THE TELECOMMUNICATIONS HANDBOOK

EDITORS-IN-CHIEF

Kornel Terplan
Patricia Morreale

CRC PRESS

IEEE PRESS

A CRC Handbook Published in Cooperation with IEEE Press

IPR2021-01406
ANCORA EX2007

THE TELECOMMUNICATIONS HANDBOOK

EDITORS-IN-CHIEF

Kornel Terplan
Patricia Morreale

CRC PRESS

IEEE PRESS

A CRC Handbook Published in Cooperation with IEEE Press

This One
6LW6-B5S-CQ9Y

IPR2021-01406
ANCORA EX2007

Library of Congress Cataloging-in-Publication Data

The telecommunications handbook / edited by Kornel Terplan, Patricia Morreale.
p. cm.
Includes bibliographical references and index.
ISBN 0-8493-3137-4 (hc. : alk. paper)
1. Telecommunication--Handbooks, manuals, etc. I. Terplan, Kornel. II. Morreale, Patricia.
TK5101.T355 1999
384—dc21

99-044580
CIP

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming, and recording, or by any information storage or retrieval system, without prior permission in writing from the publisher.

All rights reserved. Authorization to photocopy items for internal or personal use, or the personal or internal use of specific clients, may be granted by CRC Press LLC, provided that $.50 per page photocopied is paid directly to Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923 USA. The fee code for users of the Transactional Reporting Service is ISBN 0-8493-3137-4/00/$0.00+$.50. The fee is subject to change without notice. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

The consent of CRC Press LLC does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from CRC Press LLC for such copying.

Direct all inquiries to CRC Press LLC, 2000 Corporate Blvd., N.W., Boca Raton, Florida 33431.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

© 2000 by CRC Press LLC

No claim to original U.S. Government works
International Standard Book Number 0-8493-3137-4
Library of Congress Card Number 99-044580
Printed in the United States of America 1 2 3 4 5 6 7 8 9 0
Printed on acid-free paper

2.1.6 Techniques

The advanced information processing techniques are playing a major role in the realization of telecommunications services and the underlying network architectures. Among these techniques, we find object-oriented methods, open distributed processing, and the agent technology.

2.1.6.1. Open Distributed Processing

A telecommunications service is a distributed application that runs over the multiple nodes of a telecommunications network. The ODP reference model jointly defined by ISO and ITU-T provides a framework for the design of distributed systems with the introduction of viewpoints. Each viewpoint represents a different abstraction of the original system. Informally, a viewpoint leads to a representation of the system with emphasis on a specific concern. Five viewpoints were identified: enterprise, information, computation, engineering, and technology (Figure 2.6).

The *enterprise* viewpoint is concerned with the overall environment within which an ODP system is to operate. The *information* viewpoint focuses on the information requirements of the system, and deals with information object types, together with their states and permitted state changes. The *computational* viewpoint shows processing functions and data types, abstracting away from the underlying hardware structures via transparency functions. The *engineering* viewpoint establishes transparency services utilizing concepts from operating systems and communications. The *technology* viewpoint is concerned with the realization of an ODP system in terms of specific hardware and software components. ODP has been extensively used for the definition of TINA.[21]

2.1.6.2 Mobile Agents

An agent is a program, which, with a certain degree of autonomy, performs tasks on behalf of a user or an application. An agent may move between network sites and cooperate with other agents to achieve its goals.[22]

Agent development finds its roots in two research domains: intelligent agents stemming from artificial intelligence, which studies the capabilities of learning and decision making of cooperative autonomous entities; and mobile code technology that enables programs to migrate from a machine to another, while preserving their execution environment. This latter domain is evolving at a fast pace because of the emergence of languages such as Tcl[23] and Java,[24] and of their portable execution environment.

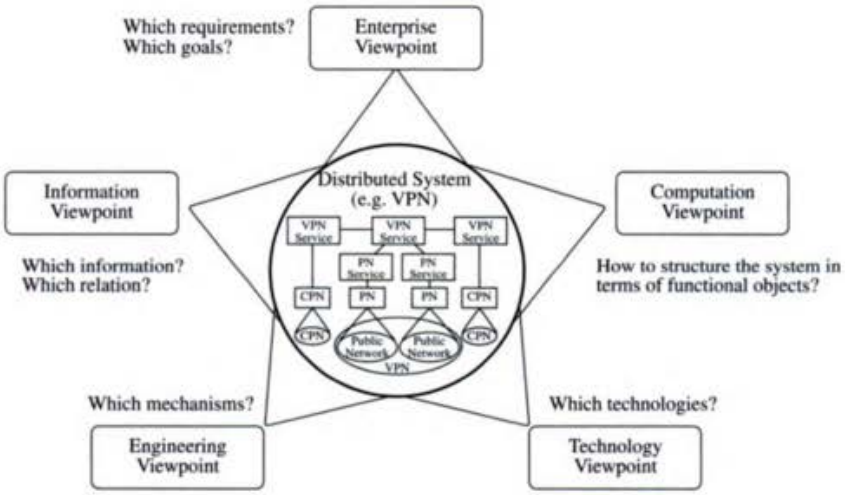

FIGURE 2.6 ODP viewpoints: different projections of a system.

