（ATM与B-ISDN技术丛书

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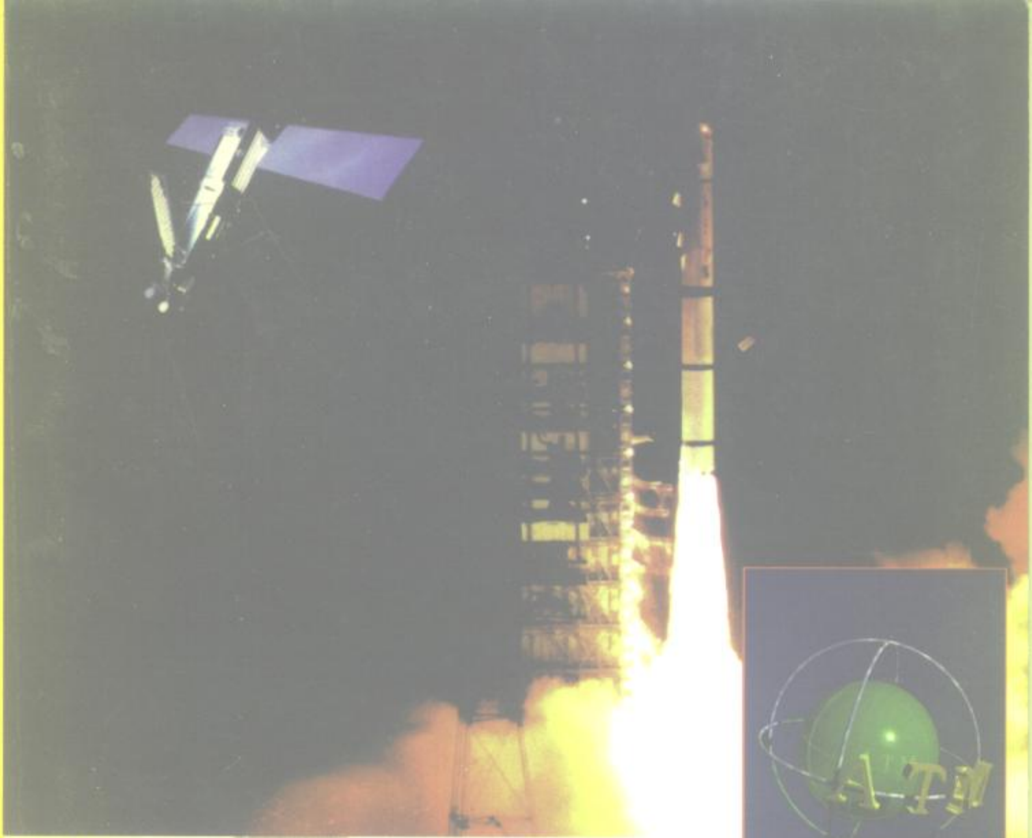

[美] UYLESS BLACK

ATM:SIGNALING IN BROADBAND NETWORKS

宽带网络信令

清华大学出版社
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PRENTICE HALL

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Uyless Black

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出版前言

90年代中期掀起了信息高速公路的浪潮。宽带综合业务数字网络(B-ISDN)代表着国家信息基础设施的最高网络层次,将在下一世纪发挥非常重要的作用。ATM是B-ISDN的核心技术,已经得到了迅速地发展。广大科技人员和大专院校的师生为了掌握该领域最新发展的知识,迫切需要一套全面、系统地介绍ATM与B-ISDN详细技术的文献,为此我们精选了一些最新英文版图书,组成一套《ATM与B-ISDN技术丛书》,影印奉献给广大读者。

本套丛书既系统全面,又分工明确,各有侧重。在内容安排上包括ATM与B-ISDN技术基础、宽带网信令、宽带网性能分析、ATM网的规划与管理、ATM网与其它网的互通以及ATM网络的应用等技术。希望这套丛书对从事ATM和B-ISDN研究的广大科技人员和大专院校师生有所帮助。

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This book is dedicated to my good friend and goddaughter Holly Gillen

During the time that I was writing this book about communications and signaling in broadband networks, I happened to watch a film about dolphins. The film demonstrated how dolphins communicate among themselves with certain types of audible signals, and how they use different signals for selected purposes such as location detection and mating rituals.

