teleradiology in Europe, EEC project TELEMED
1991/05 PACS and Teleradiology Conference

The RACE TELEMED Project R1086
1989/10 AIM Concertation Meeting

The robusness of communication of emotion via facial expression
1991 European Journal of Social Psychology

The TELEMED approach to terminology standardisation
1991/03 Workshop ECR-SCDI

The TELEMED project
1990/12 AIM Euroforum

The Teleradiology in Europe
1991/03 Milano Europa

Value Added and Data Services in Health
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
1991/09 L'Onde Electrique - Vol 71 No 5 pp 34-39

Asynchroner Transfer-Modus : Grundbaustein fuer das Breitband-ISDN
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 Teleinfomatics fo. 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 fÅr 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 : Germany

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.

Communication of the Commission to the Council concerning R&D in Advanced Communications technologies for Europe (RACE) - Progress report '89 and 30-month review, SEC(89) Final, July 1989.

Annual technical reports on the RACE programme - RACE '88; RACE '89; RACE '90; RACE '91, and RACE '92 - Available on request from the RACE central office, DG XIII, Direction B.

Perspectives for Advanced Communications in Europe: PACE '89; PACE '90; and PACE '92, January 1992 - Available on request from the RACE central office, DG XIII, Direction B.

Council Decision 91/352/CEE of 7th June 1991 adopting a Specific Programme of research and technology development in the field of Communications technologies: O.J. No L 192/8, 16.7.91

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 Fermeldewesen	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]

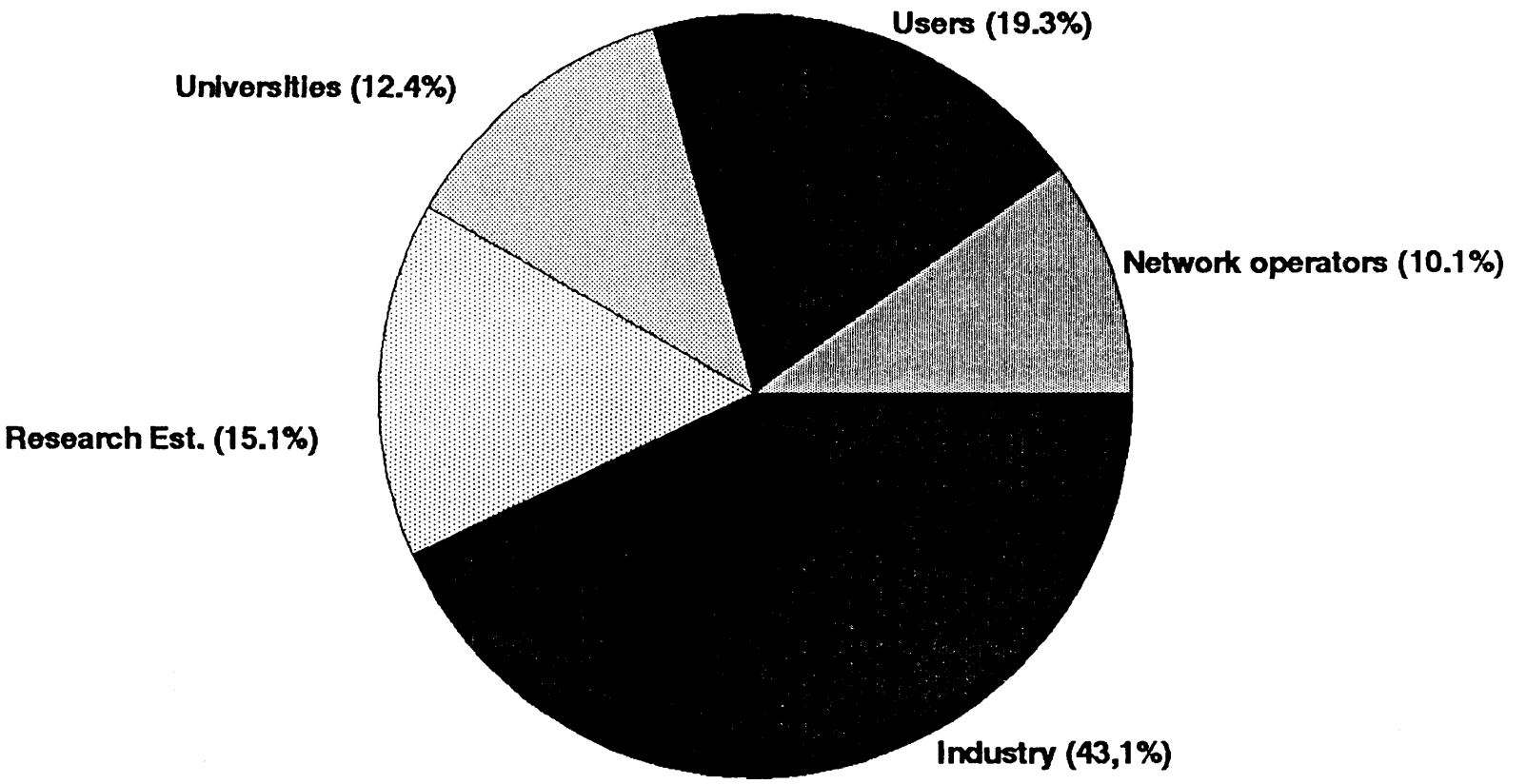
USTL	Université de Sciences et Techniques du Languedoc	F	R1029
UVA	University of Aarhus	DK	R1040
UVD	University of Durham	UK	R1084
UVL	University of Leuven	B	R1040
UVS	University of Surrey	UK	R1023
VERITAS	Det Norske Veritas	N	R1062
VITEC	VITEC	F	R1079
W&G	Wandel & Goltermann GmbH & Co	D	R1083*
WRC	Work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