IPR2021-01406
ANCORA EX2007

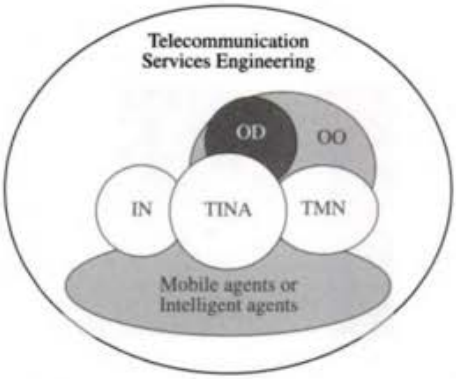

FIGURE 2.7 Interrelations between network architectures and impact of techniques.

The use of agent technology for telecommunications services engineering is a very hot topic in particular in the area of service and network management.[25,26] It lies within the boundaries of areas such as telecommunications, artificial intelligence, and software engineering. This can be seen as an advantage because it promotes the convergence of research results from different communities.

2.1.6.3 Other Techniques

Among the other techniques not detailed in this survey, we mention formal methods for the verification, validation, and testing of telecommunications services before deploying them. The goal of formal methods is to improve the reliability of these services.[27] Indeed, the rapid growth of the number of services makes the problem of proving that the services conform to their specification more acute. In fact, reacting rapidly to customer or market needs requires introducing new services only a few months or even a few weeks after the first specification; such a short interval makes it quite impossible to go through the tedious and long (several months) tests usually performed for new services. This problem is getting worse since there are more services continually added to the networks, contributing to the overall complexity. Services must all work correctly without hindering the function of other services; this last problem is often referred to as the "feature interactions problem." These obstacles on the road to rapid service introduction call for new approaches to increase confidence in the service.

Figure 2.7 summarizes the interrelations among the different network architectures of telecommunication services engineering and the impact of techniques on these architectures. TMN, TINA, and ODP follow the object-oriented approach. TINA applies the ODP concepts, principles, and viewpoints and integrates the IN and TMN architectures. Finally, mobile or intelligent agents may be perceived as an emerging technology for the next generation of telecommunications.[28]

2.1.7 Conclusion

As we have seen, telecommunications services engineering is composed of two major parts.

One part is related to the network architecture which is in charge of executing the service in the network. The IN evolution will notably encompass its integration with the International Mobile Telecommunication 2000 architecture[29] for rapid introduction of services and efficient service control. In addition, there is an increasing interest in bringing telephone services provided by PSTNs to Internet users through the IN.

The TMN evolution is integrating CORBA-based management particularly for the new task of service management. Interoperability will play a very important role. Indeed, if a service extends over multiple networks, network operators of these networks should be able to negotiate service provision and contract establishment with each other. Although the effort spent toward the provision of an integrated IN/TMN architecture called TINA has been important, TINA in its current status is not deployed. Indeed, TINA is

IPR2021-01406
ANCORA EX2007

Telecommunications/Electrical Engineering

THE TELECOMMUNICATIONS HANDBOOK

EDITORS-IN-CHIEF

Kornel Terplan
Patricia Morreale

A panel of renowned experts from around the world contributed to this authoritative handbook that covers the essential aspects of this most dynamic field of communications and networking activity. Edited by Drs. Kornel Terplan and Patricia Morreale, this important new handbook provides basic principles and definitions, details the tremendous advances in technology, outlines implementation techniques, and discusses the outstanding issues and key challenges faced by communications and networking specialists.

The telecommunications topics addressed include:

- Basic principles
- Services on broadband networks
- Signal processing and coding schemes
- Mobile and wireless networks
- DSL technologies
- Digital video and multimedia
- Quality of service
- Regulation
- Standards
- Emerging technologies

Exhaustive in scope and packed with diagrams, tables, and illustrations, ***The Telecommunications Handbook*** is an indispensable, detailed reference for engineers, analysts, managers, and students involved in a wide range of telecommunication and networking activities.

CRC Press Catalog Number 3137

IEEE Order Number: PC5790

ISBN 0-8493-3137-4

90000

9 780849 331374

IPR2021-01406
ANCORA EX2007