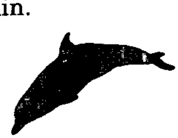
I was taken by the nature of their communication signals. At times they seemed to send digital "clicks"—something like the binary pulses employed by modern computer-based networks. At other times, they emitted different audible signals similar to the squeal of a high-pitched analog whistle. In a remarkable display of communications versatility, they alternated between transmitting "digital" and "analog" signals depending upon the occasion. These capabilities are performed by human-made systems with great difficulty and awkwardness (for example, the Digital AMPS technology).

Upon further study, I discovered that the digital clicks are also used as sonar signals and through a process called echolocation, dolphins can navigate and stay aware of their location and surroundings (something like our use of the global positioning system [GPS]).

Some researchers even claim that dolphins can use their signals to stun or kill a prey of another species with an acoustic shock (something like our use of a boom box on our own species).

The dolphins are quite social and scientists state that they possess an intelligence level far above most other mammals. They are said to be great imitators and some can imitate parts of human speech.

But in the final analysis, it is we humans who are the imitators. For time and time again, we find that our human creations and inventions are antedated by the natural world, in this case, the dolphin.



Preface

This book is one in a series of books called *Advanced Communications Technologies*. It is a companion book to *ATM: Foundation for Broadband Networks*. In the first volume, a chapter was devoted to ATM-based signaling operations at the UNI. Since the publication of that book, there has been an increased interest in the industry in signaling, both at the user-network interface (UNI) and the network-network interface (NNI). In addition, most of the specifications that define broadband signaling have now been released, and were not available when I wrote Volume I.

This book is written in response to the general interest of the public and provides a detailed description of the broadband signaling specifications. As the name of Volume I implies, ATM serves as a foundation for broadband networks. These broadband networks may or may not use signaling techniques in their operations, but the term broadband signaling does imply the use of signaling operations in a broadband network.

A separate book in this series is devoted to "narrow band signaling" and it is titled, *ISDN and SS7, Architectures for Digital Signaling Networks*. While this book is a useful reference guide when reading the book you have in your hands, I have included enough tutorial information in *ATM, Volume II* for you to deal with narrowband signaling. I also provided comparisons of narrowband and broadband signaling in this book.

I hope you find this book a valuable addition to your library and I hope you find it fulfills your needs. You can reach me at:

102732.3535@compuserve.com.

Contents

1

Introduction

INTRODUCTION

This chapter introduces the concept of a signaling system and compares a signaling system with a transport system. Early signaling systems are explained and compared to current systems (which are the focus of this book). Narrowband signaling systems are defined and are compared to broadband signaling systems. We also examine the role of the Asynchronous Transfer Mode (ATM) and Signaling System Number 7 (SS7) in broadband signaling networks.

PURPOSE OF A SIGNALING SYSTEM

The purpose of a signaling system is to transfer control information (signaling units) between elements in a telecommunications network. The elements are switches, operations centers, and databases. This information includes signaling units (also called messages) to establish and terminate connections (e.g., a voice call, a data connection) and other information such as directory service and credit card messages.

Originally, signaling systems were designed to set up connections between telephone offices and customer premises equipment (CPE) in order to transport only voice traffic through a voice-oriented, analog network. Today, they are designed to set up connections between service provider offices and CPE in order to transport not only voice but video or data signals through either an analog or a digital network.

TRANSPORT SYSTEMS AND SIGNALING SYSTEMS

A transport system is different from a signaling system. A transport system provides the physical facilities over which the signaling system operates. For example, a transport system defines the physical channel and the electrical/optical nature of the signals that operate on the channel. Examples of transport systems are T1 and the Synchronous Optical Network (SONET).

A signaling system defines how the physical channels are used and how they are allocated and provisioned to fit the user's needs. Signaling networks possess traits that allow the provisioning of bandwidth (capacity) on the physical channels to meet varying user throughput and delay requirements.

Signaling systems allow a user to request the network to provide certain quality of service (QOS) features to the user. They also provide a means for the user to convey certain QOS information to another end user, which the signaling network may act upon or pass (as a courtesy) directly to another user.