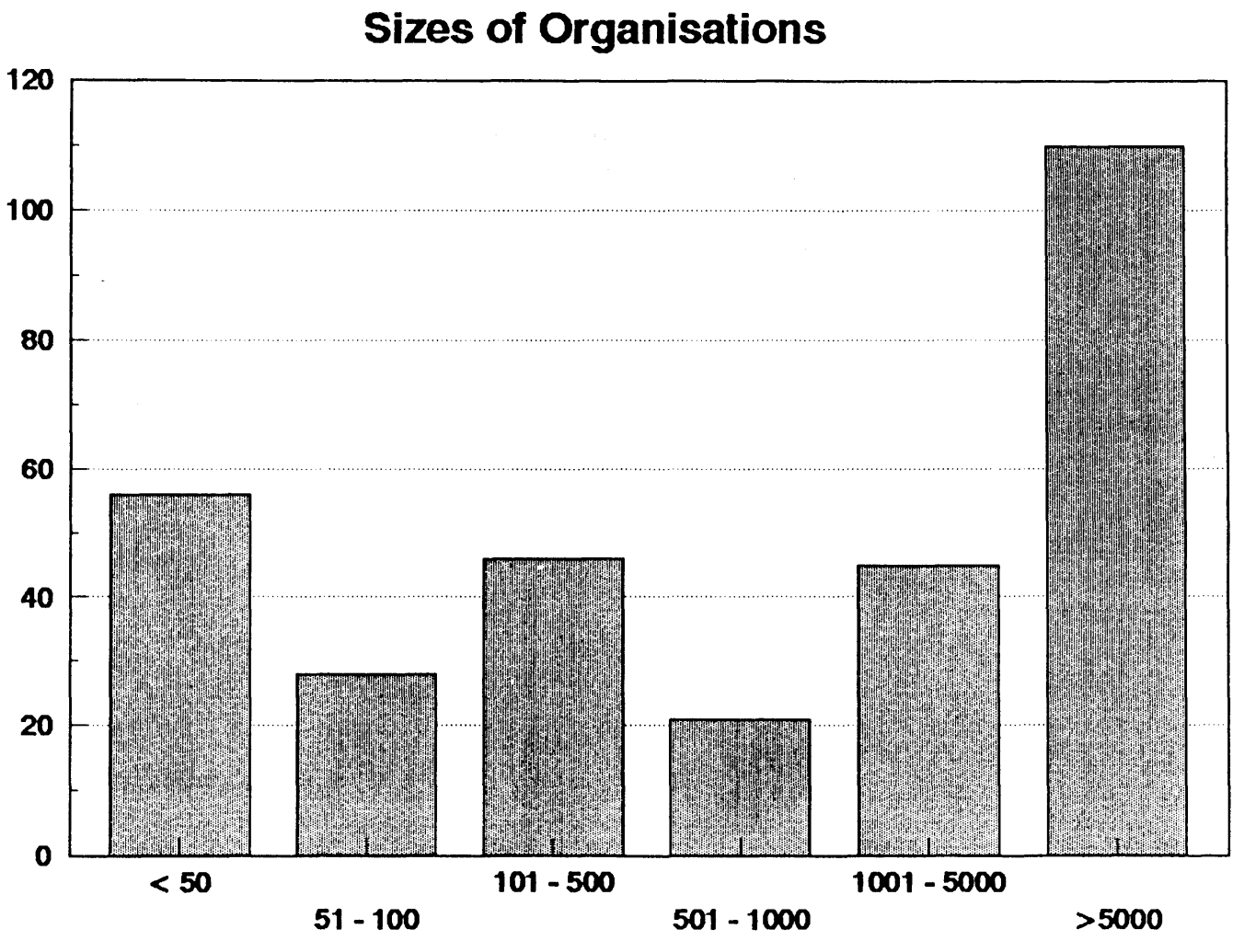
* **Prime Contractor for Project**

Annex IX

Financial and participation statistics

Types of Organisations




