

# *Chapter 1*

## **Introduction**

Authors: Richard Lewis, Nicholas Karatzas

This book contains the highlights of the RACE II project Integrated Communications Management (ICM), addressing the technologies and methods required for the management of Integrated Broadband Communication Networks - a discipline which is referred to as Telecommunications Management Network (TMN).

The book is intended for telecommunications students, researchers, developers and operators in search of information about practical experience of TMN implementation. It contains some relevant background information and detailed technical descriptions of ICM's results, covering a range of topics related to TMN implementation from definition of case studies, through design and implementation, to validation and experimentation. The book aims to be self-contained, although a basic knowledge of TMN and ATM is an advantage to the reader.

### **1.1 Why is management important?**

The telecommunications world of today hosts a large number of services, covering a wide range of areas (from plain telephony, telex, fax, teleconferencing, and cable TV, to videoconferencing and multimedia document exchange). These services make use of different physical and logical network infrastructures. Issues of management, security, pricing, planning, performance and customer satisfaction are currently dealt with in a per-case and ad-hoc manner by the service providers.

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Advanced telecommunications techniques and technologies under development will facilitate the introduction of a new generation of services, improve quality and reduce cost. These services will satisfy the growing demand for fast data transmission and will allow greater use of visual communications. This will open the capabilities of telecommunications to both technical and non-technical users, and will offer better adaptation to human communications needs. The prospects for realisation of Integrated Broadband Communication (IBC) Networks are promising to bring economic and social advantages in Europe.

The success of the introduction of IBC-based services will mainly depend on the satisfaction of user needs which are foreseen to keep on growing rapidly. A large portion of these users will be members of the general public, drawn from a heterogeneous population with markedly different characteristics. Among others, key items will be the quality of new services, as well as maintenance, support and other management functions.

Network Management issues have been investigated so far primarily on a technology-driven basis. As defined by ITU-TS, a Telecommunication Management Network (TMN) provides the means to transmit and process information related to the management of telecommunications networks. It is intended to support a wide variety of management application functions that manage a telecommunications network and its services. Nine functional areas have been identified by RACE (CFS H400): design, installation, planning, provisioning, maintenance, performance, security, customer query and control, and accounting management. Typically these areas are supported by different management services used both by TMN administrations and by external users. Issues related to policy, specification, management, verification, negotiation are present in all of these areas. In order for IBC to receive high marketplace acceptance, customer satisfaction is mandatory. This must be the primary objective for the telecommunication stakeholders of the future. To this end TMN systems will play a key role.

## 1.2 The ICM project

ICM is a RACE II project, comprising commercial and academic partners from across Europe. The project builds on the results of RACE I and RACE II projects, in particular TMN architectures and models, case studies, TMN functional specifications, distributed management platforms, network simulators, implementation approaches, and Advanced Information Processing (AIP) evaluations. ICM also integrates the results of relevant external initiatives, such as Eurescom and the Network Management Forum. The main project objectives are:

- To show that the integration of AIP technologies for TMNs is possible.
- To validate selected TMN functional implementations.
- To establish an environment (testbed) which enables the validation of other TMN functional implementations and the integration of additional AIP technologies.

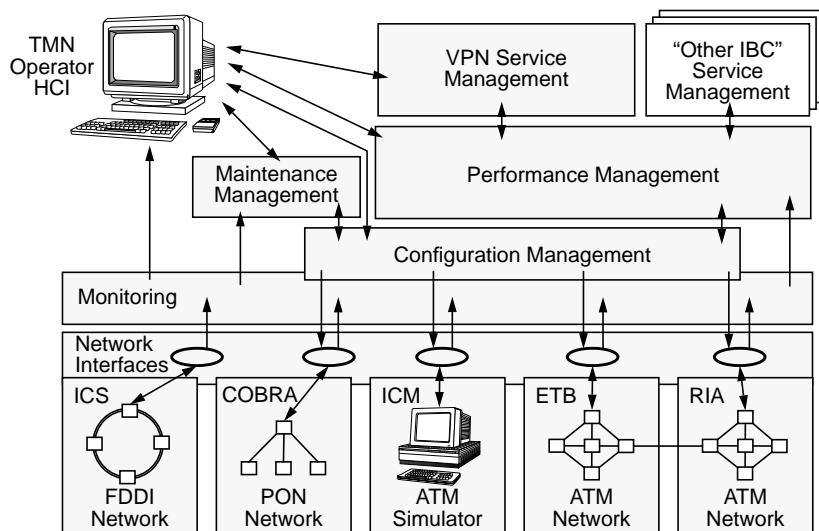
The key issue to the project is the conceptual and physical integration of Management Applications for TMN applied to IBC networks. In order to satisfy the requirements of the users of these Management Applications, it is essential that they are conceptually,