Figure 1–1 shows the relationships of a signaling system and a transport system between two machines labeled A and B. The transport

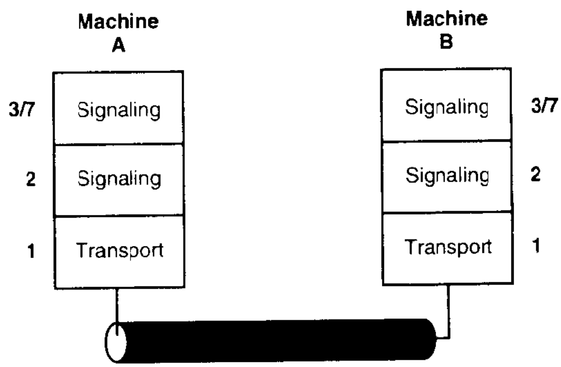


Figure 1–1 Signaling and transport systems.

system operates at layer 1 of the layered model and the signaling system operates at layer 2 or perhaps layers 2 and 3, or layer 7.

The Blurring of the Distinction between Transport and Signaling Networks

The distinction between transport and signaling networks may be blurred in some systems, because they may do some of both. For example, SONET is primarily a transport technology, but it does have some signaling capabilities, and the narrowband Integrated Services Digital Network (ISDN) exhibits both transport and signaling characteristics. I will clarify and amplify this point in later discussions.

NARROWBAND TRANSPORT AND SIGNALING NETWORKS

The T1 System

In 1962 the U.S. Bell System (as it was known in the predivestiture days) installed the first commercial digital voice system in Chicago, Illinois. The system was known as T1 and carried 24 voice channels over copper wire between Bell's telephone offices. (This book uses the terms T1 and DS1 synonmously.)

T1 is designed to act principally as a transport network. Its signaling capabilities are very few, and the provisioning of channels (in the original T1 networks) was a labor-intensive, manual operation in which cables, dip switches, and other hardware had to be altered each time a new or revised user requirement developed.

T1 was designed to support fairly modest requirements for user applications, at least when compared to modern applications' needs. For example, the T1 systems support a transfer rate of 1.544 Mbit/s, and 28 T1s (called T3) operate at approximately 45 Mbit/s. These bit transfer rates may seem high to the reader, but remember that a 45 Mbit/s transport system like T3 only supports 672 voice calls—a lot of T3s have to be in operation to support the public telephone network.

These systems are often called narrowband signaling networks due to their limited capacity, typically no greater than 1.544 Mbit/s or 2.048 Mbit/s.

The T1 systems were designed to set up physical circuits (connections) for a call between two parties. These circuits were provisioned through hardware registers and by apportioning a physical circuit (which is usually called a DS0 channel, with a bit rate of 64 kbit/s) or a part of a physical circuit capacity (part of the circuit's bandwidth) for a call. Once the bandwidth was set up, it was fixed and could not be used by anyone else, even though the original customer would not be using the bandwidth. These networks suffered from bandwidth waste, because of the rigid manner in which bandwidth is allocated. Expensive and time-consuming tasks were involved in modifying and reprovisioning the bandwidth on these earlier systems.

Increasingly, many applications require bandwidth only when sending and receiving information. The vast part of the 64 kbit/s DS0 channel is wasted with a typical user needing only a fraction of the 64 DS0 slice of bandwidth.

X.25 and Packet Switching Systems

In the early 1970s, another technology, called packet switching, was deployed to support data networks. Unlike the T1 networks, which were designed for voice applications, packet switching networks have become the foundation for the majority of data networks.

Unlike T1, packet switching has a more flexible way of allocating bandwidth to users. First, bandwidth is not charged on a fixed basis; a user pays for what is used. Second, bandwidth need not be "nailed-up"; it can be allocated on a more dynamic basis to meet the varying needs of the user. And third, the network has more flexibility in managing bandwidth for all users and can make better use of network resources. Most of the functions came through the use of software to support user requirements instead of the T1 focus on hardware. Experience demonstrates that packet switched systems can be engineered to support up to eight times as many data users on the same T1 channel.

At about the same time that packet switching networks were being deployed, the International Telecommunications Union-Telecommunication Standardization Sector (ITU-T, formerly, the CCITT) published the X.25 specification. X.25 defines the procedures for user computers to communicate with network machines (packet switches) to transport data to another user computer. X.25 has become a widely used industry standard and has facilitated the building of standardized communications interfaces between different vendors' machines.

X.25 was designed for data systems that operate at only a few bit/s or a few hundred bit/s—typically 600 to 9600 bit/s. Although X.25 can be placed on very high-speed media and can operate efficiently at high speed, a substantial amount of subscriber equipment and software has been designed for modest transfer rates—typically no greater than 19.2 kbit/s.