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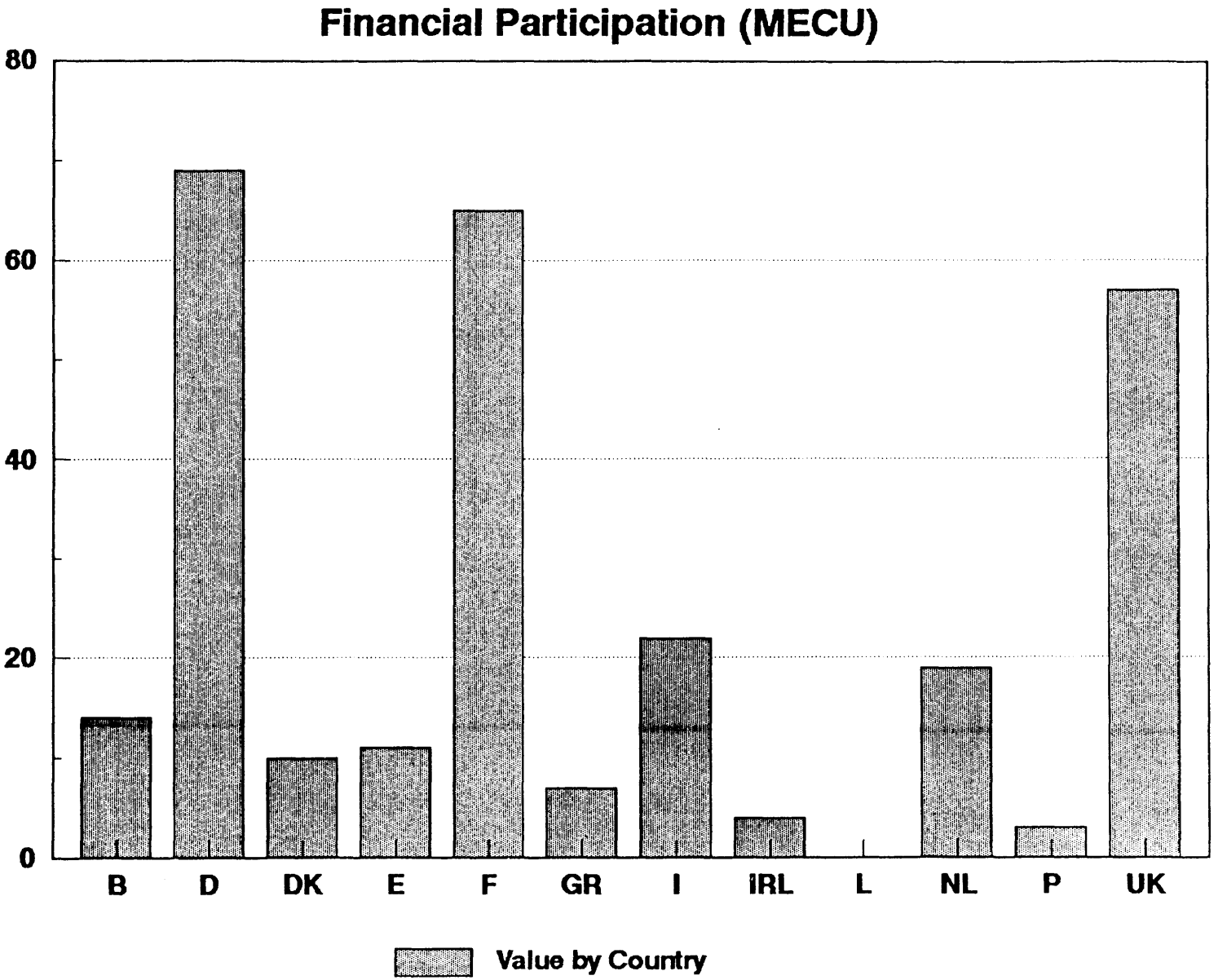
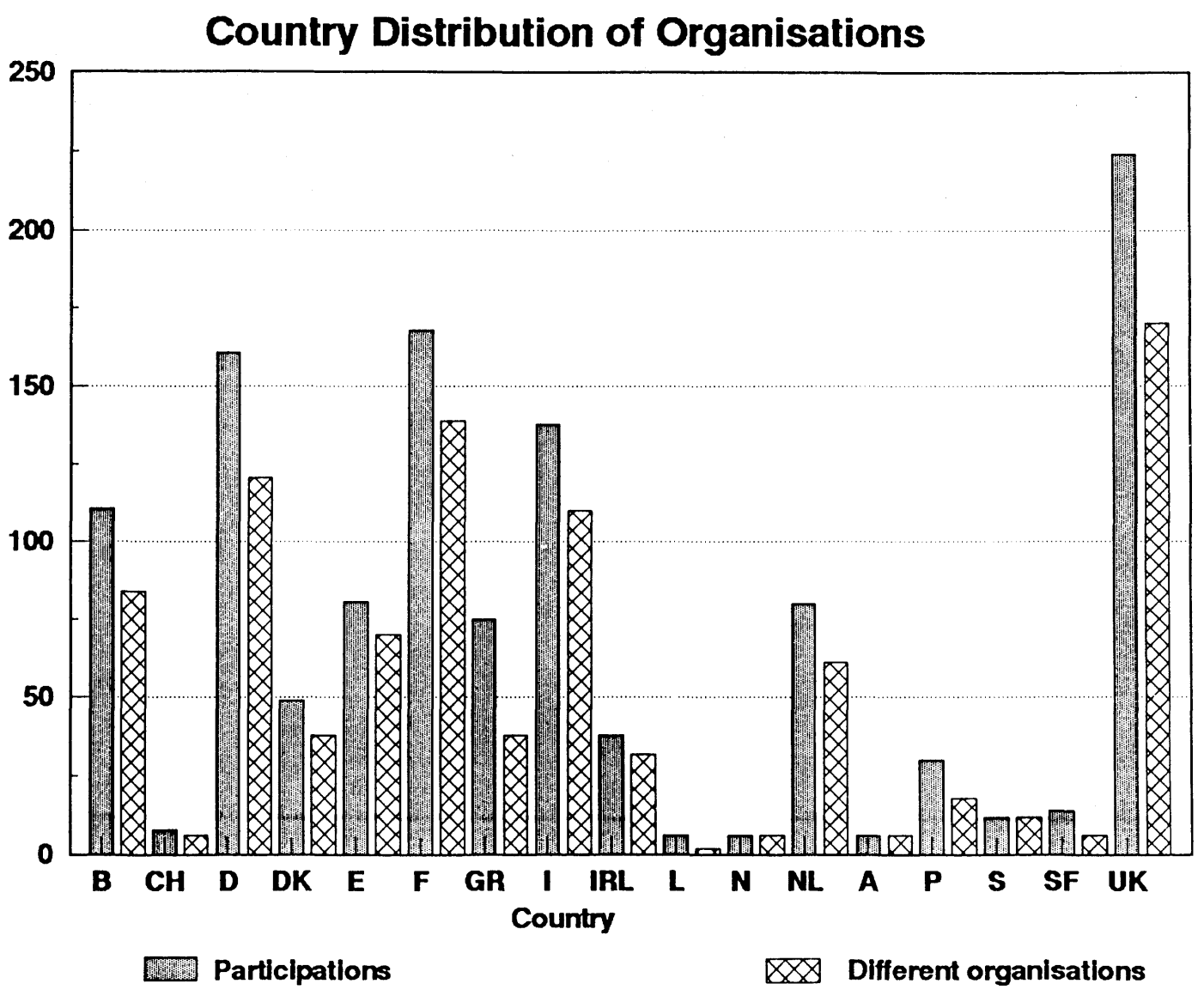
100
80
60
40
20
0
< 50
51 - 100
101 - 500
501 - 1000
1001 - 5000
>5000


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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