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functionally and physically integrated with the network and services being managed. ICM demonstrates this integration, in a realistic environment, through the operation of a TMN Testbed executing appropriate experiments. The following approaches are applied to the development of the Testbed and to the definition of the experiments:

- definition and use of life-cycle design methodologies,
- adoption of TMN architectures and emerging standards,
- incorporation of key implementation technologies,
- evolution and adaptation of existing management techniques, tools, systems, interfaces, and platforms,
- validation through representative case studies, focusing on performance and configuration management.

The project processes are conducted with reference to appropriate drivers, such as progress in technology and standards definition, and an understanding of the RACE Programme and ICM Consortium exploitation requirements. The ICM implementation method is founded on established TMN principles. The project specifies Case Studies and further develops the definition of TMN Functions, Architectures, models and methods, forming the basis of the implementation process which resulted in a TMN Testbed on which experiments can be conducted.



**Figure 1.1 ICM TMN Testbed overview**

The ICM TMN Testbed itself, an integration of software developed within the project integrated and external components, comprises the following major elements:

- a TMN platform,
- Management Applications,
- real networks and network interfaces,
- an advanced ATM network and service simulator.

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The Testbed is exercised through experimentation in order to validate the functional implementation. A complete network approach is adopted, with validation performed using real networks representing characteristic IBC domains. Additional validation capability is provided using network simulation. Figure 1.1 provides an overview of the ICM TMN Testbed and its components.

The main application areas addressed by the project are Performance, Configuration and Maintenance management within heterogeneous network environments, in particular ATM and Passive Optical Networks. End-to-end management, with inter TMN co-operation, was studied within an overall Virtual Private Network case study.

Within RACE it has been important to ensure consensus and to promulgate the results of the research performed. To this end ICM established close relations with RACE projects PREPARE (R2004) and PRISM (R2041) in order to co-ordinate a common approach to the VPN, which was used as a case study by each project. In addition, RACE projects PREPARE, TOMQAT, UNOM and BAF reused ICM components, in particular making use of the TMN Platform. These collaborations were intended to reduce duplication of work, encourage consensus and provided validation of the project results.

### 1.3 The book

Chapter 2 briefly describes the characteristics of ATM which are relevant to ICM's area of study.

Chapter 3 and Chapter 4 describe, respectively, the general TMN development methodology adopted by the project, and the TMN architectural issues which are important.

Chapter 5 gives an overview of the ATM Virtual Path Connection Management system, discussing the main principles and summarising the high level design. Chapter 6 describes the iVPN management system developed by the project, also discussing the basic tVPN system that was designed (though not implemented).

Chapter 7 provides an overview of Passive Optical Network (PON) management, and the applicability of the ICM approach to this network technology.

The requirements and implementation issues of the HCI component are presented in Chapter 8. The various technologies used for the development of three HCIs are also discussed.

Chapter 9 details the specification, design and implementation of the Q<sub>3</sub> interfaces developed by the project. One such interface is based on experimental equipment, the ATM switches which are a key part of the Exploit Testbed. Also described are the interfaces to commercially available switches which were developed using the SNMP-CMIP tools developed by the project.

Chapter 10 discusses in some detail the OSIMIS TMN platform that was developed by the project. This experimental platform is used as the key vehicle for the development of the Manager-Agents that perform the selected management functions.

Chapter 11 presents the ATM-based simulator developed by the project. This simulator is able to support multiple interconnected networks, can simulate traffic from multiple sources and uses realistic signalling components for the CAC procedure. A Q<sub>3</sub>

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interface allows the ICM TMN to receive notifications from the simulated network, and to change network parameters in a realistic fashion.

Finally, Chapter 12 and Chapter 13 describe the validation principles and procedures followed, and report the main conclusions of the project as a results of the experiments performed.

Apart from these last two, each chapter can be read in isolation. However, the order in which the chapters are presented is the most logical sequence to follow, starting with the introduction to ATM and the basic assumptions made by the project for the purposes of its ATM case studies.

There are three appendices. The first, Appendix A, provides additional details of the HCI design presented in Chapter 8. Appendix B documents the deliverables and publications of the project, and Appendix C is a reference to the acronyms and abbreviations used throughout the book.

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